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Extended essay cover

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Candidate session number			
Candidate name			
School name			
Examination session (May or November)	May	Year	2015

Diploma Programme subject in which this extended essay is registered: Geography

(For an extended essay in the area of languages, state the language and whether it is group 1 or group 2.)

Title of the extended essay: To what extent have farmers in Bolivia and specifically in the municipality of Uyuni benefited from the recent worldwide growth in quinoa demand?

Candidate's declaration

This declaration must be signed by the candidate; otherwise a mark of zero will be issued.

The extended essay I am submitting is my own work (apart from guidance allowed by the International Baccalaureate).

I have acknowledged each use of the words, graphics or ideas of another person, whether written, oral or visual.

I am aware that the word limit for all extended essays is 4000 words and that examiners are not required to read beyond this limit.

This is the final version of my extended essay.

Candidate's signature: _____ Date: 01/26/15

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The supervisor must complete this report, sign the declaration and then give the final version of the extended essay, with this cover attached, to the Diploma Programme coordinator.

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Please comment, as appropriate, on the candidate's performance, the context in which the candidate undertook the research for the extended essay, any difficulties encountered and how these were overcome (see page 13 of the extended essay guide). The concluding interview (viva voce) may provide useful information. These comments can help the examiner award a level for criterion K (holistic judgment). Do not comment on any adverse personal circumstances that may have affected the candidate. If the amount of time spent with the candidate was zero, you must explain this, in particular how it was then possible to authenticate the essay as the candidate's own work. You may attach an additional sheet if there is insufficient space here.

wanted to study how the promotion by the media can affect the people and production of quinoa in Bolivia. Spent hours gathering data (translating secondary sources, contacting various officials here & in Bolivia. She went to Uyuni to acquire an understanding of the local economy & culture. (She was stuck there for 2 days due to a protest related blockade). 's essay is an excellent example of how concepts & issues in geography can be evaluated at various scales. All criteria are perfectly met.

This declaration must be signed by the supervisor; otherwise a mark of zero will be issued.

I have read the final version of the extended essay that will be submitted to the examiner.

To the best of my knowledge, the extended essay is the authentic work of the candidate.

As per the section entitled "Responsibilities of the Supervisor" in the EE guide, the recommended number of hours spent with candidates is between 3 and 5 hours. Schools will be contacted when the number of hours is left blank, or where 0 hours are stated and there lacks an explanation. Schools will also be contacted in the event that number of hours spent is significantly excessive compared to the recommendation.

I spent 3½ hours with the candidate discussing the progress of the extended essay.

Supervisor's signature: _____ Date: Feb 8/2015

Assessment form (for examiner use only)

Candidate session number		

Criteria	Achievement level				
	Examiner 1	maximum	Examiner 2	maximum	Examiner 3
A research question	2	2		2	
B introduction	2	2		2	
C investigation	4	4		4	
D knowledge and understanding	4	4		4	
E reasoned argument	3	4		4	
F analysis and evaluation	4	4		4	
G use of subject language	4	4		4	
H conclusion	2	2		2	
I formal presentation	4	4		4	
J abstract	2	2		2	
K holistic judgment	3	4		4	
Total out of 36	34				

Name of examiner 1: _____ _____ Examiner number: ___ ____
(CAPITAL letters)

Name of examiner 2: _____ Examiner number: _____
(CAPITAL letters)

Name of examiner 3: _____ Examiner number: _____
(CAPITAL letters)

IB Assessment Centre use only: **B:** _____

IB Assessment Centre use only: **A:** _____

To what extent have farmers in Bolivia and specifically in the municipality of Uyuni benefited from the recent worldwide growth in quinoa demand?

Extended Essay

Subject: Geography

Word Count: 3989

Table of Contents

Abstract

Before contents !

Word Count: 282

This investigation examines the socioeconomic impacts of the recent skyrocketing of quinoa demand on the small farmers in the Southern Altiplano of Bolivia, specifically in the municipality of Uyuni. This essay tests the relationship between quinoa demand and four factors to measure impacts: amount of quinoa production, income, living conditions and education. It was expected that the indices for all variables would have a positive relationship with quinoa demand, with the exception of school dropout rate which was expected to have an inverse relationship.

Data for all factors between 2000 and 2013 were collected from various Bolivian Ministries and Statistics Institutes. Spearman's Rank statistical analysis was then used to measure the correlation and significance between quinoa demand and these factors. The author also visited Uyuni, Bolivia to interview farmers and authorities in the quinoa industry to reinforce the data. Data analysis showed that there have been indeed major socioeconomic changes in the municipality of Uyuni in the past 15 years, which had long been stagnant as a very poor region of indigenous farmers. With increased quinoa demand, production and surface area cultivated increased. However, yield unexpectedly decreased. This could be attributed to expansion of crop production in marginal areas and overworked soils. The local market quinoa price available to farmers skyrocketed, as did the Free on Board (FOB) international export price, and therefore so did income. The indices for living conditions and education revealed an order of priorities in how increased income should be spent. Interestingly, the data suggest that community living conditions and access to basic necessities did not necessarily improve much. Instead, increased income lead to many more children staying in school and many more households owning cars and televisions.

Acknowledgements Word count: 150

I would like to dedicate my work on this Extended Essay to my Grandmother, . In taking me as seriously as a colleague, she pushed me to pull on all my resources to produce this paper. I must also thank my Mom for bringing my essay to life in organizing our trip to Uyuni and helping me push through this complex investigation when I felt I couldn't.

To my sponsor, , I credit for guiding me through the year-long process of formally writing the Extended Essay, while keeping me laughing throughout.

The above-mentioned women are three of the smartest people I know.

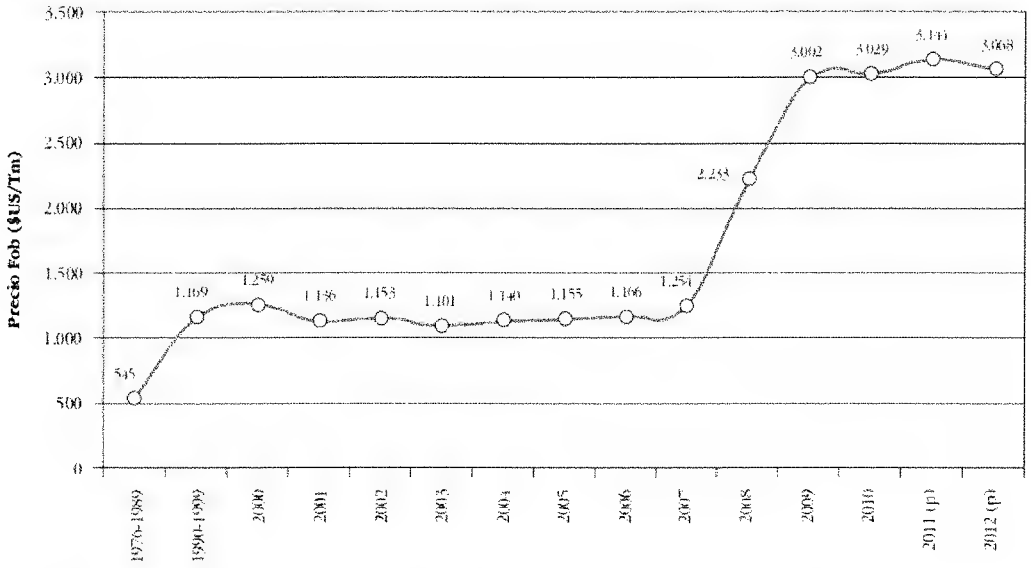
Finally, I'd like to deeply thank all of the organizations, cooperatives, companies and farmers (PROINPA, FAUTAPO, Real Andina, CADEQUIR, ANAPQUI) who met with me in person to discuss their lives and also the statistic centers that provided me with data (INE, Ministry of Education and various others).

Introduction

Word Count: 1,157

The aim of this essay is to investigate the rapid increase in international quinoa demand (volume of exports and price) and its impacts on the quinoa farmers in the Southern Altiplano of Bolivia, specifically the municipality of Uyuni. Quinoa is a grain that has recently exploded on the international market as a superfood that is packed with protein and vitamins. Although it has only recently been recognized as such a healthy food, it has been grown for thousands of years in the Altiplano of South America—largely Bolivia and Peru—where the high altitude and arid year round conditions are suitable for quinoa harvesting. Quinoa has gained so much momentum of popularity over the past decade that the FAO declared 2013 as the International Year of Quinoa (Instituto Boliviano), which caused its demand to surge further. Before 2006, the Free on Board (FOB) price of quinoa, which will be taken as the international price of quinoa, had remained practically unchanged since 1990--about 1.2$US/Metric Tons (MT). However, in 2008, the price jumped to 2.23$US/MT, and continued to rise (Graph 1) (Ormachea) Bolivia is the world's largest producer of quinoa, with 46% of the world's total production (Graph 2) (Instituto Nacional). As the world's quinoa industry is concentrated in small areas within Bolivia, the sudden increase in demand and price has had huge socioeconomic impacts on these regions. For this reason, the study is focused on the Altiplano of Bolivia. In order to bolster the data, the author visited Uyuni, Bolivia and gained firsthand information by interviewing farmers and organizations.

