Norwegian University of Life Sciences
Faculty of Veterinary Medicine and Biosciences
Department of Plant Sciences

Master Thesis 2015
30 credits

ECONOMIC ANALYSIS OF SMALL SCALE ORGANIC FARMING IN MID-RANGE ALPINE CONTEXT

A Case Study implemented at la Berthe Farm, Savoie, France

Analyse économique de maraîchage biologique sur petite surface de moyenne montagne

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Master thesis
MSc Agroecology
2013-2015

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Date: 15/10/2015

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La Berthe Farm

Author: Valentin Barberoux **Year: 2015**

Topic category:

Economic analysis of small scale organic farming in mid-range alpine context.

A case study implemented at la Berthe farm, France, Savoie.

Key-words : organic farming, intensification, no mechanization, high density, quick rotation, low charges

Mots-clés: maraîchage biologique, intensification, pas de mécanisation, densité élevée, rotation rapide, charges faibles

Résumé: (15 lignes)

L'agriculture de demain est un enjeu essential des prochaines décennies. Une des solutions parmi les plus durable est l'Agroécologie. Des fermes collectives pratiquant l'agriculture biologique à petite échelle est une alternative prometteuse à l'agriculture industrielle pour les jeunes agriculteurs. Cependant, ce type d'agriculture doit être economiquement durable. Ce mémoire présente l'analyse économique d'un système de maraîchage biologique sur petite surface dans le but de participer à l'évaluation de cette agriculture alternative. Cette analyse se base sur un cas d'étude, qui est une ferme collective située dans le massif de la Chartreuse, en Savoie (France): la ferme de la Berthe. Cette ferme produit des legumes biologiques, du miel ainsi que du fromage de chèvre. Cette ferme se situe à 500m d'altitude, dans un contexte de moyenne montagne. Aucune mécanisation est possible en raison d'une pente importante. La performance économique consiste en des lits de culture à forte densité de semis et à rotation rapide. Les agriculteurs veulent pouvoir vivre de leur activité tout en ne dépassant pas les 40 h de travail par semaine. Des données ont donc été récoltées au sujet du rendement des récoltées et comparées à celles d'autres maraîchers biologiques pour évaluer la rentabilité de cette ferme.

Abstract: (15 lines)

The future of agriculture is an essential issue for the next decades. One of the most sustainable answers to it is Agroecology. Collective farms developing organic small scale agriculture are a promising alternative to industrial agriculture for the young farmers. However, this kind of agriculture has to be economically viable. This thesis presents the economic analysis of small-scale organic vegetable production system in order to give a small contribution to the assessment of this alternative agriculture. This analyze is based on a case study, which is a collective farm, located in the Chartreuse mountain range (French Alps): la Berthe farm. This farm produces organic vegetable, honey and goat cheese. The farm is located in a mid-range mountainous context, around 500m above sea level. No mechanization is possible due to an important slope. The economic performance is based on developing raised beds with a high density, and a quick rotation. Farmers there want to make a living while having a 40 hours/week working schedule. Data have been collected about the harvest yield and compared to other vegetable growers to assess this farm profitability. Critics and suggestions of improvements are proposed to make the next years year more profitable.

Total number of volumes: 4
Number of pages of the main document: 77

Host institution: La Berthe Farm, 73360 Saint-Franc, Savoie, France

AKNOWLEDGEMENTS

I would like to thank the farm of la Berthe and its people for having given me the opportunity to work, study and live with them during 6 months and a half.

I am thankful to the vegetable growing team of the farm, to Corentin Moriceau who was my external tutor. He is an inspiring entrepreneur, and a passionate gardening teacher. Thank you to Frederic Choffel, who impressed me with his communication skills and its technical knowledge. Thanks to Monique Ximenez for her constant positive behavior and her smiling touch in the garden.

Thank you to my teachers Jacques Godet and Tor Arvid Breland for their advices and help all along this thesis writing.

I would like to tell the rest of the farm that I am grateful to have been accepted inside the collective experience of la Berthe, which was quite challenging for me and which is very rich in terms of life experience learning.

I would like to thank my girlfriend, Federica Varini, who has always been there for me in the farm, and without whom this experience would have been totally different.

I would like to thank then my mother for her constant attention and help while I needed it, and my stepfather for his manager and decision-maker skills to help me keeping clear the goal and the structure of my thesis.

Thank you to my friends Cyril, Octave, Max, Tom, Nam, Cyril D for being around during the end of this work and for their encouragements.

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AE	Agroecology

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1. INTRODUCTION

1.1. Agro-ecological farming: challenge of nowadays

A short definition of Agroecology

Agroecology gives different ways of solving challenges of the current agricultural context. AE deals with crop production but also with environment, social and economic aspects. Agroecology today has different signification. It can refer to a science, a practice or a movement, which can be political or social. The term was first used in the 1930s and this could not mean anything else than a science until the 60s. From this moment appear different meanings of AE until the 90s. In the 80s, the definition of AE as a practice appears. Furthermore, the study framework of AE developed progressively from the farm to the agro ecosystem. Nowadays, we can define three main approaches of AE studies, the field scale, the farm scale and the food system scale. Today, several interpretations of the term AE are used in literature, without always being explicit on its meaning (Wezel A., 2011).
Therefore, it is important to define what kind of AE we mean when we use this term.

Agroecology as a solution for poor farmers

All over the developing world, poor farmers still do not have access to modern agricultural technics that requires heavy investments. A new method must be used in order to make agricultural management systems better adapted to the specific conditions of the farms. Agroecology is the scientific background enabling to define agroecosystem able to be self-sufficient. Clearly, it has been shown than Participatory Action Research, implying farmers into the scientific work is the most relevant way of conducting a study. Furthermore, institutions should be included in the stakeholders conducting the study. (Altieri, 2002)

Agroecology as a solution for the future

The current context of climate change, energy and economic crisis create a situation of food crisis. The peasant agriculture is a response to this issue. Indeed, this peasant agriculture could enable countries to guarantee their food sovereignty, by developing agroecologically based production systems. The challenge is to mix modern agriculture based on new technologies and ancient indigenous knowledge. In the developing world, this has clearly shown positive results up to now. Farmers working together with NGOs, scientists and governments increase the food security level and at the same time they succeed in maintaining the quality of the natural and agricultural resources. This is made possible thanks to communities still maintained in the developing world. The redevelopment of small farms systems could be one of the only solutions to respond to the issue of food requirement today and in the future. Agroecology seems to be one of the best options for the future of agriculture, designing bio diverse, productive and resilient agroecosystems. (Altieri, Funes-Monzote, & Petersen, 2012)

In the context of difficulty to have access to land for young people desiring to start a farm (due to land monopol and very high price) and the problem of lack of support many farmers in Western Europe are facing (Terre de Liens, 2013), small scale vegetable production seems to be a promising alternative for the next generation of farmers as some examples around Europe are showing (e.g. Bec Hellouin farm in Normandy, France). Indeed some farms have already developed such a small surface production system and got after some years positive results in terms of economical benefits.

