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RESEARCH ARTICLE

Analysis of rural egg production to improve the economy of the Andean communities in Ecuador [version 1; peer review: 2 approved with reservations]

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V1 First published: 13 Nov 2019, 8:1919
<https://doi.org/10.12688/f1000research.21023.1>
Latest published: 13 Nov 2019, 8:1919
<https://doi.org/10.12688/f1000research.21023.1>

Abstract

Background: An economically active population refers to people involved in any economic activity, such as agriculture, livestock, or industry. This activity can supply benefits to its owners and may generate the growth of small businesses. Our study presents a qualitative analysis of the egg production in Ecuadorian Andean communities (Tzimbuto, Bayushig "La Liberad," and La Victoria "Pusuca.")

Methods: Analysis was performed using a random sample of 81 hens and 29 eggs obtained from 65 producers, belonging to 50 farming families at the Utopia Community Fair. Zoometric characterization of the hens was carried out according to FAO protocols, and egg yolk quality, egg width and weight, and egg shell weight and thickness were calculated. The 65 producers were interviewed to answer questions pertaining to selling eggs, costs of production, and realized profit. The profit/cost indicator was calculated from the ratio of expenditure (egress) and total revenue of egg sales.

Results: 84% of surveyed participants indicated that they purchase eggs for their nutritional value, 12% because the animals are raised with organic food, and 4% showed preference for the eggs' special flavor. The quality analysis of the eggs sold at the Fair demonstrated that the average weight of the eggs was 47.24 g; the length was 55.24 mm; and the width was 41.66 mm; weight and thickness of the shell were 4.90 g and 0.42 mm, respectively. The color of the yolk had a brightness of 57.62 L*, 5.53 a* for red/green tones and 47.15 b* for yellow/blue tones. The costs to produce the eggs for the Fair was US\$0.21 with a profit/cost of US\$0.04 per egg; the unit sale price is US\$0.25.

Conclusions: 84% of surveyed participants indicated that they purchase eggs for their nutritional value, revealing the need to train the communities toward more efficient egg production.

Open Peer Review

Approval Status ? ?

	1	2
version 1	?	?
13 Nov 2019	view	view

1. **János Felföldi**, University of Debrecen, Debrecen, Hungary

2. **Terence Zimazile Sibanda** , University of New England, Armidale, Australia

Any reports and responses or comments on the article can be found at the end of the article.

Keywords

domestic economies, rural development , consumer protection, rural egg productionn

This article is included in the **Agriculture, Food and Nutrition** gateway.

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Author roles: **Bravo Avalos MB:** Conceptualization, Investigation, Methodology, Resources, Writing – Original Draft Preparation, Writing – Review & Editing; **Vaca Cárdenas M:** Investigation, Methodology, Writing – Original Draft Preparation; **López Salazar JL:** Conceptualization, Investigation, Methodology, Writing – Original Draft Preparation; **Herrera Chico MF:** Investigation, Methodology, Project Administration, Writing – Original Draft Preparation; **Villamarín Padilla JM:** Investigation, Methodology, Writing – Original Draft Preparation

Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

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How to cite this article: Bravo Avalos MB, Vaca Cárdenas M, López Salazar JL *et al.* **Analysis of rural egg production to improve the economy of the Andean communities in Ecuador [version 1; peer review: 2 approved with reservations]** F1000Research 2019, **8**:1919 <https://doi.org/10.12688/f1000research.21023.1>

First published: 13 Nov 2019, **8**:1919 <https://doi.org/10.12688/f1000research.21023.1>

Introduction

An economically active population (EAP) attempts to grow small businesses, allowing significantly more employment opportunities. [Jiménez \(2012\)](#) states that the purpose of any economic activity, whether agricultural, livestock or industrial, is to supply a benefit to its owners. The main global activity carried out in rural areas is animal raising for commercial purposes ([Ordoñez & Lasso, 2010](#)). Poultry farming is a key activity that can provide several benefits especially for the rural economy. However, it is important that poultry farmers become aware of the importance and value of poultry in the creation of companies, more than just meeting basic needs; when the obtained products are marketed, an EAP is formed.

