

Raissa Rachel Salustriano da Silva-Matos  
Fernando Freitas Pinto Júnior  
Jonathas Araújo Lopes  
(Organizadores)



Investigación, tecnología e innovación  
**EN CIENCIAS AGRÍCOLAS**

4

**Atena**  
Editora  
Ano 2022

Raissa Rachel Salustriano da Silva-Matos  
Fernando Freitas Pinto Júnior  
Jonathas Araújo Lopes  
(Organizadores)



Investigación, tecnología e innovación  
**EN CIENCIAS AGRÍCOLAS**

4

**Atena**  
Editora  
Ano 2022

**Editora chefe**

Profª Drª Antonella Carvalho de Oliveira

**Editora executiva**

Natalia Oliveira

**Assistente editorial**

Flávia Roberta Barão

**Bibliotecária**

Janaina Ramos

**Projeto gráfico**

Bruno Oliveira

Camila Alves de Cremo

Luiza Alves Batista

Natália Sandrini de Azevedo

**Imagens da capa**

iStock

**Edição de arte**

Luiza Alves Batista

2022 by Atena Editora

Copyright © Atena Editora

Copyright do texto © 2022 Os autores

Copyright da edição © 2022 Atena Editora

Direitos para esta edição cedidos à Atena Editora pelos autores.

*Open access publication* by Atena Editora



Todo o conteúdo deste livro está licenciado sob uma Licença de Atribuição *Creative Commons*. Atribuição-Não-Comercial-Não-Derivativos 4.0 Internacional (CC BY-NC-ND 4.0).

O conteúdo dos artigos e seus dados em sua forma, correção e confiabilidade são de responsabilidade exclusiva dos autores, inclusive não representam necessariamente a posição oficial da Atena Editora. Permitido o *download* da obra e o compartilhamento desde que sejam atribuídos créditos aos autores, mas sem a possibilidade de alterá-la de nenhuma forma ou utilizá-la para fins comerciais.

Todos os manuscritos foram previamente submetidos à avaliação cega pelos pares, membros do Conselho Editorial desta Editora, tendo sido aprovados para a publicação com base em critérios de neutralidade e imparcialidade acadêmica.

A Atena Editora é comprometida em garantir a integridade editorial em todas as etapas do processo de publicação, evitando plágio, dados ou resultados fraudulentos e impedindo que interesses financeiros comprometam os padrões éticos da publicação. Situações suspeitas de má conduta científica serão investigadas sob o mais alto padrão de rigor acadêmico e ético.

**Conselho Editorial****Ciências Agrárias e Multidisciplinar**

Prof. Dr. Alexandre Igor Azevedo Pereira – Instituto Federal Goiano

Profª Drª Amanda Vasconcelos Guimarães – Universidade Federal de Lavras

Profª Drª Andrezza Miguel da Silva – Universidade do Estado de Mato Grosso

Prof. Dr. Arinaldo Pereira da Silva – Universidade Federal do Sul e Sudeste do Pará

Prof. Dr. Antonio Pasqualetto – Pontifícia Universidade Católica de Goiás

Profª Drª Carla Cristina Bauermann Brasil – Universidade Federal de Santa Maria



Prof. Dr. Cleberton Correia Santos – Universidade Federal da Grande Dourados  
Prof<sup>o</sup> Dr<sup>a</sup> Diocléa Almeida Seabra Silva – Universidade Federal Rural da Amazônia  
Prof. Dr. Écio Souza Diniz – Universidade Federal de Viçosa  
Prof. Dr. Edevaldo de Castro Monteiro – Universidade Federal Rural do Rio de Janeiro  
Prof. Dr. Fábio Steiner – Universidade Estadual de Mato Grosso do Sul  
Prof. Dr. Fágner Cavalcante Patrocínio dos Santos – Universidade Federal do Ceará  
Prof<sup>o</sup> Dr<sup>a</sup> Girlene Santos de Souza – Universidade Federal do Recôncavo da Bahia  
Prof. Dr. Guilherme Renato Gomes – Universidade Norte do Paraná  
Prof. Dr. Jael Soares Batista – Universidade Federal Rural do Semi-Árido  
Prof. Dr. Jayme Augusto Peres – Universidade Estadual do Centro-Oeste  
Prof. Dr. Júlio César Ribeiro – Universidade Federal Rural do Rio de Janeiro  
Prof<sup>o</sup> Dr<sup>a</sup> Lina Raquel Santos Araújo – Universidade Estadual do Ceará  
Prof. Dr. Pedro Manuel Villa – Universidade Federal de Viçosa  
Prof<sup>o</sup> Dr<sup>a</sup> Raissa Rachel Salustriano da Silva Matos – Universidade Federal do Maranhão  
Prof. Dr. Renato Jaqueto Goes – Universidade Federal de Goiás  
Prof. Dr. Ronilson Freitas de Souza – Universidade do Estado do Pará  
Prof<sup>o</sup> Dr<sup>a</sup> Talita de Santos Matos – Universidade Federal Rural do Rio de Janeiro  
Prof. Dr. Tiago da Silva Teófilo – Universidade Federal Rural do Semi-Árido  
Prof. Dr. Valdemar Antonio Paffaro Junior – Universidade Federal de Alfenas



## Investigación, tecnología e innovación en ciencias agrícolas 4

**Diagramação:** Camila Alves de Cremo  
**Correção:** Yaiddy Paola Martinez  
**Indexação:** Amanda Kelly da Costa Veiga  
**Revisão:** Os autores  
**Organizadores:** Raissa Rachel Salustriano da Silva-Matos  
Fernando Freitas Pinto Júnior  
Jonathas Araújo Lopes

### Dados Internacionais de Catalogação na Publicação (CIP)

l62 Investigación, tecnología e innovación en ciencias agrícolas 4 / Organizadores Raissa Rachel Salustriano da Silva-Matos, Fernando Freitas Pinto Júnior, Jonathas Araújo Lopes. – Ponta Grossa - PR: Atena, 2022.