1.2. Collective farming as a way of going back to the land

Since years, an increasing number of people start to share the dream of living in a different way. They fund communities in the countryside where they develop life projects together. Creating a life together is a good alternative of going back to the land as the price of land is a main constraint for young people to settle in the countryside. However, only 10% succeed because of the lack of structure developed in the Intentional Community. Indeed, some rules have to be put in place from the start of the community. It is important to visit several communities and to define the role of the funder(s). (Christian D.L., 2006)

1.3. Organic farming in Rhône-Alp Region

Rhône-Alp is the first region in France in terms of amount of organic farms. The amount of them doubled in 10 years, from 2000 until 2010. The vegetable part represents 4 % of it, as it is shown in *Figure 1* here below. Most of the time, organic farm leaders are younger than the ones of conventional farms. Furthermore, they have a better education. Rhone-Alp is also the French region with the highest conversion rate. The amount of organic farms could double in 5 years (2013-2018) (Agreste, 2013).

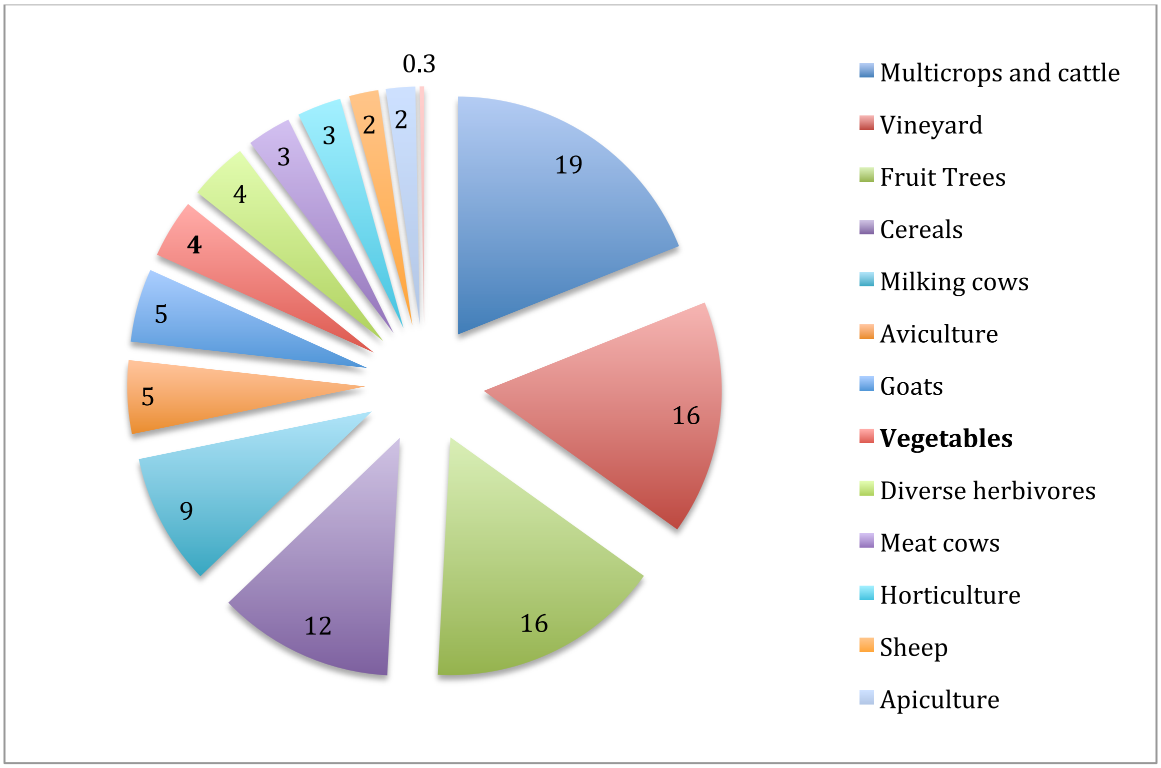

Figure 1: Repartition of the organic farming into the different farming sectors of the Rhone-Alp Region (Agreste, 2010)

1.4. Research objective and question

The aim of this thesis is to test the economic performance of organic vegetable farming on small surface by collecting data on one farm that will be the case study. Those data will be compared to the data of other organic vegetable farms in order to define the economic performance state of the case study.

2. RESEARCH QUESTION

The research question of this work is based on the analysis of data to test whether or not the methods used in organic vegetable farming on small surface are economically performing. Can vegetable growers make a living with the methods used?

3. MATERIAL AND METHODS

3.1. Material

3.1.1. The Intentional Community of La Berthe

3.1.1.1. Geography and climate

The farm of *"La Berthe"* is located in Savoie, France, at 30km from the city of Chambéry, on the Saint-Franc commune (INSEE, 2015). The farm is at the northern limit of the Chartreuse mountain range.
The Chartreuse has a mountainous oceanic climate, which causes high precipitation (https://fr.wikipedia.org/wiki/Massif_de_la_Chartreuse).

Figure 2: Location of the Chartreuse Mountain Range in France (ENS, 2010)

Figures 3 & 4: Hydrologic map of the Chartreuse moutain range & Map of the RNP and NP of France (Amisdesparcs, 2015)

