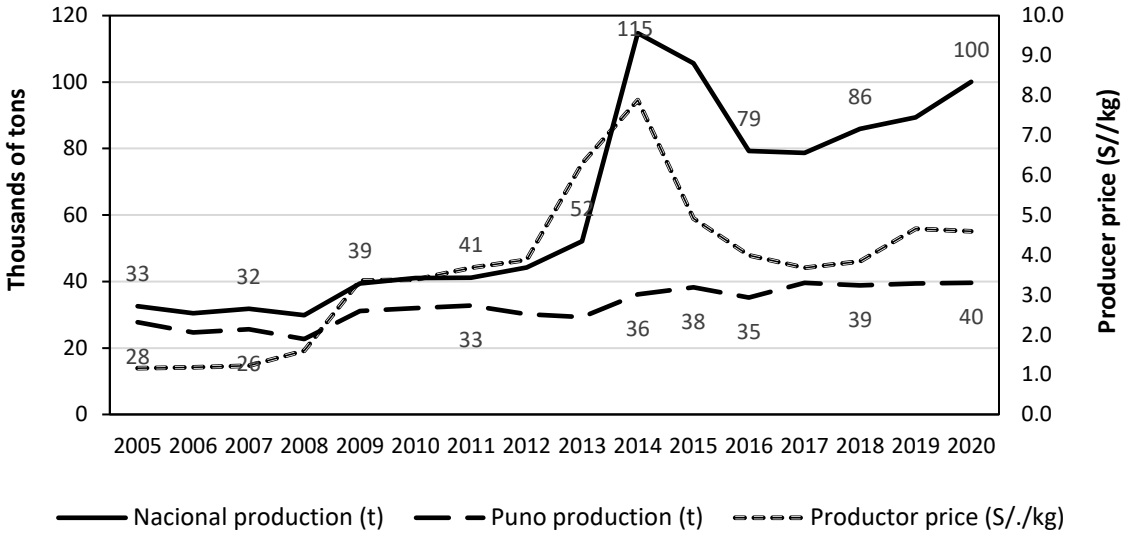
Classification, technical efficiency, and economic performance of producers in the main productive region of quinoa in Peru

Supplementary material

Supplementary Material 1: Evolution of quinoa production (Nationwide and at Puno in t), and prices received by the producer (Peruvian Soles/kg) between 2005-2020



Source: MIDAGRI (2021).

Supplementary Material 2: Survey applied to quinoa producers in the Puno region

I. HOUSEHOLD IDENTIFICATION

Province		District	
Household ID		Town/Community	
The surveyor has to be a producer who cultivated quinoa in the last growing season (2016)			

II. CROP

* "Coverage", "Amount Produced" and "Sale Price" must-have equivalent units.

Cultivo	Mark what applies (x)	Crop Coverage		Amount Produced	How much of production goes to self-consumption?	How much of the production goes for sale?	How much was the selling price Soles/Kg
		Amount	Unit *1.Acre, 2.Hectare 3. Square Meters 4. Yards 5.Others___*	1. Kg 2. Ton, 3. Pounds 4. Bunch 5. Sack 6. Others____			
1. Quinoa							
TOTAL							

III. USE OF PRODUCTION FACTORS IN QUINOA CULTIVATION

Request to the producer to indicate the variety most used in the last growing season:

* "Coverage", "Amount Produced" and "Sale Price" must have equivalent units.

