CHAPTER

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Production Costs of Chenopodium quinoa in Andean Communities

https://doi.org/10.56238/alookdevelopv1-084

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ABSTRACT
Adequate management of production costs will allow establishing real production prices in a precise and pertinent manner, without affecting the farmers' work. Under this premise, the objective of the present study was to determine the production costs of Chenopodium quinoa in the Province of Chumbivilcas, 2021. The study was descriptive, non-experimental and quantitative. The sample consisted of information provided by farmers and producers, in addition to documentation related to the production of organic quinoa in the unit of analysis. The results show that the historical costs were established based on experiences in other realities and market suggestions, putting profitability at risk.

Keywords: Costs, Production costs, Chenopodium quinoa, Organic quinoa.

1 INTRODUCTION

Quinoa is a food that contains high nutritional and protein values, so its commercialization is important (Sulca, 2022); However, the calculation of their production costs is lacking, so producers cannot calculate their profits and are subject to the price set by the stockpilers. In this regard, Regaño and Valencia (2018) argue that this product is cultivated by the community members of different provinces in the south of the country, who try to gradually improve the quinoa production chain, however, they still cultivate it independently, lacking cost control.

In this context, in Europe, Andreotti et al. (2022) report that quinoa prices rise as a result of increased consumer demand, while production increases rapidly, however local benefits are not evident due to the lack of control systems and costs. For their part, Alandia et al. (2020) argue that due to its high nutritional value, quinoa is an Andean grain crop that is recognized as an ally for global food security. The globalization of quinoa, however, presents challenges for countries of origin. Agronomists face a scenario full of new concerns and rivals. Quinoa was present for research and production in 123 passes in the year of 2018. While they are Peru and Bolivia.

Accounting for 74% of global exports, production outside the Andes is growing, but producer prices remained unsustainable.

In South America, Gamboa et al. (2020) report that quinoa, with its unique nutritional characteristics, can contribute to a more sustainable global food production, but that soil fertility must be taken into account, as well as the management and cost control techniques of small farmers to decrease their environmental impact and increase quinoa productivity. Walsh-Dilley (2020) argued that despite knowing that doing so would result in extremely low yields, not covering production costs, and damaging already fragile and degraded soil, producers increased production of extensible quinoa.

For Delatorre et al. (2013) quinoa farmers manage their crops at a technological level that makes them marginally competitive; The expected yields are less than 600 to 900 kg / ha in wet times and 60 kg / ha in dry times, which makes it urgent technological advances to improve the production process, such as improved varieties derived from their own germplasm, irrigation systems and post-harvesting machines, among others.

On the other hand, much of the quinoa production in the Chilean Altiplano is traded on the black market, either through the border market or through buyers from Bolivia who pay between 80 and 120 dollars per Spanish quintal (46 kg).

According to Jacobsen (2013) traditionally, quinoa production was intended for personal consumption. After long periods of fallowing, tillage, pit sowing, fertilizing, harvesting, threshing and cleaning, weeding procedures were carried out manually; The most significant purpose of the fallow of the traditional system is the storage of water in the soil during the year before planting since the annual rainfall is insufficient to support production; In this way, quinoa uses two years of rainfall during its growth cycle. Other uses of quinoa are to restore soil fertility after harvests and reduce the prevalence of diseases and parasites.

Quinoa has a minor role in other economies, occupying less than 2% of arable land and only 5% of land destined for cereals, despite this, has been chosen as a priority product to improve living conditions in the Andean region, since the Altiplano depends almost entirely on these products.

At the national level, Vilca (2017) points out that the management of an adequate cost system will allow in a precise and pertinent way, to establish real prices in production, without bringing to the detriment the work of farmers, For its part, the Food and Agriculture Organization of the United Nations (FAO) reports that crops such as quinoa have been for many years a link in the strengthening of family and peasant agriculture, since they contribute to the security, sovereignty and food autonomy of the territories.