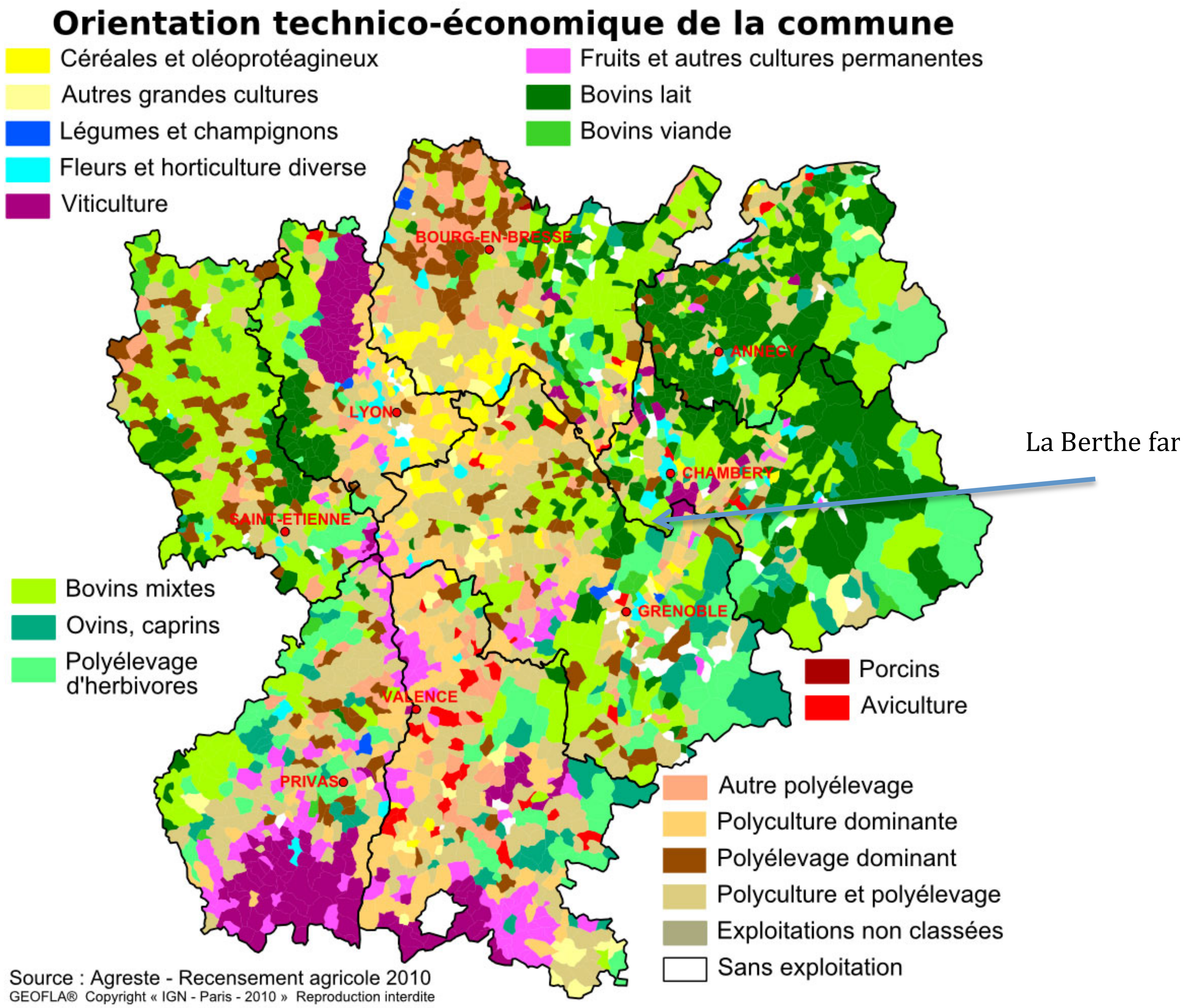

Figure 5: Map of the Rhone-Alp Region with the main socio-economic activity for each commune of the Rhone-Alp Region (Agreste, 2010)

This picture in French shows the socio-economic main activity of each commune of the Rhone-Alp Region. Saint-Franc commune, where la Berthe farm is located, is a commune where most of the economy is related to cattle for both purposes of meat and milk production (light green color in the text, in French "bovins mixtes").

The Chartreuse mountain range has a mountainous oceanic climate. This mountain range is a barrier before the Alps for the wind coming from the Atlantic Ocean on the West. Heavy precipitations are present, from 2000mm to 3000mm per year, with a main peak at

the beginning of spring and another at the beginning of autumn. A third of this precipitation is snow. The layer of snow can reach a meter at 1300m of altitude in February. The average snow layer is about 50cm. The peak of melting snow is reached around April.
(Wikipedia, 2015)

3.1.1.2. The Chartreuse mountain range geological history

The mountain range is mainly formed of karsts that are dug into the limestone (Wikipedia, 2015) (https://fr.wikipedia.org/wiki/Massif_de_la_Chartreuse).

The Chartreuse mountain range is a sub-alpine calcareous mountain range, which is part of a big unit of subalpine mountain ranges, going from Vercors until Haut-Giffre, passing by Chartreuse, the Bauges, the Bornes for the Northern part of the Alps. The Chartreuse mountain range is basically part of the Pre-Alps. The highest point is around 2000m of altitude. From those mountain ranges, the Chartreuse one is the lowest in altitude, but it is still well defined in the landscape.

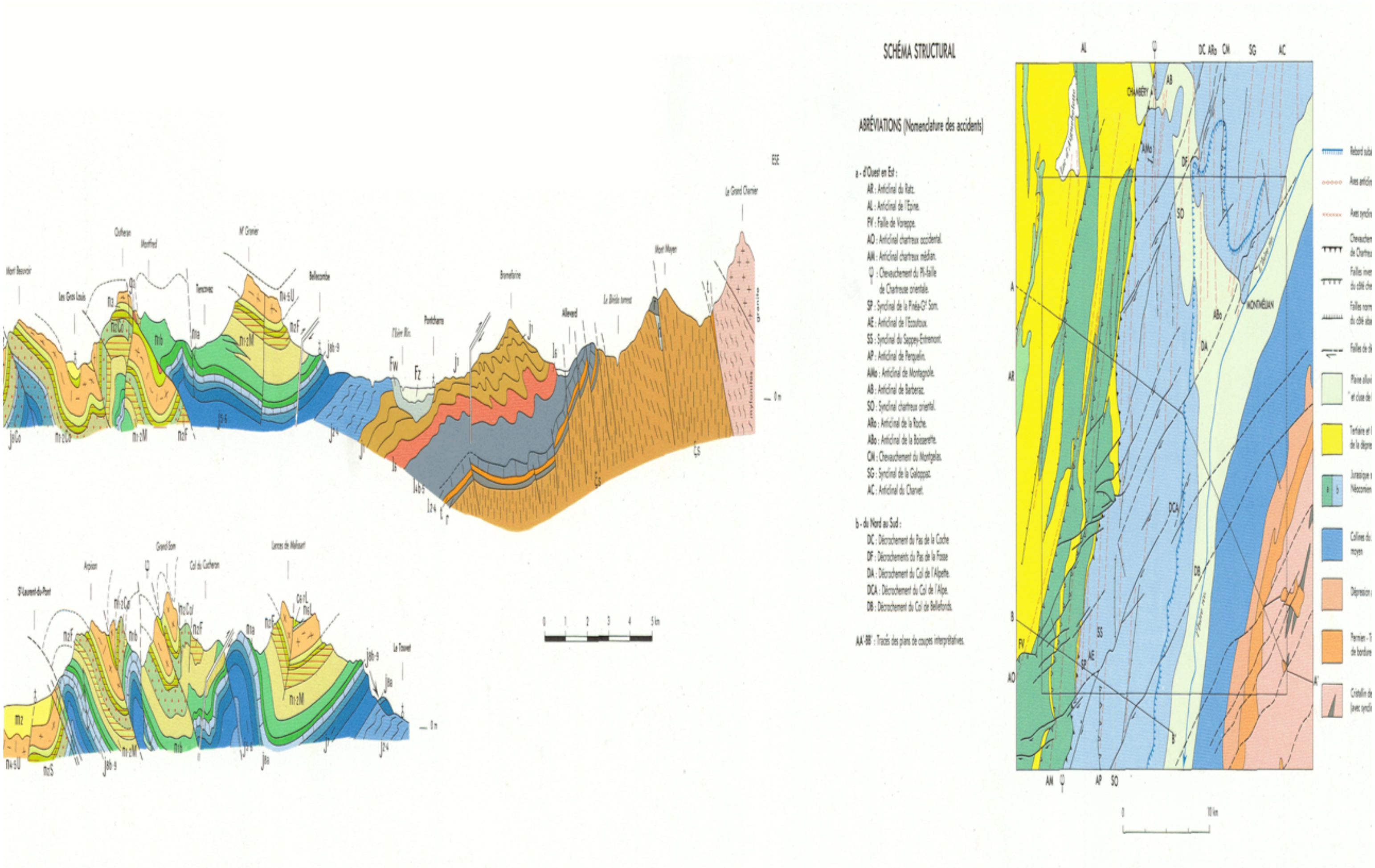

Figure 6: Geological map of the Chartreuse mountain range (BRGM: Bureau de recherche géologique et minière- Research Bureau for geology and mines)

The current landscape has been formed during the Mesozoic era (−252,2 until – 66 Millions of years), more precisely from -140 until -110 millions of years BC. The geological formations are mostly calcareous. The limestone was formed by sedimentation below the oceans during millions of years. It took 10 to 15 millions of years to form a wall of 400m high.