ACTIVITY	Unit/option (Circle or Mark)
Total area of the land (in ha., or in *topos*):	
1. Land Preparation	
Dragging (Soil Breaking)	Tractor (1.Yes 2. No) _____ Hours _____ How many times?_____ Price _____
Did you fertilize the cultivated area?	Tipo (1. Estiércol natural 2. Otros_____) Cantidad _____ Price _____
Do you perform furrowing? (rows previous to planting)	Máquina (1.Yes 2. No) Hours _____ How many times?_____ Price_____ Yunta (1.Yes 2. No) Hours _____ How many times?_____ Price_____
Do you do leveling?	Manual (1.Yes 2. No) Hours _____ How many times?_____ Price_____ Yoke (1.Yes 2. No) Hours _____ How many times?_____ Price_____
Land Cleaning	Manual (1.Yes 2. No) Hours _____ How many times?_____ Price_____
2. Planting	
Planting (*boleado*)	Manual (1.Yes 2. No) Hours _____ How many times?_____ Price_____
Did you perform covering?	With Cattle (1.Yes 2. No) Hours _____ How many times?_____ Price_____ Manual (1.Yes 2. No) Hours _____ How many times?_____ Price_____
3. Agricultural Labor	
Do you perform cultural practices?	Hilling (1.Yes 2. No) Hours _____ How many times?_____ Price_____ Manuring (1.Yes 2. No) Hours _____ How many times?_____ Price_____ Weeding (1.Yes 2. No) Hours _____ How many times?_____ Price_____
Did you apply fungicide or pesticide?	(1.Yes 2. No) Type _____ Hours _____ How many times?_____ Price_____
4. Harvest	
Type of Harvest	1. Mechanical 2 Manual (*Ciega*, Others) Hours _____ How many times?_____ Price_____
Arches (Gathering of quinoa branches)	Manual (1.Yes 2. No) Hours _____ How many times?_____ Price_____
Treshing	Mechanical (1.Yes 2. No) Hours _____ How many times?_____ Price_____ Manual (1.Yes 2. No) Hours _____ How many times?_____ Price_____
5. Post Harvest	
Drying (extend the seeds)	Manual (1.Yes 2. No) Hours _____ How many times?_____ Price_____
Grain Selection	Manual (1.Yes 2. No) Hours _____ How many times?_____ Price_____ Machine (1.Yes 2. No) Hours _____ How many times?_____ Price_____
Grain Sales	Manual (1.Yes 2. No) Hours _____ How many times?_____ Price_____
6. Inputs	
6.1. Seeds	Kilograms/ha Amount_____
6.2. Synthetic Fertilizer (Ammonium Nitrate, Ammonium Sulphate Urea, Foliar Manure and Others:	_____ (1. Yes 2. No)
6.3. Organic Fertilizer (Island Guano, Manure, Harvest Residues, Compost, Worm Humus, *biol* and others):	_____ (1. Yes 2. No)
6.4. Other Inputs	
Land Rent	Soles per Month
7. Financing	
7.1 Have you accessed to credit in the last season to produce quinoa?	_____ (1. Yes 2. No)
8. Trainning	
8.1 .Did you get training on Andean grains in the last season?	_____ (1.Yes 2. No)
8.2 How many sessions of training did you received?	Number of Times:

IV. DESTINATION AND COMMERCIALIZATION

Crop in the last season	What amount of the harvested is destinated to: 1. Kg, 2. Ton, 3. Pounds 4. Bunch 5. Sack 6. Others____				Do you belong to an association that is not the community?
	Self-Consumption	Seeed	Storage for future sales	Harvest Sales	1. Yes 2. No
QUINOA					

* "Coverage", "Amount Produced" and "Sale Price" must have equivalent units

Andean Grain	¿Who do you sell? And ¿How much do you sell?		
	Mark with a (X) to who or whom you sell	Amount	Units 1. Kg, 2 Ton, 3 Pounds, 4 Bunch, 5 Sack, 6 Others____
QUINOA			
1. Local Seller			
Wholeseller			
Wholeseller at Puno or Juliaca			
Mill Factory			
Transformative Company			
National Organism			
Small Retailers			
Others_____			
Others_____			

V. ECONOMIC ACTIVITIES

Relationship with head of household	Gender	Age	Ocupation	Education Level	Income	Income Source
1. Husband 2. Wife 3..Children 4. Others _____	1. M 2. F		1. Farmer 2. Rancher 3. Agricultural 4. Housewife 5. Employee 6. Comerciante 7. Student 8. Job Seeker 9. Handicapped/Sick 10. Otros _____	1. Without Education 2. Incomplete Primary Education 3. Completed Primary Education 4. Incomplete Secondary Education 5. Completed Secondary Education 6. Incomplete Technical Superior 7. Completed Technical Superior 8. Incomplete University/College 9. Completed University/College	1. None 2. less than 250 soles 3. 250 – 550 soles 4. 550 – 800 soles 5. 800- 1200 soles 6. more than 1200 soles	1. Works at his/her own farm 2. Works at other farms 3. Works in a small Business place 4. Work at his/her own Business 5. Remittances 6. Artcrafts/Handicrafts 7. Works for the Government in a Public Institution 8. Ohers___
Head of a Household						