Formato: PDF

Requisitos de sistema: Adobe Acrobat Reader

Modo de acesso: World Wide Web

Inclui bibliografia

ISBN 978-65-258-0617-4

DOI: <https://doi.org/10.22533/at.ed.174221110>

1. Ciências agrícolas. I. Silva-Matos, Raissa Rachel Salustriano da (Organizador). II. Pinto Júnior, Fernando Freitas (Organizador). III. Lopes, Jonathas Araújo (Organizador). IV. Título.

CDD 338.1

Elaborado por Bibliotecária Janaina Ramos – CRB-8/9166

**Atena Editora**  
Ponta Grossa – Paraná – Brasil  
Telefone: +55 (42) 3323-5493  
[www.atenaeditora.com.br](http://www.atenaeditora.com.br)  
[contato@atenaeditora.com.br](mailto:contato@atenaeditora.com.br)



## DECLARAÇÃO DOS AUTORES

Os autores desta obra: 1. Atestam não possuir qualquer interesse comercial que constitua um conflito de interesses em relação ao artigo científico publicado; 2. Declaram que participaram ativamente da construção dos respectivos manuscritos, preferencialmente na: a) Concepção do estudo, e/ou aquisição de dados, e/ou análise e interpretação de dados; b) Elaboração do artigo ou revisão com vistas a tornar o material intelectualmente relevante; c) Aprovação final do manuscrito para submissão; 3. Certificam que os artigos científicos publicados estão completamente isentos de dados e/ou resultados fraudulentos; 4. Confirmam a citação e a referência correta de todos os dados e de interpretações de dados de outras pesquisas; 5. Reconhecem terem informado todas as fontes de financiamento recebidas para a consecução da pesquisa; 6. Autorizam a edição da obra, que incluem os registros de ficha catalográfica, ISBN, DOI e demais indexadores, projeto visual e criação de capa, diagramação de miolo, assim como lançamento e divulgação da mesma conforme critérios da Atena Editora.



## DECLARAÇÃO DA EDITORA

A Atena Editora declara, para os devidos fins de direito, que: 1. A presente publicação constitui apenas transferência temporária dos direitos autorais, direito sobre a publicação, inclusive não constitui responsabilidade solidária na criação dos manuscritos publicados, nos termos previstos na Lei sobre direitos autorais (Lei 9610/98), no art. 184 do Código Penal e no art. 927 do Código Civil; 2. Autoriza e incentiva os autores a assinarem contratos com repositórios institucionais, com fins exclusivos de divulgação da obra, desde que com o devido reconhecimento de autoria e edição e sem qualquer finalidade comercial; 3. Todos os e-book são *open access*, *desta forma* não os comercializa em seu site, sites parceiros, plataformas de *e-commerce*, ou qualquer outro meio virtual ou físico, portanto, está isenta de repasses de direitos autorais aos autores; 4. Todos os membros do conselho editorial são doutores e vinculados a instituições de ensino superior públicas, conforme recomendação da CAPES para obtenção do Qualis livro; 5. Não cede, comercializa ou autoriza a utilização dos nomes e e-mails dos autores, bem como nenhum outro dado dos mesmos, para qualquer finalidade que não o escopo da divulgação desta obra.



## APRESENTAÇÃO

A agronomia desde os tempos remotos atua como uma área de conhecimento que além de ampla, é necessária para o desenvolvimento econômico e social. Desse modo, a pesquisa e inovação nos segmentos que fazem parte do setor agrário são indispensáveis para promover um melhor desempenho no futuro.

Nos últimos anos, a inclusão da tecnologia tem impulsionado a grade de estudo no campo das ciências agrárias. Tal avanço, evidentemente, permitiu que novas técnicas e melhorias chegassem até produtores, de forma a garantir um novo cenário, a fim de aliar produtividade e rendimento econômico.

As ciências agrárias, em sua totalidade, agrupam um conjunto de conhecimentos que permitem uma melhor utilização dos recursos naturais. Assim, este livro intitulado “ORGANIZACIÓN, INVESTIGACIÓN, TECNOLOGÍA Y INNOVACIÓN EM CIENCIAS AGRÍCOLAS 4” tem como finalidade abranger uma série de estudos focados em apresentar métodos e tecnologias para impulsionar os processos agrícolas já existentes, desde técnicas no campo e laboratório.

Os temas aqui abordados refletem estudos de artigos científicos e revisões bibliográficas, de maneira a reunir informações precisas e fundamentais para uma estratégia de aproveitamento dos recursos naturais. Nesse sentido, ao longo da obra são apresentados 10 trabalhos que objetivam imergir o (a) leitor (a) dentro de um panorama agrônomo.

Espera-se que este estudo permita ao presente leitor (a) a possibilidade de conhecer novos mecanismos de pesquisa para fins agropecuários, além de agregar mais conhecimento e um novo olhar sobre a importância da tecnologia no meio agrário.

Raissa Rachel Salustriano da Silva-Matos

Fernando Freitas Pinto Júnior

Jonathas Araújo Lopes



## SUMÁRIO

### **CAPÍTULO 1..... 1**

#### **ACTIVIDAD ANTIMICROBIANA DE NANOPARTÍCULAS DE PLATA OBTENIDAS POR VIA BIOLÓGICA CONTRA HONGOS FITOPATÓGENOS**

Gabriela Lucero Cuatra-Xicalhua

Diana Alexandra Calvo Olvera


Norma Gabriela Rojas-Avelizapa

Paul Edgardo Regalado-Infante

Daniel Tapia Maruri

Ricardo Serna Lagunes

Luz Irene Rojas-Avelizapa

 <https://doi.org/10.22533/at.ed.1742211101>

### **CAPÍTULO 2..... 11**

#### **AVALIAÇÃO VISUAL DA QUALIDADE ESTRUTURAL DO SOLO EM PROPRIEDADE AGRÍCOLA FAMILIAR NA AMAZÔNIA ORIENTAL**

Douglas Silva dos Santos

Antonia Kilma de Melo Lima

Nazareno de Jesus Gomes de Lima

Ana Lorrynny Ramos Lima

Fernanda Gisele Santos de Quadros


Wilton Barreto Morais

Liliane pereira da Silva

Raimunda Tainara Lino Ribeiro

Luan Daniel Silva Ferreira

Luana Costa da Silva

 <https://doi.org/10.22533/at.ed.1742211102>

### **CAPÍTULO 3..... 25**


#### **CARACTERIZACIÓN Y RENDIMIENTO DE DOS MAÍCES CRIOLLOS POZOLEROS DE LOS ESTADOS DE GUANAJUATO Y MICHOACÁN EN EL MUNICIPIO DE ZUMPANGO, ESTADO DE MÉXICO**