The Chartreuse mountain range has been formed at the same time than the Alps during the tertiary, starting around 65 millions of years BC.

During the quaternary, an important glaciation occurs which will give place to a vegetation growth starting from the valleys until the higher altitudes.

The mains particularities of the Chartreuse mountain range are:

- its relief upside-down. The calcareous rocks have been bent during the Alps growth. Erosion and pressures provoked that the depressions parts of the relief (called synclinal) are now on the summits of Chartreuse. Those summit synclines are typical from this area.
- its cragged relief. The CMR (Chartreuse Mountain Range) has a lot of transversal crags. It is also very wet. With the vegetation highly dominated by forests, water has an important erosive action on the limestone. The CMR is full of holes that make it suitable for speleology.

La Berthe Soil Analysis

The soil is a mix of silt and sand and belongs to the category of the sandy "molasse". The soil depth is variable, between 0,1m and 1,5m. The percentage of rock is between 0 and 5 %.

Table 1: Table of the main elements of la Berthe's soil

Main elements	
	Quantity (ppm) t0
Phosphorus P_2O_5	**41**
Potassium K_2O	**133**
Magnesia MgO	**1770**
Sodium Na_2O	**214**

Table 2: Table of the oligo-elements of la Berthe's soil

Oligo-elements	
	Quantity (ppm) t0
Zinc (Zn)	**4,14**
Manganese (Mn)	**162**
Copper (Cu)	**1,8**
Iron (Fe)	
Bore (B)	**0,5**

Table 3: Environmental conditions of la Berthe farm

Environmental conditions of la Berthe farm	
Positive points	***Negative points***
Good soil quality	Loam-silt soil--> can dry easily, getting **compact** and hard to plow (not a problem because of compost cultivation)
Loam-silt soil--> rich and good drainage	Silt dominancy--> higher risk of crusting phenomenon
Deep and fresh soil (especially in the downest pastures)	Slope makes mechanization impossible
Balanced meadows (with melliferous and forage species)	Mountainous area with shorter season for vegetables
Concentration of plots around the farm buildings	Acid and Ca-poor soil
Vegetable growing area well protected from wind and with good sun orientation	
Many isolated trees and high bushes	

The most important information is that the farm benefits from a soil in good condition. The loam-silt nature of the soil provides a good drainage except in some spots in the vegetable garden where some resurgences of water provoke a constant situation of humidity.

The acid and Ca-poor characteristic of the soil are being progressively resolved, as gross carbonate has been spread on the garden area in 2014 and guanor and needle manure is used as fertilizer, as it will be detailed further.

The nature of the soil can also provoke compaction. However, as the vegetable are produced in a slope, no mechanization is used, which means no tractor and then, no heavy weight on soil. This point is important as it is a positive point related to an initial issue (the slope conditions, instead of a flat soil).

3.1.1.3. Description of the Intentional Community of *La Berthe*

Picture 1: The five full-year inhabitants of la Berthe in 2012

The *ferme de La Berthe* (Saint Franc (73) France) is a community farm collaborating with *Terre de Liens* . This is a French citizen movement, born in February 1998, whose goal is to remove the burden of land acquisition for farmers and to work towards the preservation of land, including fighting against speculation and industrial farming..

The *ferme de la Berthe* has been started by 10 people 3 years ago and 4 of them work directly with agriculture (vegetables, goat cheese and honey productions), while the other ones are working outside the farm.

In 2015, They are currently exploiting 1200m2 of vegetables, have 20 goats, plus 8 baby goats born during spring and 80 bee hives.

This farm is not a family farm neither a company with a classical hierarchy. Decisions are taken in common, expenses for food and renting fees are shared. As they started the farm only 3 years ago, most of the people have still a job outside the farm, but the goal is to focus on farming becoming the only income source in the next two years.

The background of the 10 people is quite diverse also (civil engineers, graphist, comedian) which presents a diverse panel of people on farm.

Geography of the farm

Picture 2: The vegetable garden in february 2015, under 50cm of snow and -8 degree.

Picture 3: The tomato greenhouse after tranplantation in May

The three production sectors are economically independent and the vegetable one starts its second year of production now in 2015. After a first year of investment and an expectable negative result in terms of budget, their aim is to be profitable this year. Therefore, they were interested in a person carrying out a master thesis on the economic analysis of the entire agronomic process as the research could provide them with new ideas and projects for the future. Indeed the monitoring of the costs (seed purchase, material, manure, biocontrol) and benefits (sales on market) all along the season added to the one of last year could define what could be improved to get to higher benefits in year three.

This research will be conducted on site in order to have a realistic view of the everyday challenges.

The collective

The collective where the vegetable growing activity takes place is another challenge. The co-living of people carrying on their own activities on the same place is not an easy thing. A good and frequent communication is necessary for preventing conflicts of misundertandings. In the current context, the three activities developed are economically independent, which is a challenge for their respective future development.
Another point of this thesis is to propose an improvement of the interaction between the activities to make this collective farm sustainable.

Current challenges of the collective

8 people bought the place as a *SCI (Société Coopérative Immobilière, a Real Estate Cooperative Company)*, but two of them are not living there (Sylvain and Mathieu), and one of them lives there only third time (Ronan), which already makes a difference of fact. Five people of the eight initial members of the *SCI* live there permanently (Thomas, Ian, Fred, Caro, Diane).

A SCI, or Real Estate Cooperative Company is a kind of participative housing structure, which aim is to offer to their members the least expensive housing. This third way of housing, between renting and private property is becoming very popular in France, Switzerland and Canada.
As taking part is free of charge and depends on the will and the community choosing process, the housing cooperative (SCI) can be considered as a kind of intentional community. However, the quality of life of a community is highly variable. Indeed, this quality of life relies mostly on the people involvement and their experience in terms of community life.

Furthermore, another couple became permanent residents. They arrived after the formation of the *SCI* and they are working on the vegetable growing activity. They should be integrated to the *SCI* in a short-term future.

3.1.2. Global context of the vegetable growing

3.1.2.1. Adaptation of farming to the local mountainous context

As explained previously, the Chartreuse mountain range has a quite wet climate (2000 to 3000mm per year), those high precipitations mean a lower level of sun hours than in the Southern mountain range of Vercors (1500mm per year). Furthermore, as it has been said, the winter is quite rough, with temperature in negative and some months of snow (two months during winter 2014-2015). In addition, the garden is located in a progressive slope from 10% up to 25%.

The heavy rain episodes can make the working conditions difficult as a lot of mud can accumulate inside the garden, with some flood occurring, especially during spring, when snow is melting.

The working conditions can then be very difficult during this period of the year.

Cultivating in a slope is quite challenging (searching slope cultivation), this is why the idea of terraces came up at the farm.