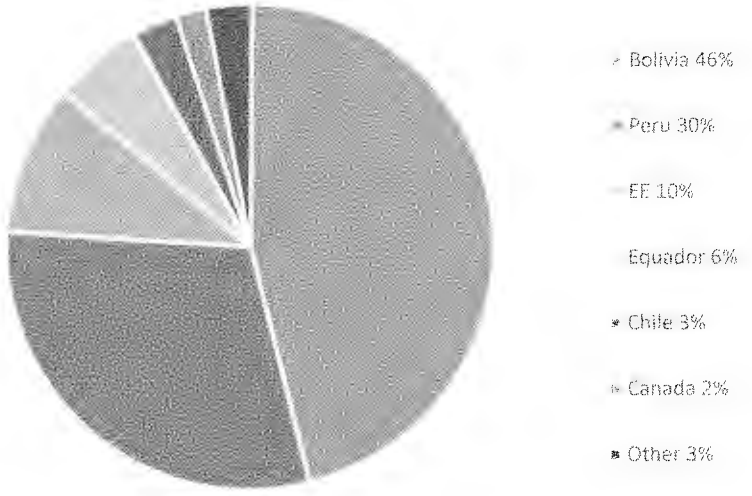
Graph 1: Evolution of FOB quinoa prices between 1976 and 2012



Nota: (p) Preliminar.
Fuente: Elaboración propia con base en: BCB, 1984; MICT-IMCOMEX 1982, 1983, 1984, 1985 y 1986; INE.

Source: Ormachea and Ramirez Report with data from INE

Graph 2: Distribution of world quinoa production

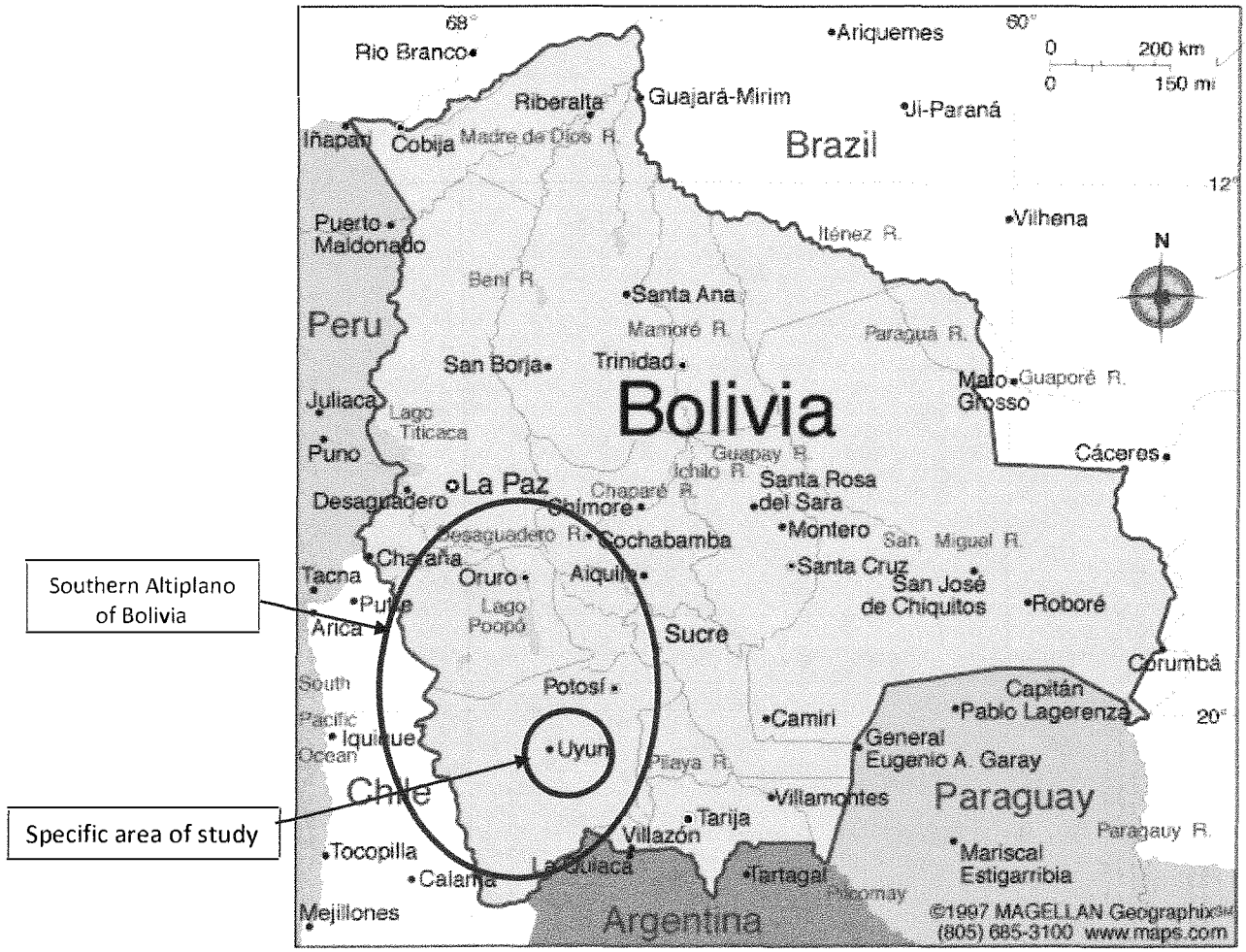


Source: INE 2009

Geographical Context

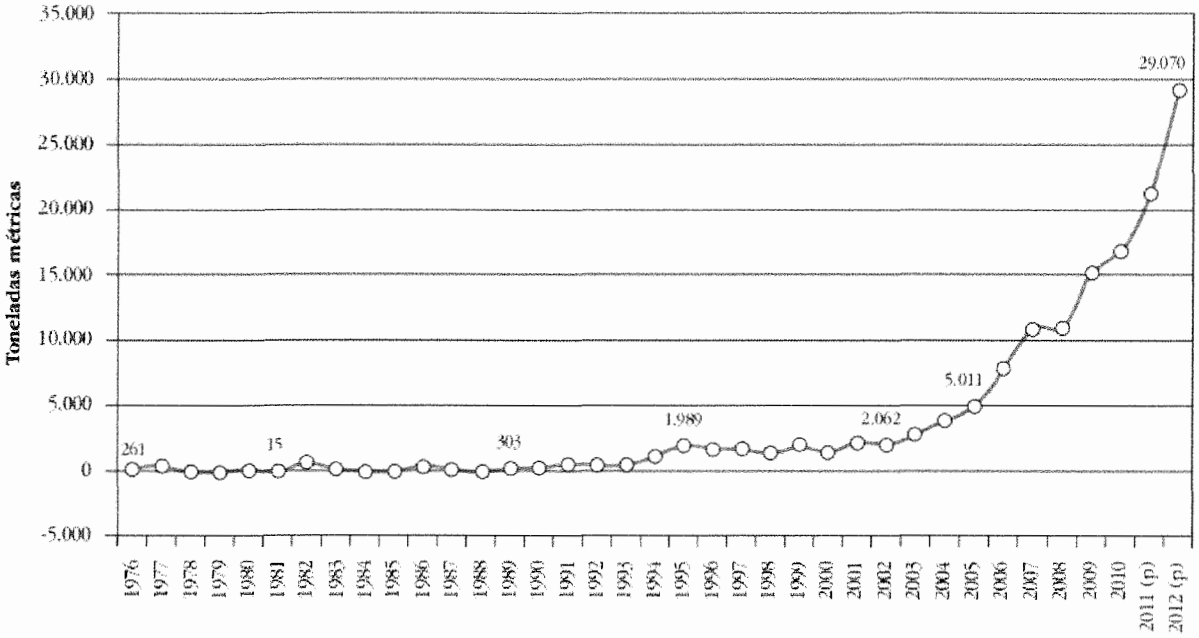
The map of Bolivia below indicates the specific area of study (Figure 1). The rise in international demand for quinoa is clearly demonstrated in the evolution of quinoa exports from Bolivia (Graph 3). Before the late 1990s, Bolivia hardly exported any quinoa; production was all for internal consumption. In the first few years of the new millennium, exports started going up, to about 2,000MT. Between 2005 and 2012, exports increased from about 5,000MT to nearly 30,000MT—an increase of 500% (Graph 3) (Ormachea).