For Jilapa (2019); Apaza et al. (2018) these crops have allowed adaptation in many of the regions that venture into production, through practices that require regular economic investment and human capital, due to the employment of family labor and production system, however, they require a better model of control of their costs, which are implemented by hand through peasant knowledge.

Carrillo et al. (2019) point out that this peculiarity of cultivation creates the need to properly implement production costs.

For their part, Sinchi et al. (2020) report that cost systems are procedures or guidelines that companies must follow to establish their sales prices and profit margins. Likewise, Correa et al. (2019) mention that companies must identify the costs incurred to obtain a final product.

Soto and García (2020) point out that currently the very competitive market forces producers to handle information related to costs, to facilitate the establishment of prices fairly.

According to Parra and Leguizamón (2018) concluded that, in the case of agricultural crops, most of the cost is absorbed by labor and inputs. For his part, Vilca (2017) theoretically exposes the bases for implementing agricultural costs; In this, he highlights that the development and success in this activity is subject to a good observation of production and optimal market conditions.

Likewise, Kaldiyarov (2018) and Laurente (2020) refer that the lack of water in the river, excessive rainfall or the absence of.

These, the increase or decrease in temperature and pests represent eventualities that significantly affect the cost of production, which, if not controlled, could reduce the profits of producers.

Therefore, the purpose of this research work is to describe the production of quinoa, of the family agricultural groups of the community of the Province of Chumbivilcas in the Cuzco region, which will be decanted into a cost model, which may be adopted by these producers, because they cannot pay or adopt a traditional costing system because of the onerous of its implementation. and the absence of necessary resources to be able to pay for its maintenance, in addition to the payment to the costista professional.

Consequently, the following research question arises: What are the production costs of organic quinoa in the family agricultural groups of the community of the Province of Chumbivilcas of the Cuzco region? which translates into the following general objective: To describe the production costs of organic quinoa in the family agricultural groups of the community of the Province of Chumbivilcas of the Cuzco region.

The present study is socially justified, because through cost control, a production that pays fairly the work of the producers will be promoted, as the basis of the productive chain.

It is justified at a practical level, because it will allow an adequate management of costs, which will contribute to future production and marketing operations.

It is justified at a theoretical level, because through cost accounting and the elementary concepts inherent to the quinoa production activity, knowledge related to the cost of production of chenopodium quinoa will be extended.

2 LITERATURE REVIEW

2.1 PRODUCTION COSTS

In the microeconomic framework, it is impossible to understand enterprises as a whole without taking into account the role played by competitive advantages.

This is because, through these advantages, various activities such as product marketing, delivery and support play a specific role in helping companies achieve a position relative to production costs, which serves as the basis for differentiation.

Consequently, factors such as the acquisition of raw materials, preparation of the land, planting, cultural work, and other indirect factors become substantially important (Cely and Ducón, 2015).

The cultivation of quinoa in Peru is crucial to the country's economy, especially now that national and international market trends are positive. Therefore, it is necessary to present the costs of its production, commercialization and industrialization in all its aspects (Borda and De la Vega, 2019).

2.1.1 Production of Chenopodium quinoa

Pseudocereals are a group of dicotyledonous plants that, like true cereals, have seeds high in gluten. The seeds of pseudocereals can be ground into a gluten-free flour that can be used instead of wheat flour in bakery and pasta products. Quinoa (Chenopodium quinoa Willd) is a very popular pseudocereal that was cultivated from 5000-3000 BC in the Andean region of South America, until the time of Spanish colonization, when true cereals were introduced. The Incas venerated quinoa as a sacred food. Since then, quinoa production has continued to increase; In fact, both production and consumption have experienced exponential growth since 2013; and in 2019, 184,585 hectares were used for cultivation, mainly in Peru and Bolivia (Graziano et al., 2022).