3.1.2.2.Architecture of the garden

The garden is composed of four external gardens and three greenhouses. The gardens outside contain ten raised beds each, while the ones inside are composed of six raised bed. Each raised bed is 25m long on 0,8m wide.

The forest surrounds the gardens, which is very suitable for having a high biodiversity level in the garden.

There are no bushes making ecological corridors yet, but this is an idea for the future to enhance the biodiversity level inside the garden and have an agroecological system more advanced than this season.

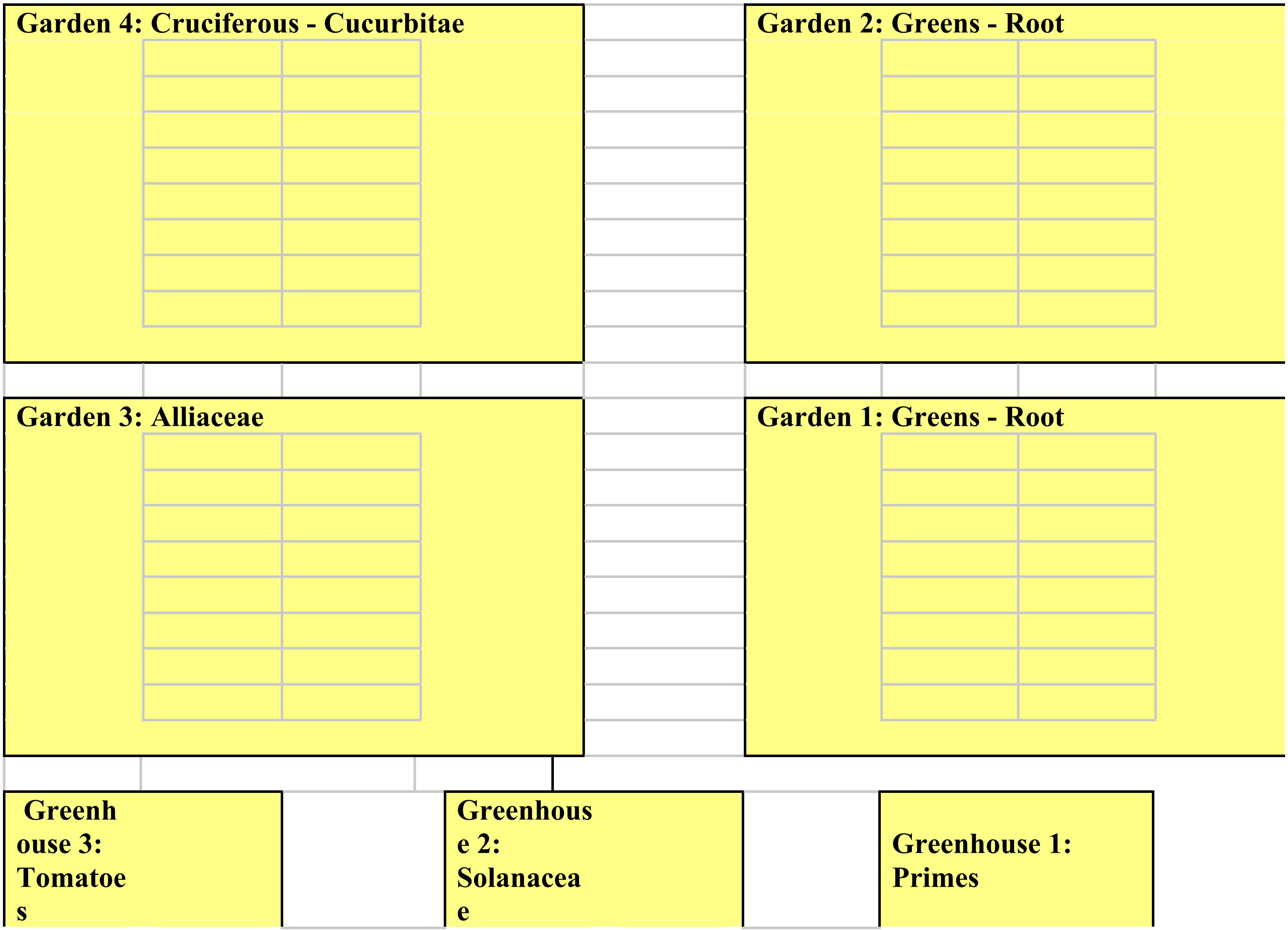

Figure 7: Schematic views of the gardens at la Berthe

The figure 7 represents schematically the gardens. The gardens 2 & 4 are the upper ones (with a slope of 25 %), and the slope is progressively decreasing until the bottom of the garden, where the greenhouses are located (slope of 5 %). Each external garden contains 10 raised beds, while the greenhouses contain 6 of them. The Greenhouses were not represented at their real length.

Picture 4: View of the gardens during the setting up of the raised beds (beginning of April)

3.1.3. Terraces and compost

3.1.3.1.Compost cultivation

Since the beginning of the activity in 2014, the vegetable growers decided not to plant straight on the ground, but to use a layer of compost of 15 cm high in which the vegetables would be planted. The decision of using compost was due to the different reasons.

First of all, the gardens are not flat, but in slope. This slope starts around 5% at the bottom of the gardens (at the level of the greenhouses) going until 25% at the top of the external gardens. Using machinery to plow the soil is then complicate. The vegetable growers bought an old tractor to make the vegetables transportation until the road located at the top of the gardens, but this tractor was not thought to plow the soil. The slope makes it dangerous, as the tractor would not be stable enough. In addition, this tractor does not have power enough to plow the soil and the cost related to it would be too important and not economically interesting on such a small surface of 1000m2.

The conventional plowing was therefore considered as an option not so interesting.

A neighbor of the farm is working at the composting platform of Chambéry, the city nearby. He is bringing hundreds of m3 of compost for his wife, which is growing cattle.

Therefore, the idea of using compost emerged at la Berthe. This could be an interesting alternative to the inconvenient plowing, as the compost is sold at low price. The farm started to buy compost to this person in 2014 and used it in the gardens as a layer on some raised bed while they were plowing manually most of the raised bed. 2014 was an experiment for the compost use and also for the wooden board. As those experiments seemed to be concluding, they bought 3 m3 per raised bed in 2015 to use it all over the gardens. This represents around 50 m3 of compost.

Table 4: Compost seeding advantages and problems

Compost seeding	
Advantages	***Problems***
no plowing	poor quality
easy harvest	can fall down with time
composition checked	

This compost was put straight on the ground, on each raised bed (25mX0,8m).

The quality of compost has a tremendous impact on the quality of the soil. The compost quality depends on many parameters. It depends a lot on the composting platform, but also on the way organic waste is collected and the way of storing it.

The compost that is used at the farm has been stored for a year in the composting platform; its state of decomposition is still not much advanced. Indeed, branches are still present. It will take a couple of years still for this compost to decompose until having a sandy structure.

Picture 5: View of the decomposition state of the compost used on raised-bed

As it has been shown in some articles, compost cultivation can lead to a higher fertility of the soil after some years (Allievi, Marchesini, Salardi, Piano, & Ferrari, 1993). However, the **compost** at la Berthe farm is used as a **substrate**, not so much as a fertilizer. The fertilizer role is provided by the guanor and the needle manure added.