José Luis Gutiérrez Liñán

Carmen Aurora Niembro Gaona

Alfredo Medina García

María Candelaria Mónica Niembro Gaona

 <https://doi.org/10.22533/at.ed.1742211103>

### **CAPÍTULO 4..... 36**

#### **EFFECTO DEL PRE-TRATAMIENTO Y TEMPERATURA EN LA CINÉTICA DE SECADO Y VARIACIÓN DE COLOR EN EL AGUAYMANTO DEL ECOTIPO ALARGADO SELECCIÓN CANAÁN**

Marianela Díaz Lloclla

Fredy Taipe Pardo


María del Carmen Delgado Laime

 <https://doi.org/10.22533/at.ed.1742211104>

**CAPÍTULO 5..... 52**

**ESTIMULACIÓN DE LA GERMINACIÓN DE SEMILLAS DE TRIGO POR EXPOSICIÓN A CAMPOS MAGNÉTICOS ESTACIONARIOS**

Edwin Huayhua Huamani  
Juan Manuel Tito Humpiri  
José Luis Pineda Tapia  
Julio Cesar Laura

 <https://doi.org/10.22533/at.ed.1742211105>

**CAPÍTULO 6..... 58**

**FACTORES NO GENÉTICOS QUE AFECTAN LA PRODUCCIÓN DE LECHE EN VACAS CARORA**


Marcano J.M.  
Chirinos Z.

 <https://doi.org/10.22533/at.ed.1742211106>

**CAPÍTULO 7..... 74**

***Klebsiella variicola*, *Klebsiella pneumoniae*, Y *Klebsiella quasipneumoniae* PROMUEVEN IN VITRO EL CRECIMIENTO RADICULAR DE *Solanum lycopersicum* L**


Gutiérrez Morales Iris Guadalupe  
Garza-Ramos Martínez Jesús Ulises  
Nava Faustino Getsemaní  
Ramírez Peralta Arturo  
Forero Forero Angela Victoria  
Romero Ramírez Yanet  
Toribio Jiménez Jeiry

 <https://doi.org/10.22533/at.ed.1742211107>

**CAPÍTULO 8..... 79**

**PRODUCERS OF QUINUA IN LAKE TITICACA. CASE: CAMPESINA DE CARABUCO COMMUNITY SEEN FROM THE GENDER APPROACH**

Yudy Huacani Sucasaca


 <https://doi.org/10.22533/at.ed.1742211108>

**CAPÍTULO 9..... 92**

**THIAMINE AND SOIL AMENDMENTS ON *Urochloa brizantha* PRODUCTION**

Eduardo Pradi Vendrusculo  
Cleicimar Gomes Costa  
Eder Luiz Menezes da Silva  
Harianny Severino Barbosa  
Thales Silva Ferreira  
Vitória Carolina Dantas Alves  
Gabriela Rodrigues Sant' Ana

 <https://doi.org/10.22533/at.ed.1742211109>

<b>CAPÍTULO 10.....</b>	<b>102</b>
TOTAL REPLACEMENT OF FISHMEAL BY SOYBEAN, RAPESEED AND LUPINE MEALS IN CHILEAN SOUTHERN RIVER CRAYFISH JUVENILES, <i>Samastacus spinifrons</i> Italo Salgado-Leu Andrés Salgado-Ismodes  <a href="https://doi.org/10.22533/at.ed.17422111010">https://doi.org/10.22533/at.ed.17422111010</a>	
<b>SOBRE OS ORGANIZADORES .....</b>	<b>118</b>
<b>ÍNDICE REMISSIVO.....</b>	<b>119</b>

## PRODUCERS OF QUINUA IN LAKE TITICACA. CASE: CAMPESINA DE CARABUCO COMMUNITY SEEN FROM THE GENDER APPROACH

*Data de aceite: 03/10/2022*

*Data de submissão: 30/08/2022*

**Yudy Huacani Sucasaca**

Professional School of Economics and  
International Business  
School of Accounting and Financial Sciences  
Andean University Néstor Cáceres Velásquez  
Juliaca – Peru  
<https://orcid.org/0000-0003-4283-1120>

**ABSTRACT:** The objective of the research was to describe the uses and perceptions of quinoa (*Chenopodium quinoa*), differentiated by gender of the producers of the Campesino Community of Carabuco, located on the shores of Lake Titicaca (Puno region, Peru). The tools used in this research are: the cross section, the activity diagram by gender, analysis of access and use by gender, surveys and semi-structured interviews. The results show a great participation of women in the cultivation of quinoa, harvest and post - harvest (threshing, pre - cleaning, drying, sorting, grading and storing grain) as well as its marketing to local, regional markets , National and international. The woman recognizes the importance of quinoa in the food security of the family from: the preparation of traditional foods such as kispíño, p'esque and soup; non-traditional such as bread and biscuit and new ones as combinations with beans, barley and wheat; the nutritional, medicinal and nutraceutical properties are also valued. Formerly the women of the Campesino Community of Carabuco

used the saponin extracted from bitter quinoa as shampoo, detergent and toothpaste. Due to its geographical location, Carabuco has been favored by the climatic conditions of the lakeside zone for the cultivation of quinoa. It is concluded that quinoa is of transcendental interest for the food security of the producers of Carabuco and its production should be promoted as an alternative for development and included in the economic and social development programs.

