Czech University of Life Sciences Prague

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Diploma Thesis

Agribusiness in Peru: A Case Study

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Declaration

I declare that I have worked on my diploma thesis titled Agribusiness in Peru: A Case Study by myself and I have used only the sources mentioned at the end of the thesis.

In Prague on date

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Acknowledgement

I would like to thank Ing. Petr Procházka, MSc., Ph.D. and all other persons, for their advice and support during my work on this Thesis.

Agrobusiness v Peru: Případová Studie

Souhrn:

Tato studie se zabývá podnikatelskou činností podniku Dio Latina, který operuje v Peru. V první, teoretické části se zaměřuje na představení teorie k dané problematice. Stručně je představen kontinent Jižní Amerika, podrobněji pak země Peru a její region Piura, kde podnik vyvíjí zemědělskou činnost. Jelikož se práce zabývá právě zemědělskou činností, v další kapitole je představena teorie půd a hnojiv. Konec teoretické části pak popisuje finanční analýzu, zejména pak finanční ukazatele. Úplně nakonec je uvedena teorie nutná k sestavení ekonometrického modelu.

Praktická část se věnuje výzkumu. Je zde představen podnik, jeho struktura, legislativa a podnikatelský záměr. Dále se zkoumá finanční situace podniku, a to pomocí jak fundamentální tak technické analýzy. Následuje rozbor půdy, přičemž se zkoumá zejména kvalita půdy. Na základě poznatků nabytých za celou práci, potom autor doporučuje plodiny, nejlépe se hodící pro pěstování v dané lokalitě. Je sestaven plán, jak lze plodiny pěstovat s nejvyššími výnosy a v nejvyšší kvalitě. Konec výzkumu pak tvoří ekonometrický model, který obsahuje proměnné relevantní k výzkumu. Závěr práce pak tvoří zhodnocení výsledků a diskuze.

Klíčová slova:

Zemědělství, Peru, Piura, vodní hospodářství, plodina, quinoa, sladký brambor, hnojivo

Agribusiness in Peru: A Case Study

Summary:

This study deals with the business of the company Dio Latina, which operates in Peru. In the first, theoretical part focuses on presenting theories on the matter. Is briefly introduced to the continent of South America, and in detail the country and Peru's Piura region, where the company develops agricultural activity. Since the work deals precisely with agricultural activities, the next chapter presents the theory of soils and fertilizers. The end of the theoretical part describes financial analysis, especially financial indicators. At the very least is mentioned theory needed to build an econometric model.

The practical part is devoted to research. There introduces the company, its structure, legislation and business concept. It then examines the financial situation of the company, using both fundamental and technical analysis. Following analysis of soil is examining particular soil quality. Based on the knowledge gained at the entire work, then the author recommends the crops best suited for cultivation in the locality. It is a complete plan on how to grow crops with the highest yields and the highest quality. End of research then forms an econometric model that includes variables relevant to the research. End of the work is then an evaluation of the results and discussion.

Keywords:

Agriculture, Peru, Piura, water management, crop, cultivation, quinoa, sweet potatoes, fertilizer

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1. Introduction

Peasant - nowadays contradicting expression that had been said with respect 100 years ago. Back in the days peasants were farmers, owners of land and estates, which were able to supply a variety of foods for the village or throughout the entire municipality, feed himself, his family, live in prosperity and also live in harmony with nature. They were therefore regional breadwinners, caregivers about the landscape and people which always had a recognized position and strong voice among the society in which they were involved.

However, in current times the reality is quite different. The first problem is the fact that most of the world's agricultural production is controlled by multinational companies which are focusing on the so-called "intensive" agriculture. Intensive agriculture mean; focus on the production of monoculture crops on the largest area using minimal costs to achieve the highest yields, thus profits. Unfortunately, it involves the use of large amounts of fertilizers, pesticides, sprays and other toxic substances, harmful not only to human life but also for nature as a whole. Companies misuse the soil, completely destroy it for future use, and continue their action elsewhere. Another problem is the unnatural discharging watercourse outside their natural basin. On one hand, this water is used for growing plants intended for the subsistence of the population, on the other hand, the artificial draining of water resources leads to dry of land surface, erosion and other natural disasters, which ultimately leads to far greater losses than gains. Finally, multinational companies focus their production on genetically modified organics (GMOs), which seem to be bigger, better and more colourful. However, is it healthy and correct? When perfect nature walks through diversity and imperfect people make up one crop the same as another. Examples misstatement may be the weakness of some breed species, which are characterized by the vulnerability to all kinds of disease and by the difficulty of further reproduction. In recent years, GMO’s are still debated but yet unresolved topic, with unclear consequences. All these facts are only short-term solutions leading to famine and devastation of the natural landscape. Examples from the world can be; Fire in Indonesia, deforestation in Brazil, and soil erosion in Portugal. That approach is unsustainable, and in the case that this runaway system fundamentally didn’t change, we can expect a rapid increase of the inhospitable deserts worldwide.

The size of these companies and their financial dispositions determine the rules on agricultural markets, and compete with them can only be with difficulty, let alone stop them from their actions. Current practice is as follows; Farmer with great effort grown a certain amount of crops, of course, with the use of pesticides and other chemicals, all in the presence of national and multinational commands and prohibitions. Because the farmer has no other means to handle this crop to sell itself at a competitive price, he is left with no choice then resort to signing long-term contract with one of these companies. These companies in this way gain very easy crop at a very good price without expending greater effort, while get rid direct competitors. Farmer thus becomes not only a "slave" for large organizations, but he is entirely depending on the size and quality of the harvest. In case when barren period happens the only source of income for the farmer are subsidies. Of course, in many cases subsidies are useful tool and the only solution, but only in the short term. What's the point, for example, subsidies for expired rotten goods? These subsidies lead farmers to apathy with the resources they have available. If such a situation occurs, it is usually due to high local competition, which should lead to reduction in farmers produce one crop and to expand production plants other, thus; Farmer should diversify production with the needs of the local market.

Currently, there are organizations that all of the above problems faced, such as Fair Trade, farmer’s markets (economic aspect) or Ethnic botanical institute Sepp Holzer (environmental aspect). Unfortunately, these societies are still far from enough in the fight against the present system of agriculture. If the system has to fundamentally transform, it is necessary to start from the basics, i.e. from future generations of farmers. Therefore, it is necessary to find appropriate resources and tools that will streamline these generations in the right direction and returns the concept of "farmer" correct meaning.

2. Objectives and methodology

2.1 Objectives

The main aim of this Case Study is to construct the plan for another sustainable development of chosen enterprise. Other goals are to evaluate present reality. Analyse the current state of the company and its surrounding area. Determine suitable crops identification for cultivation. Subsequently define the methodology by which the growing will be the most effective

2.2 Methodology

The first part, the theoretical one, through a literature review and using scientific literature sources briefly presents environment of South America. More deeply are described Peru and its region Piura where the enterprise operate. Especially it is investigate geographical, climatic and legislative conditions. The first part also discuss theoretical basement for the operations made in practical part. Mainly it is theory of soils, crops, theory of financial analysis and econometric theory needed for an assembling econometric model.

Practical part focuses on concrete business intention. Begins with land demarcation where the company operates, continuous with description of climatic conditions in the area, company structure, economic perspective and strategy of company. Practical part deals with soils samples as well. The first step is to take a sample of cultivation land. Then it continues with measurement of active and passive pH and measurement of COx. The last is evaluation of results. On the basis of the measurement data in the next step study designate appropriate crops for cultivation under given conditions. It is also carried out a survey of global and regional food market. Based on the findings, it is recommended best provided profitable crops and crop rotations. Outcome of this case study is econometric model which should contain variables which was determined in previous chapters. That should show us how much is a project advantageous or disadvantageous.

3. Literature review

3.1 South America in general

A continent South America lays on the Western Hemisphere, mostly in the Southern Hemisphere, with a relatively small segment in the Northern Hemisphere. It is considered as a subcontinent of the Americas as well, which is the word commonly used in Spanish-speaking nations and in the most of South America.

Pacific Ocean bounds a continent on the west and on the north. East is bordered by the Atlantic Ocean. North America and the Caribbean Sea are situated on the northwest. South America contains twelve sovereign states Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, and Venezuela. Two dependant areas – French Guiana which is controlled by department of France, and the Falkland Islands, a British Territory (though disputed by Argentina). On top of, the ABC islands of the Netherlands and Trinidad and Tobago may also be counted as a part of the continent.[1]

South America spans more than 17,840,000 square kilometres (6,890,000 sq mi). Its population as 2015 has been estimated is more than 415,053,000 people. South America is than the fourth biggest continent (after Asia, Africa, and North America) and it is fifth in population (after Asia, Africa, Europe, and North America).

Unambiguously Brazil is most populous South American country, with more than half of the continent's population, followed by Colombia, Argentina, Venezuela and Peru. Most of the population lives near the west or east coast of the continent. Inland is rarely inhabited mostly by indigenous tribes because there is a tropical forest the same applies for the south of the continent where for a change is expanding desert.[2]

[1] The World Book Encyclopaedia, World Book, Inc. 2006. (p. 407-409)
[2] South America: List of South American countries by Population (2015). *Statistics time* [online]. New York: United Nations.

TABLE 1: LIST OF SOUTH AMERICAN COUNTRIES BY POPULATION, SEX RATIO AND DENSITY

Country/Territory	Population		Rank (Population)		Sex ratio	Rank (Sex ratio)		Density (per sq km)	Rank (Density)	
	2014	2015	World	S. America		World	S. America		World	S. America
Argentina	41,803,125	42,154,914	32	3	95.89	46	2	15.16	204	9
Bolivia (Plurinational State of)	10,847,664	11,024,522	82	8	99.87	119	6	10.04	214	10
Brazil	202,033,670	203,657,210	5	1	96.61	56	3	23.92	186	5
Chile	17,772,871	17,924,062	61	6	97.86	80	5	23.69	187	6
Colombia	48,929,706	49,529,208	28	2	96.63	58	4	43.49	167	2
Ecuador	15,982,551	16,225,691	68	7	99.9	121	7	57.22	150	1
Falkland Islands (Malvinas)	3,052	3,058	230	14	-	-	-	0.25	232	14
French Guiana	255,455	261,729	185	13	99.95	123	8	2.91	228	13
Guyana	803,677	807,611	162	11	103.22	177	13	3.76	221	11
Paraguay	6,917,579	7,032,942	105	9	101.46	153	12	17.29	197	8
Peru	30,769,077	31,161,167	42	5	100.46	140	11	24.25	185	4
Suriname	543,925	548,456	170	12	100.35	135	9	3.35	225	12
Uruguay	3,418,694	3,429,997	136	10	93.57	24	1	19.60	193	7
Venezuela (Bolivarian Republic of)	30,851,343	31,292,702	41	4	100.44	138	10	34.31	173	3

S*ource:* South America: List of South American countries by Population (2015). Statistics time [online]. New York: United Nations.

3.1.1 Geography and biodiversity

South America spreads from the Gulf of Darien in the north all the way to the group of islands Tierra del Fuego in the south. The geography of western South America is dominated by the Andes Mountains. As opposed, east contains both highland regions and large Lowlands where rivers as the Amazon, Orinoco and Paraná flow. South America's physical geography and environment resources also human geography can be thought separately.[3]

[3] Cohen, Saul Bernard. 2003. "North and Middle America" (Ch. 5). Geopolitics of the World System.

South America is divided into three unique zones: **mountains and highlands**, **river basins**, and **coastal plains**. Mountains and coastal plains are generally situated in a north-south while mountains and rivers are particularly located in east-west of the continent. South America's large geographic diverse cause of that the continent has an extreme number of biomes. A biome is a union of fauna and flora that expands over a territory with a kind of constant climatic conditions. Within a several hundred kilometres, South America's coastal plains dry desert biome rises to the rough alpine biome of the Andes Mountains. The Amazon River is qualified by dense and tropical rain forest, while the Paraná River is made up of vast grasslands. With an incomparable number of fauna and flora Latin America's abundant biodiversity is unmatched among the whole world.[4]

Andes, is the longest mountain system worldwide. The range covers about 8,850 kilometres (5,500 miles). On the western border of the continent, Andes extend from the southern lappet to the very north shore of the continent. There are dozens of peaks more than 4,500 meters (15,000 feet) high and most of them are of volcanic origin.

The highest peak in the Andes is Aconcagua. It reaches a height 6,962 meters (22,841 feet) and intersects the Argentina and Chile border. Aconcagua is the tallest mountain except of Mountains in Asia (concretely in Nepal). Except the Andes, on the continents are two main highland areas such as the Brazilian Highlands and the Guiana Highlands.[5]

River Basins

In the continent are three significant rivers: the **Amazon**, **Orinoco**, and **Paraguay/Paraná**.

The **Amazon River** covers a continent surface from nearly 8 million square kilometres (2.7 million square miles). This fact makes it the widest watershed in the world at all. Every second, flows through Amazon River about 209,000 cubic meters of freshwater to

[4] Dunn, Margery G. 1993. "Exploring Your World: The Adventure of Geography". (Ch.7). Washington, D.C.: National Geographic Society.
[5] South America: Physical Geography. National Geographic.org [online]. Washington, D.C: National Geographic Society, 2012

the Atlantic Ocean. The Amazon River is the vein of the equally enormous Amazon rain forest, which creates almost a half of the tropic forest of the whole planet.

This rain forest biome has about 100 different tree species on a single acre, including the rubber tree, silk cotton tree, and Brazil nut tree. Other important plant species include palms, ferns, and rope like vines known as lianas. The diversity of fauna in the rain forest is unmatched from the other continents. The tropical environment is perfect for arboreal or tree-living animals. In the rain forest live about two million species of insects, mainly hundreds of spiders and butterflies can be found here. Primates are plentiful howler monkeys, spider monkeys, and capuchin monkeys along with sloths, snakes, and iguanas have their home there. Hundreds of native birds as brightly coloured macaws, parrots, toucans, and parakeets live there as well.[6]

The **Orinoco** is located northern of the Amazon. The Orinoco is running in for more than 2,736 kilometres (1,700 miles), originating in the Guiana Highlands of northern Brazil and emptying in the Atlantic Ocean in Venezuela. The river spreads over an area above 948,000 square kilometres (366,000 square miles) and flow through roughly 80 percent of Venezuela.

A huge savannah or grassland region, known as the Llanos, is the primary ecosystem of the Orinoco. The Llanos is primarily created of grasses. Swamp grasses, sedges and bunchgrass are built up in wet, low-lying areas. Like most grassland biomes, the Llanos is the perfect environment for many birds, involving the scarlet ibis, bellbird, and umbrella bird. Unique river animals are the piranha, electric eel, and the Orinoco crocodile.

The **Paraná River** spreads about 3 million square kilometres (1,100,000 square miles), which are much of south eastern Bolivia and Brazil, northern Argentina and Paraguay. On the Paraná lay Iguazu Falls, huge waterfalls that extend for 2.7 kilometres (1.8 miles). The Paraná River discharges into the Rio de la Plata estuary between Argentina and Uruguay. Parana naturally builds the border between Argentina, Brazil and Paraguay.

[6] Smith, Nigel J.H.. Amazon Sweet Sea: Land, Life, and Water at the River's Mouth. (p.1–2). University of Texas Press. (2003)

Plains

Coastal plain is the zone of flat and low surface next to a shore. Continent coastal plains are situated on the north eastern coast of Brazil, on the Atlantic Ocean, and the western, Pacific coast of Peru and Chile. The coastal plains of north eastern Brazil are extremely dry. The western coastal plains are also extremely dry. They are trapped between the cold Peru Current to the west and the Andes Mountains to the east. The Peru Current brings cold water to the Pacific coast of Peru and Chile. The Atacama Desert is a segment of the coastal plain that lays in the west. This desert is the driest region worldwide. The average rainfall is about 1 millimetre per year and in some parts of the Atacama never rained in the history. In addition to that on the desert the life of plants and animals is very rare. Even bacteria, fungi and insects are very unique there. [7]

3.1.2 Socio – political development

For the current socio-political situation and its development were important last two decades of the last century and the first decade of the current century. In the last period of the 20th century, there were significant changes not only in the whole capitalist world system, the transformation of the post-war order and full development of globalized capitalism, but along with it has also changed the political and social situation in Latin America and in their individual countries. Since the early eighties, in connection with the given internal, historical conditions, demographic growth and socio-economic conditions, different levels and forms of political development occur there. Clearly, it is possible to say that the eighties and nineties mean the end of the period of military dictatorship, for example in Argentina, Brazil, Chile, Paraguay, Bolivia and Peru. This led to the gradual creation or restoration of pluralistic bourgeois-democratic regimes. This development, though it was limited in time and in different forms, all was characterized by a recovery in domestic political life. Along with that it also brought hope that this will improve social

[7] South America: Physical Geography. National Geographic.org [online]. Washington, D.C: National Geographic Society, 2012

conditions for the broadest popular strata. In this period, practically all Latin American countries except Cuba have adopted neo-liberal ideology as the basis for the construction of the bourgeois-democratic state and economic models. The ruling class under pressure from the World Bank and the International Monetary Fund promote neoliberal path as the only solution to problems that accumulated in individual countries over the years. Government class for their argument appropriately used the disintegration and disappearance of socialist block in Eastern Europe and the Soviet Union. Both phenomena such as pointing out liberalism and the failure of socialism in Europe had a very negative effect on the left wing parties in the region and therefore their activity and influence were strongly attenuated. In the 21st century, most of South America is democratically oriented and as a political system they chose a presidential republic.[8]

3.2 Peru in general

Peru is located in the western part of the continent and according to territory it is the third biggest state in the Latin America. Its area spreads over 1,285,216 km^2, where the percentages of river basins are insignificant. Peru and Ecuador are neighbours to the north, Colombia to the northeast, Brazil to the east, Bolivia and Chile to the southeast, and the Pacific Ocean bordered to the west.