3.1.3.2.Terraces building

Picture 6: Making of the wooden boards in the barn before bringing them down to the garden

The vegetable growers did not use any terrace on the first year (2014). They were only using compost.

Anyway, it was not efficient enough as the compost was not maintained correctly. For the second year then, they started using wooden planks to maintain the compost. The dimension of one raise bed is 25m out of 0,8m. Therefore, 20 wooden planks of 2.5m were used for each raised bed. The wood is pine-tree, and it comes from the forests around the farm (20km maximum). The wood is processed at a sawmill located at less than 10 km from the farm, on the neighbor commune of Attignat-Oncin. This sawmill uses wood from the forests around it, which makes this wooden use local and sustainable. These wooden planks are thought to last for a minimum of 10 years. The stakes will have to be changed progressively beforehand, as it is the weakest part of the plank.

Picture 7: Raised bed forming wooden terraces in the sloppiest part of the garden

3.1.4. Irrigation

Table 5: Quantification of the irrigation power for each type of irrigation system

IRRIGATION							
	One line drop by drop	*Two lines drop by drop*	*Mini sprayers (1 for 300 m2)*	*EUS roots 30 cm (L/m2)*	*EUS roots 20 cm (L/m2)*	*EUS roots 10 cm (L/m2)*	*EUS= Easily usable stock*
Irrigation power (L/h/m2 = mm/h)	8.3	16.7	1.7	25.92	17.28	8.64	

An adequate irrigation is a condition *sine qua non* for a good productivity of the garden. This summer 2015 was especially hot and dry, which shows the relevance of having an accurate irrigation system. During the dry days, each day 3,5m3 are used for watering.

During the first year, there was no automatic irrigation. This situation was requiring a five hours per day work of one person for watering manually during the hot days. This was a lot of time consumed by one only activity in the garden. They decided for the second year to invest in automatic supply in order to free more time for the other activities of the garden.

The irrigation system has been progressively installed along the season. Automatic automatic device have been set up around May so that the system was autonomous and did not require more intervention.

The irrigation system took a while to set up but eventually was quite performing.

3.1.4.1.Drop by drop technique

The drop by drop technique has been progressively installed in the Cucurbitae garden, the Alliaceae garden, the Solanaceae greenhouse and the Tomato greenhouse. It has been used to spray needle manure and comfrey manure. This is suitable for watering only the roots of plants without making the leaves wet. It prevents from some diseases to spread such as the downy mildew (Kincaid, Solomon, & Oliphant, 1996).

3.1.4.2.Aspersion technique

The aspersion technique is used in the two green-roots external garden, in the primes vegetables greenhouse and in the solanaceae greenhouse. The irrigation of each garden is connected to a automatic program, so that the every garden was irrigated 7 times 15 minutes during summer.

3.1.5. Weeding control

Grass is cut to prevent from an invasion of weeds inside the planks. When those weeds are not controlled, they spread fast, invade the planks and decrease the yield. Moreover, pests such as mices can hide much easier in high grass than when it is cut low. Those mices too present a danger for the gardener, as they are keen on peas seeds. However, it is important to maintain those paths with grass in order to maintain a minimum level of biodiversity and preserve the soil from erosion. This is especially important for the area of the garden with the highest slope.

After harvest, the empty raised beds were covered with black plastic until the next plantation or transplantation in order to prevent weed from growing.

Picture 8: Path in between raised beds of onions

3.1.6. Fertilization

Table 6: Quantification of the fertilization methods used at la Berthe farm

Guanor Frayssinet 6-3-13	T/ha	Kg/raised bed	N in U/ha	P in U/ha	K in U/ha
Carrots, turnips, radishes	1	**2**	60	30	130
Beet roots, cabbage, leak, pumpkin	2	**4**	120	60	260
Spinach, onions, chard	1.5	**3**	90	45	195
Garlic, shalott, lettuce	1.1	**2.2**	66	33	143
Potatoe	2.5	**5**	150	75	325
Chews	0.5	**1**	30	15	65
Tomatoes, peppers, eggplants	5	**10**	300	150	650
Cucumbers	4	**8**	240	120	520
Zucchinis	3.3	**6.6**	198	99	429
Max quantity	2.5	**8.9**			
Max quantity on 2000m2 (kg)	500				

The table on the top represents the initial plan for the amount of guanor of the brand Freyssinet (N6-P3-K13) that has to be used for each kind of crop before planting or transplanting it. While the compost had been set up inside the wooden planks, guanor was added and mixed with the compost so that it could be integrated within the compost. Sometimes, the guanor hadn't been integrated correctly enough and remained in surface, which was decreasing the quickness of effect of it.

In reality, this plan was difficult to follow, as the season started quite in a rush.

Indeed, everything had to be installed, the wooden planks, the compost and all plantations and transplantations. This is the reason why the plan of fertilization was simplified and **4 kg of guanor** was integrated to **each raised bed**.

This did not seem enough as the compost was poorly decomposed and **5 more kg** of guanor were added to each raised bed after the harvest of the first rotation and before the second rotation.

This makes a total of 9 kg of guanor for each raised bed, only leguminous crops (peas) received a lower quantity of fertilizer (around 5 kg).

Table 7: Quantification of the liming on the garden area

LIMING	NOTHING in 2015	2014	
Ca Carbonate		4	t/ha
		0.088125	ha
		0.3525	t to spread
		20	m2/raised bed
		0.4	kg/m2
		8	kg/raised bed

The table shows the liming quantity used on the garden area in the year 2014, at the very beginning of the vegetable activity. This Ca carbonate has been added to increase the pH and enhance the fertility level of the soil.

3.1.7. No tillage technique

The no-tillage agriculture enables to maintain a higher soil quality biologically, chemically and physically compared to plowed soils.

The microbial environment

For microbes, the number of microorganisms is defined by the characteristics of soil environment, in terms of chemical and physical characteristics. There are many differences that are pointed out biologically between no-tillage and tilled fields. Therefore, the effects of tillage would induce contrasts in terms of soil microbes, transformation of organic matter and mineral nutrients. The factors that are defined as being the most relevant between no-tillage fields and tilled-fields are the differences in distribution and quantity of organic matter, plus the moisture regime (House & Parmelee, 1985).

Microbial activity is affected by the difference of moisture and temperature of no-tillage agriculture compared to conventional tilled agriculture. Soil moisture content is usually increased by no tillage or other kind of tillages that leaves in surface plant residue. In dry conditions, microbial activity is higher in non-tilled soil compared to tilled soil. However, it has been shown that a soil under no-tillage has more risk of water saturation and getting into an anaerobic state due to precipitation or even irrigation. The transformation of N fertilizer could than be modified. The thermal insulation provided by the mulch on surface could have consequences that depend on the climatic conditions. During spring, soils without tillage are less warm, which would decrease the microbial activity. However, a main advantage of non-tilled soil is their surface mulch that enables a regulation of temperature inside the soil. The microbial activity is doubled for every enhancement of 10 degrees. As the difference of temperature is rarely higher than 10 degrees between tilled and non-tilled soils, except at some times of the year, temperature is not the main factor of explaining differences between plowed and non-tilled soil (Blevins & al, 1984).