Figure 1: Map of Bolivia showing location of study area



Source: Map: Bolivia, Infoplease

Graph 3: Evolution of volume of Bolivia's quinoa exports between 1976 and 2012



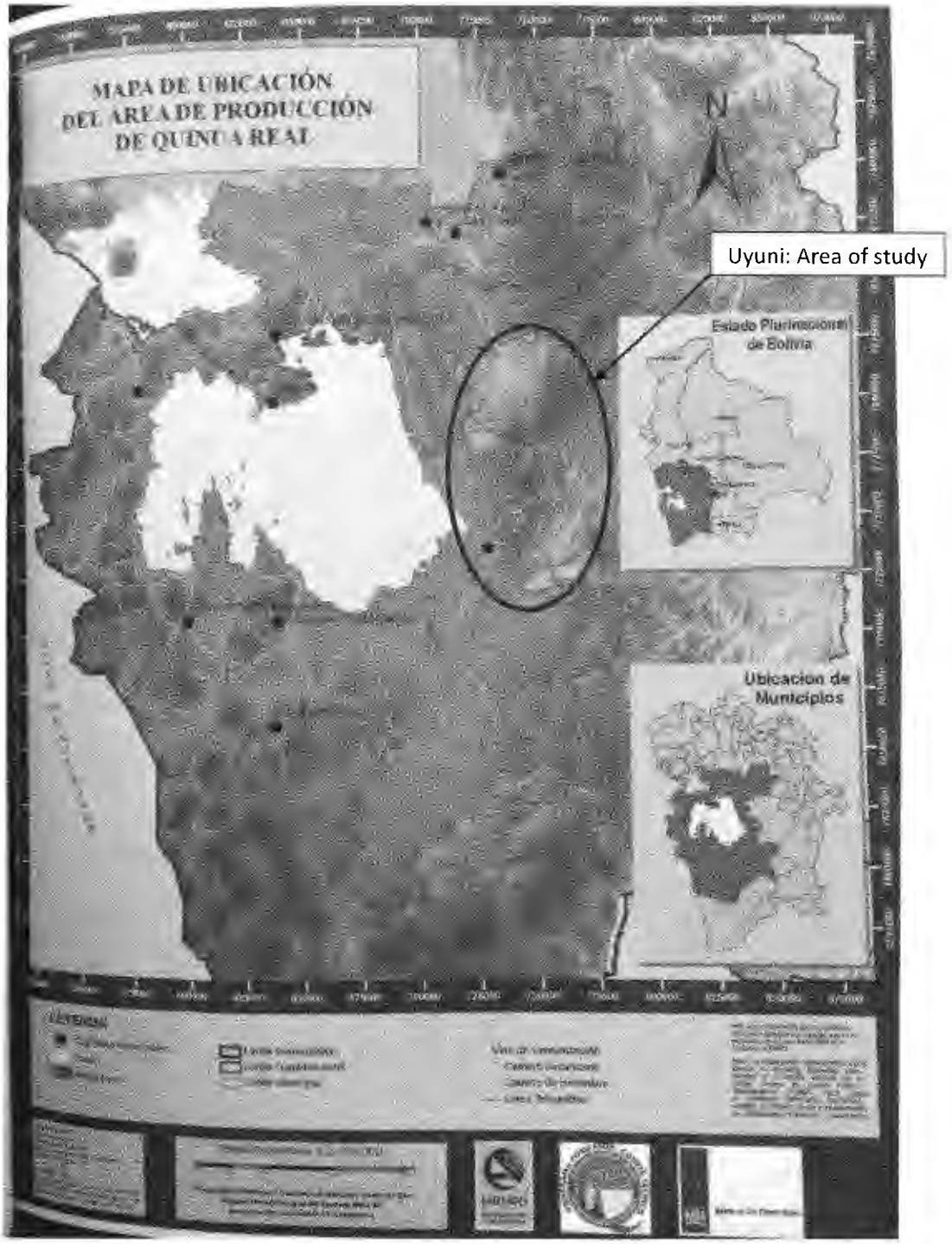
Nota: *(p) Preliminar.*

Fuente: *Elaboración propia con base en: BCB, 1984; MICT-DICOMEX, 1982, 1983, 1984, 1985 y 1986; INE.*

Source: Ormachea and Ramirez Report with data from INE

Most of Bolivia's quinoa for export comes from the municipalities in the Southern Altiplano. This quinoa is known as "quinua real" (royal quinoa), for its reputation of having the best quality in terms of nutrition and texture (FAUTAPO). To narrow down the study, a map of the main quinoa producing municipalities and tables of their production were examined.

Figure 2: Map of the Southern Altiplano and major quinoa producing municipalities of Bolivia, within which is Uyuni, the area of study



Source: Fundacion FAUTAPO

Total area of quinoa production is dominated by the municipalities of Salinas de Garci Mendoza and Uyuni (See graphs in Appendix) (Fundacion FAUTAPO); the two together have more than half of the land that produces quinoa for export. Uyuni yielded the highest production per family in 2006 (right before the quinoa boom really took off) (Fundacion FAUTAPO). Additionally, 90% of Uyuni is used for farmland (Appendix) (Fundacion FAUTAPO); indicating that the majority of the population is dependent on agriculture for income.

The municipality of Uyuni (Figure 2) was therefore used to test the socioeconomic impacts on quinoa farmers. Uyuni is a small municipality, inhabited largely by poor, indigenous farmers. It is one of the world's physically highest regions, at nearly 4,000m above sea level (Fundacion Mileno).

Hypotheses

To find the extent to which Uyuni farmers have been impacted, the following hypotheses will be tested:

A) Intensity of Production

RH_1: There is a direct correlation between the increase in international demand for quinoa and an increase of production/surface area/yield of quinoa. Farmers must produce more quinoa from the fields they have, and extend their harvest to keep up with the growing demand.

N0: There is no correlation between the increase in exports of quinoa from Bolivia and an increase of production/surface area/yield of quinoa, as there is simply a shift domestic consumption to foreign export.

B) Income

RH_2: There is a direct correlation between the increase in exports and quinoa farmers' income.

N0: There is no correlation between the increase in demand and quinoa farmers' income, as large commercial operations are making most of the gains, or cost of production for export is too high (loans, lack of cooperatives, middle men, transport costs) and therefore profit are low.

C) Household conditions

RH_3: There is a direct correlation between the increase in demand for quinoa and improved household conditions/basic necessities, as these are the first areas on which farmers will spend increased income in order to improve their lives.

N0: There is no correlation between the increase in demand for quinoa and improved household conditions, as they are not the top priority in terms of how higher income should be spent.

D) Education

RH_4: There is an inverse correlation between the increase in demand for quinoa and dropout rate of school age children in Uyuni, as parents no longer need their children to start adding to family income immediately and they may have more money to pay for further education.

NO: There is no correlation between the increased price/demand for quinoa and school dropout rate, as farmers' children are in fact needed to work on the farm or just prefer to start farming quinoa rather than continue education.

Data was provided by the 2001 and 2012 censuses collected by INE, the Bolivian Ministry of Education and collected from various other sources. The Spearman's Rank correlation statistical analysis was used to determine the strength and significance of correlations between international demand for quinoa and three of the four socioeconomic variables being tested (calculations in Appendix). The test could not be used for RH_3 (household conditions), as there were not enough available data points. Therefore, an alternative form of analysis was used in conjunction with information gathered from first-hand interviews.

Method

To the extent possible, all variables were tested specifically for the municipality of Uyuni, to serve as a good example of impact.

As quinoa was initially a subsistence grain grown primarily for farmers' consumption, a change in production could lead to a change of eating habits and the balance of internal consumption and foreign sale. Therefore, the first variable, farmer quinoa harvest, was tested in terms of:

- volume of production
- surface area harvested
- yield

It is important to investigate the extent to which quinoa farmers are reaping the benefits from quinoa's surge in growth, versus quinoa production becoming a commercialized industry where the money does not reach the source of the primary product. The second variable, farmer income, was tested with:

- the progression of local market prices throughout the quinoa boom
- gross income, calculated by an estimated break down of cost of production per hectare subtracted from the average market price quinoa farmers reap to from year to year.

It is also imperative to investigate how farmers spent increased income, as a result of their priorities. The third variable, household conditions, was tested by a comparison between various indicators before and after demand in quinoa rose so steeply:

- toilet in dwelling
- television possession
- car possession

Education is a key determinant in whether or not a community has evolved to reduce the long-term poverty the quinoa region had long experienced. The fourth variable, education, was tested by examining progression of dropout rates in Uyuni, as compared to Bolivia as a whole and the department of Potosi.