Peru is consisted of 25 regions. In Peru in 2015 lives approximately 32 million people where in the capital, Lima, lives above 33% of the whole Peruvian population. [9] The 55% of the inhabitants occupy the cost, than 32% live in the mountains and 14% in the tropical rain forest. In 2011, an estimated 77% lived in urban areas. Current population growth is at 1.5% annual. It is therefore expected that by 2030 the population of Peru exceeds the number of 35 million.[10]

About 35% inhabitants of Peru live in the in 2015. It is higher number than in Brazil and Chile but less than in other neighbouring states. The average income in purchasing power

[8] DEGREGORI, Ivan a Robin KIRK. The Peru Reader: History, Culture, Politics. 2nd. Durham: Duke University Press Books, 2014. (p.112-129)
[9] South America: List of South American countries by Population. Statistics time [online]. New York: United Nations. 2015
[10] Instituto Nacional de Estadística e Informática: Peru en cifra [online]. Peru: INEI, 2012

parity terms in 2011 was 8,629USD. But the poorness decreased about 30% since 2004, and total poverty dropped by almost one-half, from 18% percent in 2004 to 10% in 2012. In 2012, poverty in rural areas was at 55%, much higher than in the cities where it stood at 20%.

Like in the neighbours in Peru's illiteracy rate is very small, as well as the percentage of school attendance is high. In 2011, just 7% percent of all Peruvians were illiterate. Of children between the age 6 and 11, only 2% not attended primary school, and 93% of all kids in the age between 12 and 16 were signed at secondary education in 2011. But, only 35% of the Peru's population had education at university level in 2011, which is one of the lowest rates between other countries in region. Despite the continuous improvement of health conditions in Peru, there are still a large proportion of inhabitants without access to clean water, medicines and health care. It reflects very badly on the percentage of child mortality, where 21 out of 1,000 live births, unfortunately, do not survive Average life expectancy in Peru is estimated 75 years, and this figure is better only in Chile.

Peru occupies 72th position out of 146 countries on UNDP's Gender Equity Index. Just 57% of women older than 25 years have had secondary school, but the number for men is 76%. Only 30% of women population have a university level education. It is the same situation in government where less than 30% of the working people are women.[11]

Appropriate indicator for the general conditions of living is Development Index (HDI). This indicator summarizes conditions in the country such as education, life expectancy rate and average income. As can be seen in the following table Peru occupies the 80th place worldwide.[12]

[11] United Nations Development Programme (UNDP) (2012). Crisis Prevention and Recovery. Disaster Reduction Unit. Risk Reduction Tools. New York. Retrieved February 2012. (p-102.)
[12] Instituto Nacional de Estadística e Informática: Peru en cifra [online]. Peru: INEI, 2012

TABLE 2: HUMAN DEVELOPMENT INDEX VALUES AND COMPONENTS FOR PERU AND NEIGHBOURING COUNTRIES

COUNTRY	HDI RANK (2011)	HDI VALUE (2011)	LIFE EXPECTANCY (YEARS, 2011)	MEDIAN YEARS OF SCHOOLING (2011)	EXPECTED YEARS OF SCHOOLING (2011)	GROSS NATIONAL INCOME PER CAPITA (CONSTANT 2005 PPP USD)
Bolivia	108	0.663	66.6	9.2	13.7	4,054
Brazil	84	0.718	73.5	7.2	13.8	10,162
Chile	44	0.805	79.1	9.7	14.7	13,329
Colombia	87	0.71	73.7	7.3	13.6	8,315
Ecuador	83	0.72	75.6	7.6	14	7,589
Peru	80	0.725	74	8.7	12.9	8,389
South America (Average)	*81.67*	*0.72*	*73.57*	*8.17*	*13.73*	*8,810*

Source: UNDP. Human Development Report 2011: Sustainability and Equity: A Better Future for All. New York: Palgrave Macmillan, 2011.

3.2.1 Political and economic situation

Peru is according to the Constitution of 1979 republic with a presidential system. In 1992, President Alberto Fujimori dissolved the bicameral Parliament. The new constitution, which was adopted in 1993 by referendum, has introduced a unicameral parliament and strengthened the power of the president. In 2003 we started the process of decentralization.

In the eighties in Peru carried out a terrorist campaign of guerrilla groups movement called the Sendero Luminoso (Shining Path). This revolution killed tens of thousands of people. Extremists wanted to establish a communist regime and dominate the country through terror. They are murdering opponents and intimidate the bombings in the cities. In 1992, he was their leader Abimael Guzman was captured and imprisoned.

Peru is involved in several projects and organizations in the field of Latin American integration. Peru is a member state in the organizations such as Community of Latin American and Caribbean States, Union of South American Nations, the Pacific Alliance, the Latin American Economic System, Latin American Integration Association, Andean Community and MERCOSUR Associated State.

Peru's territory since November 18, 2002 is managed by 25 regional governments. Each regional government manages one department and the constitutional province of Callao. Departments are further divided into provinces, which are composed of districts. In total the whole territory is divided into 195 provinces and 1,838 districts. The capital Lima is not covered by any regional government.[13]

The Peruvian Gross Domestic Product (GDP) in 2010 valued 157 billion of USD. That makes from Peru the seventh largest economy in South America at all. In terms of numbers for 2010, sectors in Peru were divided as **services** cover the biggest part almost 43% of GDP. It was followed by **manufacture** sector with 17.3%, **commercial services** with 17%, than **agricultural sector** almost 10%, mining 6.5% and construction had .% of GDP share. Most of population, namely 44%, was employed in **non-commercial services**, than in agriculture worked 23% of population, **commerce** stands on 18% and lastly manufactured sector had 9%. Since 2006, Peru's economy is growing steadily around 8% per year. The only exception was recorded in 2009 due to the economic crisis, but despite that the local economy was growing about 1%.[14]

Due to the United Nations Office on Drugs and Crime, Peru is among the countries with the lowest suicide rate in Latin America. Peru is also one of three states (along with Colombia and Bolivia), where it is allowed to legally grow coca leaves. Unfortunately, despite the efforts of local authorities due to this fact, the country is still very much tied to the gray economy. Proof of this is the fact that, the government of Peru has decreased the amount of land for coca growing from 120,000 ha in 1989 to less than 60,000 ha in 2005.[15]

Peru’s aims are very similar as the United Nations’ Millennium Development Goals. For example, Peru wants to get better at social level by lowering poorness to 10 percent and extreme poverty to 5 percent. Next goal is improvement of education when Peruvian government wants that 70% of pupils in primary schools have a sufficient reading and mathematics skills. Subsequently, health care focuses to decrease child mortality rates to 15 for every 1,000 newborns. Other goals are to establish universal health centres; and improve availability to clean water. In addition of environmental aims, Peru is looking for

[13] LimaEasy: The Lima Guide. Politics & Political History of Peru [online]. Lima, 2015
[14] The World Bank Group Data: Peru. The World Bank [online]. Washington, D.C.: Fraud & Corruption, 2016
[15] United Nations Office on Drugs and Crime. The Globalization of Crime: A Transnational Organized Crime Threat Assessment. Vienna: United Nations Publication, 2010. (p.81)

to place 75% of its rain forest under public resource management and stop the deforestation in the Amazon in very high level.[16]

3.2.2 Agricultural sector in Peru

Almost 6% of Peruvian area is used for agriculture in 2009 where most of the production came from Andes and Amazon territory. In the other hand, the shore has less favourable areas for agriculture, but better logistic conditions and infrastructure. Land holdings in Peru are broke up in condition of the geography. About 85% of arable lands are in parcels of 10 ha or less, it means that 50% of all agricultural land is owned by small farmers. Agricultural sector in Peru creates 9% of GDP in 2010 and employed 23% of the all citizens. However, the rural population included in agriculture is much wider. The World Bank estimates the share is 50% for 2010. The same sources estimate that 7% of all goods exports came from agriculture. The agricultural sector is continuously increasing in average from 4 to 5% since 2001. For example whole export from agriculture was 2.6 billion USD in foreign exchange earnings in 2009. The most exported crops are in long term conditions potatoes, coffee, asparagus, chillies and fruits as proofs the following table from the year 2010.[17]

[16] Instituto Nacional de Estadística e Informática: Peru en cifra [online]. Peru: INEI, 2012
[17] *Food and Agriculture Organization of the United Nations: Peru - Agricultural Sector* [online]. Rome: United Nations, 2010

TABLE 3: HARVESTED AREA, PRODUCTION AND VALUE FOR KEY CROPS IN PERU, 2010.

CROP	HARVESTED AREA (HA)	PRODUCTION (T)	VALUE (1,000 USD)*
Asparagus	30,896	335,209	238,334
Barley	154,005	216,193	67,517
Cassava	105,408	1,240,120	177,213
Coffee, green	349,633	264,605	474,701
Grapes	15,000	280,468	162,139
Maize (all types)	543,748	1,949,381	751,608
Mangoes, mangosteens, guavas	25,230	454,330	129,802
Plantains	156,114	2,007,280	280,016
Onions (dry)	21,568	724,042	211,710
Potatoes	289,873	3,814,370	836,491
Rice (paddy)	288,659	2,831,370	648,950
Sugar cane	76,983	9,660,900	195,150
Wheat	154,285	219,454	83,853

Source: United Nations Food and Agriculture Organization (FAO). Peru.[Online], Rome: 2010.

Due to the different technologies, infrastructure and access to credit and markets, agriculture in Peru can be divided to four subsectors. There is modern, traditional, internal market production and subsistence agriculture. Table 5 describes the key features of each subsector.

TABLE 4: AGRICULTURAL SUBSECTORS IN PERU

AGRICULTURAL SUBSECTOR	SIZE, LOCATION AND OWNERSHIP	CROPS AND LIVESTOCK	OTHER FEATURES
Modern	Approximately 45,000 ha, primarily on the coast; medium-sized land owners and agroindustries	Asparagus, paprika, citrus fruits, artichokes, mangoes, poultry, pork	Crops mainly for exports; livestock for internal markets; modern technology
Traditional	1.2 million ha across the country; small land owners	Rice, cotton, sugar cane, maize, coffee, potatoes, cattle	Lack of appropriate technology; dependency on middlemen for credit and market access
Internal market production	Mainly in the Andean and Amazon regions	Vegetables, quinoa, kichiwa, tara, camu-camu, pijuayo, palm heart, sacha inchi, medicinal and aromatic plants, guinea pigs	Heavy dependency on governmental support for technology
Subsistence	Only about 400 families, in extreme poverty, on marginal lands of approximately 0.5 ha on average	Various	Income generation depends on other activities and on public support

Source: United Nations Food and Agriculture Organization (FAO). Peru.[Online], 2010.

The development of the agriculture is compared to other countries such as Colombia and Chile on low level. Based on information from the Ministry of Agriculture of Peru, it is caused by high proportion of small farmers whose prevents the exploitation of economies of scale and by the fact they cannot reach the new technologies such as efficient harvesting and irrigation. Even public and private investment to agriculture is particularly low in Peru. Results are that the sector is uncompetitive, and yields and revenues are low.

3.3 Region Piura

Piura is a region situated in north western Peru. Capital is Piura and its largest port cities, Paita and Talara, are ones of the most important in Peru. The area is mainly known for tropical beaches. The Piura Region is bordered to the north by the Tumbes Region and Ecuador, to the east by Cajamarca Region, to the south by the Lambayeque Region, and to the west by the Pacific Ocean. Punta Pariñas lays in Piura and it is the most western point in whole South America.

Because of the geographical territory Piura Region has a lot of climate variations. It is just 4 degrees south of the equator. Also climate in Piura is influenced by two ocean currents at the same time. First one is cold Humboldt Current and the warm one is El Niño Current. This makes the Piura a land that is both tropical and arid at the same time. Piura is called *the land where the tropics meet the desert*.

The shore is split on the south by the Peruvian subtropical desert of Sechura and on the centre and north by savannahs. Particularly around the Piura and Sullana rivers are small valleys of tropical climate as well where rice and coconut fields are very common. Many dry plains span in the region. The Sechura Desert, situated on the south of the Piura River, is the biggest desert in Peru and one of the few examples in the world of a tropical desert. The lowest point in Peru is the Bayóvar Depression, and it is also located in this desert.

The major peak surpasses 3000m.The highest mountains are Nevada Camas (5,200m, 17,059ft), Cerro Negro (3,888m, 12,755ft) and Cerro Viejo (3,846m, 12,617ft). In the other hand the Paso de Porculla, in the southwest of Piura is just 2,138 meters (7,014 feet) high and is the lowest point of the Peruvian Andes. The Chira River is the most important

water supplier in the area and flows into the Pacific Ocean. The Piura River also flows into the Pacific Ocean but during high dry season dry up which cause huge problems for local farmers.

3.3.1 Agricultural sector in Piura

In Piura, agriculture created 12% of their GDP in 2010. Fishing and aquaculture contributed another 3% to GDP. Almost one-third of economic actively population was employed in agricultural sector in the same year. Most of agriculture is situated near the coast. The main crops in Piura include rice, plantains, cotton, mangoes, limes, corn, coffee, bananas and cocoa. Total production was earned about 254 million USD in 2010. The regional municipality face the high poverty rates, the lack of territorial planning and negative impacts from mining activities, insufficient infrastructure, and climate hazards as obstacles to agricultural development. It goals are to increase total production of bananas, mangoes and as well a cotton, cocoa and tamarind which occurs as a very good crops for export.

The Ministry of Agriculture tries to turn Piura into the leading agricultural region on continent's Pacific coast by 2020, taking into account sustainable natural resource management, competitiveness and equity as well as modernization and decentralization. It hopes to boost rural development. Specific strategic goals are: generating 12 million of USD from agriculture, growing the agricultural sector by 7% per year, thus generates 4.5 million USD from export revenues and making 40,000 new jobs just in agriculture and another 20,000 via indirect effects, making accessible investments in amount of 2.37 million USD, and reducing rural poverty by 35%. Main strategic goals focuse on water supply management, market access, agricultural information, financial services and insurance for smaller farmers, agrarian innovation and rural development[18]

[18] Ministry of Agriculture (MINAG). Multiyear Agriculture Sector Strategic Plan 2008-2018. Strategies Offices and Policy, General Office of Agricultural Planning. Lima: 2008.

3.4 Agronomic theory

3.4.1 Soil theory

Pedosphere (from the Greek word pedon = land, earth) is a soil cover of Earth, located on the surface of the lithosphere. It is the skin of the Earth and only develops when there is a dynamic interaction between the atmosphere, biosphere, lithosphere and the hydrosphere. It arises from the substrate, which is stale and sometimes chemically modified parent material and with the interaction of living organisms, climate, topography and time. At various places can be pedosphere different strengths (from a few centimetres (leptosol) to several meters (black earth). Pedosphere is divided into soil types and soil species. Among the soil types include black soil (containing large part humus), brown soils (includes smaller portion of humus), brown forest soils (containing a small part humus), pod soils (contain very small part humus). A distinction is also different soil types, sandy soils (large particles permeable), loam, sandy loam soil, loamy soil (smaller particles, moderately permeable), clay-loam soil, clayey soil, clayey soil (small particles, very little permeable to impermeable).

Soil types are classified according to the following criteria:

Graininess (texture) of the land

It is expressed as proportional representation of the skeleton or fine-ground in the solids. Based on graininess the land soil types are divided.

Soil structure

The ability of the soil to clump together, grouped in clumps (aggregates) of different shapes and size. Bounding ingredients are clay and humus particles.

Soil porosity

It depends on the structure and grain size of the soil. Porosity is the pore volume in the soil and it is important for the access of water and air into the soil

Soil sorption

It is the ability of the soil to bind the various compounds as a colloidal components or the micro-particles that attract nutrients to the surface.

Chemical composition

Affect the chemical properties of rocks, soil reaction is conditioned by the amount contained calcium carbonate, sodium carbonate, carbonic acid and acid humus in the soil. It is expressed by pH.

- pH 7 is neutral ground - occurs in drier areas
- pH <7 is acidic soil - typical of humid areas and polluted areas exhalations
- pH> 7 is alkaline soil

Soil fertility

It is the ability of soil to provide most suitable living conditions for plants during their growth cycle. A distinction is natural fertility and culture fertility.

Soil species

A distinction is based on grain size and proportion of fine ground and skeleton.

Light soil – Sandy soils

Mostly comprises a particles of size 0.1-2 mm, contain large amounts of water and air, but easily dries up. Light soils attract nutrients very little because they are washed out with water.