3.2. Methodology

3.2.1. Collection of data

Data have been collected about the harvest weight of crops, plank by plank to define the yield of each of them and try to explain it.

Therefore, in the gardening hall, where all material is stored, a schematic view of the garden was hanging on the wall. Each time a crop was planted, it was noted, with the date of plantation or transplantation, the variety, the date of harvest and the yield. The type of fertilisation was also recorded. Notes were taken as well concerning the eventual diseases or pests affecting the crop.

Data about the working hours have also been defined.

An economic analysis has been done, defining the expenses and incomes of the vegetable business all along the year. This enabled to compare the real benefit to the forecasted benefit at the beginning of the year. This enables too to draw conclusions of improvements for reaching a higher benefit for the next years.

3.2.2. **Comparison with other vegetable farmers** (Jean-Martin Fortier and organic farmers association ADABIO)

The Canadian vegetable grower, Jean-Martin Fortier, is considered as a reference by this farm, which based its system development mainly on Fortier's strategy, in term of rotation planning, garden structure and the choice of varieties used.

A comparison of yield for each crop between la Berthe farm and Fortier seemed quite relevant to define how far la Berthe gardeners have been able to develop their methods in two years compared to an experienced successful organic growers such as Jean-Martin Fortier.

A comparison with the data collected by the organic farmers association ADABIO has also been accomplished. This association is regrouping the organic farmers of four departments of the Rhône-Alp Region. ADABIO developed a program for organic vegetable growers in order to predict the yield or benefit possible to reach depending on different factors that have to be defined. Those factors are the crop density, the time of rotation, the varieties, the kind of fertilization and others. The data of this software are based on the average yields of the ADABIO farms. Farmers using this software can then modify every data and compare it with the initial data, to know the difference between their yield or benefit and the average yield.

4. RESULTS

4.1. Economic performance

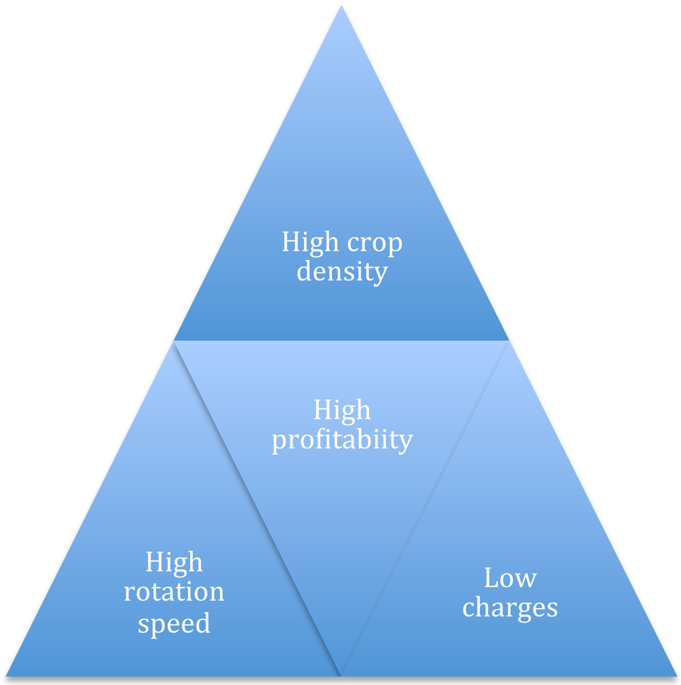

Figure 8: Modeling of the economic performance of the vegetable production

The vegetable growers at la Berthe are following a system that has made Jean-Martin Fortier economically performant on a small surface. Being performant on a limited cropping area requires developing an intensive plan of production, in order to earn an acceptable living. This economic performance is based on three pillars: a high crop density, a high rotation speed and a low charge expense. Indeed, the fact that the garden is in slope, which avoids the use of a tractor, means less expenses and than much lower charges than the conventional farmers on flat fields. Almost everything is made by hand in this garden.

4.1.1. Crops density

The crop density is much higher than in conventional agriculture and even the average organic agriculture. The common organic vegetable agriculture in the Rhone-Alp region, from which ADABIO data derive, is based on regular fields and not on raised bed. This means the use of mechanization. In order to let a tractor pass in between the rows, the density cannot be as high than in raised bed. This higher crop density with Fortier's method means a higher income on the same surface. Indeed, on a raised bed of 20m2, the crop density for carrots for instance is 4X7cm. This means that the carrots seeds are planted each 4cm on the row while every row is distant from 7cm. With this system, 10 rows of carrots can be planted for each raised bed. In comparison, according to the ADABIO data, the crop density for carrots is 3X20cm. We can clearly see that the density difference between both cannot be neglected.

Table 8: Comparison of crop density between la Berthe farm and ADABIO

Comparison of crop density (cm)		
Crop	*La Berthe*	*ADABIO*
Onion	15X17	25X16
Leak	15X15	15X70
Garlic	15X15	15X30
Carrot	4X8	3X20
Turnip	10X12	8X25
Beet root	15X12	8X25
Eggplant	45X30	100X50
Pepper	23X30	50X70
Tomato	23X80	50X70

As it is clearly shown in table 8 up here, la Berthe density is always higher than ADABIO, from 1.2 until 4 times higher, depending on the crops.

Table 9: Crop density and forecasted income related at la Berthe farm

Planted vegetables	Nb of plants 2015	Distance on the row in m	Length row in m	Nb rows / raised bed	Length of plank in m	Number of planks (25m)	Cultivated area in m2	Occupied area in m2	Production	Income/plank	Income 2015
Zucchini	**294**	0.6	176	1	176	7.1	141	212	294	400	**2822**
Squash	**200**	0.5	100	1	100	4.0	80	120		600	**2400**
Onions	**4100**	0.15	615	4	154	6.2	123	185	933	400	**2460**
Leaks	**2600**	0.15	390	5	78	3.1	62	94	455	350	**1092**
Garlic	**650**	0.15	98	4	24	1.0	20	29		400	**390**
Carrot	**50000**	0.04	2000	10	200	8.0	160	240	1200	300	**2400**
Turnip	**7500**	0.1	750	6	125	5.0	100	150	833	300	**1500**
Beet root	**1700**	0.15	255	5	51	2.0	41	61	272	300	**612**
Spinach	**5000**	0.15	750	5	150	6.0	120	180	175	200	**1200**
Lettuce	**3600**	0.25	900	3	300	12.0	240	360	104	300	**3600**
Mesclun	**165000**	0.02	3300	12	275	11.0	220	330	183	350	**3850**
Radish	**20000**	0.03	600	6	100	4.0	80	120	1000	300	**1200**
Green beans	**750**	0.1	75	3	25	1.0	20	30	50	300	**300**
Cracking peas	**10000**	0.015	150	2	75	3.0	60	90	88	400	**1200**
Chard	**875**	0.3	263	3	88	3.5	70	105		625	**2188**
Kale	**250**	0.3	75	3	25	1.0	20	30		200	**200**
Kohlrabi	**1000**	0.2	200	4	50	2.0	40	60		600	**1200**
Rutabaga	**1000**	0.15	150	6	25	1.0	20	30		800	**800**
Cabu Cabbage	**120**	0.4	48	2	24	1.0	19	29		360	**345.6**
New potatoes	**500**	0.3	150	3	50	2.0	40	60		300	**600**
						79.8	**920.0**	**1400.0**			**30360**