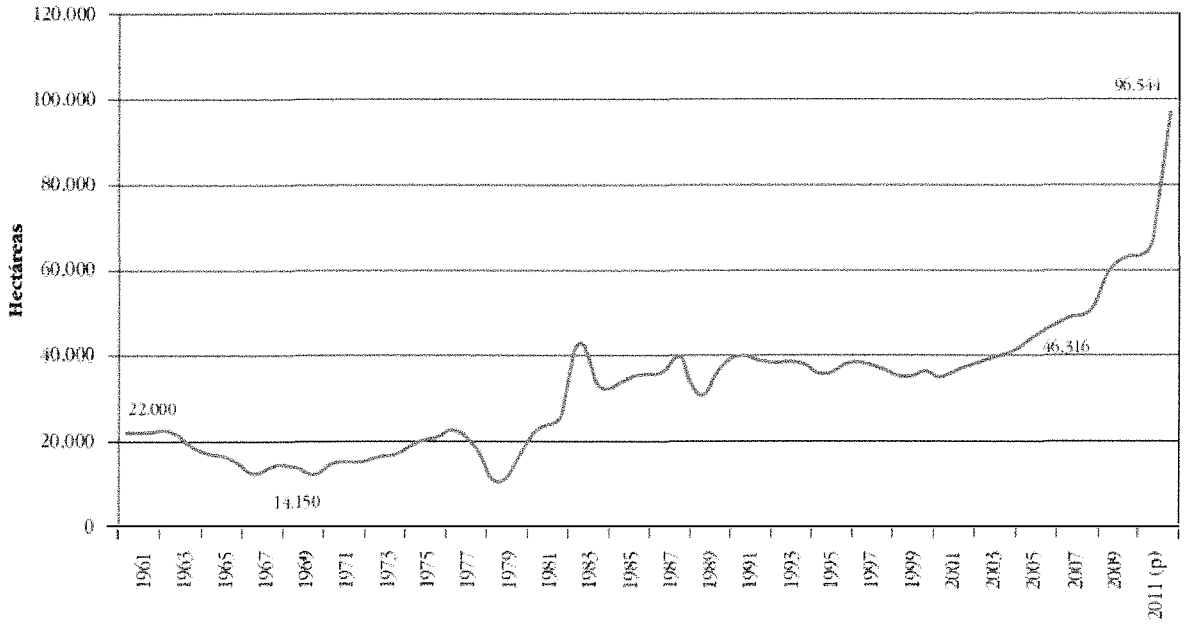
Data Analysis

Word Count: 2,179

Intensity of Quinoa Production in Bolivia

Three indices were used to measure the correlation between increased international demand for quinoa and quinoa harvest: surface area cultivated (measured in hectares--Ha) (Graph 4), production (measured in Metric Tons--MT) (Graph 5), and yield (measured in MT/Ha) (Graph 6).

Graph 4: Evolution of surface area of cultivated quinoa in Bolivia between 1961 and 2012

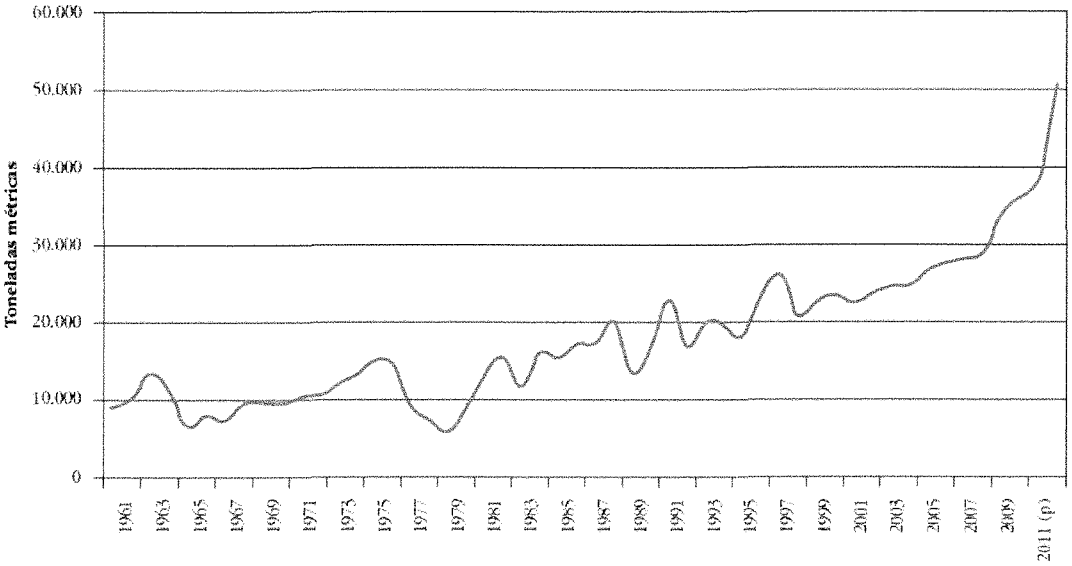


Nota: (p) Preliminar.

Fuente: Elaboración propia con base en: MACA, 1976; MACA, 1985; MACA, 1990; INE y MDRyT, 2008; INE.

Source: Ormachea and Ramirez Report with data from INE

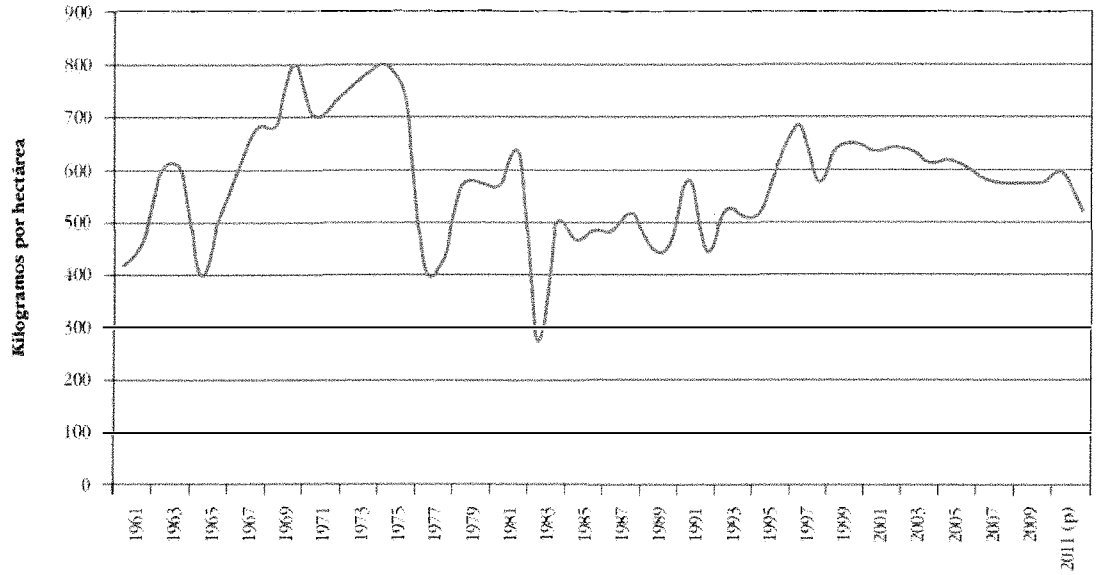
Graph 5: Evolution of volume of quinoa produced in Bolivia between 1961 and 2012



Nota: (p) Preliminar.
Fuente: Elaboración propia con base en: MACA, 1976; MACA, 1985; MACA, 1990; INE y MDRyT, 2008; INE.

Source: Ormachea and Ramirez Report with data from INE

Graph 6: Evolution of quinoa yield in Bolivia between 1961 and 2012



Nota: (p) Preliminar.
Fuente: Elaboración propia con base en: MACA, 1976; MACA, 1985; MACA, 1990; INE y MDRyT, 2008; INE.

Source: Ormachea and Ramirez Report with data from INE

Spearman's Rank correlation determined a strong and highly significant positive correlation between Bolivia's quinoa exports and total production and cultivated surface area. This supports RH_1, which hypothesized that as exports increase, harvest will also increase. However, yield had the opposite effect expected, and in fact has a negative correlation with quinoa exports. While the Spearman's rank value isn't as high as for production and surface area, the level of significance is still fairly high as the chance of error is below 5%. Therefore, yield supports neither the RH_1 nor the N0.

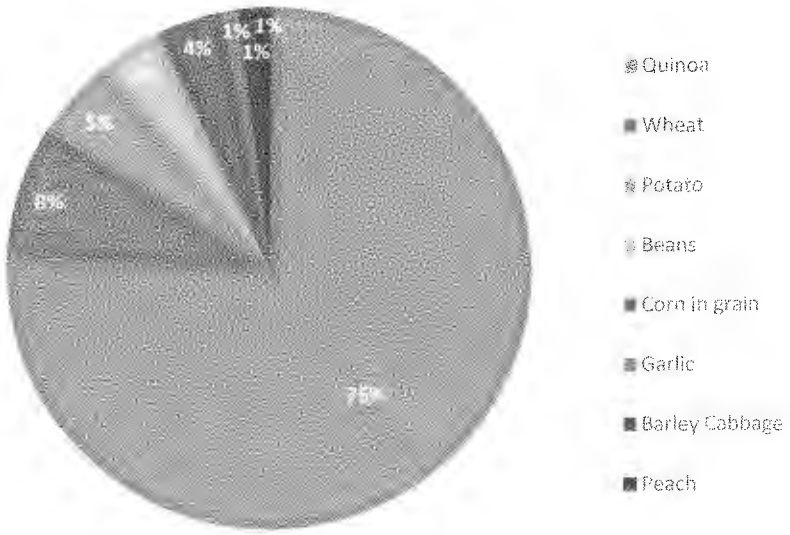
Table 1: Rs values for harvest indices based on Calculations shown in Tables in Appendix

	Production (MT)	Surface area (Ha)	Yield (MT/Ha)
Calculated Rs values for 14 samples	0.98	0.98	-0.76
Table values for n=14	99% significance level=0.65		
RH1	accept	accept	reject

Source for % significance: Nagle, pg.420

It was expected that quinoa production and surface area cultivated would increase, so to not immediately compromise internal consumption and keep up with external demand. Surface area greatly increased so that production would also increase. Quinoa was cultivated both in unused and marginal land, and on land that was previously used to grow other crops that were not as high in demand (CADEQUIR). In Potosi (the Department which Uyuni is in), quinoa composed most of the increased land use since 1990 (Graph 7) (Fundacion FAUTAPO).