Medium soil – Loamy soils

Contain particles of 0.01- 0.1 mm. They are well permeable to water and air also they are the most cultivatable, fertile and most suitable for agriculture

Heavy soils – Clay soils

In heavy soils particles smaller than 0.01 mm prevail. They are poorly permeable to water and air. They are extra little aerated, unfertile and usually unused as an agricultural land

Rocky soils - Gravelly soils

Containing more than 20% of the skeleton they are agriculturally underutilized, includes for example forest land in mountain areas.[19]

3.4.2 Fertilisers

Fertilisers are blends that used to improve plant growth. They are usually applied via the soil (for root uptake), or so-called fertilization on the leaf (for receiving leaves). Fertilizers are usually provided in various ratios. Three main biogenic elements are (nitrogen, phosphorus, potassium), secondary biogenic elements (calcium, sulphur, magnesium) and sometimes trace elements which are useful for fertilization: boron, chlorine, manganese, iron, zinc, copper and molybdenum.

Distribution of agricultural fertilizers

By origin

- **Livestock effluent or organic** (manure, compost, manure, dung)
- Industrial or mineral

By composition

- One component (urea)
- Double component (potassium nitrate)
- Triple or full component (NPK)

According to the impact on soil reaction

- Acid (potassium chloride)
- Neutral (ammonium nitrate with limestone)
- Alkaline (calcium cyanimide)

[19] B., Sarapatka. *Pedologie*. 1st. Olomouc: Univerzita Olomouc, 1996. (pg. 232-239).

By physical state

- Solid (manure, compost, superphosphate)
- Liquid (slurry, manure)[20]

3.4.4.1 Organic fertilisers

Nowadays it is a taught to do well in conventional agriculture; it is twice difficult to perform well in sustainable agriculture, which is described by profitable farming while protecting the environment to the maximum extent possible. In fact, transforming from conventional to sustainable agriculture is not easy. Organic agriculture is very challenging and requires deep knowledge of management capabilities. For instance, controlling pests requires deeper knowledge about life cycle of insects, as well as the economic know-how about the crops. Furthermore, utilizing manure to replace a urea as a nitrogen source for the plant it must be take into account the release pattern of organic nitrogen from the manure and the nitrogen demand pattern of a crop, so that two things could be synchronized.[21]

Nitrogen

It must be applied to the soil as either $NH4^{+}$ or $NO3^{-}$ otherwise crops can't soak up and turn it for a grow. That is why urea [(NH2)2CO + 2H2O ==> 2NH4OH + CO2] and ammonium nitrate (NH4NO3) is so used as nitro-fertilizers in today's agriculture. Although in ecological agriculture, it cannot be used urea nor NH4NO3, because they are synthetic chemicals. It is necessary to find other substitutes that do not burden the soil and are completely organic in order to speak of organic cultivation. Following table shows the nitrogen content in natural alternatives.

[20] Benton Jones, Jr. "Inorganic Chemical Fertilizers and Their Properties" in Plant Nutrition and Soil Fertility Manual, Second Edition CRC Press, 2012.
[21] Nick, J. and F. Bradley. Growing fruits and vegetables organically. Rodale Press, Emmaus, PA. 1994.

TABLE 5: NITROGEN CONCENTRATION IN ORGANIC ALTERNATIVES COMPARED WITH UREA

Organic Source	Total N (%)
Poultry manure	1.5-3.0
Pig, horse, cow manure	0.3-0.6
Green manure	1.5-5.0
Compost	0.5-2.0
Seaweed meal	2.0-3.0
Sewage sludge	1.0-5.0
Fish waste	4.0-10.0
Blood (slaughter house)	10.0-12.0
Human urine/night soil	1.0-1.5
Urea	42-46

Source: Caplan, B. 1992. Organic gardening. Headline Book Publ., London, UK.

Thus, based on data from the previous table clearly notices that urea is what concerns nitrogen by about 10 to 100 times greater value. Simple calculation shows you should use huge amounts of manure (or other nitrogen organic sources) comparative to urea to supply soil with nitrogen in the same level. Moreover, unlike urea, which decomposes in the ground quite instantly and supplies a plant quite immediately, compost must go through a stage when it decomposes and gradually releases nitrogen for a crop. It can take up several months, depending mainly on the temperature and humidity of the environment. Obviously, organic fertilizing has many disadvantages but in addition to sustainability there is another great advantage. Indeed, if the company takes this path, which is more expensive and complicated at the beginning. In future years, organically saturated soil begins to create its own nutrients for plant growth. And hence the need for fertilization is

increasingly shrinking. This effect can be seen just on organic farms, where despite a smaller percentage of fertilization, crop yields are increasing continuously.[22]

PHOSPHORUS

Another substance which crops must be supplied in large quantities is phosphorus. This substance is very necessary for genetic information of plants and also essential for its reproduction. If the plant is deficient of phosphorus its roots and leaves do not develop completely. So not only that the crops have low yields, but the overall quality of the crop is considerably lower. Majority crops need from 0.2% to 0.5% phosphorus in the dry matter for normal growth.

In contrast to the humans and animals who accept phosphorus from various food plants take all the phosphorus from its environment and therefore mainly from the soil. Crop roots accept phosphorus just when phosphorus is in the soil solution and in either $H2PO4^-$ or $HPO42^-$. This fact is very important because not only plants accept H2PO4 - and HPO42- but so do soils. So that naturally it leads to the fact that about this compound a big fight, which usually wins the soil. Therefore it is very important to supply the plants with this element if we want to achieve good crop yields and quality. The following table again shows the organic options that can supply phosphorus to plants.[23]

[22] Nick, J. and F. Bradley. Growing fruits and vegetables organically. Rodale Press, Emmaus, PA. 1994
[23] Benton Jones, Jr. "Inorganic Chemical Fertilizers and Their Properties" in Plant Nutrition and Soil Fertility Manual, Second Edition CRC Press, 2012.

TABLE 6: TOTAL PHOSPHORUS CONCENTRATION IN ORGANIC SOURCES

Source	Total P (%)
Rock phosphate	17-26
Bone meal	20-30
Fish meal	5-10
Wood ash	2-5
Poultry manure	0.5-1.5
Green manure	0.2-0.5
Compost	0.2-0.5
Sewage sludge	0.4-2.5

Source: Caplan, B. 1992. Organic gardening. Headline Book Publ., London, UK.

The table 6 shows phosphorus content of sources that are in accordance to organic farming worldwide. Rock phosphate is a source of phosphorus for long-term soil improvement, begins causing in the soil up to several weeks or even months. Its solubility, and thus crop availability, depends strongly on soil pH and particle size. But in the other hand, phosphorus contents of chicken manure, compost, and sludge are relatively low, usually below 3%. So a lot of them would be needed to meet phosphorus requirement of the crop. Still phosphorus from these ecological sources is quite available to plants; usually better than inorganic ways for example superphosphate which is very popular in intense agriculture.[24]

POTASSIUM

For the crop, potassium is needed for right function of cell. Because of potassium plants look tumescent. Potassium is also involved in water uptake from the soil, water retention in the plant tissue, and long distance transport of water in the xylem and of photosynthesis. With adequate content, cell walls are thicker, thereby improving plant resistance to lodging, pests and disease. Crops grown with the right content of this nutrient have a

[24] Benton Jones, Jr. "Inorganic Chemical Fertilizers and Their Properties" in Plant Nutrition and Soil Fertility Manual, Second Edition CRC Press, 2012.

longer durability. Therefore, if the plant is missing potassium is much more susceptible to disease; its fruits are smaller and shrivelled.

Potassium is present in soils such as K+ ion; in this form the roots are able to receive it

TABLE 7: TOTAL POTASSIUM CONCENTRATION IN ORGANIC SOURCES

Source	**Total K, %**
SulPoMag [Mg, K, SO4]	22
Polyhalite [Ca, K, SO4]	10-15
Wood ash	5-10
Green sand	5-7
Green manure	2-5
Seaweed meal	2-3
Compost	0.5-2

Source: Caplan, B. 1992. Organic gardening. Headline Book Publ., London, UK.

The first two sources are natural deposits of potassium minerals. SulPoMag is double salt of magnesium and potassium sulphates. Polyhalite is a double salt of Ca and K sulphates. Polyhalite is very solvent and does not differ a lot from KCl. In terms of plant response, this material is more suitable than KCl or gypsum.[25]

3.5 Financial analysis

There are many variations of how to define financial analysis. However, generally, it is a systematic analysis of collected data, which are contained mainly in accounting statements. Financial analysis is used in the overall assessment of the financial situation company. It helps uncover whether the company is profitable enough, if achieves optimum capital

[25] Nick, J. and F. Bradley. Growing fruits and vegetables organically. Rodale Press, Emmaus, PA. 1994.

structure, how to deal with the assets, whether a payment capable and more facts about the company.

The knowledge gained through financial analysis can lead to certain conclusions about the overall economic and financial situation. Further, they are valuable input for management decisions. It may be a decision for acquisition financing resources, in the provision of commercial loans or the distribution of income, etc. Financial analysis includes assessing the company's history, as well as the present and forecast future developments. Financial analysis is also part of financial management because it serves as a feedback in connection with the company. A typical financial analysis includes two interconnected parts: **fundamental** and **technical** analysis.[26]

3.5.1 Fundamental analysis

Fundamental analysis is based on deep knowledge of various connections between economic phenomena, on the experience of experts and their subjective estimates and on a feeling for the situation and trends. The core of fundamental analysis is the identification of environment where the business is located. The method of analysis is a comparative analysis which works with the particular verbal evaluation. Examples are SWOT analysis, PEST analysis and critical success factors method. Fundamental analysis focuses on the evaluation of qualitative data that is not processed through mathematical apparatus.

SWOT analysis

It is a method that is synthesis results analyses of the external environment and analysis of available resources and capacity of the company to use these resources effectively. The essence consists in identifying the strengths and weaknesses of the company, which compares with the fundamental factors affecting the company. The results of external analysis are used to identify the threats and opportunities of the company. Analysis of internal content is then content of strengths and weaknesses. The individual letters of the name are the abbreviations for the individual areas of inquiry, namely:

[26] TROY, Leo. Almanac of Business & Industrial Financial Ratios. 44. Washington D.C.: CCH Inc., 2014.

S – Strengths

W – Weaknesses

O – Opportunities

T – Threats

As already mentioned, SWOT analysis is a synthesis of many more analysis describing the company's business environment from various angles. It provides the necessary complexity and sophistication of the whole model. In order for this model was functional, all the information on which it is based, must be consistent, complete, relevant, practical, and in particular objective.

Turnaround strategy - as the name suggests, this strategy is chosen when the market has a sufficient amount of opportunities, but the company is not able to take advantage of these opportunities. Aggressive growth-oriented strategy - This strategy is applied in cases when the company has plenty of opportunities in the market and the resources needed. At this stage, the company aims to consolidate its position and gain an even larger customer base. Defensive Strategy - In cases when there are intolerable risks in the market, the company is forced to implement the necessary measures in order to face these risks. With the measures is meant maximum effort to eliminate weaknesses and also to eliminate all external negatives. Diversification strategies - Companies that choose this strategy are making efforts for horizontal extension of scope. This means that the company is trying to eliminate the potential risks of expansion with offers of product or services and primarily to the different indifferent markets.[27]

3.5.2 Technical analysis

It is based on the use of mathematical, mathematical-statistical techniques for data processing and evaluation of results from an economic point of view. According to the purpose for which analysis serves for and according to the data which is used, differentiation is:

[27] JAKUBIKOVA, Dagmar. Strategic marketing: Strategies and trends. Prague: Grada Publishing, 2008.

- Analysis of absolute ratios
- Analysis of differential indicators
- **Analysis of financial ratio indicators (profitability ratios)**
- Analysis of systems indicators

3.5.2.1 Ratio indicators

3.5.1.1 Profitability indicators

Is drawn from the financial statements balance sheet and profit and loss account, for its foundation is considered a ratio of two absolute indicators. Ratios provide a quick picture of the basic financial characteristics of the business.

$$ROA = \frac{EAT}{Total\ assets}$$

Return on assets (ROA) shows the extent to which the enterprise is capable of available assets to generate profit, regardless of the method of financing.

$$ROE = \frac{EAT}{Equity}$$

Evaluation of **return on equity** (ROE) expresses the return on capital invested by shareholders or owners of the company.

$$ROS = \frac{EAT}{Revenues}$$

Return on sales can be described as the core business efficiency. Indicator determines how much USD net profit falls to 1 USD in revenues.

3.5.1.2 Liquidity indicators

Liquidity ratios are an expression of the company's solvency. This means the ability to meet its obligations through liquid assets. The indicators are distinguished by what can be understood as liquid funds. Current assets include items with different durations of merchantability.

$$CR = \frac{Current\ assets}{Current\ liabilities}$$

Indicator of **current ratio** determines how many times current assets cover short-term foreign sources of business. Recommended values are from 1.5 to 2.5.

$$QR = \frac{Cash + Marketable\ securities}{Current\ liabilities}$$

Quick ratio has a similar character as the current ratio, however, is within current assets are excluded inventory item as required to maintain business operations. It can say that has better predictive value regarding the solvency of the firm. Zone of recommended values is the interval 1-1.5.

$$CR = \frac{Cash + Marketable\ securities + receivables}{Current\ liabilities}$$

Cash ratio expresses the immediate ability of the company to fulfil all its short-term obligations. For reimbursement used financial assets – mostly cash in hand and current accounts of the company. Cash ratio should take values in the range from 0.2 to 0.5.

3.5.1.3 Activity indicators

Activity Indicators measure the tying capital in various forms of assets. They are expressed by rate of turnover or turnover time. So it measures how efficiently company uses its assets to generate revenues.

$$Total\ assests\ turnover = \frac{Revenues}{Total\ assets}$$

Turnover of total assets determines the number of cycles for a specific period. Also expresses how much dollars from revenues is accounted for 1 USD in company's assets. Recommended values define the interval from 1.6 to 2.9. If the number of cycles per year is less than 1.5; it is necessary to consider the reduction of contributed assets.

$$Inventory\ turnover = \frac{Inventory}{(Revenues/360)}$$

Inventory turnover indicator defines the number of days after which the stocks are tied up in business before it is consumed or sold. If the indicator is lower than the average in the sector, this is an indication that the company manages inventory better than usual companies in sector.

3.5.1.4 Indicators of indebtedness (Leverage ratios)

$$Debet\ ratio = \frac{Total\ debt}{Total\ assets}$$

Total indebtedness is a key indicator of debt and expresses the ratio of foreign sources to total assets. The recommended value represents the range from 0.3 to 0.7. When evaluating

this indicator, it is necessary to take into account belongings to the sector and the ability to repay interest arising from the debt as well.[28]

3.6 Econometrics theory

Econometrics is a synthesis of economic theory, mathematics and statistics. This synthesis is not a mechanical coupling of the economic analysis with methodical apparatus of mathematics and statistics. However, it comes to transfer, interdependent disciplines that lead to a new quality of economic analysis. Sometimes econometrics means any quantitative economic analysis so into it also includes methods of operational research - linear and nonlinear programming, analysis of inter-industry relations and other scientific disciplines.

- Econometrics is the application of mathematics and statistics in economics.
- Econometrics is part of quantitative economics. Econometrics processes statistical information by using mathematical and statistical apparatus and that it mainly in multi-equation models to further develop their own methods and procedures.

Econometrics is a quantitative analysis of the relationship between economic variables: must be based on the mathematical formulation of the theoretical understanding of these relationships and the specific numerical (statistical) views the economic (and non-economic) variables. That is the core of econometrics.

Theoretical knowledge of economic analysis is qualitative; it doesn't provide quantitative indicators of analyzed variables or specific mathematical expression of their relationships. Therefore, econometrics cannot quantify knowledge of economic theory, but it must first create economic hypotheses. The economic hypothesis is such a reshaping theoretical knowledge which will allow its mathematical and statistical formalizing. Formalized expression of economic assumption leads to the construction of an econometric model.

[28] TROY, Leo. Almanac of Business & Industrial Financial Ratios. 44. Washington D.C.: CCH Inc., 2014.

Mathematical and statistical formulation of economic hypotheses requires to establish simplifying assumptions:

- Establishment of algebraic assumption model shape
- Assumption of economic significance of mathematical operations
- Assumption of a monotone shape functions

Applications of statistical apparatus mainly provide random choice of the specified economic variables, as well as the assumption that the digital display values are an adequate reflection of the studied phenomenon or process.

An econometric model is an instrument of econometrics. It may take the form of one equation, or form the system of equations, from which each hypothesis reflects the relevant parts of the process and the entire system expresses summary hypothesis reproduction process as a whole.

A quantified econometric model must have statistical significance. Results of statistical significance must be theoretically and practically justifiable, which means they must be economically interpretable.

Econometrics deals with the relationship between economic variables. The aim is to quantify, verify and apply economic hypotheses on the basis of specific statistical data, using mathematical and statistical methods.[29]

[29] Hušek, R. Aplikovaná ekonometrie: Teorie a praxe. Prague: Oeconomica, 2009.

4. Practical part

4.1 Project Dio-Latina

This project was founded in 2005 by a group of five entrepreneurs from the Czech Republic who have all previously worked in Latin America, either as entrepreneurs or as a diplomatist. The initial impulse was the possibility of acquiring land with an area of 12,000 hectares in the northern region of Piura in Peru. After acquiring this land was the main goal to obtain water for cultivation. This has been achieved in 2011 after lengthy disputes with the Peruvian legislation. Today, to its purposes the company has both the land and the opportunity to draw from the local river Chira 88 million cubic meters of water.