**KEYWORDS:** Quinoa, Carabuco, Gender, Development.

### PRODUCTORES DE QUINUA EN EL LAGO TITICACA. CASO: COMUNIDAD CAMPESINA DE CARABUCO VISTA DESDE EL ENFOQUE DE GÉNERO

**RESUMEN:** La investigación tuvo como objetivo describir los usos y percepciones sobre la quinua (*Chenopodium quinoa*), diferenciadas por género de los productores de la Comunidad Campesina de Carabuco, ubicada a orillas del Lago Titicaca (región Puno, sureste del Perú). Las herramientas utilizadas en esta investigación son: el corte transversal, el diagrama de actividades por género, análisis de acceso y uso por género, encuestas y entrevistas semiestructuradas. Los resultados evidencian una gran participación de la mujer en el cultivo de la quinua, la cosecha y la post - cosecha (labores de trilla, pre limpieza, secado, selección, clasificación y almacenamiento del grano) así como su comercialización a mercados local, regional, nacional e internacional. La mujer reconoce la importancia de la quinua en la seguridad alimentaria de la familia desde: la preparación

de alimentos tradicionales como el kispíño, p'esque y sopa; no tradicionales como el pan y la galleta y nuevos como combinaciones con habas, cebada y trigo; también se valora las propiedades nutricionales, medicinales y nutraceúticas. Antiguamente las mujeres de la Comunidad Campesina de Carabuco utilizaban la saponina extraída de la quinua amarga como champú, detergente y pasta dental. Por la ubicación geográfica Carabuco se ha visto favorecida por las condiciones climáticas de la zona lacustre del lago para el cultivo de la quinua. Se concluye que la quinua es de trascendental interés para la seguridad alimentaria de los productores de Carabuco y se debería promover su producción como una alternativa de desarrollo e incluir en los programas de desarrollo económico y social.

**PALABRAS CLAVE:** Quinua, Carabuco, Género, Desarrollo.

## 1 | INTRODUCTION

This research addresses the access and use of quinoa, differentiating between the participation of male and female producers in the rural community of Carabuco, located at 3,835 m.a.s.l. on the shores of Lake Titicaca (Peru). The official language is Spanish and the native language is Quechua, so the study area is shown schematically through a cross section (Figure 1), which shows from the lowest point of the study area where quinoa is adapted -the shore of the lake- to the highest point of the place -the houses and hills-. The road crosses the entire community; it borders the shore of the lake, integrating Carabuco with other important cities, such as Juliaca, a well-known commercial hub.

In Carabuco, agricultural activity predominates in addition to livestock farming, where each farmer has scattered crops on different types of land, from flooded land on the shores of the lake to irrigated crops on the hillsides; this allows them to change their living space and agricultural production when there are vulnerable situations, such as floods and droughts (Huacani, 2007). The houses are located on the hillsides because of the risk of flooding. The hills are covered with eucalyptus trees, although in some areas these are more dispersed than in others.

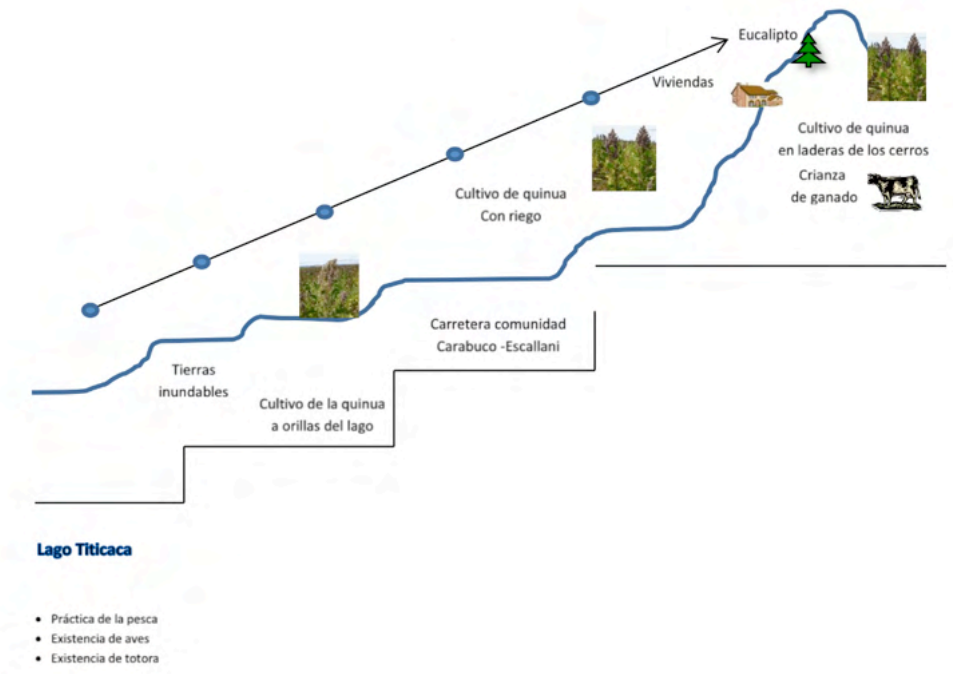


Figure 1. Cross section of the Carabuco community.

Women, accompanied by children, carry out their work in the areas adjacent to the house, livestock and arable land, while in the area of the lake there is a greater presence of men.

The agricultural calendar in the cultivation of quinoa is a determining factor in organizing time; the producers program their quinoa cultivation activities on this basis.



of Carabuco located on the shores of Lake Titicaca (Puno, Peru).

### *1.1.2 Specific objectives*

To explain the gender-differentiated uses of quinoa in the Carabuco Rural Community, located on the shores of Lake Titicaca.

To describe the gender-differentiated perceptions of quinoa in the rural community of Carabuco, located on the shores of Lake Titicaca.

## **2 | MATERIALS AND METHODS**

The research is quantitative, non-experimental, cross-sectional, the tools used are: cross-sectional, the diagram of activities by gender and semi-structured interviews with 50 producers out of a total of 350 inhabitants of the community. This research details the following sections: differentiation of activities by gender in the cultivation of quinoa, gender and quinoa cultivation, use and consumption of quinoa by gender, medicinal use of quinoa, use of bioindicators in the cultivation of quinoa, perceptions about quinoa and the development of the community.