Graph 7: Percent of total increase in surface area (Ha) cultivated in the Department of Potosi by crop between 1990 and 2013



Source: INE Agriculture Reports

As all communities and farmers in quinoa growing municipalities were scrambling to expand their territory to increase their production of the grain which had suddenly become so valuable, arguments between farmers and between communities over land borders developed (Real Andina). Before quinoa became so popular on the international market, some land was left uncultivated and land borders were generally accepted and less precise. However now, land permits are taken much more seriously, and it is impossible to move into a community to harvest quinoa without proof of ancestral ties to a particular piece of land (Real Andina).

There are various reasons yield decreased in the past decade. First of all, much of the expanded quinoa land may not have been as suitable for quinoa growth as the land that was already in use, therefore the harvest was less per hectare. Land that was previously used to harvest other crops was cleared out specifically to grow more quinoa (Antonio). Again, this land was not accustomed to quinoa growth, and therefore yield decreased. Secondly, since cultivated land increased so much, farmers put less care into the harvest of each hectare, as they had the same amount of time in the year to harvest much more quinoa. Thirdly, terrains used to be rotated,

one year in use and one year off to restore the soil nutrients. However, with the increased demand, all terrains were put to use for all years (PROINPA). Therefore, soil quality quickly degraded. Additionally, quinoa farming became highly mechanized, and the soil that was previously only cultivated by hand and fertilized with manure became subject to mechanization and treated with fertilizers, with the aim of increasing short-run efficiency (Laguana). These factors all contributed to soil degradation, which in turn helps explain the inverse relationship between quinoa demand and yield.

evidence

Valid possible reasons but no real evidence for declining yields presented.

Income

Two indices were used to test the correlation between quinoa demand and farmers' income: local market price (average domestic price for which farmers sell their quinoa) and a calculated average yearly income. The local market price is represented by the price at the end of each year at Challapata market, which is considered the center of quinoa trade, and controls Uyuni's daily average local price. The local currency is Bolivianos (in 2014 approximately 6.85Bs=US $1). Quinoa is sold in bags of 1 quintal (qq), which equals 46kg (Real Andina). To calculate an average yearly income:

1. Market price was converted from Bs/qq into Bs/kg and yield was converted into kg/ha
2. Gross revenue per hectare was calculated by multiplying yield by the market price.
3. Then, an approximate breakdown of cost of production per hectare was subtracted from this gross revenue to find net income per hectare.
4. Finally, this net income per hectare was multiplied by 10, as this is the average number of hectares per producer in Uyuni.

Until 2007, the price of production for "traditional conventional" quinoa was used; from 2007-2013 the Uyuni specific production price for "semi-mechanized organic quinoa" was used (see Appendix). This is because at some point, as quinoa demand started to rise, most farmers in Uyuni made the switch to producing organic quinoa (as this is a requisite for most exported quinoa) and started farming with more machines. However, it is unclear when exactly this change happened. Additionally, because Bolivia has experienced major inflation in the past 10 years, all prices were CPI adjusted.

Clearly, this method of calculating annual income from quinoa has many possible sources of error, so it is possible that the more accurate measure of correlation between quinoa demand and income is the local market price of quinoa.

Table 2: Local market price and calculated average yearly income between 2000 and 2013

Year	Challapata market price (local) (bs/qq)	average yearly income (bs)
2000	100	-5046.37
2001	110	-5248.42
2002	120	-2809.48
2003	160	-2747.16
2004	180	1562.07
2005	200	2749.46
2006	240	5462.95
2007	260	4936.46
2008	720	45520.62
2009	730	43079.38
2010	740	47134.80
2011	810	38128.94
2012	920	37091.65
2013	1878	172387.81

Source: Calculations performed by author with data from Fundaction FAUTAPO

Given the price of quinoa between 2000 and 2003, farmers would technically have been losing money by selling their quinoa (Table 2) because production cost exceeded the selling price. While clearly farmers would not actually sell their quinoa if they would be losing money, the calculations show how unprofitable quinoa was before its popularity suddenly skyrocketed. This further substantiates that nearly all quinoa produced before demand surged was for self-consumption. With respect to the local market prices, the price of quinoa increased fairly steadily each year, with the greatest jumps between 2007 and 2008 (177% increase) and 2012 and 2013 (104% increase).

Spearman's Rank correlation confirms the extremely strong positive correlation between quinoa demand and both local market price and calculated average yearly income, with high significance (Table 3). The definitive direct relationship between quinoa demand and farmer income proves RH_2 correct.

Table 3: Rs value for income indices

Calculated Rs values for 14 samples	1.00*	0.91
Table values for n=14	99% significance level=0.65	
RH2	accept	

*Note that the Rs value rounds to 1.00, but does not indicate a 100% perfect correlation.

Source for % significance: Nagle, pg.420

Living Conditions

Three indices were used to assess the correlation between international quinoa demand and farmers' living conditions: access to a toilet in household, television ownership and car ownership. A data comparison between the 2001 and 2012 Bolivian censuses were used as a representation of before and after the major quinoa boom (Table 4, 5, 6) because those are the only two years the author found data for each variable. For this reason, Spearman's Rank correlation could not be used and the results will simply be described analytically. All variables show data results for the municipality of Uyuni. Additionally, the data is filtered for specifically rural areas of Uyuni, which ensures that the majority of people represented are quinoa farmers.

Table 4: Toilet access in rural Uyuni in 2001 and 2012

sanitary service/ bathroom/ latrine	2001		2012		Difference between 2012 and 2001	% change in % points between 2012 and 2001
	Cases	%	Cases	%	% points	%
Yes	341	14.7	365	9.52	-5.18	-35.24
No	1979	85.3	3468	90.48	5.18	6.07
Total	2320	100	3833	100	0	

Source: 2001 and 2012 Censuses of Bolivia provided by INE

Data from the census shows that while in 2001 14.7% of people in rural Uyuni had access to a bathroom, only 9.52% of people had access to bathrooms in 2012. That means that household access to bathrooms is 35% less than what it was in 2001. This is an unexpected result. The total number of cases (people who responded to this question on the census) increased by 40%, while the number of cases of people who reported having toilets stayed roughly the same. This suggests that many more people lived in Uyuni in 2012, which makes sense with the reversal of migration flows (Real Andina). However, these people did not invest in toilet plumbing. These data suggest that quinoa farmers were not spending their increased income on improving their household living conditions; having a toilet would likely be the first development in this area of improving quality of life. This supports the N0.

Table 5: Television ownership in rural Uyuni in 2001 and 2012

Own a television	2001		2012		Difference between 2012 and 2001	% change in % points between 2012 and 2001
	Cases	%	Cases	%	% points	%
Yes	300	12.93	1336	34.86	21.93	169.58
No	2020	87.07	2497	65.14	-21.93	-25.19
Total	2320	100	3833	100	0	

Source: 2001 and 2012 Censuses of Bolivia provided by INE

The census data show that between 2001 and 2012, there was a 170% increase in the number of households with a television. In 2012 there were about 1500 more households with television, and only about 400 more without. While the new households did not get toilets, it appears that many of them did get televisions. This supports RH_3.

Table 6: Car ownership in rural Uyuni in 2001 and 2012

Own a car	2001		2012		Difference between 2012 and 2001	% change in % points between 2012 and 2001
	Cases	%	Cases	%	% points	%
Yes	256	11.03	1649	43.02	31.99	289.88
No	2064	88.97	2184	56.98	-31.99	-35.95
Total	2320	100	3833	100	0	

Source: 2001 and 2012 Censuses of Bolivia provided by INE

The data for car ownership seem to have the highest increase out of all three indices, with a 290% increase between 2001 and 2012. This supports RH_3.

Cars are a large investment—more expensive than a television. The fact that many more people have invested in cars rather than toilets suggests various insights on the farmers in Uyuni. A household cannot invest in getting a toilet if the community as a whole does not have a running

water pipe system. Therefore, the lack of increase of toilets is indicative of a lack of investment in community development (Real Andina). Instead, people have spent their money on cars, which can take them out of the communities that limit them. Cars have become increasingly necessary with the quinoa boom, as farmers must constantly go to and from the city to sell their quinoa, as well as to check what the price is to catch the market at its peak (Real Andina).