The company is currently funded from its own resources and thus has no commitments to finance homes or other institutions. Anyway, for further performance and achieve its objective, the company will seek additional strategic partners.

4.1.1 Structure and legislative

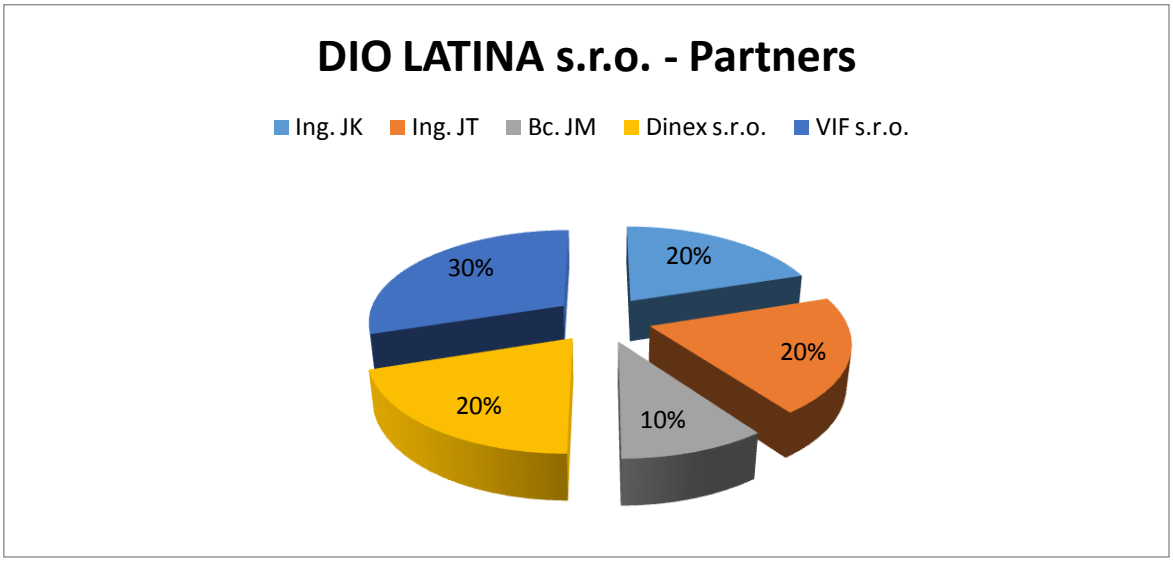
The core business of whole enterprise is Dio Latina s.r.o, CZE; which was founded in Prague and the shares are distributed among three individuals and two legal entities. Its counterpart is Dio Latina S.A. in Peru which is from 80% Dio Latina CZE, 10% has Juliaca Inversiones and 10% owns LAL - Law studio. Dio Latina S.A. jointly founded an agricultural cooperative with Miramar-Vichayal community and established company called AGROPACI S.A. where the share of local farmers account for 20%, and their share are golden. This means that even with unilateral capital increase they still remain 20% of the whole business.

TABLE 8: DIO LATINA S.R.O, CZE.

Dio Latina s.r.o. CZE
Date of Registration: 2.11.2005
Headquarters: PRAHA 5, VOLUTOVÁ 2523, 15800
Legal form: Limited company
Scope of business: Production, trade and services not specified in Annexes 1 to 3 of the Trade Act
Capital: The capital of CZK 200,000, paid 100%

Source: Own computation

GRAPH 1: DIO LATINA S.R.O., CZE



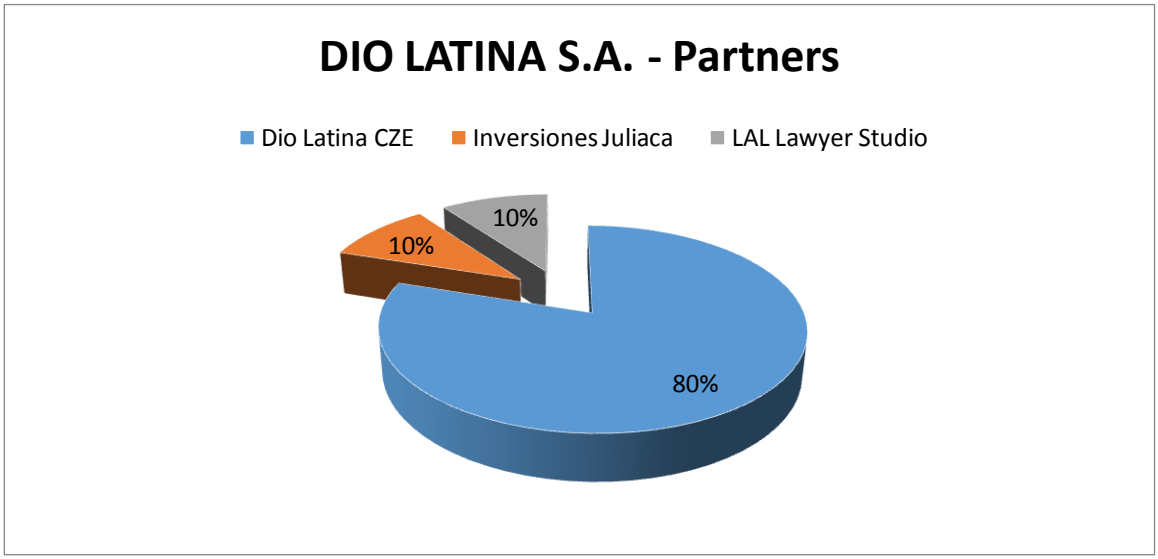
Source: Own computation

TABLE 9: DIO LATINA S.A., PERU

Dio Latina S.A. Peru
Date of Registration: 1.12.2005
Headquarters: LIMA, PJ. PASAJE HERMANOS QUINTERO 256, MIRAFLORÉS, PERÚ
Legal form: Incorporated Company
Scope of business: Agricultural Services

Source: Own computation

GRAPH 2: DIO LATINA S.A. PERU



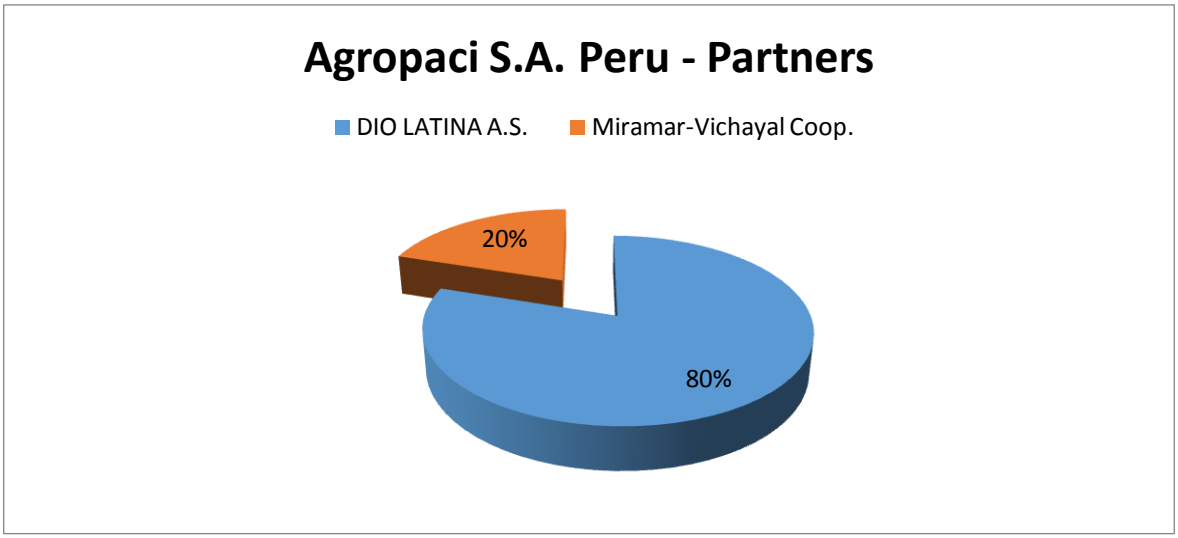
Source: Own computation

TABLE 10: AGROPACI S.A., PERU

Agropaci S.A. Peru
Date of registration: 1.1.2006
Headquarters: AV. CHIRICHIGNO S/N CUADRA 6, PIURA, PERU
Legal form: Incorporated Company, Joint Venture
Scope of business: Agricultural Services
Capital: The capital of USD 400,000, paid 100%

Source: Own computation

GRAPH 3: AGROPACI S.A., PERU



Source: Own computation

4.1.2 Commercial intent

The impuls for the creation of Dio Latina came from Peru, where, in response to the Kyoto Protocol began to think about the use of semi-desert area for growing sugar cane and consequently to produce bio ethanol as a renewable energy source. This location on the northern Peruvian coast is characterized by the fact that there rarely rains and the temperatures fluctuate throughout the year at least. While cane is necessary to irrigate via pipelines to the roots of plants, but it has one advantage that it is possible to regulate the water supply and its consumption is significantly lower. Using all of this knowledge was elaborated business plan for sugar cane cultivation to 8,000 hectares and construction of the distillery to its processing. Investment in the project is around € 150 mil USD after analysis proved exceptional economic returns; it attracted Czech Export Bank and Chemoprojekt, which wanted to become a technology distillery supplier.

As the biggest pitfalls of this project has fallen into negotiations with farmers and a closure of the joint venture. Before it succeeded, after several arbitrations, grew up in this area two more distilleries, based on the same concept and performance. The first year of production was amazing, cane yields and reached unprecedented size. In the second year, however, they began to show losses in revenues to the planted area could not supply the distillery. Yet not completely understood reasons, but one of the reasons the salt, probably due to its long roots that extend into the layers rich in salt that even after many years could not come out. Irrigation counts with 30m3 water per day per 1ha of soil. That's a lot of water that can penetrate up to depths rich in salt, where her roots suck.

This fact logically broke its own distillery and started to think how to use land area of 12,000 hectares, which include joint enterprise.

The goal of this work is to try to answer what other way can use the land, what crops are best suited to submit this issue to a comprehensive business plan.

4.2 Financial analysis

Fundamental analysis

For more complex understanding of the business position and the opportunity to draw the future direction of the company is summarized internal and external analysis using SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats). This identified strengths and weaknesses and confronted with major influences from around the company. Threats and opportunities are the conclusions drawn from the external analysis. Strengths and weaknesses are then derived from internal analysis. The importance of individual items in folders is expressed in ratios. The level of these items is evaluated using ratings on a scale from 1-10, where 1 represents the lowest score and on the contrary 10 is the highest rating.

TABLE 11: SWOT ANALYSIS

STRENGTHS			
		relevance	*ratings*
1	**Large area**	0.07	6
2	**Connections with influential people**	0.18	9
3	**Cooperation with local University**	0.05	4
4	**International connections**	0.18	8
5	**Innovative aspects**	0.1	7
6	**Loyalty of employees**	0.03	5
7	**Indebtedness of company**	0.15	9
8	**Price**	0.07	7
9	**Bio-organic quality**	0.07	8
10	**High demand - Less competitors**	0.1	8
Sum		**7.73**	

WEAKNESSES			
		relevance	*ratings*
1	**Inability to provide consistent quality**	0.06	4
2	**Lack of educated employees**	0.07	5
3	**Undiversified product portfolio**	0.05	7
4	**Elderly owners**	0.05	3
5	**Lack of organization in cooperative community**	0.15	6
6	**Lack of marketing efforts**	0.08	3
7	**Weak trademark**	0.09	4
8	**Lack of capital**	0.17	8
9	**Non-attendance of top management**	0.14	8
10	**Unexploited potential of all available areas**	0.14	6
	Sum	**5.91**	

OPPORTUNITIES			
		relevance	*ratings*
1	**Low costs of capital compare to Europe**	0.15	9
2	**Harvest two times per year**	0.13	8
3	**Free trade agreement with USA**	0.09	5
4	**Simple export to East Asia and America**	0.11	5
5	**New markets. Increase product offering**	0.05	4
6	**New technologies**	0.1	7
7	**Loosening of regulations**	0.05	5
8	**Expansion of Panamericana**	0.07	6
9	**Increasing demand in healthier food products**	0.15	9
10	**Establishing new partnerships**	0.1	9
Sum		**7.21**	

THREATS			
		relevance	*ratings*
1	**Weather and nature conditions**	0.2	7
2	**New regulations**	0.1	4
3	**Competitors intentions**	0.08	3
4	**Low availability to purchase of technologies**	0.06	4
5	**Emergence of substitute products**	0.05	3
6	**Increased trade barriers**	0.09	4
7	**Economic situation**	0.1	7
8	**Political effects**	0.08	6
9	**Currency fluctuations**	0.06	5
10	**Lack of infrastructure**	0.18	7
	Sum	**5.53**	

SWOT - Result			**57%**
Strengths	7.73	**Opportunities**	7.21
Weaknesses	5.91	**Threats**	5.53
Total internal	**1.31**	**Total external**	**1.30**

Source: Own computation

Based on the above analysis, it is possible to outline a possible strategy for further development of the company. SWOT is one of the analyses, which determines the optimal structure of the product, but also corresponds to the question of whether the company should start working in a different location, or market, to undertake new activities or terminate an existing activity. The analysis showed that the company has more strengths than the weaknesses, as well as opportunities more than threats. This shows more details thanks to a good ratio of positive to negative forces, which is 57: 43. That makes to this company a vision with very promising future and increases the probability of higher loan, therefore the realization of planned expansion, establishment of agricultural land. Based on the SWOT analysis, therefore the company should choose an aggressive growth strategy.

From the analysis, it is clear that the company is affected rather from internal environment. The difference is minimal; therefore, to a large extent the eventual success of the project depends on external conditions. As the biggest strength of the company are considered good connections at the national level (in Peru) and as well at the international level. Connections at the national level are especially useful when dealing with the local government and authorities, thus ensure greater awareness, an example may be easier to provide various permits and certificates. Connection at international level, in particular to ensure outlets, and easily export information on foreign markets. Strength of the company is relatively good ability to obtain financial capital from foreign investors. Here it is worth mentioning association with low cost of capital in Peru compared to Europe (Opportunities). The economic situation in Peru has resulted that these costs are up to three times lower than in European countries environments.

TABLE 12: COMPARISON OF COSTS IN PERU AND CZECH REP.

Cost of living	Peru price	Czech price	Ratio
Meal, Inexpensive Restaurant	71 CZK	120 CZK	1,69
Water (0.33 liter bottle)	10 CZK	22 CZK	2,20
Local Cheese	104 CZK	182 CZK	1,75
Banana (1kg)	16 CZK	31 CZK	1,94
Pack of cigarettes	38 CZK	90 CZK	2,37
Transport monthly Pass (Regular Price)	213 CZK	550 CZK	2,58
Volkswagen Golf 1.4	156 000 CZK	400 000 CZK	2,56
Basic (Electricity, Heating, Water, Garbage)	947 CZK	3 934 CZK	4,15
Rent per month apartment in City Centre	4 972 CZK	13 812 CZK	2,78
Price per Square Meter to Buy Apartment in City Centre	14 206 CZK	78 363 CZK	5,52
Average Monthly Disposable Salary (Net After Tax)	7 250 CZK	24 251 CZK	3,34

Source: NUMBEO: Cost of Living. NUMBEO.com.[online]. Serbia, 2016

Given the low cost and potentially high revenues from sales in Europe, Asia, and North America, this project is very interesting for foreign investors.

The company has also extensive grounds. Primarily, plan is stocking crops on a large area yet there is great potential for further use. Other income may be to lease land to local farmers, with it could be possible to conclude long-term cooperation. Another opportunity could be a construction of solar panels for its own use or for resale electric energy and establishment of a holiday resort for tourists. The ideal solution would be to linking tourism with agriculture in the form of ecotourism, where the visitors had the opportunity to visit agricultural areas. On these areas would have the option to purchase the crop then or learn, in which way the DIO-Latina cultivates the land. There is a large amount of possibility with further business activities. These options, however, are far more long term and it would depend primarily on the future needs and opportunities of the region.

An important factor in the potential success of the business is cooperation, not only with the local university, but also with the CULS in Prague. This collaboration with universities

provides professional workforce supply, which is still today, unfortunately, problem therefore weaknesses. In case of putting new employees into the company, there is a challenge to maintain current employee loyalty, which can currently be assessed as relatively high. Another advantage of cooperation with universities is the know-how that enables the analysis of soil, effective crop growing with bio-organic quality, as well as water management, and last but not least another method of processing agricultural crops.

Regarding Opportunities, as already mentioned, a great advantage is the very low level of costs as compared with Europe. This phenomenon is supported by the fact that within the equatorial Peru so there is no major changes in the seasons and so it is possible to plant and harvest crops twice a year. Due to the probable development of new technologies to guaranteeing the efficiency of agricultural production while increasing demand for healthier food products may lead to an even greater gap between costs and revenues, which ultimately can lead to higher profits.