In this study, we examine egg production in Ecuadorian Andean communities (Tzimbuto, Bayushig “La Libertad,” and La Victoria “Pusuca.”) A quality analysis of the eggs and an analysis regarding the demand for egg consumption was carried out at the Utopia Community Fair, Riobamba, Ecuador.

Methods

Research design

The research was performed over 120 days between February 2019 and <May 2019. Zoometric measures and egg quality

analysis were carried out in the Escuela Superior Politécnica de Chimborazo, Riobamba. Egg consumption rates and motivation for selling eggs were obtained from producers at the Utopia Community Fair located at Av. Juan Félix Proaño, Riobamba municipality, Chimborazo Province (GPS coordinates: -1.685193, -78.644049).

Participants

50 families from the communities of Tzimbuto, Bayushig “La Libertad” and La Victoria “Pusuca” were randomly selected from the main producers of the Utopia Community Fair. 81 hens owned by the selected families were chosen, having undefined age and weight. In addition, 29 eggs were analyzed and 65 consumers/producers from the 50 families were recruited for the study. The methodology related to egg/hen analyses followed procedures described in [Martínez, 2016](#).

Data collection

Table 1 shows all variables considered in the present study.

Hen data. Zoometric characterization was performed for each hen (n = 81) according to [FAO \(1981\)](#); [Lázaro et al. \(2012\)](#) and [Pérez & Polanco \(2003\)](#). In brief, the birds were weighed manually by Chick Scale (model: 103; Agrologic

Table 1. Experimental measures used in the present study.

Social component	Productive component Zoometric	Productive component Phaneroptic	Egg quality	Production cost	Demand
Number of family members	Weight (g)	Head: type of crest, color of the ears, color of the beak	Weight of the egg (g)	Cost vs. Benefit	Study of the demand on the consumption of eggs in the “Utopia Community Fair”.
	Length of the head (cm)		Width of the egg (mm)		
	Width of the head (cm)		Length of the egg (mm)		
	Length of the ears (cm)		Weight of the eggshell (g)		
	Length of the crest (cm)		Thickness of the eggshell (mm)		
Educative level	Width of the crest (cm)	Body: type of feather, color of the feather, color of the skin	Color of the yolk		
	Length of the peak (cm)				
	Length of the neck (cm)				
	Dorsal length (cm)				
	Ventral length (cm)				
Migration from the area	Torax perimeter (cm)	Legs: color of tarsus, presence or absence of feathers.			
	Femoral iliac ischiatic width (cm)				
	Length of the humeral wing (cm)				
	Length of middle wings (cm)				
	Length of distal wings (cm)				
Economic activity	Length of the thighbone (cm)				
	Length of the tarsus, tibia leg (cm)				
	Circumference of tarsus, tibia leg (cm)				
	Length of tarsus and metatarsus bones (cm)				
	Length of the middle phalanx of index finger				
	Length of the first phalanx spur (cm)				

Ltd., Israel), and direct observation of the animals was used to obtain color of feathers, types of feather, types of crest, ear color, beak color, skin color, tarsus color, and possible presence of feathers on the legs (Espinosa, 1991; SOCPA, 2007).

Egg data. In total, 29 eggs from three communities were analyzed. The width of the egg was measured with a digital Vernier caliper (Dongguan Kuaijie Ltd., China); thickness of the eggshell was measured by Egg Shell Thickness Gauge (Orka Food Technology, LLC., USA); and the weight of the egg and the eggshell without the egg was determined by means of digital balance (model galaxy SF-107R; Ravi Scientific Industries, Delhi). Konica Minolta (CR 400) Colorimeter was used for three-dimensional interpretation of the yolk's color. Color of the egg yolk was obtained on three scales L*, a*, b*: L*, luminosity, ranging from 0 (absolute black) to 100 (absolute white); a*, red and green tones, ranging from -60 to +60, with green tones indicated by negative values and red tones assessed by positive values; b*, yellow and blue tones, ranging from -60 to +100, with blue tones shown by negative values and yellow tones corresponding to positive values (González *et al.*, 2015; Ochoa, 2014).