Television provides entertainment in the household, however it does not actually improve living conditions. It is a relatively small, portable, investment, which can be said to improve quality of life in the short term.

So why haven't farmers invested in their houses and their communities? There isn't a market to sell the rural house to—it's impossible to join an indigenous community without ancestral land ties. Eventually, farmers prefer to invest in a house in the city of Uyuni, or in a different city in Bolivia, if their quinoa continues to bring in high profits (ANAPQUI). They see investing in a car as very important: It is the first step toward being able to get out of the country-side, makes life much more efficient and also gives an aspect of social status. It turns out that within the indices considered under "living conditions", there is a clear order of priority in terms of how increased income should be invested.

Education

The index used to measure the correlation between increased quinoa demand and education is school dropout rate. Dropout rate is defined as the percent of students who have left school permanently averaged over each grade from Kindergarten to the last year of secondary school (high school equivalent)—a total of 13 grades in the given year. Dropout rates for Bolivia as a whole and for Potosi, were included as comparison figures (Table 7). Annual percentage point differences from 2000 to 2013 were calculated.

Table 7: Dropout rates for Bolivia, Potosi Uyuni between 2000 and 2013

Year	BOLIVIA	POTOSÍ (dept)	UYUNI (municipality and area of study)
2000	6.50%	6.79%	11.21%
2001	6.37%	6.57%	12.00%
2002	6.19%	6.44%	8.02%
2003	5.59%	6.24%	7.73%
2004	5.97%	7.01%	6.56%
2005	5.81%	6.75%	6.64%
2006	6.38%	7.33%	5.25%
2007	5.07%	6.21%	6.03%
2008	5.30%	7.12%	6.50%
2009	3.36%	4.04%	3.81%
2010	3.42%	3.99%	3.89%
2011	2.20%	3.51%	3.19%
2012	2.65%	3.78%	3.01%
2013	2.89%	3.88%	3.14%
Average annual difference between 2012 and 2000	3.61%	2.92%	8.07%
% decrease between 2013 and 2001	55.56%	42.93%	72.03%

Source: Ministry of Education of Bolivia 2000-2013

In the year 2000, before quinoa demand surged, the dropout rate in Uyuni was 11.21%, and peaked a year later at 12%. This figure was nearly double the national dropout rate of 6.5%. In 2000, the entire department of Potosi, which comprises some quinoa producing municipalities and some non-producing, had a dropout rate almost half that of Uyuni and slightly higher than the national average, at 6.79%. By 2013, Uyuni's dropout rate had decreased to only 3.14%, only slightly higher than the national average of 2.89%. Uyuni's dropout rate was lower than that of the whole of Potosi department, which had decreased to 3.88%. In 2000 there was clearly a large disparity of dropout rates within the department of Potosi, as Uyuni's rate was so much higher than the department's average. Even though Uyuni's dropout rate decreased 77% between 2000 and 2013, the department's average only decreased about 43%. This demonstrates that not all municipalities in Potosi were experiencing the same rapid decrease as Uyuni did; further proving that there was in fact something special provoking this change in Uyuni that the other municipalities didn't have.

Spearman's rank correlation affirms that there is a highly significant inverse correlation between quinoa demand and dropout rate in Uyuni. This proves RH_4 correct.

Table 8: Rs value for education index

	Dropout rate
Calculated Rs values for 14 samples	-0.96
Table values for n=14	99% significance level=0.65
RH4	accept

Source for % significance: Nagle, pg.420

Before the quinoa boom, the reason so many children dropped out in Uyuni is primarily because they were needed to start working on the family farm to increase productivity and therefore income (ANAPQUI). Also, schools are far apart, which becomes an even greater issue at the high school level. As seen in the previous section, most households did not have a car in 2000. If there was no school at the next level within walking or biking distance, continuing school was not an option. Even if a family was fortunate enough to have a car, the drive to and from the school was not considered worth the loss of productivity of the driving family member, when instead the child could stay home and add to productivity.

However, once quinoa rose in popularity and income in turn increased, farmers no longer desperately needed additional income contributors, and their children's education rose to the top of family priorities. Additionally, as seen in the previous section, car ownership increased greatly, therefore reducing transportation as a major concern. Many farmers expressed that while before university was completely unattainable, now with increased quinoa sales and at better prices, it's a real possibility (ANAPQUI). Before, Uyuni had a very high emigration flow; anyone who could leave, left, either to another city or even outside of the country to seek any work with little education. In the past few years, the migration flows have reversed and many people are returning to Uyuni as quinoa has become so profitable (Einstein). Rather than leaving Uyuni to find a low paying job, farmers feel that the next generation will have the opportunity to get a good education and develop careers as professionals outside of Uyuni, or return to the land with more skills to what has become a profitable industry (ANAPQUI). Farmers in Uyuni agree that they have quinoa to thank for the new hope for their children.

Evaluation

Word Count: 401

Each variable had sources of error. Variable 1 and 2 (quinoa produced and income) combined two data sources for each index to create a full data progression from 2000-2013, as there was no comprehensive data bank. While only data sources whose numbers linked up were paired together, this is a possible source of error.

Additionally, there are many possible inaccuracies in calculating annual income. Cost of production depends on many factors such as methods and products farmers used to cultivate. Also, both cost calculations accounted for labor. However, most quinoa is produced on family farms, and there's no need to pay for extra laborers, overstating production cost. It's also impossible to determine the average year that farmers switched from conventional to organic farming and from traditional to mechanic cultivation. These are gradual processes, yet an individual year had to be picked to perform calculations. These variables impact other factors like yield and selling price. Finally, the CPI used to adjust the cost of production could be inaccurate and the input mix may have changed between 2000 and 2013.

In Variable 3 (living conditions), only data for 2001 and 2012 were available, and therefore it was hard to identify exactly when and why changes did/didn't happen. In Variable 4 (education) is difficult to quantify how much success in Uyuni can be attributed to increased quinoa demand. Since 2006, Bolivia's President Evo Morales has purportedly been working to improve the living conditions and education in rural areas inhabited by the indigenous population. It cannot really be measured if these efforts have reached Uyuni, and how to balance their impact with that of quinoa. It should be noted that because of efforts like these, different areas of Bolivia have varying reasons for development over the past decade; Uyuni and other quinoa producing municipalities did not necessarily advance ahead of Bolivia as a whole. While it is fair to say that the increase in quinoa demand primarily provoked advances in Uyuni, these data

cannot quantify the exact extent to which quinoa single-handedly brought about social development.

Finally, this study used Uyuni as a representation of quinoa growers in the Southern Altiplano. However, impacts in other quinoa producing areas may vary substantially. For example, quinoa growers in the Northern Altiplano still produce quinoa largely for internal consumption (Real Andian). Therefore, this study does not investigate in what ways other quinoa farmers have been impacted by quinoa's increased demand.

Conclusion

Word Count: 252

The aim of this investigation was to measure the impacts of the surge in quinoa demand on the small quinoa famers in the Southern Altiplano of Bolivia, specifically the municipality of Uyuni. Spearman's Rank Correlation was used for 3 out of 4 of the tested variables, and found all correlations significant. For Variable 1 (amount produced), 3 indices were measured: production, surface area and yield. While all correlations were significant, the correlations of production and surface area proved RH_1, but yield had the opposite expected correlation. This indicates that production did not increase accordingly with increased surface area. For Variable 2 (income), the two indices measured (local market price and annual income) both supported RH_2. The three indices used to test Variable 3 suggest that there is an order of priority in how farmers wish to improve their life conditions and spend their increased income. RH_3 grouped all under "living conditions", but farmers were actually not looking to invest in their households; instead farmers raised quality of life in the short term, with long term goals of investing outside of their communities. Variable 4 (education) used the rapid decrease in drop-out rate to demonstrate that quinoa demand and education are correlated, proving RH_4. Overall, it is clear that the lives of quinoa growers in Uyuni have changed dramatically over the past decade. These changes have begun to halt the cycle of poverty in this rural, indigenous municipality, and can be attributed to the grain farmers' ancestors harvested for thousands of years: Quinoa.