Thanks to the free trade agreements between Peru and the United States, and also between the Czech Republic and Peru, there is a fairly easy export at low cost from Peru to these countries. Thanks to good connections, it should be no problem to trade with these companies and countries and use the full benefit of trade agreements. Vital importance is also planning expansion of Panamericana highway leading across South America. Grocery crops could then be extended to northern South America as well as in southern parts of America, or it would be possible to move goods for export to North America if the final cost price of exports was lower than in the case of direct transport from the Peruvian ports.

Another opportunity may be the emergence of new markets and new demand for agricultural products. As an example transformation of the company may be mentioned McDonalds, which wants to focus on preparing healthy meals. This of course will significantly increase the demand for bio-organic products on which the company focuses DIO-Latina. With new markets and demand is irreconcilably linked with establishment of new partnerships. Partnerships can provide more yet undiscovered opportunities for the development of society.

Finally, as regards Opportunities, mention should be made possible loosening of the Regulations only nationally, but also at international level. For example, in case of closure free trade agreements with other countries, the company would like to focus on trade with those countries. Not only loosening of the Regulations but also introduce a new subsidy program seems interesting to use. In the event that subsidies options appear that are consistent with the company's vision, the company is certainly involved in these subsidy programs, which would significantly facilitate business.

The company DIO-Latina naturally wants to continue to strengthen their strengths, and take full advantage of Opportunities, which do not present themselves. Unfortunately, the same as for other businesses also DIO-Latina has weaknesses and is vulnerable to potential threats. If the company is to be successful, it is necessary to eliminate these weaknesses and try to prevent potential threats to the fullest extent.

As the current biggest weaknesses seems to be the lack of equity capital, especially financial capital and the lack of technical facilities, human capital is currently sufficient. Land is only capital to reach a satisfactory level, at least in terms of size. Soil quality is then very varied, depending on the territory in which it is located. Regarding financial capital, as an optimum solution emerges to find a sufficiently strong investor possibly a larger number of investors who would be able to financially provide for planned development. DIO-Latina wants to ensure development of human capital primarily with influx of students from both local universities and from CULS. Students from Universidad de Piura should primarily ensure that knowledge of local weather conditions, local produce and regional needs. Contrary students from CULS, should bring experience from other regions of the world, which would be implemented to the local conditions and thus support the running of the farm with new ideas for improvements. Ideally, company would then, in collaboration with universities wanted to educate their own students, who would be from the beginning or during the study prepared for future job just for the DIO-Latina, and using both theoretical background and practical study on land the company owns. Necessary technical support would be provided through outsourcing in cooperation with the relevant professional organizations. Since adequate technical background will probably not be assured by local companies it will be required to establish new business partnerships across the world. An example might be a possible cooperation with Israeli companies, which have achieved excellent results in the field of water management. Since in Peru there are fairly

strict rules regarding the management of water and irrigation, help from these companies will be almost necessary.

Technical analysis

The next chapter will be carried out technical financial analysis company. There will be evaluated mainly financial ratio indicators such as profitability, activity, liquidity and indicators of indebtedness. This analysis should consider the financial situation of the company and should serve to further decisions which relate to financial capital. For the calculations serve the accounting data provided by the company, under the condition of numbers substitution, but maintaining good relations between items. Accounting data are shown in the following tables.

TABLE 13: COMPANY PROFIT

2014/2015	**USD**
Sales / Revenue	318,750
Cost of Sales	177,083
Gross profit	141,667
Operating Expenses	24,325
Operating Profit	117,342
Interest Expense	0
Profit for year Before Tax	117,342
Tax	17,601
Profit for year After Tax	99,741

Source: Own computation

TABLE 14: COMPANY BALANCE SHEET (ADJUSTED)

BALANCE SHEET	2015	2015			2015	2015
31st December						
ASSETS	USD	USD		**EQUITY AND LIABILITIES**	USD	USD
Non Current Assets		**944,850**		**Equity**		
				Ordinary share capital	891,875	
Current Assets				Retained earnings	50,000	
Inventory	165,250			**Total Equity**		**941,875**
Receivables	59,890					
Bank	92,260			**Current Liabilities**		
Total current Assets		**317,400**		Payables	135,375	
				Accruals	155,000	
				Total Current Liabilities		**290,375**
Total Assets		**1,262,250**		**Total Equity and Liabilities**		**1,262,250**

Source: Own computation

4.2.1 Profitability indicators

Return on Assets

$$ROA = \frac{99{,}741}{1{,}262{,}250} = 0.08 = 8\%$$

This result shows that 8% of the net profit is generated from total assets. In this particular case, it demonstrates a low percentage of utilization of the available land and thus to other years, the company should focus on expanding production and increasing profits from selling crops.

Return on Equity

$$ROE = \frac{99{,}741}{891{,}875} = 0{,}11 = 11\%$$

The company is mostly funded from equity and, therefore, the result of 11% from share of net profit and equity could be a satisfactory number for the owners of the company. Their capital is growing steadily and as a large part of the partners do not distribute profits between them the company can continue to invest and expand in next year

Return of Sales

$$ROS = \frac{117{,}342}{318{,}750} = 0{,}37 = 37\%$$

It shows that company is efficient in a field of sales. It can be caused by growing of *quinoa* which is a very profitable crop nowadays and it's add value especially after delivering to the Europe is very high because of huge demand for the healthy food.

4.2.2 Liquidity indicators

Current ratio

$$CR = \frac{317{,}400}{290{,}375} = 1.09 = 109\%$$

Current ratio says that if the company has to pay all their liabilities immediately they will still have a small amount of money for funding. It is a good mainly for their suppliers and other creditors.

Quick ratio

$$QR = \frac{92260 + 0}{290{,}375} = 0.31 = 31\%$$

This indicator is a bit underestimated because company does not own any marketable securities and then the liabilities are covered in this case just by cash in the bank. But still if the company has to pay all their liabilities they can cover them from 31% by cash which is not a still sufficient enough.

Cash ratio

$$CR = \frac{92{,}260 + 0 + 59{,}890}{290{,}375} = 0.52 = 52\%$$

Cash ratio is opposed to the quick ratio is relatively at recommended levels, so despite the fact that the company has no marketable securities its receivables are sufficient to cover the company's liabilities from 52%

4.2.3 Activity indicators

Total assets turnover

$$Total\ assets\ turnover = \frac{318{,}750}{1{,}262{,}250} = 0.25 = 25\%$$

Total assets turnover reflects the real situation of the company where the principal asset of land is fitted from a very small part. And therefore, out of every dollar so far only returns 25 cents.

Inventory turnover

$$Inventory\ turnover = \frac{162{,}250}{(\frac{318{,}750}{360})} = \ 187\ days$$

Even if almost half a year might seem like a long time for the inventory turnover, due to the nature of the transactions carried out by the company, this number is not alarming. Crops must make the journey from South America to Europe, so it makes no sense to send small amounts of crops and thus storage of bigger quantities is the only option. Furthermore, the company begins to trade with crops that in Europe does not have such a tradition yet. Hence, the company sold much more after smaller quantities (to five tons), because they do not have a basement of wholesale customers so far.

4.2.4 Leverage ratios

Total debt ratio

$$Total\ Debt\ ratio = \frac{290{,}375}{1{,}262{,}250} = 0.23 = 23\%$$

This indicator exhibits a low rate of coverage of corporate assets by foreign sources. Thus, for creditors, namely the bank or investors, the company has a high degree of credibility. This situation should assist the company to acquire new foreign capital needed for further investments.

Capitalization ratio

$$CR = \frac{290{,}375}{941{,}875} = 0.30 = 30\%$$

Since the company has no long-term commitments, this indicator shows that the company is unencumbered by foreign capital.

4.2.5 Summary of technical analysis

The calculations indicate that the financial situation is very complicated. Some indicators show very auspicious values for the company and others do not.

The profitability indicators showed a situation where although the company has high-value assets, these assets are not able to generate big profits yet. Indicator return on assets and return on equity are not negative, but these returns about ten percent are not sustainable for future. On the other hand, it shows great potential for upcoming years, on condition that the company begins to use its assets more efficiently. Even in fact that the company does not import large quantities of food and thus shipping costs are still high, excellent value reaches the indicator return on sales, which is around 40%.

Liquidity indicators are again up and down. The current ratio extends a very good spread between current assets and current liabilities where assets fully cover the deficit and still 9% left. The quick ratio because of lack of any marketable securities equals 31% which is not sufficient enough. Cash ratio is again adjusted by lack of marketable securities but because of company receivables the value of this ratio equals 52% so it could be said that when the company would like to pay all their receivables by very liquidity sources it would fulfill only half.

Another group of ratios was activity indicators. The first ratio total assets turnover was 25% and again it shows the situation when the company use their assets very inefficiently. Mainly the grounds must be used by more than now. One dollar put into the assets generates only 25 cents now. As it was mentioned inventory turnover indicates that inventories are stored for a time of 187 days. If we take into account the transportation time and a small customer base of atypical crops, this situation is due to the nature of trade, which the company performs in perfect order. The only disadvantage to this is the fact that the company has to pay long-term storage, which outsources and thus incur costs.

Therefore it is worth considering building its own warehouse in the future and thus preventing this storage costs.

The very last part of financial analysis was leverage ratios. As expected, these indicators suggest very good value thanks to no long-term commitments that the company has. At first it was counted the total debt ratio. The number 23% proves that company assets are financed by own sources and just from a very little part by short-term commitments. Also a capitalization ratio which is 30% expose that the equity covers all liabilities very reliably and then company has more space for investment even from own resources.

4.3 Soil research

The most important part of the research is the soil research. Because of not so favourable conditions in that area it must be well known the structure of the soil which is so important for growing crop. The basis for the subsequent soil research is the 10 samples that were taken in October 2016 at selected areas on the land owned by the company Dio-Latina. Areas were chosen on the requirements: water availability, logistic availability, low risk of earthquakes and low risk of floods affected by El Niño. Samples were taken based on the methodology provided by CULS, specifically the Department of Soil Science and supervised by Ing.Javier Javier PhD. from the Universidad de Piura. At first were dug a hole with a depth of 1m. Then from a depth of 20 cm, 40 cm and 60 cm were taken samples of weight 1kg each. Samples was taken from one depth or mixed together. Those samples were via Czech embassy in Lima transported to the Czech Republic and subjected to the following analysis.

4.3.1 Measurement of active pH

Principle

This reaction is subject to the concentration of free hydrogen ions and their ratio to OH^- ions in the soil solution. It is hydrolytically generated carbonic acid, water soluble organic

acids and acid salts. It is determined by potentiometric measurement of pH in aqueous suspension of soil or in a soil extract in distilled H2O. Current soil acidity has a direct impact on the chemical and biochemical processes in the soil and on nutrition and development of plants and soil microorganisms. Active soil reaction expressed as the pH in H2O (pH / H2O).

Working procedure

The leached soil is mixeed with distilled water in the ratio 1: 2.5. On the technical weights 10 g of fine-earth (1 or 2 mm) is weigh. Then fine-earth is incorporated into a 100 ml beaker. Using a pipette add 15ml of boiled distilled water (cooled), cover with a watch glass, swirl stir well and let stand overnight. The day after, substance is swirled and then it is measured the pH in the suspension using a glass and calomel electrodes as a suitable pH meter.

Results of active pH

Measurement of active pH was done in triplicate under the supervision of Dr. Martin Kočárek from the Pedology Department, CULS. Results were summed using the arithmetic mean, from which went the final result then. The following table graphically shows the results. The sample is named by a local farmer, who is responsible for the field, and that field cultivates or according to the place where the field is located. Samples the first and second valley were selected based on criteria such as water availability, low risk of an El Nino and apparently low salinity.

TABLE 15: RESULTS OF ACTIVE pH

DESIGNATION OF SAMPLE AND DEPTH	LOCATION	FINAL RESULT ARITHMETICAL AVARAGE pH
Abarca 20cm	-4.879822S, -81.078947W	8.25
Abarca 40cm	-4.879822S, -81.078947W	8.28
Abarca 60cm	-4.879822S, -81.078947W	8.38
First Valley 20cm	-4.858908S, -81.067914W	8.23
First Valley 40-60cm	-4.858908S, -81.067914W	8.46
Maxmilliano 20-60cm	-4.857253S, -81.075799W	8.10
Vichayal 20-60cm	-4.879808S, -81.079095W	8.28
Second Valley 40cm	-4.851071S, -81.071945W	8.31
Miramar 40cm	-4.858544S, -81.107746W	9.08
Miramar 2 40cm	-4.858778S, -81.110225W	8.73

Source: Own computation

All measured values exceed the value of active pH 8. This clearly indicates that the soil result is alkaline. Alkalinity is caused from the fact that northward region of Piura, where the field is located, is arisen bottom of the ocean. So we can find a large percentage of salt that persists in the soil. Furthermore, the alkalinity caused by land locations that are close to the ocean and thus precipitated water fall and accumulates in the field. Strongly alkaline soils are not favourable for the cultivation and thus further analysis of passive pH should establish an appropriate methodology for the next procedure of acidification of soils.

4.3.2 Measurements of passive pH

Principle of passive pH

Exchangeable pH is an important parameter characterizing the acidity of the soil (and the influence of acid rain).

Working procedure

To a 150 ml beaker is weighed 20 g (of fine ground), 50 ml of one molar KCl and sonicated on multrasound bath for 2 hours. Load the agitator and lead system calomel electrode set to phosphate buffer. After 2 minutes of stirring the pH is recorded. If the measurement of pH less than 6.5 Titrate the suspension with stirring volumetric 0.12 molar NaOH in 1 ml increments.

TABLE 16: RESULTS OF PASSIVE pH

DESIGNATION OF SAMPLE AND DEPTH	LOCATION	FINAL RESULT pH
Abarca 20cm	-4.879822S, -81.078947W	6.25
Abarca 40cm	-4.879822S, -81.078947W	6.37
Abarca 60cm	-4.879822S, -81.078947W	6.38
First Valley 20cm	-4.858908S, -81.067914W	6.21
First Valley 40-60cm	-4.858908S, -81.067914W	6.46
Maxmilliano 20-60cm	-4.857253S, -81.075799W	6.05
Vichayal 20-60cm	-4.879808S, -81.079095W	6.15
Second Valley 40cm	-4.851071S, -81.071945W	6.23
Miramar 40cm	-4.858544S, -81.107746W	7.00
Miramar 2 40cm	-4.858778S, -81.110225W	6.56

Source: Own computation

4.3.3 Measurment of Cox

Principle

Determination of organic substances is based on the total oxidation mixture of the oxidation mixture of sulphuric acid and chromic acid. The organic component of soil is extremely important for the production of crops. Its content should be at least 2.5%. In the naturally balanced soil organic matter content correlates with humus. The organic component of soil significantly influences the results and determination of individual organic components.

Working procedure

The amount of 0.2 g of fine ground is weighed into a 100 ml titration flask. From the burette or automatic pipette add exactly 10 ml oxidizing agens. Mix the contents so that the soil is not fixed to the walls. Simultaneously in 3 flasks metered titration of 10 ml of the oxidizing agens. The flasks were covered with a watch glass and simultaneously placed in an oven at 125°C for 45 minutes. After removal from the oven, the flask was allowed to cool for 10 minutes. Furthermore, the content titrate ferrous sulphate solution to ferroin. The resulting colour is reddish brown, must be pre-tested. It is necessary to acidify a sample. The exact concentration of titrant is determined by titration of 20 ml of dichromate solution acidified with 2.5 ml of concentrated H2SO4 volumetric reagent.

Results of passive pH

Results passive pH shows a strong correlation with ph active. The advantage of this measurement is that it can provide the necessary need for liming.

TABLE17: RESULTS OF COx CONTENT

DESIGNATION OF SAMPLE AND DEPTH	LOCATION	FINAL RESULT CONTENT OF COx
Abarca 20cm	-4.879822S, -81.078947W	1.14
Abarca 40cm	-4.879822S, -81.078947W	1.09
Abarca 60cm	-4.879822S, -81.078947W	1.07
First Valley 20cm	-4.858908S, -81.067914W	0.64
First Valley 40-60cm	-4.858908S, -81.067914W	0.63
Maxmilliano 20-60cm	-4.857253S, -81.075799W	1.02
Vichayal 20-60cm	-4.879808S, -81.079095W	0.64
Second Valley 40cm	-4.851071S, -81.071945W	0.61
Miramar 40cm	-4.858544S, -81.107746W	0.42
Miramar 2 40cm	-4.858778S, -81.110225W	0.59

Source: Own computation

Results of COx measurements

From the measurement of the proportion of carbon in the soil is clear that the soil, which in the past has cultivated exhibit much higher carbon content and thus the organic substances. On the contrary soils on which never grew contain very negligible carbon content and therefore almost no content of organic substances. It follows that these soils be necessary to add organic substances artificially in the form of (organic) fertilizers.

4.4 Selected crops

Based on the previous analysis there was selected a two crops which should be suited for another growing in location. At first it was chosen sweet potato as a suitable crop mainly because their good yields in the area yet and as well because company has a contract with a BRAMCO a.s. which is a company operates in Czech Republic and it is a second larges

agribusiness in the country. BRAMCO a.s. could sell (by their opinion) 1.5t of sweet potatoes per day and that amount could be supplied by company Dio Latina. Another advantage is that potatoes are not so demanding on soils and then the costs for a adjusting a soil are not so expensive. Second selected crop is quinua. This traditional South American plant is very trendy in Europe due to its very good nutritional values as well it is gluten free and contains huge amount of vitamins, saturated fatty acids and proteins. Again, quinoa is not demanding on soil conditions and furthermore quinua was grown in company's fields last year so the know-how of process and methodology of growing is already known.