VI. GENERAL DATA

Name of the person surveyed			
Mother Language	1. Aymara; 2. Quecha; 3. Other_____	Place of Birth	
In general, what are the main activities you do in a common day? _____			
1. Agricultural Activities, 2. Grazing, 3. Transportation, 4. Business, 5. Construction, 6. Other _____			

Supplementary Material 3a: Dimensions obtained from producer's group classifications in the Puno region

	Group 1		Group 2		Group 3	
/	eigenvalue	Variance percent	eigenvalue	Variance percent	eigenvalue	Variance percent
Dim1	2.9848869	18.655543	3.3672788	19.807522	3.146711	19.666943
Dim2	2.1415781	13.384863	2.2286556	13.109739	2.158979	13.493621
Dim3	1.7469526	10.918454	1.5665212	9.214831	1.644335	10.277094
Dim4	1.3154562	8.221601	1.4122576	8.307398	1.368474	8.552961
Dim5	1.1513962	7.196226	1.1483835	6.755197	1.256217	7.851354
Dim6	1.0320221	6.450138	1.0705901	6.297589	1.149162	7.182263
Dim7	0.9327693	5.829808	1.0052366	5.913156	1.029929	6.437054
Dim8	-	-	0.8683179	5.107752	-	-

Source: From 361 surveys conducted in quinoa producers in Puno in October 2017.

Supplementary Material 3b: Explanatory variables used to obtain the dimensions for producer's group classifications in the Puno region

Var /	Grupo 1		Grupo 2		Grupo 3	
Dim	Dim1	Dim2	Dim1	Dim2	Dim1	Dim2
producX	0.80103	0.2668197	0.8068602	0.4172277	0.7575104	0.41418223
exten	0.6199481	-0.2962615	0.6909401	-0.2934761	0.7338412	-0.0204177
beneficio	0.7702895	0.1371352	0.6221097	0.3038966	0.1133868	-0.1227862
mo	-0.1565348	0.5853015	-0.5273977	0.3841149	-0.468515	0.65017224
Venta_ea	0.7718961	0.4192765	0.8397416	0.398393	0.8183625	0.4670558
edad	-0.1589888	0.1808305	-0.0331995	0.3647889	-0.2595874	0.34927337
maq	-0.1525365	0.5683329	-0.3013381	0.4541043	-0.3792293	0.4015861
sem	-0.2721352	0.6501845	-0.4278966	0.5622047	-0.460644	0.6456333
prod	-0.1949178	0.5212274	-0.222448	0.6942225	-0.4225467	0.29687515

Source: From 361 surveys conducted in quinoa producers in Puno in October 2017

Supplementary Material 4: Result of the estimation of technical efficiency

Stoc. frontier normal/half-normal model — Number of obs = 361
Wald chi2(2) = 146.17
Log likelihood = -503.30935 — Prob > chi2 = 0.0000