An excellent investigation into socio-economic geography

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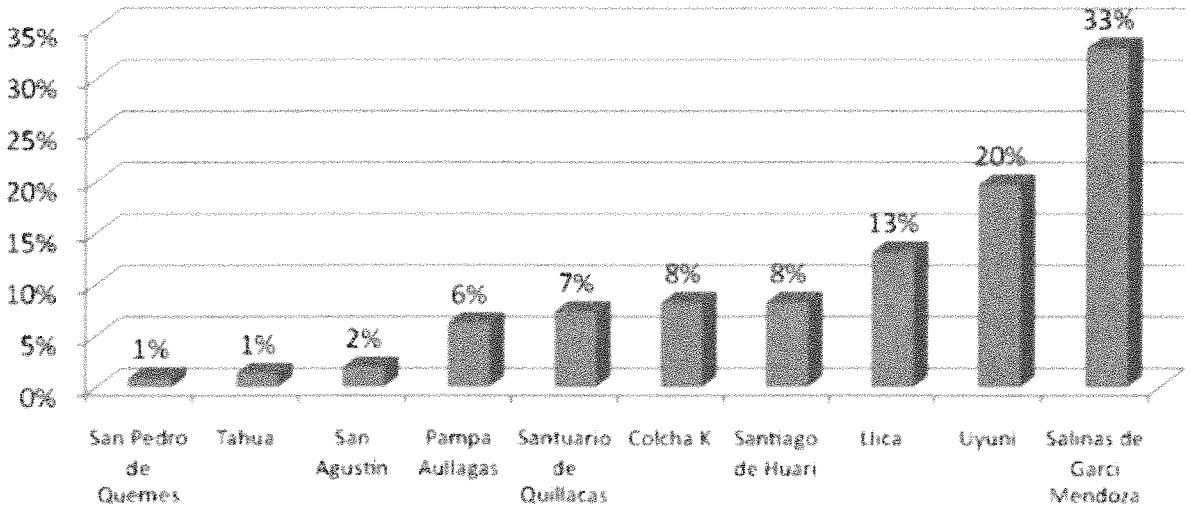
Appendix

Surface area cultivated in each major quinoa producing municipality

MUNICIPIOS	AREA (HA)	PORCENTAJE
San Pedro de Quemes	1.231,06	1%
Tahua	1.788,00	1%
San Agustín	2.565,11	2%
Pampa Aullagas	8.361,44	6%
Santuario de Quillacas	9.827,21	7%
Colcha K	11.016,33	8%
Santiago de Huari	11.021,75	8%
Llica	17.619,50	13%
Uyuni	26.372,04	20%
Salinas de Garci Mendoza	44.207,51	33%
TOTAL	134.009,95	100%

Source: Fundacion FAUTAPO

Percent of total cultivated surface area in Southern Altiplano by municipality



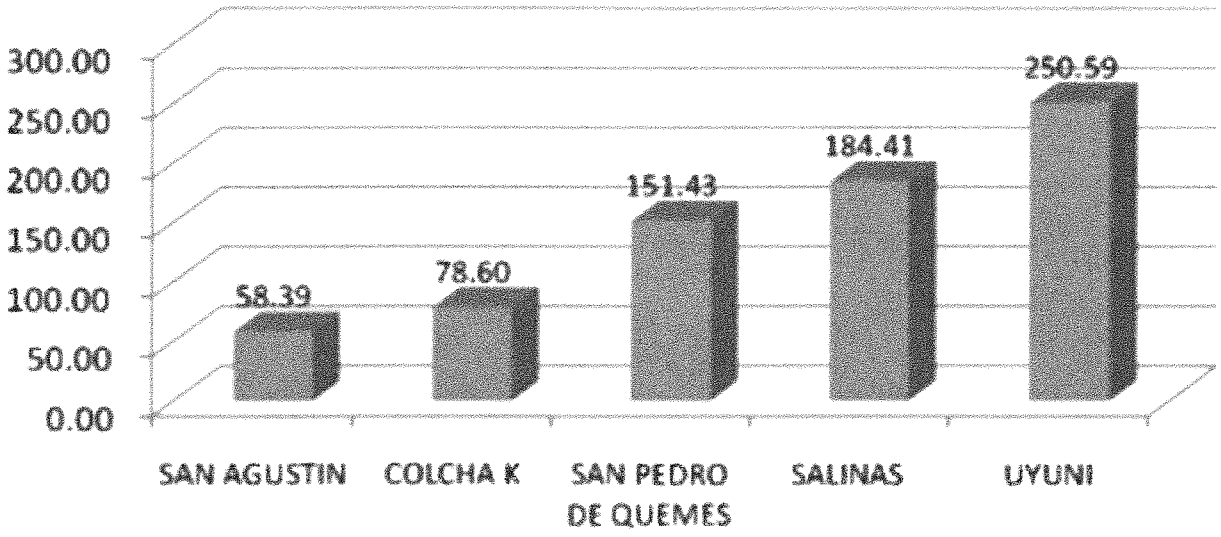
Source: Fundacion FAUTAPO

Average production per producer for main quinoa producing municipalities in 2006

MUNICIPIO	PRODUCCIÓN ESTIMADA (QQ)
(2006 – 2007)	78,60
SAN AGUSTIN	58,39
COLCHA K	78,60
SAN PEDRO DE QUEMES	151,43
SALINAS	184,41
UYUNI	250,59

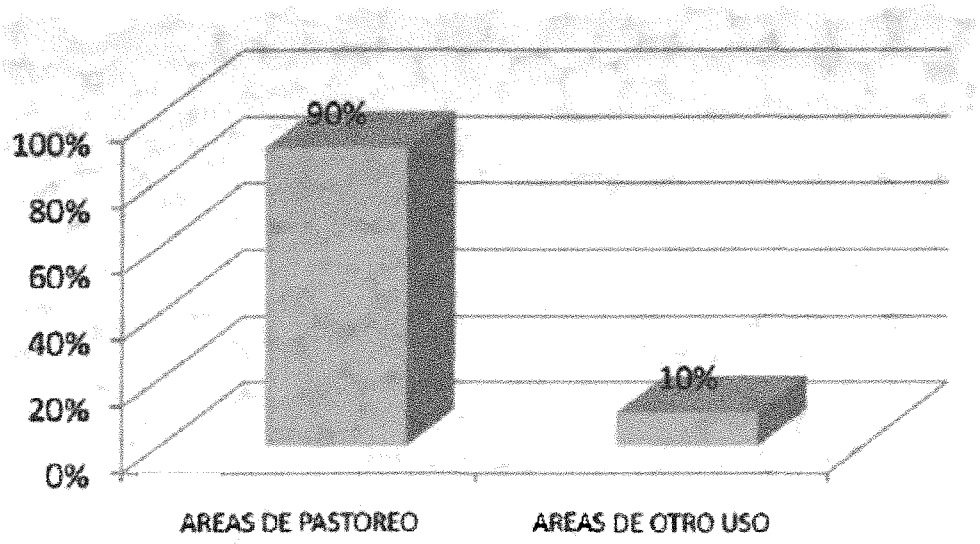
Source: Fundacion FAUTAPO

Average production per producer for main quinoa producing municipalities in 2006 (qq)



Source: Fundacion FAUTAPO

Areas of farmland versus land for other use in Uyuni



Source: Fundacion FAUTAPO

Calculation for Spearman's Rank Correlation for production

n	year	exports (thousands of mt)	rank	production (thousands of mt)	rank	D	D^2
1	2000	1.43	1	23.22	3	2	4
2	2001	2.12	3	21.71	1	-2	4
3	2002	2.02	2	23.03	2	0	0
4	2003	2.8	4	24.46	4	0	0
5	2004	3.87	5	24.96	5	0	0
6	2005	4.83	6	27.74	6	0	0
7	2006	7.65	7	28.23	7	0	0
8	2007	10.16	8	28.81	8	0	0
9	2008	10.31	9	34.16	9	0	0
10	2009	14.38	10	36.12	10	0	0
11	2010	15.4	11	38.26	11	0	0
12	2011	20.37	12	50.57	12	0	0
13	2012	26.25	13	61.18	13	0	0
14	2013	35.1	14	95.53	14	0	0
						sum	8
						n	14
						Rs	0.98

Calculation for Spearman's Rank Correlation for surface area

n	year	exports (thousands of mt)	rank	surface area (ha)	rank	D	D^2
1	2000	1.43	1	35715	3	2	4
2	2001	2.12	3	33928	2	-1	1
3	2002	2.02	2	33865	1	-1	1
4	2003	2.8	4	45680	5	1	1
5	2004	3.87	5	43782	4	-1	1
6	2005	4.83	6	46316	6	0	0
7	2006	7.65	7	48897	7	0	0
8	2007	10.16	8	50356	8	0	0
9	2008	10.31	9	59924	9	0	0
10	2009	14.38	10	63010	10	0	0
11	2010	15.4	11	64789	11	0	0
12	2011	20.37	12	96,544	12	0	0
13	2012	26.25	13	131,192	13	0	0
14	2013	35.1	14	169,094	14	0	0
						sum	8
						n	14
						Rs	0.98

Calculation for Spearman's Rank Correlation for yield

n	year	exports (thousands of mt)	rank	yield (mt/ha)	rank	D	D^2
1	2000	1.43	1	0.650	13	12	144
2	2001	2.12	3	0.640	12	9	81
3	2002	2.02	2	0.680	14	12	144
4	2003	2.8	4	0.535	3	-1	1
5	2004	3.87	5	0.600	11	6	36
6	2005	4.83	6	0.599	10	4	16
7	2006	7.65	7	0.577	8	1	1
8	2007	10.16	8	0.572	6	-2	4
9	2008	10.31	9	0.570	5	-4	16
10	2009	14.38	10	0.573	7	-3	9
11	2010	15.4	11	0.590	9	-2	4
12	2011	20.37	12	0.524	2	-10	100
13	2012	26.25	13	0.466	1	-12	144
14	2013	35.1	14	0.565	4	-10	100
						sum	800
						n	14
						Rs	-0.76