4.4.1 Sweet potato production

Classification

Sweet potato, known also as batata (Spanish), is widely cultivated as perennial tropical and subtropical agro-ecologies. Sweet potato belongs to family of Convolvulaceae and is originated in tropical Central America. Mostly only the underground part of the plant is commercially used. The most common type distributed in Northern America and Europe is the red-skinned type with moist, dark-orange flesh, while the dry-fleshed types are traded the most into both Caribbean and Asia. Sweet potato is cultivated in more than 100 countries, mostly throughout tropical and subtropical Asia. Despite its tropical nature, sweet potato can be cultivated widely in different environments.

Plant description

Though sweet potato is a perennial, commercially it is grown as annual. Roots form large, fleshy bodies, which are classified as storage roots rather than tubers. These are the only edible part of the plant and vary not only in flesh and skin, but also in size and shape. When cultivated as an annual, sweet potato grows trailing stems up to 4 meters long, which send roots at the nodes. Leaves are generally heart or halberd-shaped, as common in the morning glory family. Flowers have purple throats and white rims. Blooms are extremely rare, making it very hard to produce new cultivars, as sweet potato reproduce almost solely vegetative.

Cultivars

TABLE 18: CULTIVARS OF SWEET POTATOES

Skin	Flesh	Shape	Examples	Features
orange/ copper	orange	long, cylindrical/ elliptic	Beauregard, Hernandez, Beerwah Gold	high beta-carotene, quick growth
white/ cream	white/ cream	long, curved	Hawaii, Kestel. Blesbok	high yield, good storage life
red/ purple	cream/ white	oval	Northern Star, Red Abundance, Rojo Blanco	attractive/tasty, long growth

Source: Own computation

Cultivation

Propagation

Sweet potatoes are propagated either from sprouts or slips, while sprouts are preferred. Plant stock to produce sprouts is carefully selected. About 75kg of the stock is needed for planting one hectare. Approximately 30 to 40 cm long cuttings with about eight nodes are collected either from nursery bed or the last planting. The crops used for cuttings should be old enough to provide suitable material, while back cuts with various maturities will result in yield reduction. The lowers leaves should be removed. Cuttings can be placed under moist cloth in a shade before planting. Cuttings can be also produced in a seedbed from collected roots. This method requires less material, but is not as reliable. Cuttings are then planted into heaps at approximately 45° angle to ensure good root development. Manual planting is widely practiced using 1 to 2 man-o-days of labour per hectare production. When roots are sufficiently preconditioned, sprouts are produced in cold frames, heated beds or directly in beds of sand or sandy soils, by covering them with thicker level of soil sand. Adequate moisture and temperature about 25°C is critical to germination of the

sprouts and proper root formation. Sprouts are set out into field as they develop 6 to 10 leaves and strong root system. Good water management is critical to avoid transplant shock. An alternative way of cultivating sweet potatoes can be applied, making storage roots themselves sprout under certain temperature and moisture conditions. This mean of propagation is however unreliable and requires large amount of sprouting material, that moreover could have been used commercially.

Field preparation

Sweet potato is growth on raised beds or mounds to provide friable environment, so the storage roots can reach their maximal potential size. It also allows easy harvesting. Beds are about 30 cm high and 40 cm wide at the base (the same for mound diameter), 1 to 2 meters apart. The basic fertilization should also be applied in the preparation phase to ensure needed nutrient concentrations. The acidity should be also adjusted to ideal value of pH 6. If the soil is too acidic, lime or dolomite should be applied. On the contrary, if the soil is too alkaline, it should be acidified either by organic substances as compost, moss or forest soil or by inorganic solutions as elemental sulphur, ammonium sulphate or other inorganic acidic salts. For longer lasting and more stable reduction of pH, cottonseed meal is often used; however the pesticide treatment and also the genetic engineering properties (production of bacterial toxin) are making it insufficient for fertilizing crops used for consumption. Considering these possible complications, soybean meal appears as a better alternative.

Planting

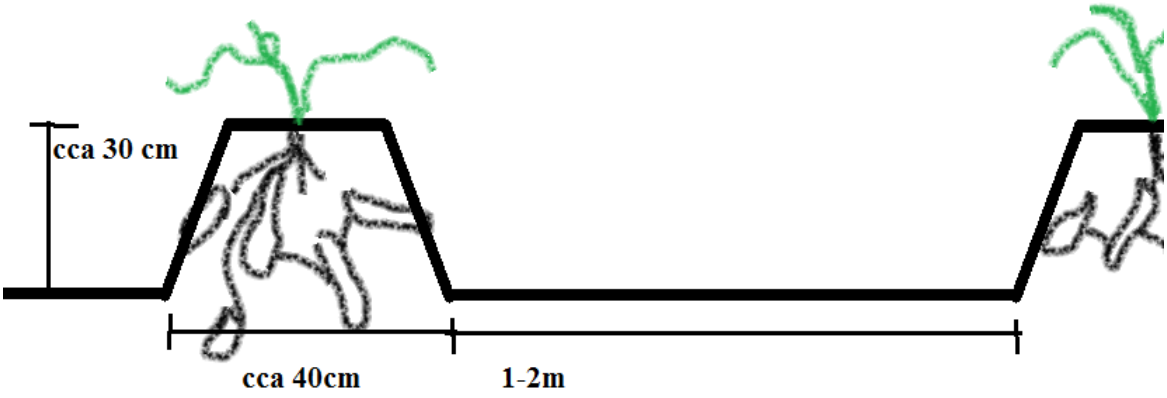
In equatorial Peru, the temperatures throughout the year are very stable. This would theoretically allow two planting period in a year. However slightly higher summer temperatures adversely affect the storage root development. Sweet potatoes in subtropical conditions need 4 to 5 months to acquire the best yield. Full grown storage roots have to be harvested as late as El Niño meteorological effect starts in early summer (usually November to December), for heavy rains may damage the harvest or even the field as whole, when untreated. Facing these conditions, it would be very problematic to fit two planting periods in one year on one field. Moreover, this regime would heavily encumber

the soil; therefore it appears better two plants in two periods, but on separate fields, if possible.

Sweet potatoes can also be damaged by light frost, whisch is not the case of equatorian lowlands at all.

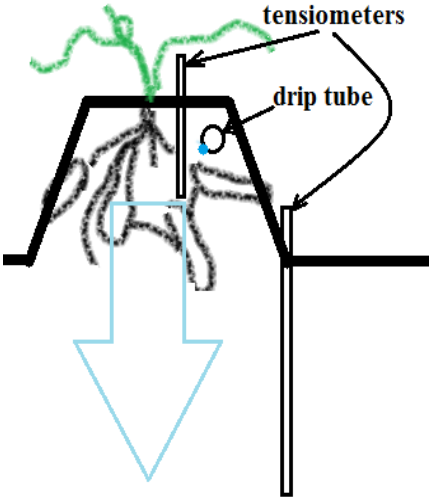
Number of 30,000 to 60,000 of cuttings is needed to plant 1 ha. Rows are recomended to be 1 to 1,25 meters apart depending on required planting density and specifications of used technology. In-row spacing should be set at least 25cm. Sweet potatoes are grown either in piled up beds or mounds, which are more traditional, but less sufficien for machinal treatment and harvest.

FIGURE 1: SWEET POTATOES PLANTING SCHEMATIC



Source: Own computation

FIGURE 2: IRRIGATION OF SWEET POTATOES



Source: Own computation

Fertilization

Fertilization values are related to crop removal figures.

TABLE 19: OPTIMAL VALUES FERTILIZATION FOR SWEET POTATOES

Element	Removal (kg/ha)
N	100
P	90
K	200
Ca	200

Source: Own computation

All the phosporus, 50 kg of N and 50 kg of K can be applied before or at the beggining of planting. Remainig N and K is applied in two side-dressings approximately 5 and 11 weeks from planting. As the Piuran sandy soils are mostly basal, calcium should not be applied in

the form of lime, but as gypsum, that rather lowers the soil pH. Spray should also include zinc,copper,manganese, iron and boron. Sulfur in SO_4^{2-} form may be applied to adjust the soil acidity. Analyzing the ptiole sap can provide information about nutritients levels even in single growth phases, which may help mintain the proper levels of those.

TABLE 20: OPTIMAL FERTILIZATION FOR SWEET POTATOES (CONSIDERING THE PERIOD)

Nutritient (ppm)	Early	Mid	Late
	until 10^{th} week	$10^{th} – 15^{th}$ week	from 15^{th} week
N	2,000-3000	1,000-2,000	500-1,000
P	100-200	100-200	100-200
K	3000-4,500	3000-4,500	2,500-4,000
Ca	300-700	300-700	300-700
Mg	300-700	300-700	300-700

Source: Own computation

Rates of side-dressing should be calculated on actual planted area. When using technical, drip or sprinkler irrigation, the fertiliser can be injected in the system. Using solid form or natural fertilisers in dry, hot areas, where common irrigation is unsuitable or even prohibited, would be very problematic.

Irrigation

Sweet potato is well affected by increased irrigation, however it can withstand very dry conditions, as it is deep rooted plant. On the other hand, excessive moisture can retard storage root development, in late seaons it may even make the storage roots crack and/or rott. Actually the sweet potato acquires the best yields with evaporespiration rates round zero. Certain rates of irrigation may vary depending on soil type and climatic conditions.

TABLE 21: OPTIMAL IRRIGATION FOR SWEET POTATOES

Weekly irrigation	Early	Mid	Late
Column (mm)	18-20	40-45	~20
Per ha (m^3)	180-200	400-450	~200

Source: Own computation

Soil moisture can be well estimated using tensiometers. One tube should be placed on top of the hill or mound, 15 to 20 cm deep, to estimate certain timing of irrigation. Second at the base, 40-50 cm deep to estimate proper lenght of irrigation. On sandy soil types, both tensiometers should read values of 10-20 kPa.

Weed control

Various weeds can suppress the growth especially before upper plant vines cover the beds. Right after the beds are piled up, they should be irrigated to support regermination of any weeds present. Usually a knockdown herbicide is applied before planting. When using herbicides is not appropriate, weeding using rotary finger cultivators or manualy can be applied.

Pest control

Most serious pest ravaging the sweet potato crops internationally is the sweet potato weevil. Adults lay eggs on plants, larvae then burrow into the roots. Once estabilished, this pest can hardly be controlled. It can be transfered by plant residues, which are important to be destroyed or at least removed from the fields. It can also be spread in planting material as it gets into the stems. Treatment of cuttings with chloropyrifos is somewhat reliable way of fighting pest spreading, however potential after-planting tretment has to be handled with care and sufficiently chronoligacally separated from harvest, as chloropyrifos is seriously toxic to human and most animals as well.

Ants and termites are also a threat as they may damage the roots. Leaf feeding catepillars can cause fatal damage to the leaves, causing the plant to not fotosyntetize enough. Last but not least, any herbivore animal constitutes potential risk for the plants.

To ensure health of the soil, an after-harvest tillage is appropriate as well as fallow period. Green manure planting can help suppress any unwanted sweetpotato regrowth or weed propagation. Also it provides natural soil structure improvement after mow/pasture and another tillage.

Disesase control

Mycoplasma is the main representant of bacterial diseases. Infection results in severe leaf growth reduction, reduced chlorophyle production and overall plant health impairment. Field should be treated by selection and removal of infected plants.

Fungual soil-born infection are not a serious problem, however any organic matter added to the soil should be decomposed well or even sterilized by irradiation, if it does not contain essential microorganisms.

Viruses are mostly spread by insect vectors and planting material. Main representant is the feathery mottle virus. In case of severe infection, it may cause yield reduction and root distorsion, but in most cases it has no observable symptoms, which makes it hard to detect. When planting sweet potatoes for a long period, controlled virus-free planting material should be used every few cycles.

Harvesting

Approximately one weeek before actual harvesting, the overground plant parts have to be removed. Optimal way is to use pulveriser that at the same time removes the residues from top of the beds, but this can be as well acquired manually. Cutting into the planting bed should be avoided at all costs as the roots could be damaged. Cutting the vines off make the root skin thoughen and get ready for the harvest. Harvesting can be performed either by moving chain platform or the beds can be raked off and the roots can be collected manually. Roots are then placed into crates manually, to avoid possible bumps or scratches as much as possible. One standard quarter-pallet crate can hold about 15 kg of roots. Trailer-high loaded EPAL can easely exceed half a ton weight. Depending on cutivar, conditions and managment 30 to 50 tons per hectare are usually produced.

Storing

After harvest, the roots should be carefully sortet, leting out damaged, cut or observabely infected or infested roots. Self-curing process is then initiated, by certain conditions (temp. 29°C, rel. hum. 80-90%). During this phase light scratches are spontaneously cover with cork-like layer and the roots start to produce natural wax covering. This may take up to one week. Later the roots are cleaned by soft brushes and high pressure water jets. They should be transported by water hopper along the process in order to prevent further damage. For long term storage the ideal temperatures are from 13 to 16°C. Storing below 12°C should be avoided for it may cause chilling injury to the roots. Freezing the roots is inappropriate at all, because, due to high tissue moisture, it causes acute fatal damage. High relative hummidity over 80% should be maintained to prevent water loss. Roots can be stored for 12 months or longer, with approximately 20% losses. It is important to point out, that relative losses are not constant, but increase with time. This can be modelled using simple differential equation, considering absolute losses over time depend on total stored amount and encrease lineary with time, which is sure not the real case, but more complex models exceeds the frame of this thesis. Quantifiing the given theoretical assumption, following equation is acquired.

$$-\frac{\delta Q}{\delta t} = Q * a * t$$

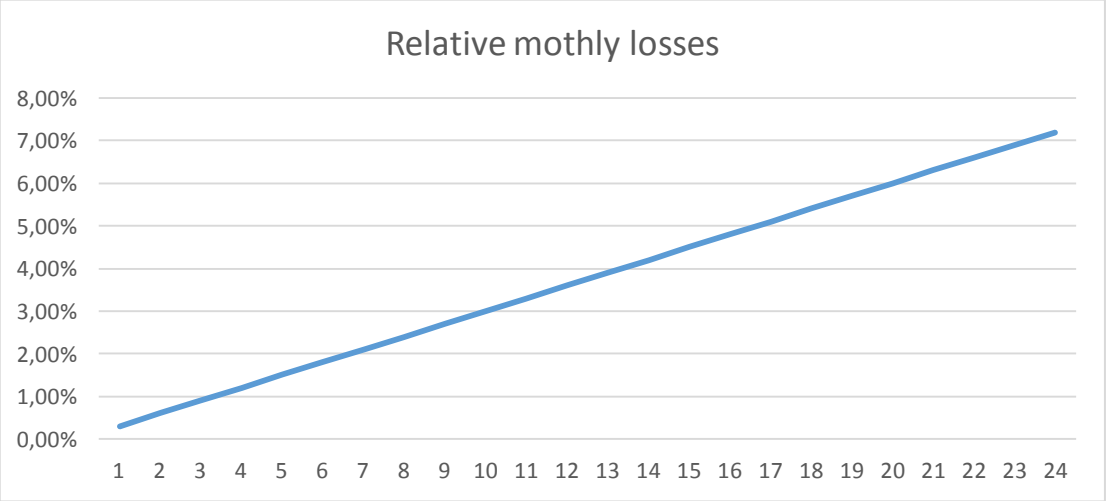
Where Q is the current ammount, t is time in months, and a is the monthly loss increase. The $a*t$ element therefor represents increasing losses, considering no initial losses. The equation results in following time function for undamaged items.

$$Q(t) = Q_0 e^{-\frac{a}{2}t^2}$$

After dividing the equation by the initial ammount and finding the complement to the total, a time function for losses is obtained. Coefficient a can then be estimated from known values (20% after 12 months), resulting approximately 0.3% monthly increase of losses in this case.