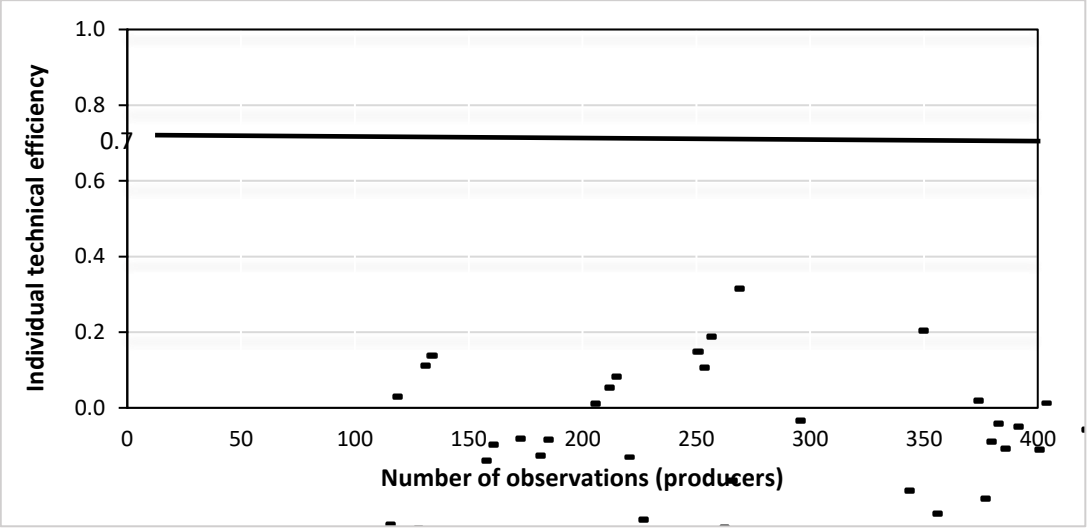
logyi	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
logx1	-.4279234	.0425318	-10.06	0.000	-.5112842	-.3445626
logx4	.1126718	.0277157	4.07	0.000	.05835	.1669936
/lnYesg2v	-.7708039	.1616064	-4.77	0.000	-1.087547	-.4540612
/lnYesg2u	.3685615	.1550505	2.38	0.017	.0646681	.6724549
Yesgma_v	.6801772	.0549605			.5805535	.7968964
Yesgma_u	1.202353	.0932127			1.032862	1.399657
Yesgma2	1.908295	.1922912			1.531411	2.285179
lambda	1.767706	.1321881			1.508622	2.02679

Likelihood-ratio test of Yesgma_u=0: chibar2(01) = 15.31 Prob>=chibar2 = 0.000

Logyi: logarithm of quinoa yield in TM/Ha.
Logx1: logarithm of the cultivated total area in Ha
logx4: logarithm of quinoa seeds in Kg/Ha

Source: from 361 surveys applied to quinoa producers in Puno in October 2017 (Stata).

Supplementary Material 5: Dispersion of individual technical efficiency and cut-off point 0.70



Note: The figure shows the level of technical efficiency, at individual levels, for quinoa producers in the Puno region. This shows that only 13.3% of the responders had a value greater than 0.70.
Source: From 361 surveys conducted by quinoa producers in Puno in October 2017.

Supplementary Material 6: Linear regression of technical efficiency as a function of qualitative variables

Source	SS	df	MS	Number of obs = 361		
Model	81.9319199	9	9.10354665	F(9, 352) = 330.37		
ReYesdual	9.69958454	352	.027555638	Prob > F = 0.0000		
Total	91.6315044	361	.253826882	R-squared = 0.8941 Adj R-squared = 0.8914 Root MSE = .166		
efic_gen3	Coef.	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
Training	-.0686252	.0375147	-1.83	0.068	-.1424064	.005156
Credit	.2324003	.0449216	5.17	0.060	-.1440517	.3207489
Association	.0703755	.0361049	1.95	0.052	-.0006329	.1413838
Fertilization	-.0480913	.0208728	-2.30	0.022	-.0891424	-.0070402
Composting	.0476058	.0320884	1.48	0.139	-.0155034	.110715
Fertil_Comp	.035146	.0415591	0.85	0.398	-.0465894	.1168813
Weeding	.0193542	.0203675	0.95	0.343	-.0207031	.0594115
Fungicide	.0252821	.0235027	1.08	0.283	-.0209413	.0715054
Sale	-.0900578	-.0178553	-5.04	0.000	-.1251743	-.0549413

Efic_gen3: Individual Technical Efficiency. Training: received training. Credit: received credit. Association: member of an association. Fertilization: performs chemical fertilization. Composting: applies compost, manure. Fertil/Comp: does fertilization and composting. Weeding: performs weeding. Fungicide: apply fungicide or insecticide. Sale: put quinoa for sale.
Source: From 361 surveys applied to quinoa producers in Puno in October 2017 (Stata).