Calculation for Spearman's Rank correlation for market price:

n	year	exports (thousands of mt)	rank	market price (bs/qq)	rank	D	D^2
1	2000	1.43	1	100	1	0	0
2	2001	2.12	3	110	2	-1	1
3	2002	2.02	2	120	3	1	1
4	2003	2.8	4	160	4	0	0
5	2004	3.87	5	180	5	0	0
6	2005	4.83	6	200	6	0	0
7	2006	7.65	7	240	7	0	0
8	2007	10.16	8	260	8	0	0
9	2008	10.31	9	720	9	0	0
10	2009	14.38	10	730	10	0	0
11	2010	15.4	11	740	11	0	0
12	2011	20.37	12	810	12	0	0
13	2012	26.25	13	920	13	0	0
14	2013	35.1	14	1878	14	0	0
						sum	2
						n	14
						Rs	1.00

Tables used to calculate cost of production for each year:

Organic, semi-mechanized specifically for Uyuni in Bs for 2013:

ACTIVIDAD	UNIDAD DE MEDIDA	Nº DE UNIDAD	VALOR UNITARIO (Bs.)	COSTO TOTAL (Bs.)
I.- COSTOS DIRECTOS				
A. GASTOS DE CULTIVO				
1. Mano de Obra:				
1.1 Preparación de terreno (nivelación)				
- Limpieza de campo	Jornal	2	100.00	200.00
1.2 Siembra				
- Desinfeccion y distribucion de sem	Jornal	3	100.00	300.00
1.3 Abonamiento				
- 1er abonamiento	Jornal	2	100.00	200.00
- 2do abonamiento	Jornal	1	100.00	100.00
1.4 Labores Culturales				
- Desahije	Jornal	2	100.00	200.00
- Aporque	Jornal	4	100.00	400.00
1.5 Control Fitosanitario				
- Aplicación pesticidas	Jornal	5	100.00	500.00
1.6 Cosecha				
- Cortadores	Jornal	6	120.00	720.00
- Emparve	Jornal	2	120.00	240.00
- Trilla	Jornal	2	120.00	240.00
- Venteado	Jornal	2	120.00	240.00
- Encostalado y carguio	Jornal	1	120.00	120.00
SUB-TOTAL DE MANO DE OBRA				3.460.00
2. Maquinaria agricola				
- Barbecho	Hora	3	120.00	360.00
- Trastra	Hora	2	120.00	240.00
- Mullido (roto -vector)	Hora	2	120.00	240.00
- Siembra	Hora	2	120.00	240.00
SUB-TOTAL DE MAQUINARIA AGRICOLA y/o TRACCION ANIMAL				1.080.00
3. Insumos:				
3.1 Semilla	kg	15	23.91	358.65
SUB-TOTAL DE INSUMOS				358.65
B. GASTOS GENERALES				
1. Imprevistos (10%) cultivo	global	1	469.87	469.87
SUB-TOTAL DE GASTOS GENERALES				469.87
C. ALQUILER DE TERRENO				
Periodo vegetativo del cultivo				0.00
SUB-TOTAL DE ALQUILER DE TERRENO				0.00
D. DEPRECIACION				
Herramientas y equipo	global			437.50
SUB-TOTAL DEPRECIACION				437.50
TOTAL DE COSTOS DIRECTOS (A+B+C+D)				5.826.02
II.- COSTOS INDIRECTOS				
A. Costos Financieros (1.58% C.D./mes)				
TOTAL DE COSTOS INDIRECTOS				0.00
III.- COSTO TOTAL DE PRODUCCION				5.826.02

Source: Ministerio de Desarollo

Conventional, traditional for Bolivia in USD for 2009:

Costo de Producción Convencional Tradicional de Quinua
(En Dólares Americanos)

ACTIVIDAD	UNIDAD	CANTIDAD	COSTO UNITARIO	COSTO TOTAL
Preparación de suelos:				**72.00**
Destholado	Jornal	8	4	32.00
Barbecho manual	Jornal	10	4	40.00
Siembra:				**48.00**
Siembra (hoyado)	Jornal	8	4	32.00
Tapado de semilla	Jornal	4	4	16.00
Labores Culturales:				**12.00**
Control fitosanitario	Jornal	3	4	12.00
Cosecha:				**140.00**
Arrancado y emparve	Jornal	10	4	40.00
Trilla	Jornal	7	4	28.00
Venteado y embolsado	Jornal	8	4	32.00
Transporte	Viaje	2	20	40.00
Insumos:				**77.00**
Semilla	Kgr	8	1.50	12.00
Abono orgánico	Bolsa	20	3	60.00
Fitosanitario (insecticida Sistémico)	Lt.	0.50	10	5.00
Herramientas y accesorios :(*)				**81.50**
Bolsas de plástico	Piezas	15	1.50	22.50
Palo de trilla	Piezas	8	3	24.00
Manteles	Piezas	5	5	25.00
Mochila fumigadora	Piezas	1	40	40.00
Imprevistos :				**23.02**
5% sobre total de costos				22.02
COSTO TOTAL DE PRODUCCION DE QUINUA/ha.				**460.50**

(*)Tomando en cuenta 5 años de depreciación.

Source: Programa Complejo Productivo

Consumer Price Index used to adjust cost of production:

Year	CPI
2013	140
2012	135
2011	130
2010	115
2009	115
2008	105
2007	100
2006	90
2005	85
2004	80
2003	78
2002	75
2001	75
2000	70

Source: Trading Economics

Calculated cost of production:

year	cost of production (taking CPI into account)
2000	1918
2001	2055
2002	2055
2003	2137.2
2004	2192
2005	2329
2006	2466
2007	2740
2008	4369.5
2009	4785.643
2010	4785.643
2011	5409.857
2012	5617.929
2013	5826

Calculation for revenue/ha and annual income:

Year	market price (bs/kg)	yield (kg/ha)	revenue/ha (bs) =price x yield	income/ha (bs) = revenue-cost	average yearly income (bs)
2000	2.17	650.15	1413.36	-504.64	-5046.37
2001	2.39	639.88	1530.16	-524.84	-5248.42
2002	2.61	680.05	1774.05	-280.95	-2809.48
2003	3.48	535.46	1862.48	-274.72	-2747.16
2004	3.91	600.10	2348.21	156.21	1562.07
2005	4.35	598.91	2603.95	274.95	2749.46
2006	5.22	577.36	3012.29	546.29	5462.95
2007	5.65	572.11	3233.65	493.65	4936.46
2008	15.65	569.99	8921.56	4552.06	45520.62
2009	15.87	573.02	9093.58	4307.94	43079.38
2010	16.09	590.49	9499.12	4713.48	47134.80
2011	17.61	523.76	9222.75	3812.89	38128.94
2012	20.00	466.35	9327.09	3709.16	37091.65
2013	40.83	564.95	23064.78	17238.78	172387.81

Calculation for Spearman's Rank Correlation for yearly income:

n	year	exports (thousands of mt)	rank	average yearly income (bs)	rank	D	D^2
1	2000	1.43	1	-5046.37	2	1	1
2	2001	2.12	3	-5248.42	1	-2	4
3	2002	2.02	2	-2809.48	3	1	1
4	2003	2.8	4	-2747.16	4	0	0
5	2004	3.87	5	1562.07	5	0	0
6	2005	4.83	6	2749.46	6	0	0
7	2006	7.65	7	5462.95	7	0	0
8	2007	10.16	8	4936.46	8	0	0
9	2008	10.31	9	45520.62	12	3	9
10	2009	14.38	10	43079.38	11	1	1
11	2010	15.4	11	47134.80	13	2	4
12	2011	20.37	12	38128.94	10	-2	4
13	2012	26.25	13	37091.65	9	-4	16
14	2013	35.1	14	172387.81	14	0	0
						sum	40
						n	14
						Rs	0.91

Calculation for Spearman's Rank Correlation for droupout rate:

n	year	exports (thousands of mt)	rank	droupout rate	rank	D	D^2
1	2000	1.43	1	11.21	13	12	144
2	2001	2.12	3	12	14	11	121
3	2002	2.02	2	8.02	12	10	100
4	2003	2.8	4	7.73	11	7	49
5	2004	3.87	5	6.56	9	4	16
6	2005	4.83	6	6.64	10	4	16
7	2006	7.65	7	5.25	6	-1	1
8	2007	10.16	8	6.03	7	-1	1
9	2008	10.31	9	6.5	8	-1	1
10	2009	14.38	10	3.81	4	-6	36
11	2010	15.4	11	3.89	5	-6	36
12	2011	20.37	12	3.19	3	-9	81
13	2012	26.25	13	3.01	1	-12	144
14	2013	35.1	14	3.14	2	-12	144
						sum	890
						n	14
						Rs	-0.96