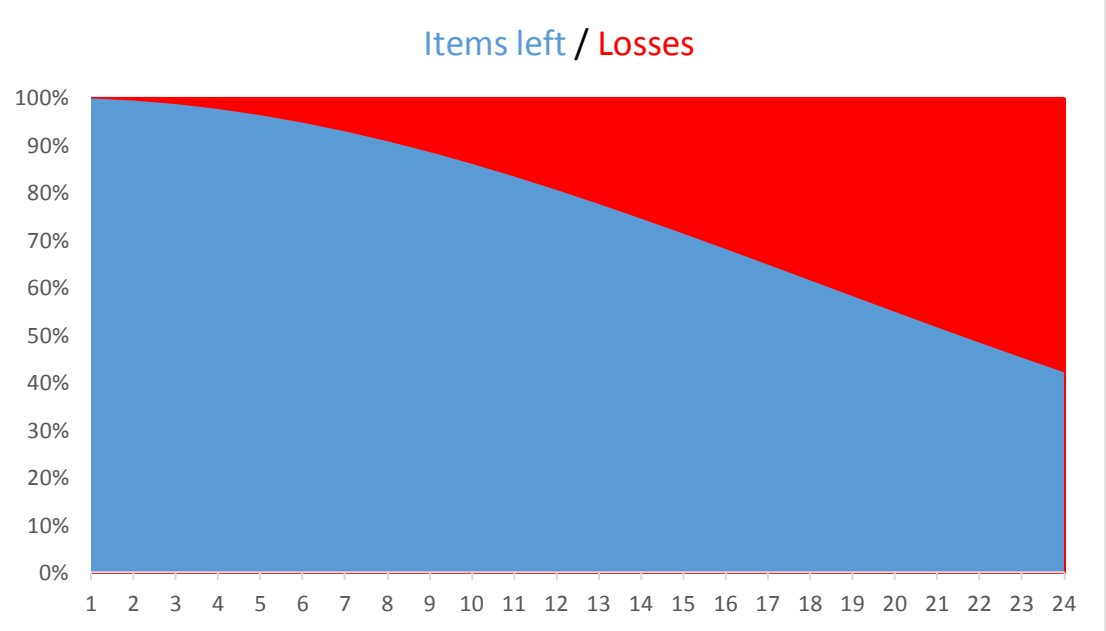
$$RelL = 1 - e^{-0.0015t^2}$$

GRAPH 4: RELATIVE MONTHLY LOSSES IN % PER MONTH



Source: Own computation

GRAPH 5: ABSOLUTE LOSS RATIO



Source: Own computation

Packing and transport

Sweet potato roots are usually transported in quarter-pallet crates by approximatelly 15 kg amounts. Eight-pallet paper crates are also often used in further redistribution. Storing and transport of roots in larger container may lower bumps and scratches caused by contact with crate walls, on the other hand it potentially supports spreading of infections or pests, if present. Roots can be also canned or mashed and dried, as further processing.

Marketing

Marketable weight of roots starts at 0.25 kg. Roots over 0.6 kg are classified as jumbos. Roots over 1 kg are considered overgrown and are mostly unmarketable as unprocessed. Class 1 roots should also have undamaged skin, good even shape and no insect damage. On european and north american markets retail prices usually range from 2 to 3 USD per kg. Wholesale prices often exceed 15 USD per carton (15-20kg), but can get as much low as the planting and trasport costs allow.

4.4.2 Quinoa production

Classification

Quinoa is a type of goosefoot and its Latin name is Chenopodium quinoa. . Its inclusion is pseudo-cereals and is grown primarily for its edible seeds. Like goosefoot is related to plants such as spinach or beets. Name quinoa comes from the ancient language of Quechua. The reason for this is that it was grown mainly a nation of ancient Incas, who spoke this language. Name quinoa comes from the ancient language of Quechua. The reason for this is that it was grown mainly by nation of ancient Incas, who spoke this language. In ancient times it was grown mainly for its great nutritional value and also for her unpretentiousness. Quinoa can be grown at altitudes up to 4,000 meters and in addition has not great demands on soil fertility. Even so, it grows best in well-drained soils and requires a relatively long growing season. Many of varieties of quinoa exist in the Andes, but three are mostly cultivated and available: white, red, and black.

Soil and climate condition for growing

As already mentioned in the previous paragraph quinoa is plant intensive cultivation. However, the best returns were achieved on sandy loam soils, in opposite soils that do not conform are clay heavy soils. The crop grows best in soils with a neutral pH, but most are grown on soils alkaline, which suits Dio Latina project, because there was proved high alkalinity of land owned by the company. The span acidity which can withstand quinoa is between 9.0 to 5.0 pH.

Temperatures suitable for cultivation again have a high span. The ideal climatic conditions are between 20-25°C, but as it is demonstrated already by the previous harvests of company, quinoa can withstand temperatures above 30°C.

Propagation of quinoa

Reproduction of quinoa is also very simple, as to its planting are used directly its seeds which germinate in the ground after the first irrigation.

Land preparation and sowing

Soil should be before the first sowing ploughing to a depth of 20 cm, especially to get rid of all weeds. Quinoa is normally planted from mid-May, where temperatures in the region of Piura reach 15-20cm. A conventional row spacing is between 25 cm to 50 cm and a typical depth of sowing seed is 1 cm to 3 cm. Per hectare is needed 25-50 kg of seeds and the first signs of growth can be observed within the first 24 hours since the first irrigations.

Water requirements

Quinoa is a very suitable crop for the conditions in which the firm operates, because it is not demanding on water too much. Water requirements range from 200 to 800 mm^3/ha. However, acceptable production levels are obtained with 150 mm^3/ha. Although it requires reasonable precipitation for germination and flowering it can tolerate periods of drought after the plant has become established. Crops have been observed in areas with 1 000 mm of annual precipitation.

Pest and disease control

The most common pests which are parasitic on the plant are: Tarnished plant bugs, aphids, beet armyworm and flea beetles. Most often attack these plant diseases: fungal leaf spot, stalk rot, gray mould and bacterial blight. In addition to diseases and pests there cause problems birds, which pick off the seeds. However, by selecting good seeds for cultivation, can prevent most of these diseases and therefore it is very important that these seeds have very good quality and being well tested. Since the firm has grown high quality quinoa in previous years this should not be a problem. Alternatively, it would be necessary to use suitable organic spraying after infection diagnosis.

Harvesting and storage

How has proven in recent years, quinoa is in most efficient way harvested by hand. The advantage of this harvesting is the low labour costs of local residents and intact plants at harvest and therefore no loss of grain.

Quinoa is stored in similar conditions as cereals. Through harvest quinoa is stored is stored at about 15°C. Subsequently, as it dries, the storage temperature decreases gradually to 5-8°C.

Marketing

As mentioned in the financial analysis quinoa is now very popular crop in Europe. Thanks to its excellent nutritional values and the fact that it is gluten-free. Prices for which the company sells it at wholesale receive up to a 30% of profit, in retail it is even up to 70% of profit before tax.

4.5 Econometric model

Dataset completion and processing

Six variables have been chosen for analysis of Pacific South American quinoa market situation. Quinoa production for Peru and Bolivia has been stated as endogenous variables

for market analysis, as these two countries are the top regional producers. Average producer price in these two countries has been chosen as first predetermination, while as a second one price of sweet potato has been chosen as possible, but distant substitute. Finally, GNI per capita for both countries separately was included as a sufficient economic performance indicator.

TABLE 22: DESCRIPTION OF VARIABLES

Variable	Gretl signation	Description
y1	v1	Peruvian quinoa production
y2	v2	Bolivian quinoa production
x1	v3	Average regional quinoa price
x2	v4	Average regional batata price
x3	v5	Peruvian GNI per capita
x4	v6	Bolivian GNI per capita

Source: Own computation

Data was collected in period 2005 to 2014 using public FAO database.

TABLE 23: ORIGINAL DATASET

Year	y1	y2	x1	x2	x3	x4
2005	32590	25201	399.26	86.16	2540	1030
2006	30429	26873	401.67	110.41	2790	1120
2007	31824	26601	426.18	140.51	3180	1240
2008	29867	27169	646.70	180.73	3760	1490
2009	39397	34156	1210.88	123.92	3920	1640
2010	41079	36724	1044.63	187.55	4380	1810
2011	41182	40943	1138.38	181.35	4870	2170
2012	44213	50874	1221.40	248.54	5650	2320
2013	52130	61182	1659.51	210.55	6230	2340
2014	114343	77354	2124.41	217.09	6360	2370

Source: Own computation

A correlation matrix was assembled to capture potential multicollinearity in the dataset.

TABLE 24: ORIGINAL CORRELLATION MATRIX

	y1	y2	x1	x2	x3	x4
y1	1	0.89	0.84	0.49	0.71	0.62
y2		1	0.95	0.74	0.93	0.87
x1			1	0.71	0.93	0.90
x2				1	0.89	0.89
x3					1	0.98
x4						1

Source: Own computation

Between selected data there is a multicollinearity present. Mutlicollinearity is removed using variable differentiation. After this process no multicollinearity is present. Variable x2 probably had not to be differentiated, nevertheless in purpose of model consistency, it was performed so.

TABLE 25: DIFFERENTIATED DATA

Period	Δy1	Δy2	Δx1	Δx2	Δx3	Δx4
2005/2006	-2161	1672	2.4	24.2	250	90
2006/2007	1395	-272	24.5	30.1	390	120
2007/2008	-1957	568	220.5	40.2	580	250
2008/2009	9530	6987	564.2	-56.8	160	150
2009/2010	1682	2568	-166.3	63.6	460	170
2010/2011	103	4219	93.8	-6.2	490	360
2011/2012	3031	9931	83.0	67.2	780	150
2012/2013	7917	10308	438.1	-38.0	580	20
2013/2014	62213	16172	464.9	6.5	130	30

Source: Own computation

TABLE 26: DIFFERENTIATED DATA OF CORRELLATION MATRIX

	y1	y2	x1	x2	x3	x4
y1	1	0.80	0.54	-0.20	-0.53	-0.49
y2		1	0.64	-0.31	-0.14	-0.50
x1			1	-0.79	-0.37	-0.35
x2				1	0.46	0.16
x3					1	0.31
x4						1

Source: Own computation

Simultaneous model interpretation is following.

y1=f1(y2,x1,x2,x3)

y2=f2(y1,x1,x2,x4)

Where f1 and f2 are linear functions of used variables. Coefficients were resolved using TSLS method. Both the equations are just identified as number of endogenous variables in a single equation reduced by one equals to the count of exogenous variables excluded from the equation. The Gretl SW TSLS results are following.

FIGURE 3: GRETL SOFTWARE OUTCOME

```
Equation system, Two-Stage Least Squares

Equation 1: TSLS, using observations 1-9
Dependent variable: v1
Instruments: const v3 v4 v5 v6

             coefficient   std. error       z      p-value
  ------------------------------------------------------------
  const      8793.71       10140.8        0.8672   0.3859
  v2            1.73866        2.59207    0.6708   0.5024
  v3           43.4590        64.5227     0.6735   0.5006
  v4          295.900        223.032      1.327    0.1846
  v5          -52.8225        18.6333    -2.835    0.0046  ***

Mean dependent var   9083.667   S.D. dependent var   20321.83
Sum squared resid    4.02e+08   S.E. of regression   10021.25
R-squared            0.881676   Adjusted R-squared   0.763351

Equation 2: TSLS, using observations 1-9
Dependent variable: v2
Instruments: const v3 v4 v5 v6

             coefficient    std. error       z      p-value
  ------------------------------------------------------------
  const      3153.76        5944.41         0.5305   0.5957
  v1           -0.0476120      0.229673    -0.2073   0.8358
  v3           23.1641        21.6975       1.068    0.2857
  v4           68.1552        98.0716       0.6950   0.4871
  v6          -15.8386        24.1749      -0.6552   0.5124

Mean dependent var   5794.778   S.D. dependent var   5484.103
Sum squared resid    1.33e+08   S.E. of regression   5769.920
R-squared            0.453803   Adjusted R-squared  -0.092393

Cross-equation VCV for residuals
(correlations above the diagonal)

  4.4634e+007      (0.531)
  1.3641e+007  1.4796e+007

log determinant = 33.7929
Breusch-Pagan test for diagonal covariance matrix:
Chi-square(1) = 2.53589 [0.1113]
```

Source: GRETL system, 2015.

Statistic properties and verification

Following tables show basic statistic properties of original and diferentiated data respectively.

TABLE 27: ORIGINAL DATA STATISTIC PROPERTIES

	y1	y2	x1	x2	x3	x4
Average	45705	40708	1027	169	4368	1753
Dispersion	6.32E+08	3.04E+08	3.31E+05	2.68E+03	1.90E+06	2.77E+05
Std. Dev.	25133	17444	575	52	1380	526
MIN	29867	25201	399	86	2540	1030
MAX	114343	77354	2124	249	6360	2370
Median	40238	35440	1092	181	4150	1725
Skewness	2.72	1.23	0.60	-0.17	0.24	-0.09
Kurtosis	7.90	0.75	-0.21	-0.94	-1.33	-1.76

Source: Own computation

TABLE 28: DIFFERENTIATED DATA STATISTIC PROPERTIES

	Δy1	Δy2	Δx1	Δx2	Δx3	Δx4
Average	9084	5795	192	15	424	149
Dispersion	3.75E+08	3.01E+07	5.79E+04	1.63E+03	5.90E+04	1.22E+04
Std. Dev.	19374	5486	241	40	243	111
MIN	-2161	-272	-166	-57	130	20
MAX	62213	16172	564	67	780	360
Median	1682	4219	94	24	460	150
Skewness	2.78	0.79	0.29	-0.48	0.06	0.86
Kurtosis	8.01	-0.19	-1.18	-0.69	-0.72	0.85

Source: Own computation

Following table shows exact outcomes for regression coefficients of performed TSLS method for both equations.

TABLE 29: PERUVIAN MODEL COEFFICIENT VALUES

Variable	Mean	Std. Error	z-value	singnificant at z(0,025)
const	8793	10140	0.867	N
y2	1.738	2.592	0.671	N
x1	43.46	64.52	0.674	N
x2	295.9	223	1.327	N
x3	-52.82	18.63	-2.835	Y

Soure: Own computation

TABLE 30: BOLIVIAN MODEL COEFFICIENT VALUES

Variable	Mean	Std. Error	z-value	singnificant at z(0,025)
const	3154	5944	0.53	N
y1	-0.047	0.229	-0.207	N
x1	23.16	21.7	1.068	N
x2	68.16	98.07	0.695	N
x4	-15.84	24.17	-0.655	N

Source: Own computation

Only the x3 variable in the first equation comes out as significant at confidence level of 95%, where z-value threshold equals 1,96.

Econometric verification

This simultaneous model puts quinoa production in Peru and in Bolivia in a relation. Theoretically assuming a closed market system, these values of these two endogenous variables would appear as substituting each other, giving negative partial coefficients in their mutual relation. It is however important to mind, that the whole dataset was differentiated, therefore the model deals with inter-year changes of values rather than actual values of used variables. Moreover most of production in both countries is exported, an so the both values are more likely expect to be positively correlated as they both relates

to growth of international trade and huge instauration of worldwide demand makes the demand unable to be considered as limited. Regression coefficient of Bolivian production in the Peruvian model is estimated 1.74, meaning that if Bolivian inter-year production growth increases by one ton per year the Peruvian inter year growth increases by 1.74 tons per year. Vice versa, the regression coefficient of Peruvian production in the Bolivian model is estimated -0.05 , meaning that if Peruvian inter year production growth increases by one kiloton per year the Bolivian inter-year growth decreases by 5 tons per year. These outcomes can be explained so, that mildly smaller Bolivian production has only a small effect on the Peruvian production, making the outer factors prevail, while the steep growth of Peruvian production may actually slightly impede the growth of Bolivian production. Such conclusions are however strongly unconfident, due to low significance of involved parameters.

Coefficients for Peru-Bolivian average quinoa price are 43.5 for Peru and 23 for Bolivia. The values for price elasticises comes out as 0.32 for Peru and 0.66 for Bolivia. These data has been differentiated as well, so the interpretations relate to inter-year changes. Therefore, relative increase of Peruvian production growth is expected to be 32% of combined relative quinoa price growth, while relative increase of Bolivian production growth is expected to be 66% of combined relative quinoa price growth. The model involves differentiated data and so faster price growth appears to lead to faster production growth. It still essentially meets the common theoretical criteria, if considered the production reflects quinoa supply rather than demand, other way this result could not be taken as economically verified.

Relation between growth of sweet potato price and quinoa production appears to be positive for both models. The values of coefficients are 296 for Peru and 68 for Bolivia, cross-price elasticity values (in fact change of production to change of price) are 0.03, 0.027 respectively. To consider sweet potato a quinoa substitute, it would have had been assumed that sweet potato price change effect propagates mainly through demand. Also the resulting values are unexpectedly high, though sweet potato is not so closely related to quinoa. Considering these conflicts with previous theoretical assumptions, it is not adequate to econometrically verify this parameter.

Gross national income per capita has been chosen as national economic performance indicator for both countries. After differentiation it shows in fact GNI/ca inter-year change. For both models the economic performance effect appears to be negative in relation to quinoa production. The actual coefficient values are -52.8 for Peru and -15.8 for Bolivia. The negative trend might seem illogical in the first sight, but as the data is differentiated, the model actually states that faster economical growth is associated to slower growth of quinoa production. Considering phase of economic development which these countries find themselves in, fast economic growth can actually lead to impediment of growth of primary sector and especially cultivation of traditional crops like quinoa. Therefore, this parameter can be fairly well regarded as econometrical verified.

Trend prediction

As the simultaneous model overall verification showed low significance and logical discrepancies, calculation of forecasted production values using approximated trend of predeterminations cannot be expected to give sufficiently fidelitous outcomes. Assuming the main cause of quinoa production steep growth is apparent disproportion between recent production and worldwide demand volume, an approach based on analysis of production growth trend itself has been chosen. The trend is approximated using regression over time. Differentiated data is used in this model as well for it has better resolution over the development than the actual values. Retarded values have also been involved in order to capture possible cyclicity, typical for agricultural sector.