## **3 | RESULTS**

### **3.1 Adaptive capacity of quinoa in the Carabuco Campesino Community on the shores of Lake Titicaca**

Quinoa cultivation is seasonal and depends on rainfall; however, the community of Carabuco, due to its location in the agroecological zone around the lake (Figure 2), benefits from the microclimate, as there are no intense frosts, producing quality quinoa in three varieties: kankolla, white and pasankalla; the most widely cultivated variety is kankolla (Table 2). One characteristic of the circumlacustrine zone is the existence of smallholdings, which limits the cultivation of large areas of quinoa.



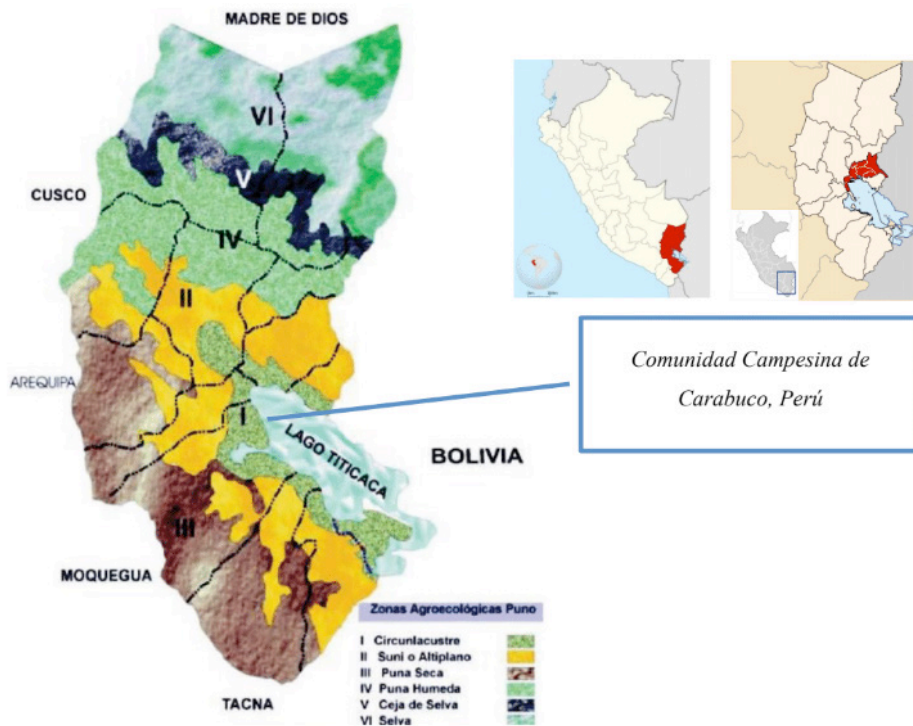


Figure 2. Map of the Puno region - Peru.

Note: Marca (2011). Regional Government of Puno

*We women always plant quinoa, we know with our hands how much quinoa we should put in the furrow at the time of planting (Paula, 74 years old).*

Variety	Growing season (days)	Grain			Yield (Kg/ha)	Biotic and Abiotic	
		Size	Color	Saponin		Tolerant	Susceptible
Kankolla	170 to 210	Large	White	Bitter	1100 to 2500	Humidity	Hail and flooding
White	160 to 180	Large	White	Bitter	1200 to 2500	Humidity	Hail and flooding
Pasankalla	180 to 200	Large	Light lead	Sweet	2000 to 3500	Humidity	Hail and flooding

Note: Information gathered during field work.

Table 2. Characteristics of quinoa varieties in the Comunidad Campesina de Carabuco

Elaboration: Own.

### 3.2 Planting, harvesting and post-harvesting of quinoa crops

Both men and women are aware that the cultivation of quinoa requires soil management, which requires the practice of crop rotation. The women indicate that potatoes are planted first, followed by quinoa and then wheat or beans, and so on each following year so that production achieves greater productivity (Figure 3).

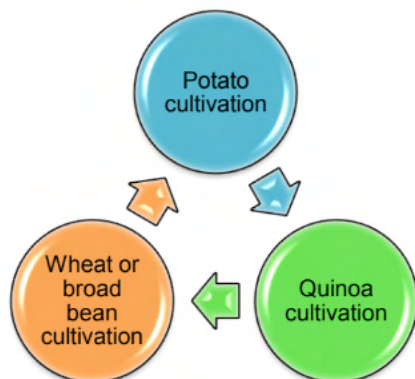


Figure 3. Quinoa crop rotation in the Comunidad Campesina de Carabuco

According to the women's experiences, quinoa is planted (planting is done in furrows spaced 40 to 60 cm apart) in dry soil and when rainfall begins, germination, emergence and plant growth is uniform (Care Perú, 2012). It also depends on the time and preparation of the soil, seed quality, fertilization and weed control (Marca, Cancha, Quispe and Mamani, 2011). It is common for women to use seed from the same organic-type harvest. It is cultivated in different areas from the hillside, foothills and lake zone. The technology used is manual by the use of tools such as: pico, chaquitajlla, segadera, huajtana, susunas. Quinoa is very susceptible to weeds and this work is generally done by women.

Men and women share the work of harvesting quinoa during the months of March to May, work that is done in the mornings or afternoons since the rest of the day the humidity is higher to avoid shelling or loss of grain. The cutting or mowing of the quinoa is done manually. After mowing the quinoa, men and women make arches to complete the maturation of the grain and the drying of the stalks, leaves and pre-drying of the grain, which is done in the same field. These must be covered to protect from rain and birds.

One problem we have during the quinoa harvest is the abundant pigeons that eat the quinoa grains, even though we cover them with plastic or straw, they always take the grain from us.

In the post-harvest of quinoa, women carry out the following tasks: pre-cleaning, drying, selection, classification, storage and marketing, while men do the work that requires more physical strength, such as threshing, and in some cases women also do this work (Figure 4).



Figure 4. Post-harvest management by gender in the Comunidad Campesina de Carabuco

We protect the quinoa from hail, my grandparents always burned around the farm to make the hail pass and protect the quinoa. We burned with kerosene, with logs and logs, we lit it so that it would not hail. If someone has twin children, we ask the parents that the children shout saying: “pasai pasai totola”, all that we do so that the hail does not take away our quinoa harvest, and it is a concern every year (Paula, 74 years old).