According to Muriel and Evia (2011) rural highland families value quinoa as a grain not only for its inclusion in the diet, but also for the way its cultivation fits so well with their working practices and cultural traditions. In this sense, increasing grain production is an effective alternative to produce more income and reduce poverty in the southern Altiplano for several reasons. The first reason is that the price increase is the result of an increase in the consumption of locally produced quinoa, which has become more valued as a result of knowledge of its superior nutritional qualities and organic production style. Secondly, because technological advances and improvements in land use can actually increase the Productivity of the mainland without compromising environmental aspects. Finally, because it is practical to replace, in some way, the areas destined for the cultivation of other products by cereals, taking advantage of their relatively higher profitability.

2.1.2 Production process

This process is considered as the set of activities whose processes are made up of: sowing, sanitary and phytosanitary control work, harvesting, selection and storage (Regaño and Valencia, 2018).

Quinoa has a growing season of 6 to 8 months, and harvest times usually coincide with wet periods. This can lead to grain germination on the plant and the presence of pests such as fungi and insects, which can cause the grain to become discolored and therefore not meet the color criteria of the standard. For example, watering the lawn during dry seasons and storing seeds in a cool place and out of reach of rodents and birds, the spread of moths that have been discovered in samples can be prevented (Coca et al., 2016).

2.1.3 Factors of production

Capital: It is constituted by the capital goods belonging to the farmer, which can be made up of machinery, facilities, inputs, equipment, tools and money.

Labor: Consisting of the personal effort of farmers, who are engaged in this activity, are also considered the laborers hired for the various production activities.

Natural resources: Made up of water, favorable climates, air, and solar rays.

Technology: Technology has incurred, for some time now, in the production process, and consists of the rental or purchase of agricultural machinery such as tractors, drags, motor pumps, fumigators, among others.

2.1.4 Production work

Constituted by the following: Preparation of the land, which consists of ploughing, scraping. Sowing, which can be volleyed, in a row or in furrow. Fertilization, as the name implies, consists of adding manure of sheep or cattle, camelids or birds, which is applied in the tillage of the soil. Cultural tasks consisting of weeding, aporque, defoliation or thinning, demixing. Harvesting, consisting of the cutting or mowing of plants, pre-drying, sandwiching or arching, threshing or beating, pre-cleaning or venting, drying of grains, cleaning, selection and classification of grain. Storage, consisting of the storage of grains in suitable places and conditions.

2.1.5 Production phases

According to Acosta (2022) in the production process of chenopodium quinoa, the following phases are met: In case of emergency, the plant shoots out of the ground and spreads its cotyledone leaves, the stems can be seen protruding from the ground like gnarled weeds in the distance; The plant can survive with little or no water if the soil is sufficiently moist. From the seventh to the tenth day of spring, these flowers are especially vulnerable to bird attacks.

Real leaves on both sides: There is rapid root growth in the first 10-15 days after planting, and at the end of that time, you will see two full, spreading leaves with a lanceolate shape. The plant can be without water for 10-14 days without dying.

Four leaves: There are two sets of long, green leaves, and cotyledonal leaves are still present; the next set of leaves from the apex is forming a button in the armpit of the first set of leaves; This occurs 25-30 days after planting, and it is at this stage that the seedling shows good resistance to cold and drought.

Six true leaves, with three sets of leaves appearing at this stage and cotyledonal leaves turning a bright yellow. During this stage, which occurs between days 35 and 45 of the growth period, the vegetative apex of the plant

It is visibly protected by its more mature leaves, which is especially useful when the plant is subjected to low temperatures at night, stress due to lack of water or salt, or other environmental stresses.

Branching: Eight true leaves appear, and axillary leaves appear up to the third node; cotyledonal leaves fall off and leave scars on the stem; flowers appear, but are hidden from view by the leaves; This occurs around day 45 to 50 of the growing season.

Start of pajonamiento: The inflorescence begins to leave the apex of the plant, and you can see the small leaves that will end up covering three quarters of the panicle grouping around the stem; This can occur between day 55 and 60 of the growing season. At this time, it can also be observed that the first pair of true leaves begins to turn bright green.