TABLE 31: PERUVIAN FORECAST MODEL, OUTCOME

coefficient std. error t-ratio p-value

---

const −1.94142e+07 2.01203e+07 −0.9649 0.5114

year 9660.76 10009.7 0.9651 0.5113

t-1 0.442268 4.19947 0.1053 0.9332

t-2 −0.998502 4.79021 −0.2084 0.8692

t-3 −2.49661 4.34642 −0.5744 0.6681

Year	Production	Growth	1Y back	2Ys back	3Ys back
2009	39397	9530	-1957	1395	-2161
2010	41079	1682	9530	-1957	1395
2011	41182	103	1682	9530	-1957
2012	44213	3031	103	1682	9530
2013	52130	7917	3031	103	1682
2014	114343	62213	7917	3031	103
2015	181137	66794	62213	7917	3031
2016	193097	11960	66794	62213	7917

Source: Own computation

TABLE 32: BOLIVIAN FORECAST MODEL, OUTCOME

coefficient std. error t-ratio p-value

---

const 2.65482e+06 1.55304e+07 0.1709 0.8922

year −1320.92 7732.18 −0.1708 0.8923

t-1 0.691886 1.96867 0.3514 0.7848

t-2 0.698902 1.80588 0.3870 0.7649

t-3 1.44252 2.25583 0.6395 0.6378

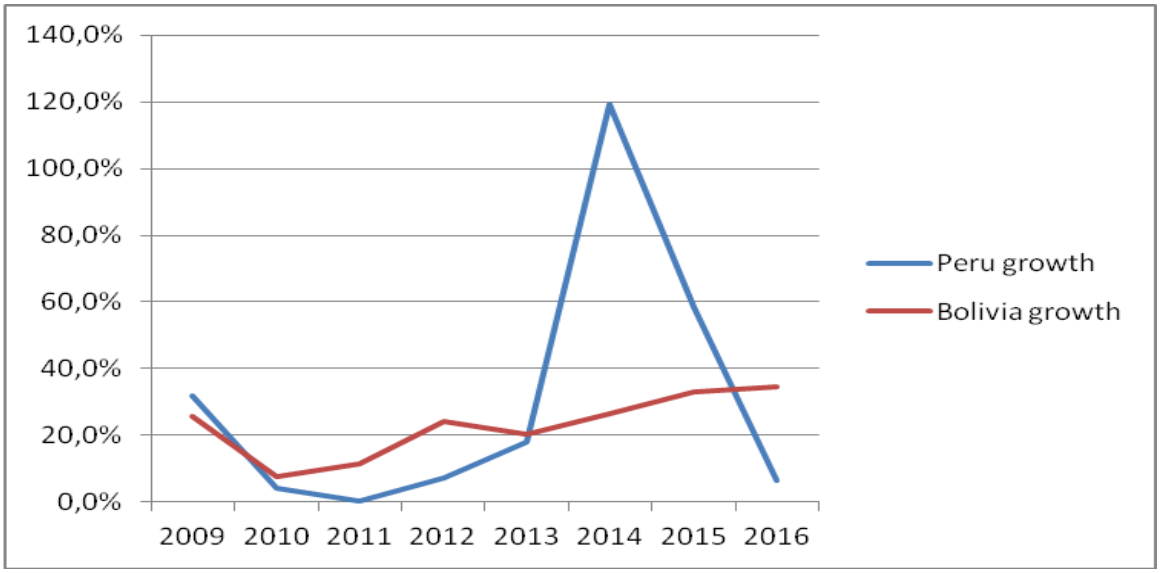
Year	Production	Growth	1Y back	2Ys back	3Ys back
2009	34156	6987	568	-272	1672
2010	36724	2568	6987	568	-272
2011	40943	4219	2568	6987	568
2012	50874	9931	4219	2568	6987
2013	61182	10308	9931	4219	2568
2014	77354	16172	10308	9931	4219
2015	103034	25680	16172	10308	9931
2016	138601	35567	25680	16172	10308

Source: Own computation

The Peruvian growth appears to slow down rapidly in current period while the Bolivian growth will probably keep on increasing slightly. However, most of the parameters have very low significance which causes the forecasts to be strongly unconfident. As the calculation is partially based on retarded values that are approximated themselves in further periods, the forecast confidence decreases rapidly. Therefore, further approximations are not stated at all.

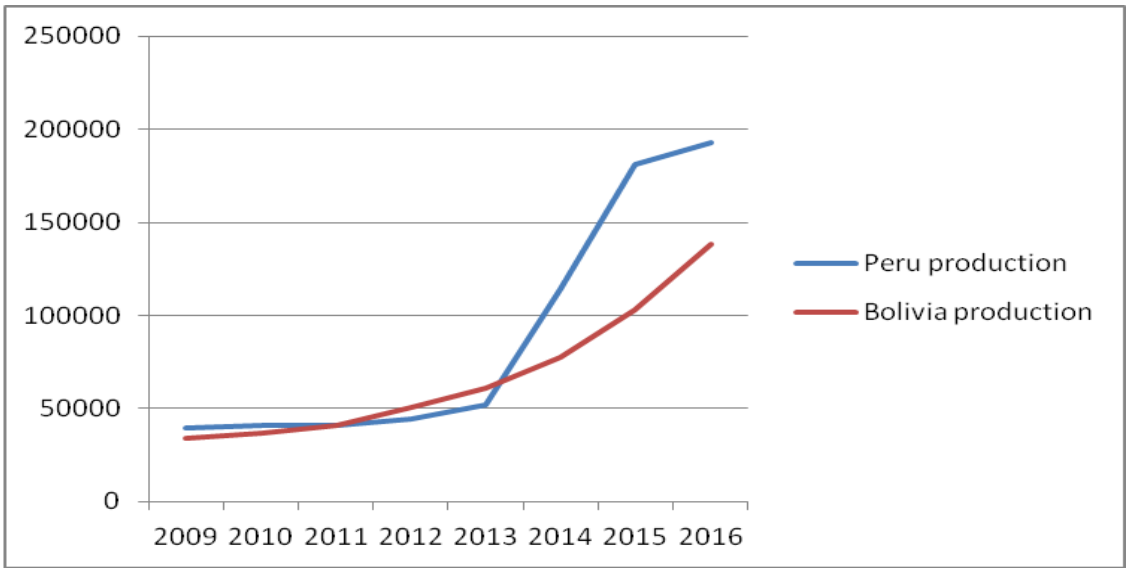
Table: forecast of quinoa production growth

GRAPH 6: ESTIMATED QUINOA RELATIVE PRODUCTION GROWTH TREND



Source: Own computation

GRAPH 7: ESTIMATED QUINOA PRODUCTION TREND (IN TONS)



Source: Own computation

5. Results and discussion

5.1 Results

5.1.1 Results of financial analysis

The first research was executed by **fundamental financial** analysis. It was performed using a SWOT analysis, which was quantified using credit ratings. From the results we can say that the company has more advantages than disadvantages in the ratio of 57% of strengths and opportunities, and 43% of weaknesses and threats. The most important output of this analysis is that the company should choose an aggressive expansion strategy.

As the most important partial strengths were assessed the facts that the company disposes of large area of land, has very good connections in the area, it is very open to investment, and the last it is able to grow a very profitable crop for a low price. The biggest weaknesses are then discussed the lack of capital for further expansion, the absence of top management and not too diversified portfolio of products. The external analysis is then presenting opportunities and threats. Among the greatest opportunities are the low cost of capital in Peru as well as low labour costs. Furthermore, the increase in demand for exotic and healthy crops in developed countries. And lastly big opportunity also offers a free trade zone with the United States and many countries in Eastern Europe, including the Czech Republic. The last part of the SWOT analysis was threats. The biggest threat was determined unpredictability of weather and associated natural disasters. Last threat was not good economic situation in Peru that is connected with poor infrastructure in the region.

The second part of the financial analysis is **technical analysis**. The calculations indicate that the financial situation is very complicated. Some indicators show very auspicious values for the company and others do not.

The profitability indicators showed a situation where although the company has high-value assets, these assets are not able to generate big profits yet. Indicator return on assets and return on equity are not negative, but these returns about ten percent are not sustainable for

future. On the other hand, it shows great potential for upcoming years, on condition that the company begins to use its assets more efficiently. Even in fact that the company does not import large quantities of crops and thus shipping costs are still high, excellent value reaches the indicator return on sales, which is around 40%.

Liquidity indicators are again up and down. The current ratio extends a very good spread between current assets and current liabilities where assets fully cover the deficit and still 9% left. The quick ratio because of lack of any marketable securities equals 31% which is not sufficient enough. Cash ratio is again adjusted by lack of marketable securities but because of company receivables the value of this ratio equals 52% so it could be said that when the company would like to pay all their receivables by very liquidity sources it would fulfill only half.

Another group of ratios was activity indicators. The first ratio total assets turnover was 25% and again it shows the situation when the company use their assets very inefficiently. Mainly the grounds must be used by more than now. One dollar put into the assets generates only 25 cents now. As it was mentioned inventory turnover indicates that inventories are stored for a time of 187 days. If we take into account the transportation time and a small customer base of atypical crops, this situation is due to the nature of trade, which the company performs in perfect order. The only disadvantage to this is the fact that the company has to pay long-term storage, which outsources and thus incur costs. Therefore it is worth considering building its own warehouse in the future and thus preventing this storage costs.

The very last part of financial analysis was leverage ratios. As expected, these indicators suggest very good value thanks to no long-term commitments that the company has. At first it was counted the total debt ratio. The number 23% proves that company assets are financed by own sources and just from a very little part by short-term commitments. Also a capitalization ratio which is 30% expose that the equity covers all liabilities very reliably and then company has more space for investment even from own resources.

5.1.2 Results of soil research

The research was conducted from soil samples collected by author in October 2016 in selected localities. In the research on soil were performed three tests. The first focused on active pH; second one to passive pH and the third research examines carbon content in the soil. The first research shows anticipated fact that the soils in the area are very alkaline. The second test only proves this fact. The third test, examining carbon, points out a small percentage of organic matter in the soil. These results are not satisfactory, since plants need rather neutral environment and also the presence of organic substances promotes good growth of crops. The results of these tests are then recommended plants that can tolerate such a challenging environment. And also implies the urgent need for fertilizers and other cultivation of these soils.

5.1.3 Results of recommended crops

Based on previous analyzes and taking into account the conditions of the company were recommended two crops which should be planted in the shortest possible time. These crops are sweet potatoes and quinoa. This part deals with all aspects that should lead from a successful sowing to the sale itself. In this chapter were analyzed as conditions for planting, fertilization, modification of soil, irrigation, storage and subsequent marketing. Sweet potatoes appeared as the plant that is very demanding on water, in particular from the beginning. However, they are not so demanding on soil conditions. Soil treatment is very specific, and it has to create because lumps of soil in which the tubers are plowed into. A second crop was quinoa. This crop has been planted company in the previous year. Quinoa is very undemanding crop for sowing the need to water and so does not need neutral ground. This crop promises very good sales after importation into Europe and achieved great profitability.

5.1.4 Results of econometric model

The last part of practical research was econometric model. As variables for this study were selected overall production of quinoa and sweet potatoes in Peru and Bolivia, as well as the prices of these crops for which they are sold wholesale. The last indicator was elected as an indicator of Gross National Income as one of the country's macroeconomic indicators. Setting up a basic dataset provided multicollinearity between selected variables, for which all variables have grown by about 5%. This problem was solved by differentiating data.

This simultaneous model puts quinoa production in Peru and in Bolivia in a relation. Theoretically assuming a closed market system, these values of these two endogenous variables would appear as substituting each other, giving negative partial coefficients in their mutual relation. Moreover most of production in both countries is exported, an so the both values are more likely expect to be positively correlated as they both relates to growth of international trade and huge instauration of worldwide demand makes the demand unable to be considered as limited. Regression coefficient of Bolivian production in the Peruvian model is estimated 1.74, meaning that if Bolivian inter-year production growth increases by one ton per year the Peruvian inter year growth increases by 1.74 tons per year. Vice versa, the regression coefficient of Peruvian production in the Bolivian model is estimated -0.05 , meaning that if Peruvian inter-year production growth increases by one kiloton per year the Bolivian inter-year growth decreases by 5 tons per year. These outcomes can be explained so, that mildly smaller Bolivian production has only a small effect on the Peruvian production, making the outer factors prevail, while the steep growth of Peruvian production may actually slightly impede the growth of Bolivian production. Such conclusions are however strongly unconfident, due to low significance of involved parameters.

Coefficients for Peru-Bolivian average quinoa price are 43.5 for Peru and 23 for Bolivia. The values for price elasticises comes out as 0.32 for Peru and 0.66 for Bolivia. These data has been differentiated as well, so the interpretations relate to inter-year changes. Therefore, relative increase of Peruvian production growth is expected to be 32% of combined relative quinoa price growth, while relative increase of Bolivian production growth is expected to be 66% of combined relative quinoa price growth. The model

involves differentiated data and so faster price growth appears to lead to faster production growth. It still essentially meets the common theoretical criteria, if considered the production reflects quinoa supply rather than demand, other way this result could not be taken as economically verified.

Relation between growth of sweet potato price and quinoa production appears to be positive for both models. The values of coefficients are 296 for Peru and 68 for Bolivia, cross-price elasticity values (in fact change of production to change of price) are 0.03, 0.027 respectively. To consider sweet potato a quinoa substitute, it would have had been assumed that sweet potato price change effect propagates mainly through demand. Also the resulting values are unexpectedly high, though sweet potato is not so closely related to quinoa. Considering these conflicts with previous theoretical assumptions, it is not adequate to econometrically verify this parameter.

For both models the economic performance (GNI) effect appears to be negative in relation to quinoa production. The actual coefficient values are -52.8 for Peru and -15.8 for Bolivia. The negative trend might seem illogical in the first sight, but as the data is differentiated, the model actually states that faster economical growth is associated to slower growth of quinoa production. Considering phase of economic development which these countries find themselves in, fast economic growth can actually lead to impediment of growth of primary sector and especially cultivation of traditional crops like quinoa. Therefore, this parameter can be fairly well regarded as econometrical verified.

As the simultaneous model overall verification showed low significance and logical discrepancies, calculation of forecasted production values using approximated trend of predeterminations cannot be expected to give sufficiently fidelitous outcomes. Assuming the main cause of quinoa production steep growth is apparent disproportion between recent production and worldwide demand volume, an approach based on analysis of production growth trend itself has been chosen. The trend is approximated using regression over time. Differentiated data is used in this model as well for it has better resolution over the development than the actual values. Retarded values have also been involved in order to capture possible cyclicity, typical for agricultural sector.

5.2 Discussion

Currently agriculture is facing many challenges. On the one hand, we observe a very advanced agriculture using many new technologies and methods on the other hand; we are facing a very primitive cultivation, mainly in developing countries. However, neither of these variants is correct. The first method is very straining the planet as a whole and exhausts its available resources. However, the second method is not able to achieve qualities which would be able to feed the whole population. This study tried to answer the question whether it is possible to find some sort of middle that would be both profitable and environmentally friendly to the earth. Land in the developing Peru and especially in the region of Piura is not very fertile and have not been used for agriculture so far but among that climatic conditions are one of the best in the world. So primarily this case study face to the question:"Is it possible to use this land regard to the efficient and sustainable growing?" The answer is: maybe. The biggest problems of today's intensive agriculture are chemical fertilizers and growing monocultures. Despite that promise high returns and their effects always occur very rapidly, soil treated by these synthetic substances lose their natural nutritional potential. And that's not the only disadvantage. The present time is characterized by a large number of different diseases and illnesses and it is therefore very important to choose a healthy meal. And what could be healthier and more natural than nature itself. Therefore, it seems very reasonable and even economically advantageous grown organically. Even though this study explores possible solutions, it is still only on theoretical base, or in other words on paper. But as the author of this thesis contributes significantly to the overall project will be an opportunity to review this procedures in real world. Then the main aim is not classical economic approach, which applies effort to maximize the profit, but the effort to make things right and that mean in harmony with nature.

6. Conclusion

The theoretical part was generally introduced environment of South America. It has been described by its geography, biodiversity, states associated with that continent, as well as social and political development. Then were more detailed presented Peru and its region Piura, where the chosen company operates. In that part was shown the fundamentals of the area, but already were outlined the conditions prevailing in the local agriculture and its economy. Another chapter dealt with agronomic theory, especially with the theory of soils and fertilizers. Furthermore, were introduced the necessary theory of the financial analysis, and it was described fundamental and technical analysis. Especially were selected indicators of profitability, activity, liquidity and indebtedness. The very last chapter of theoretical part described the theory of econometrics.

The practical part begins with a description of the selected company Dio Latina. It is the outlined the structure and the legislation of the company and its economic intent. Furthermore, from data provided by the company is conducted economic analysis. Fundamental analysis is illustrated using SWOT analysis. That is quantified with the result, where 53% are the positive aspects and negative aspects have 47%. Furthermore, the practical part deals with research of soil. Tests were conducted for active pH, passive pH and for content of carbon in the soil. These tests showed that the soil is not too favourable for cultivation. Based on the previous findings were recommended crops of sweet potatoes and quinoa. In other part were examined procedures, how crops can be grown under these conditions. In the last section was assembled econometric model. In as input variables here were chosen: the production of sweet potato and quinoa in Peru and Bolivia, the producer price of these two crops in these countries, and lastly Gross National Income as a macroeconomic indicator of the maturity of the country.

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