Human participant data. A total of 65 registered members (demographics: age, gender, marital status, number of family members) were subjected to a descriptive statistical analysis according to Rustom (2012). To understand the demand for eggs, we analyzed the type of consumed eggs, frequency of consumption, quantity of consumed eggs, amount of money spent on buying eggs, preferred characteristics of eggs and place of purchase (*Underlying data* (Bravo Avalos, 2019d)) using central trend measures (mean, media and mode) and deviation (variance and standard deviation). For the economic analysis, the profit/cost indicator was established from the ratio of expenditure (egress) to total revenue corresponding to the sale of eggs as follows: total revenues (US\$) divided by expenditure (US\$) (Anzola, 2002; Díaz, 2005; Hammershoj, 2015). See Extended data for the survey used in the study.

Data analysis

Summary percentages were calculated for survey responses from participants, and hen and egg parameters. Egg quality analysis, production costs, and demand analysis for egg consumption were analyzed according to Bruni (2000); FAO (2014); Jeréz (2014); Juárez (1999); Juárez, (2000); Quintana (2011); Villanueva (2015), and World Visión (2008).

All statistical analyses were performed with SPSS (version 22.0).

Ethical statement

The Committee Fundación UTOPIA approved this study. Participants provided informed oral consent to participate in the study prior to its start. Oral consent was obtained from participants instead of written consent because of time constraints and illiteracy of some participants.

Results and discussion

From farming family surveys, it can be observed that 100% of producers own Creole birds. The majority of producers (72 %) own 0–10 birds and 28 % own 10–20 birds.

Analysis of the types of egg consumed found that 49% of families consume laying eggs, 47% consume rural eggs, while only 4% consume quail eggs.

In total, 84% of producers buy eggs because of their nutritional value, 12% because the animals are fed with organic food, and 4% because the eggs have a special flavor. Therefore, it is necessary to inform producers about the requirements of hens to produce eggs rich in essential nutrients, and to convey an added value to the product by disseminating the nutritional composition of the egg being commercialized, based on nutritional information.

Regarding the commercialization of eggs, 57% of producers sell their products at the Utopia Community Fair, 30% sell them in stores, and 6–7% go to markets or deliver them directly to consumers' homes. This shows that there is great support for direct community association with producers. Therefore, producers understand that direct association with customers results in beneficial sales channels, as they avoid intermediate vendors, who usually obtain higher profits without investing in or producing the product.

According to the producers, 96% of them sell 1–2 egg cartons, each containing 30 eggs, and only 4% sell 3–4 cartons. Using the latter figure, this means that 90–120 eggs are sold at a cost of US\$0.25/egg. These statistics represent that the egg production is intended for a retail scale; however, an increase in production will yield greater profits.

This study demonstrated that production cost of eggs contains several expenses: cost of poultry, chick feed, natural alternative medicines for hens, labor cost, and transportation (Table 2). Poultry purchase according to Andrade (2011) indicates that production cost of the chicken at the end of the breeding phase is US\$3.78. When all incurred costs are considered, the total cost of rearing the 81 birds included in this study summed to US\$306.18/hen.

For the purchase and rearing of animals (including food and medicine), labor and transportation, the total costs are US\$1263.77. Sales of eggs amounted to US\$1,500.00. The profit/cost indicator for egg production is US\$1.19, indicating that producers have a profit margin of 0.19 cents for each dollar invested, value that can vary according to the age, production phase, and feeding of birds, complying with very strict food principles, the quality of production, and necessary marketing (Table 2).

Out of the surveyed producers, 75.4% were women and 24.6% were men; 61% have a family composed of 4 to 5 members,

Table 2. Economic analysis of the eggs sold at the Utopia Community Fair.