Strawing: The flowering clearly exceeds the leaves and you can see the glochidia that compose it. At the same time, individual flower buds can be seen on the bottom glochidia 65-70 days after planting; From this moment until the beginning of milky grain production, flowers can be consumed as a substitute for leaves.

Flowering begins: When the apical flower opens and shows its stigmas, around day 75-80 of flowering, the plant is most vulnerable to frost damage.

Flowering: This stage is reached when half of the flowers of the panicle of the inflorescence is open; This can occur approximately 80-90 days after planting; This stage is extremely sensitive to frost and snow; And the flora should be observed at midday on days with high solar intensity because flowering occurs at its peak when the sun is at its brightest.

Milky grain: When the fruits inside the glomeruli of the panicle burst under pressure, releasing a sweet liquid, around day 100 to 130 of the vegetative cycle, the lack of water is devastating to crop yield, drastically reducing the amount of grain harvested.

Pasty grain: At this stage, the attack of birds (sparrows, pigeons) causes significant damage to the crop by building nests and eating the grain. This can occur between 130 and 160 days into the growing season. At this time, rain and snow are no longer necessary.

Physiological maturity: It is when the grain formed is pressed by the uas, presents resistance to penetration, approximately 160 to 180 days or more after sowing, the moisture content of the grain vara of 14 to 1 The rains at this stage are harmful since they decrease the quality and flavor of the grain.

In addition to the production phases, the Peruvian Andes usually add three stages to the process, these three stages of the grain cleaning process coincide with the periods of commercial growth of quinoa, which are:

The producer is limited to grinding, threshing and selling the grain before storing it for eventual marketing during the initial phase, in which primary production focuses on small-scale domestic use with few quality requirements. Saponin and other impurities are eliminated by the consumer through several phases of manual or domestic washing (Nieto and Vimos, 1992).

In the second phase, when production begins to focus on the foreign market, producers must wash with nearby river water and air dry the grain before selling it (Nieto and Vimos, 1992).

In the third phase, new technological advances are sought to optimize production parameters and reduce costs, especially the amount of washing water used (Nieto and Vimos, 1992).

3 METHODOLOGIES

The research will be developed based on a quantitative, descriptive, non-experimental approach, because the shortcomings of the absence of cost determination in quinoa production will be shown, and then move on to the determination of them based on a detailed scheme of them. In this regard, Ávila (2016) argues that a quantitative study considers that knowledge must be objective and that it arrives through a

Deductive process in which previously formed hypotheses are validated using computer technology and inferential statistical analysis.

For his part, Baena (2014) reports that descriptive studies describe situations and events to decide what a certain phenomenon is and how it manifests itself. The aim of descriptive studies is to point out the crucial characteristics of individuals, groups, communities, etc. From a scientific perspective, description is the most accurate measure possible. They can offer the possibility of making predictions, even if they are crude. For Hernández-Sampieri and Mendoza-Torres (2018) with the information collected, proposals are made for a measurement system, performance, or to address the current problem and the deficiencies discovered, based on a need or lack within the unit of analysis.

The population of the analysis unit was composed of 84 family agricultural groups, belonging to the community of the Province of Chumbivilcas in the Cuzco region, which are dedicated to the cultivation of quinoa. For Ruiz (2012) the population is made up of the number of individuals with similar characteristics, of which you want to know something, or about which it is necessary to solve some problematic situation.

Data collection techniques were interviews, observation and analysis of source documents. In this regard, Gallardo (2017) refers that interviews are configured as methods to collect information, in order to know the problematic reality and / or evidence new ones. For their part, Bisquerra et al. (2009) argue that the objective of document analysis is to represent their content and enable their identification and analysis in order to achieve a proposed objective. Likewise, Namakforoosh (2005) states that observation uses tools to collect data or observable facts determining in advance what aspects need to be studied.

The present study does not require statistics as a measurement tool; however, the Excel program will be used to formulate the production cost scheme of chonopodium quinoa.