The quinoa producers of the Comunidad Campesina de Carabuco market quinoa in weekly fairs (known as *k'atos*), in small quantities (*arroba* or 12 kilograms), of different qualities, at different times of the year, mainly as grain, with no value added - traditional system. In Carabuco, quinoa is marketed through intermediaries made up of wholesalers and retailers who frequent the weekly fairs in Taraco and Juliaca (Figure 5). Unwashed quinoa is more widely marketed at the Taraco and Juliaca fairs, although in Juliaca there is significant demand for washed quinoa (for the preparation of quinoa juice, soup, bread, *mazamorra* and *p'esque* because it is a commercial hub city in the southern Peruvian region).

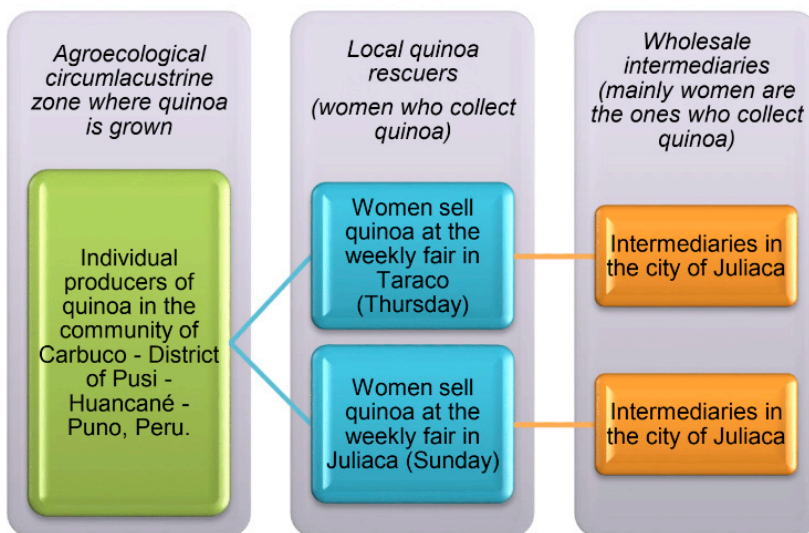


Figure 5. Diagram of quinoa collection in the Community of Carabuco

An important aspect of quinoa producers with respect to marketing is that it is free of impurities and has a low price in the production and harvest stage, improving in the post-harvest stage, which implies a high demand for the quality itself, and the absence of the use of pesticides attracts marketers to demand organic quinoa from Carabuco (Table 3). In Carabuco, the traditional mode quinoa production system prevails, as it has shown to be sustainable over time, whose production and demand is recognized by the local and regional market (Gómez-pando & Julca-otiniano, 2018).

Stages	Month	Prices
Production	October to march	Low
Harvest	April, may and june	Low
Post – harvest	October to february	High

Note: Field work.

Table 3. Quinoa price behavior in production, harvest and post-harvest stages

Elaboration: Own.

## 4 | DISCUSSION

### 4.1 Quinoa use and consumption by gender in the rural community of Carabuco

According to the community members of Carabuco since ancient times quinoa has provided food security for the family (Nowak et al., 2016). Seventy percent of production is destined for self-consumption based on their traditional customs and because it is considered essential for food. Its importance in consumption is due to two factors: its economic purchasing power and the cultural habits of the rural population in their diet.

Quinoa consumption is valued by men and women due to its nutritional benefits -quinoa for its high nutritional value, can be used as an industrial by-product as a beneficial alternative for health (Márquez-villacorta & Pretell-vásquez, 2018)-, medicinal and nutraceutical benefits that are healthy and recommended for pre-diabetic patients (Abellán et al., 2017). It is used in different ways, in soup, seconds, drinks, p'esque, salad, mazamorra, kispíño, phiri, bread -a key aspect to highlight about quinoa bread is that it manages to reduce anemia in children (Soncco et al., 2018)- and cookie, quaker (Table 4). Its use is in whole washed and ground quinoa. In recent years the processed quinoa products are quinoa flour and quinoa flakes .

In the past, the women of the Carabuco community used the saponin extracted from bitter quinoa as shampoo, detergent and toothpaste.

Products	How is it used?	Who makes?	If you sell, how do you use the money?	Who decides the use of money?	Place	Frequency of use
Whole washed quinoa	Quinoa soup 1/.	Woman			Home	Always
	b. Quinoa grains 2/.	Woman			Home	Always
	c. Drinks 3/.	Woman			Home	Sometimes
	d. P'esque 4/.	Woman			Home	Sometimes
	e. To market	Woman	To purchase basic household necessities	Male and female	Weekly fair in Taraco and Juliaca	All year round
Unwashed quinoa	a. Generally sold	Woman	To purchase basic household necessities	Male and female	Weekly fair of Taraco and Juliaca	Troughout the year
Quinoa stems	a. Distributed as livestock feed	Male and female			Farm on near home	After harvest
	b. Ad firewood when the stem are dry	Woman			Home	After harvest
Green quinoa leaves	a. In soup substituting for vegetables, as well as in salads	Female and male			They collect from the quinoa farm	When the quinoa is green before harvesting
	Mazamorra 5/.	Woman			Home	Always
	Kispiño 6/.	Women and girls			Home	Always
Ground and flaked quinoa	Phiri 7/.	Female and Male			Home	Sometimes
	Bread and cookie	Male and Female				All saints
	Quaquer 8/.	Woman			Home	Sometimes
	f. For sale at the local market on fair days	Woman	To purchase basic household necessities	Varón y mujer	Weekly fair in Taraco and Juliaca	Sometimes

Note: Based on information provided by quinoa producers in the Comunidad Campesina de Carabuco, Peru, June 2022.

1/. Quinoa soup: Quinoa cooked with meat or charqui, tubers or vegetables.

2/. Toasted and grained quinoa, replacing rice.

3/. Soft drink, quinoa with milk, quinoa juice and quinoa chicha (macerated cold drink).