	Unit	Quantity	Unit value (US\$)	Monthly value (US\$)	Total value (US\$)
Number of animals	Aves	81.00	3.78		306.18
Price of food:					
Maize	qq	3.50	27.00	94.50	378.00
Barley	qq	2.00	22.00	44.00	176.00
Grass	Pounds	203.70	0.14	28.52	114.07
Harvest waste	Pounds	129.00	0.25	32.25	129.00
Alternative natural medicine		3.00	1.00	3.00	12.00
Labor	Hours	0.50	0.94	28.13	112.52
Transportation	Nº Fairs	9.00	4.00	8.00	36.00
TOTAL EXPENDITURE					1263.77
Selling of eggs		6000	0.25	0.5	1500
TOTAL REVENUE					1500
BENEFITS/COST					1.19
Cost/egg					0.21

Calculation explanation: Total cost for feeding 81 birds over a time period of four months was valued at US\$769.07. For this calculation, one considered the type of diet supplied to hens, which consisted of maize, barley, grass, and harvest waste. The value of harvest waste represented 5% of total diet. The cost of medicinal plants for the 81 birds was of US\$3.00 per month, and a total cost of US\$12.00 was incurred, since it is a common practice to use medicinal plants for improving birds' health conditions. One day's wage of a producer is US\$15.00. Time needed for feeding 81 hens and collecting the eggs is 30 minutes a day (estimated cost, US\$0.94/day). This item is multiplied by four months for a total cost of US\$112.50. The fortnightly commuting cost (round trip) for moving products from communities to the Utopia Community fair is US\$4.00. During this study, nine trips were made for nine fairs, leading to a total expenditure of US\$36.00.

followed by 28% with 2 to 3 members, and the remaining 11% with 6 to 7 members. In total, 98.46% of producers surveyed include eggs in their diet, while only 1.54% do not consume eggs.

The results show that 72.31% of producers purchase both types of egg (processed and rural), 16.92% prefer processed eggs, 9.23% like for rural eggs, while as few as 1.54% do not consume eggs at all. Exploration of consumer behavior revealed that 48.44% of the producers surveyed buy eggs daily, 37.50% purchase eggs fortnightly, 12.50% acquire eggs weekly, and 1.56% buy them monthly. The average number of eggs that families purchase is 13 units daily, 33 weekly, 30 fortnightly, and 60 per month. The average amount that producers pay to buy eggs is US\$7.50 for rural eggs and US\$3.25 for commercial eggs; producers said they allocate US\$8.00 to buy any type of eggs per week.

A total of 60% of the producers go shopping in stores located in their neighborhood, 18.46% go to Utopia Community Fair, 13.85% choose public markets, while 4.62% prefer to buy them directly from producers.

The main characteristics of the eggs sold at the Utopia Community Fair show that the average weight of the eggs was 47.24 g; the length 55.24mm; width 41.66mm; weight and thickness of the shell 4.90 g and 0.42 mm, respectively. The color of the yolk obtained a brightness of 57.62 L*, 5.53 a* for red/green

tones and 47.15 b* for yellow/blue tones. The measurement of color and brightness of the yolks reveals high quality of the overall egg, which can be rated as a top product offered by the Ecuadorian market.

Conclusions

The costs to produce a rural egg for the Utopia Community Fair is US\$0.21 with a profit/cost of US\$0.04 per egg (the unit sale price being US\$0.25).

Statistical data of our study reveal that 18.46% of producers purchase rural eggs, their average consumption is 30 units, and they spend US\$7.50 fortnightly. It can be noticed that all producers possess Creole birds; 72% own 0-10 birds and 28% own 10-20 birds. Therefore, it was considered that poultry production is not widespread even though it is considered a very profitable business. Training those who farm Creole hens can be provided in the future so that they provide greater livestock and demand in the market. Analysis of the type of eggs consumed found that 50% of producers consume Creole hen eggs, 44% consume eggs from laying birds, and only 1% prefer quail eggs, which demonstrates high acceptance of Creole eggs by families living in the area of the Utopia Community Fair.