4 RESULTS

Table 1
Raw material

Item	Unit	Value	Kg/Ha	Total	%
Kancolla seed	1 kg.	11.20	10	112	2.76%
	TOTAL			112	2.76%

Source: Interviews 2022

As shown in Table 1, the raw material used for the production of quinoa in the family agricultural groups of the community of the Province of Chumbivilcas in the Cuzco region, has a unit cost of 11.20 per kilo, and S / 112.00 for an organic quinoa production campaign, which represents 2.76% of the cost of production.

Table 2
Direct labor

Item	Total	%
Preparing the ground	700.00	17.28%
Sown field	450.00	11.11%

Cultural work	700.00	17.28%
Harvest	900.00	22.21%
TOTAL	2,750.00	67.87%

Source: Interviews 2022

Table 2 shows the costs of direct labor for a campaign of 180 days for the production of organic quinoa, which amounts to S / 2,750.00 which represents 67.87% of the total cost of production of this material. Likewise, it is observed that the cost of preparing the land amounts to S / 700.00 which is equivalent to 17.28% of the total cost, the activity of sowing has a cost of S / 450.00 equivalent to 11.11% of the total cost, cultural work has a cost of S / 700.00 equivalent to 17.28% of the total cost, the harvesting activity has a cost of S / 900.00 equivalent to 22.21% of the total cost.

Table 3

Indirect costs				
Item	Unit	P.Unit.	Total	%
Starter parts	1	22.00	22.00	0.54%
Plastics and tapes	200	1.20	240.00	5.92%
Segaderas	10	15.00	150.00	3.70%
Tolderas	4	34.00	136.00	3.36%
Sacks	20	3.50	70.00	1.73%
Blankets	2	6.00	12.00	0.30%
Raucana	8	15.00	120.00	2.96%
Huactanas	10	44.00	440.00	10.86%
TOTAL			1,190.00	29.37%

Source: Interviews 2022

As evidenced in Table 3, the indirect costs incurred by the family agricultural groups of the community of the Province of Chumbivilcas of the Cuzco region, for a campaign of 180 days in the production of organic quinoa, which consider starter pieces, plastics, tapes, segaderas, tolderas, sacks, blankets, raucanas and huactanas, amount to S / 1,190.00 equivalent to 29.37% of total costs.

Table 4

Production Cost Determination Sheet					
12	**Month of execution**	**Unit of measurement**	**Number of units**	**Unit price**	**Total, cost**
A. DIRECT COSTS					**2,750.00**
1. Preparation of the ground					**700.00**
Arado	Ago - set	Hr/Máq.	4	70.00	280.00
Rastrado	Ago - set	Hr/Máq.	3	60.00	180.00
Furrows	Ago - set	Hr/Máq.	3	80.00	240.00
2. Seeding					**450.00**
Seed	Set - Oct	Medical history.	10	10.00	100.00
Sowers	Set - Oct	Newspaper	2	25.00	50.00
Subscriber	Ago - set	Newspaper	2	25.00	50.00
Manure	Set - Oct	Ton	3	90.00	250.00
3. Cultural work					**700.00**

Aporcado	Nov - Dec	Newspaper	8	25.00	200.00
1er. deshierbado	Dec - Jan	Newspaper	5	24.00	120.00
Raleo	Dec - Jan	Newspaper	3	25.00	75.00
2nd. dehierbado	One - Feb	Newspaper	5	25.00	125.00
Phytosanitary control	Ene - Mar	Newspaper	1	25.00	25.00
Backpack rental	Ene - Mar	Day	1	15.00	15.00
Discarded ayaras	Feb - Mar	Newspaper	2	25.00	50.00
Biol	Dec - Sea	Liter	60	1.50	90.00