4/. Quinoa grains cooked with water and without salt, served with milk or grated cheese.

5/. Quinoa flour with katahui (lime) and milk.

6/. Steamed buns in different shapes and sizes.

7/. Toasted and slightly moistened rough quinoa flour.

8/. Ground quinoa in the form of small leaves used for soup, soft drink, juice, also substitutes quaquer.

Table 4. Analysis of access and use of quinoa in the Carabuco Campesino Community

## 4.2 Medicinal use of quinoa

Due to the high content of essential amino acids in its protein, quinoa is considered the only food in the plant kingdom that provides all the essential amino acids. According to traditional medicine, the infusion of the leaves is used to treat urinary tract infections or as a laxative. The fresh leaves of quinoa “layo”, consumed either in the form of soups or second is the indicated remedy against diseases caused by a lack of some vitamin in the body (PROINPA, 2011). In addition, quinoa broth, soup, or hot graneado is a nutritional tonic, increases mother’s milk, repairs strength, and protects against tuberculosis.

## 4.3 Use of bioindicators in quinoa cultivation

In Carabuco, producers use bioindicators. However, it can be detected that, at present, young farmers are losing the tradition of practicing ancestral knowledge through bioindicators. They do not give much importance to the knowledge to develop quinoa cultivation and if they practice it, they do it in a different way, far from the original knowledge. Adults and elders are aware that there is this loss of knowledge in some of the knowledge related to bioindicators. Women, in particular, preserve hidden knowledge about the use of bioindicators, which they continue to use to carry out activities in quinoa cultivation. This knowledge allows them to predict in which years there will be a good harvest or a shortage of quinoa, and therefore helps them to make decisions in advance regarding the convenience of advancing or delaying the sowing.

The year that the yellow k’areo blooms in abundance is an indicator for good quinoa production; this bio-indicator helps us make decisions for quinoa cultivation (Paula, 74 years old).

In flood years there is little quinoa (Victoria, 76 years old).

## 4.4 Perceptions about quinoa and the development of the Carabuco Campesino Community

Quinoa producers perceive that quinoa has been showing changes and challenges due to local, regional and national demand. However, the women indicate that to date they have not received support from public or private institutions for the production, processing and marketing of quinoa (Table 5).

Males	Females
<p>a. Positive characteristics</p> <ul style="list-style-type: none"> <li>- They value quinoa for its nutritional qualities in the family's diet, in addition to its grain quality as one of the best in the lake area.</li> <li>- They propose organizing among producers to market quinoa.</li> <li>- They hope to receive training in the management of quinoa processing.</li> <li>- They know, participate and maintain the ancestral customs in the cultivation of quinoa.</li> <li>- They are familiar with the management of flora and fauna bioindicators for quinoa cultivation.</li> <li>- They see Lake Titicaca as an important agroecological zone with a favorable microclimate for quinoa cultivation.</li> </ul> <p>b. Negative characteristics</p> <ul style="list-style-type: none"> <li>- Individualized supply, low quality, low standardization and poor product presentation, poor market articulation, low associativity among producers.</li> <li>- Low market prices.</li> <li>- They observe the parceling and lack of land.</li> <li>- More and more young people are moving to the cities, providing the quickest solution for better opportunities.</li> <li>- They are responsible for assuming community positions, and machismo still exists.</li> <li>- In spite of having better levels of education than women, they observe low levels of education in rural areas.</li> </ul>	<ul style="list-style-type: none"> <li>- They value quinoa for its nutritional qualities in the family diet, especially for children. In addition, the quality of the grain is one of the best in the lake area.</li> <li>- They agree that their husbands should organize among producers to market quinoa, despite their commercial development.</li> <li>- They hope to receive training in quinoa management, among other training according to their needs.</li> <li>- They know, participate in and maintain ancestral customs in the cultivation of quinoa.</li> <li>- They are familiar with the management of bioindicators of flora and fauna for quinoa cultivation.</li> <li>- They see Lake Titicaca as an important agroecological zone with a favorable microclimate for quinoa cultivation.</li> <li>- Individualized supply, low quality, low standardization and poor product presentation, poor market articulation, low associativity among producers.</li> <li>- Low market prices.</li> <li>- They observe land parceling and have limitations on possession rights.</li> <li>- More and more young people are moving to the cities, providing the quickest solution for better opportunities.</li> <li>- They do not have access to high-level positions of communal responsibility and are limited in their ability to express their opinions, which is why they are not heard in assemblies.</li> <li>- They complain about the low levels of education; in many cases they are illiterate and want to take literacy courses.</li> </ul>

Note: Based on information provided by the quinoa producers of the Comunidad Campesina de Carabuco.

Table 5. Positive and negative characteristics of quinoa in the Rural Community of Carabuco

## 5 | CONCLUSIONS

The producers of the Carabuco Peasant Community (Peru) are favored by the climatic conditions of the lake area for the cultivation of quinoa. Therefore, women play a greater role than men in the whole process of growing and marketing quinoa, which is of transcendental importance for the food security of the inhabitants of Carabuco, and its production should be promoted as a development alternative and included in economic, social, tourism, and gastronomic development programs, and marketing chains should be improved.

Men and women perceive that they should organize themselves to make joint sales as partners, as well as access credit to improve their level of production, and strengthen the quinoa production chain through competitive monitoring, since there is a trend towards

mass consumption of cereal-based products (Maria & Quintero, 2014).

## REFERENCES

Abellán et al. (2017). Effect of quinoa (*Chenopodium quinoa*) consumption as an adjuvant in nutritional intervention in prediabetic subjects. *Nutrición Hospitalaria*, 34, 1163-1169.

CARE PERU (2012). Promotion of Andean grains and native potato as an alternative for economic social inclusion and competitiveness for Andean rural agriculture. Care Perú.