Data availability

Underlying data

Figshare: Zoometric characterization.xlsx, <https://doi.org/10.6084/m9.figshare.9978890.v1> (Bravo Avalos, 2019a).

Figshare: Egg quality.xlsx, <https://doi.org/10.6084/m9.figshare.9978896.v1> (Bravo Avalos, 2019b).

Figshare: Egg colour (3 repetitions).xlsx, <https://doi.org/10.6084/m9.figshare.9978899.v1> (Bravo Avalos, 2019c).

Figshare: Individual survey results for the economic analysis, <https://doi.org/10.6084/m9.figshare.9980033.v1> (Bravo Avalos, 2019d).

Extended data

Figshare: Survey, <https://doi.org/10.6084/m9.figshare.9979025.v2>

Fig share: Survey, <https://doi.org/10.6084/m9.figshare.9979025.v2> (Bravo Avalos, 2019e).

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](#) (CC-BY 4.0).

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Open Peer Review

Current Peer Review Status: ? ?

Version 1

Reviewer Report 19 August 2020

<https://doi.org/10.5256/f1000research.23134.r68841>

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Terence Zimazile Sibanda

School of Environmental and Rural Science, University of New England, Armidale, Australia

This brief research reports a cost-benefit analysis of egg production in three communities of Ecuador. The element of cost-benefit analysis is clearly articulated in the study that shows the potential of the egg production Ecuador and one would want to see further analysis of the challenges in egg poultry production. Egg quality, zoometric measurements, and producer survey data are presented are collected although the zoometric data is completely missing in the results and discussion section. In general, it is not clear why the study was carried out. What the problem was? Correct terminology should be used. The introduction is too short and doesn't cover variables that are going to be studied. The sample size of 29 eggs is not a good representative of the 3 communities? How many hens are in total in these communities? Justify your sample sizes.

Areas of improvement:

1. The purpose and background of the study should be clearly articulated.
2. The author should include subsections on the results to improve structure. A clear structure of the data collected is presented nicely in Table two and this should be maintained in presenting the results.
3. The zoometric measurements and tables of descriptive data of the three communities should be included in the results.
4. Further discussion of the egg quality and zoometric measurements is required.
5. More comparison of the results to other studies is highly warranted in the discussion.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Poultry science

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 29 May 2020

<https://doi.org/10.5256/f1000research.23134.r62000>

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János Felföldi

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In general, the article partially meets the standards of a scientific research paper.

1. Abstract:

- The abstract gives the reader a general and clear idea about the article. It could be good if the author highlights the used statistical techniques.

2. Jel classification could be added.

3. Introduction:

- The introduction is not enough as an introduction to a scientific research paper. It should be longer to give the reader an idea about the considered variables.

4. Literature review:

- It is missed in this article, and that is not accepted. Any research article should contain in addition to the introduction, a good theoretical part to show the author's level of literary knowledge about the topic.
Otherwise, in case there are not enough pages, the author can write a comprehensive and coherent introduction to express the theoretical background of the article, in addition, to mention the objectives of the article at the end of the introduction.

5. Methods:

- The methodology part was discussed well.
- Research design: The time horizon and measurements have been discussed.
- Samples and sampling techniques have been discussed. It is much better to mention clearly if the producers are the consumers themselves.
- Data collection and data sources have been mentioned.
- Data analysis, the author can provide some tables to show the outcomes of the analysis especially for descriptive analysis by SPSS.

6. Results and conclusion:

- As a paragraph, it had discussed well, the author can compare his results to other studies which had done before by other authors and consider the same geographic areas or compare them to other areas in the same country, to show if the consumption trends are the same or changed by time.

7. References:

- The list of references should reorganize again. Some references used in the text of the article but not mentioned in the references list, on the other hand, some references mentioned in the final list but not used in the text of the article.

Summary:

- Accepted after doing major corrections. It should send back to the reviewer again after doing the recommended modifications.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Agribusiness; Farm business management; Agri-food industry; Agri-food supply chains

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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