4. Harvest					**900.00**
Mowed	Sea - Apr	Newspaper	10	30.00	300.00
Emparvado	Sea - Apr	Newspaper	4	25.00	100.00
Hackneyed	Abr - May	Newspaper	10	25.00	250.00
Threshing assistant	Abr - May	Newspaper	2	25.00	50.00
Venting	Abr - May	Newspaper	4	25.00	100.00
Transport	Abr - May	Transport	1	50.00	50.00
Scarred, weighed and stored	Abr - May	Newspaper	2	25.00	50.00
B. INDIRECT COSTS					**1,190.00**
Starter parts	Jan - Apr	Package	1	22.00	22.00
Plastics and tapes	Mar - May	Metro	200	1.20	240.00
Segaderas	April	Unit	10	15.00	150.00
Tolderas	Apr - Jul	Unit	4	34.00	136.00
Sacks	May	Unit	20	3.50	70.00
Blankets	Abr - May	Unit	2	6.00	12.00
Raucana	One - Feb	Unit	8	15.00	120.00
Huactanas	Abr - May	Unit	10	44.00	440.00

Source: Interviews 2022

As presented in Table 4, the components of the costs for quinoa production by the family agricultural groups of the community of the Province of Chumbivilcas of the Cuzco region, for a campaign of 180 days, are divided into direct costs and indirect costs. According to this model, the direct costs of this campaign amount to S / 2,750.00, and indirect costs amount to S / 1,190.00.

Discussions

The results are consistent with Vilca (2017) who pointed out that the management of an adequate cost system will allow in a precise and pertinent way, to establish real prices in production, without bringing to the detriment the work of farmers. They are concordant with

Carrillo et al. (2019) who concluded that this peculiarity of cultivation creates the need to properly implement production costs; in a theoretical study by Sinchi et al. (2020) refer that cost systems are procedures or guidelines that companies must follow to establish costs.

They are similar to Soto and García (2020) who concluded that in such a competitive market, producers demand information related to costs, which facilitates the establishment of prices fairly; In addition to the above, it highlights that the establishment of an adequate cost system affects the profitability of production. They are consistent with Parra and Leguizamón (2018) who show a structure of costs and annual income (monetary and domestic) of the agricultural production of the coca leaf; It presents an analysis of price sensitivity and a classification of coca farmers, from which their surpluses and remuneration for their work are established, concluding that the highest costs in agricultural production in this crop are represented in labor and inputs.

They are similar to Vilca (2017) who theoretically exposes the bases for implementing agricultural costs; In this, he highlights that the development and success in this activity is subject to a good observation of production and optimal market conditions.

5 CONCLUSIONS

In relation to the general objective, to determine the production costs of Chenopodium quinoa in the Province of Chumbivilcas, 2021, it was concluded that the components of the costs for the production of organic quinoa in a campaign of 180 days. According to this model, the direct costs of this campaign amount to S / 2,750.00, as well as indirect costs amount to S / 1,190.00.

In relation to the first specific objective, to determine the raw material costs of Chenopodium quinoa in the Province of Chumbivilcas, 2021, it was concluded that the raw material has a cost of S / 112.00, the same that represents 2.76% of the cost of production, which includes a 180-day campaign for the production of organic quinoa.

In relation to the second specific objective, to determine the direct labor costs of Chenopodium quinoa in the Province of Chumbivilcas, 2021, it was concluded that the costs of direct labor for a 180-day campaign for the production of organic quinoa, the same that amounts to S / 2,750.00 the same that represents 67.87% of the total cost of the production of this material. Likewise, it is observed that the cost of preparing the land amounts to S / 700.00 which is equivalent to 17.28% of the total cost, the activity of sowing has a cost of S / 450.00 equivalent to 11.11% of the total cost, cultural work has a cost of S / 700.00 equivalent to 17.28% of the total cost, the harvesting activity has a cost of S / 900.00 equivalent to 22.21% of the total cost.

In relation to the third specific objective, to determine the indirect costs of Chenopodium quinoa in the Province of Chumbivilcas, 2021, it was concluded that the indirect costs incurred for a 180-day campaign in the production of organic quinoa, which amount to S / 1,190.00, equivalent to 29.37% of the total costs.

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