González, J., Dios, D., Alonso-arroyo, A., & Alexandre-benavent, R. (2019). Half a century of *Anales de Pediatría*. Evolution of its main bibliometric indicators in the Web of Science and Scopus international databases □. *Anales de Pediatría (English Edition)*, 90(3), 194.e1-194.e11. <https://doi.org/10.1016/j.anpede.2018.12.002>

Gómez-pando, L., & Julca-Otiniano, A. (2018). *Chenopodium quinoa*, 5(15), 399-409. <https://doi.org/10.19136/era.a5n15.1734>

Huacani, Y. (2007). The management of natural resources of Lake Titicaca in the peasant community of Carabuco seen from a gender perspective. In: *Gender and natural resource management. Summaries of research, experiences and lessons learned*. Sepia, first edition, Lima.

Marca, S., Cancha, W., Quispe, J., and Mamani, V. (2011). "Comportamiento actual de los agentes de la cadena productiva de quinua en la Región de Puno". Project of capacities of the quinoa production chain in the Puno Region. Dirección Regional Agrario Puno. Puno Regional Government.

María, D., & Quintero, D. (2014). Competitive monitoring of quinoa : potentiality for the department of Boyacá. *Suma de Negocios*, 5(12), 85-95. [https://doi.org/10.1016/S2215-910X\(14\)70030-8](https://doi.org/10.1016/S2215-910X(14)70030-8).

Márquez-villacorta, L. F., & Pretell-vásquez, C. C. (2018). Evaluación de características de calidad en barras de cereales con alto contenido de fibra y proteína Evaluation of quality characteristics in cereal bars with high fiber and protein content Avaliação das características de qualidade nas barras de cereais com fibra alta e conteúdo à proteína, 16(2), 67-78.

Morillo-coronado, A. N. N. A. C., & Castro-roberto, M. A. (2017). Genetics of a quinoa (*Chenopodium quinoa* Willd) collection, 15(2), 49-56.

Nowak et al. (2016). Evaluation of the nutritional composition of quinoa (*Chenopodium quinoa* Willd). *Food Chemistry*, 193, 47-54. <https://doi.org/10.1016/j.foodchem.2015.02.111>.

PROINPA (2011). Quinoa: millennial crop to contribute to global food security. July. FAO. Regional Office for Latin America and the Caribbean.

Soncco et al. (2018). Impact of an educational program including a fortified bread to reduce anemia levels in school children in Yocará, Puno - Peru. *Revista Altoandinas*, 20(1), 73-84.



## ÍNDICE REMISSIVO

### A

Actividad antimicrobiana 1, 4, 6

Agricultura familiar 11, 12, 16, 23

Agroforesta 11

### B

Bioensayos 1, 4, 6

### C

Campo magnético 52, 53, 55, 56

Carabuco 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91

Cinética de secado 36, 38, 39, 40, 41, 43, 50

Color y metabisulfito de sodio 36

Crecimiento radicular 74, 75, 76, 77, 78

Criollo Carora 58

Criollos 25, 26, 27, 31, 32, 33, 34, 35

### D

Desarrollo 1, 2, 3, 29, 45, 59, 71, 72, 74, 76, 78, 80

Doble propósito 58, 59, 64, 66, 68, 70, 72, 73

### E

Estrutura do solo 11, 12, 13, 15, 17

### F

Fishmeal 102, 103, 104, 105, 107, 108, 109, 110, 111, 112, 113, 115

Forage production 92

### G

Género 6, 7, 8, 9, 74, 78, 79, 80

Germinación 52, 53, 54, 55, 56, 75, 76, 78

Guanajuato 25, 26, 27, 28, 29, 30, 31, 33, 34, 35

### H

Hongos fitopatógenos 1, 4, 6, 9

### I

*In vitro* 1, 2, 4, 6, 8, 10, 74, 75, 77, 78

## J

Jitomate y pelos radiculares 74

## L

Livestock 72, 80, 81, 88, 92, 93

Lupin 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 113, 114, 115, 116, 117

## M

Maíces 25, 26, 27, 31, 32, 34, 35

Michoacán 25, 26, 27, 28, 29, 30, 31, 33, 34, 35

## N

Nanopartículas de AgNP 1

## P

Plant protection 92

Pre-tratamiento 36, 38, 39, 43, 48, 49, 50

Producción 2, 3, 5, 8, 10, 26, 27, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 75, 76, 80, 112, 114

Producción de leche 58, 60, 62, 63, 64, 65, 66, 67, 68, 70, 71, 72, 73

## Q

Quinoa 79, 80, 91

## R

Raps 102

Rendimiento 25, 26, 27, 28, 29, 31, 32, 33, 34, 35

Replacement 102, 105, 107, 108, 109, 110, 111, 112, 113, 114, 115

Reproducción 9, 53, 58, 72, 73

Rizobacterias 74

## S

Semillas 52, 53, 54, 55, 56, 74, 75, 76, 78

Soil 10, 13, 21, 22, 23, 24, 82, 84, 85, 92, 93, 94, 95, 96, 97, 98, 99, 100

Soybean 102, 103, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117

*S. spinifrons* 102, 105, 107, 108, 110, 111, 117

## T

Temperatura 23, 26, 27, 36, 38, 39, 42, 43, 48, 49, 50, 53, 54, 60, 75, 76

Trigo 34, 52, 53, 54, 55, 56, 80

Tropical grasses 92, 94

## V

Vitamin B1 92, 94, 95

🌐 [www.atenaeditora.com.br](http://www.atenaeditora.com.br)  
✉ [contato@atenaeditora.com.br](mailto:contato@atenaeditora.com.br)  
📷 @atenaeditora  
📘 [www.facebook.com/atenaeditora.com.br](https://www.facebook.com/atenaeditora.com.br)



Investigación, tecnología e innovación  
**EN CIENCIAS AGRÍCOLAS**

4

**Atena**  
Editora  
Año 2022

🌐 [www.atenaeditora.com.br](http://www.atenaeditora.com.br)  
✉ [contato@atenaeditora.com.br](mailto:contato@atenaeditora.com.br)  
📷 @atenaeditora  
📘 [www.facebook.com/atenaeditora.com.br](https://www.facebook.com/atenaeditora.com.br)



Investigación, tecnología e innovación  
**EN CIENCIAS AGRÍCOLAS**

4

**Atena**  
Editora  
Ano 2022