Tunnel Solanaceae

Planted vegetables	Nb of plants 2015	Distance on the row in m	Length of row in m	Nb rows / planks	Length of plank in m	Number of planks (25m)	Cultivated area in m2	Occupied area in m2	Production	Income/plank	Income 2015
Eggplant	**220**	0.45	99	2	50	2.0	40		220	743	**1470**
Pepper	**220**	0.23	51	2	25	1.0	20		220	500	**506**
Basil	**75**	0.2	15	3	5	0.2	4		38	500	**100**
Melons	**160**	0.23	37	1	37	1.5	29			600	**883**
						5.68	**114**	**255**			**3971**

Tunnel Tomatoes

Planted vegetables	Nb of plants 2015	Distance on the row in m	Length row in m	# rows / raised bed	Length of raised bed in m	Number of raised bed (25m)	Cultivated area in m2	Occupied area in m2	Production	Income/raised bed	Income 2015
Gourmandia Tomatoes	52	0.23	12	1	12	0.7	10			1330.4	**936**
Corazon Tomatoes	22	0.23	5	1	5	0.3	4			1330.4	**396**
Kakao Tomatoes	37	0.23	9	1	9	0.5	7			1330.4	**666**
Cornabel Tomatoes	37	0.23	9	1	9	0.5	7			1330.4	**666**
Fenda Tomatoes	37	0.23	9	1	9	0.5	7			1330.4	**666**
Cherry-tomatoes	34	0.23	8	1	8	0.5	6			1330.4	**612**
						5.0	**68**	**170**			**6606**

Total Income	**40937**
Total m2 cultivated	1101
Total m2 occupied	2075.0

With the density used on farm, the growers were expecting at the beginning of the season a turnover of 40000 euros. We will come back later on this forecasted benefit.

4.1.2. Rotation speed

The idea is to have three rotations on the season, making a minimum of 300 euros per crop, which makes around 1000 euros per raised bed at the end of the season. This is the case for the two external gardens of green-roots and the greenhouse of prime vegetables. These three rotations have to be accomplished from early March until end of November. For the garden of Cucurbitae, the garden of Alliaceous, the Solanaceae greenhouse and the prime vegetables greenhouse, only two rotations are expected.

Ideally, this rotation speed could generate a profit of 10000 for each external garden of green-roots, and 500 euros for each of the external Alliaceae garden and Cucurbitae garden. This makes already a total of 30000 euros for the external gardens. To these 30000 euros, 18000 have to be added for the three greenhouses (prime vegetables, solanaceae and tomatoes). This makes a total of 48000 euros. To this, the charges have to be withdrawn, however those are quite low (around 8000 euros). This would make a gross benefit of 40000 euros. The salaries that the growers could pay to themselves are not withdrawn from those 40000 euros.

This performance is based on an optimization of the raised bed use. Each time a crop is harvested, it is replaced by another crop within a few days.

Table 10: Rotation plan in the garden green-root 1

Garden 1 : rotation green-root (10 raised beds)

Raised Bed 1	Radishes	SD : 15th May – 5th July	Green beans	T : 5th July- 5th August	Turnips	DS : 8 August - 30 October
Raised Bed 2	Peas	SD : 23th March – 23rd June	Napoli Carrots	DS: 25th June- 15th November		
Raised Bed 3	Nandera Napoli Carrots	SD : 24th March - 24 June	Green beans	DS: 2nd July - 12 September	Radishes	DS : 15 September - 15 October DS : 24 Sept. -30 October
Raised Bed 4	Turnips	SD : 24 march – 1st June	Yaya & White Carrots	DS: 29th May – 15th September	Radishes	DS : 1 October - 7 Nov. DS : 12 October - 15 Nov
Raised Bed 5	Mesclun	SD : 16th April – 16th June	Beet roots	T: 15th June – 15th September	Spinach	T : 19 Sept. – end of season
Raised Bed 6	Crunchy peas	SD : 12th April – 12th July	Lettuce	T: 17th July – 30th August	Spinach	T: 1er Sept – end of season
Raised Bed 7	Spinach	T : 9th April – 9th June	Green beans	DS: 13th June – 23rd August	Lettuce	T: 1st Sept. – 1st Nov.
Raised Bed 8	Chard	T : 10th April - 30 June	Napoli Carrots	DS: 11th July - End of October		
Raised Bed 9	Beet roots	T : 20th April – 20th July	Green beans	DS: 20th July – 1st October		
Raised Bed 10	Lettuce	T : 16th April – 20th June	Negovia , Rothild and Colmar Carrots	DS: 25th June – 10th November		

Table 11: Rotation plan in the garden green-root 2

Garden 2: rotation Alliaceae (10 raised beds)

Raised Bed 1	Onions	T : 22 April		Green manure of peas and oat seeded beginning of September	DS: beginning of September
Raised Bed 2	Onions	T : 22 April			
Raised Bed 3	Onions	T : 22 April			

Raised Bed 4	Onions	T : 21 April			
Raised Bed 5	Onions	T : 21 April			
Raised Bed 6	Onions	T : 21 April			
Raised Bed 7	Garlic	T : end of March			
Raised Bed 8	Leaks	T : mid of May			
Raised Bed 9	Leaks	T : mid of June			
Raised Bed 10	Leaks	T : mid of June			

Table 12: Rotation plan in the garden 3 of Cruciferae-Cucurbitae

Garden 3: rotation cruciferae-cucurbitae (10 raised beds)		
Raised Bed 1	Zucchini	T : 27th April
Raised Bed 2	Zucchini	T : 27th April
Raised Bed 3	Zucchini	T : 13th June
Raised Bed 4	Zucchini	T : 13th June
Raised Bed 5	Kohlrabi /rutabaga	T : 9th April – 30th June/ T : beginning of July
Raised Bed 6	Cabbage / Kohlrabi	T : 9th April – 30th June / T : mid of July
Raised Bed 7	Pumpkin	T : 25th May
Raised Bed 8	Squash	T : 25th May
Raised Bed 9	Butternut	T : 25th May
Raised Bed 10	Butternut	T : 25th May

Table 13: Rotation plan in the garden 4 of Alliaceae

Garden 4: rotation green-root (10 raised beds)						
Raised Bed 1	Nandera-Napoli Carrots	SD : 13th April – 1st August	Mesclun	DS : 13 August - 13 October		
Raised Bed 2	Green beans	SD : 19th April – 1st July	Mesclun	DS : 17 July - 17 September	Mâche (Salad)	T : 21 Sept. – end of season

Raised Bed 3	Turnip	DS : 21st April – 10th July	Lettuce	T: 3 August - 20 September	Mâche (Salad)	T : 21 Sept. – End of season
Raised Bed 4	Radishes	DS : 30th April – 15th June DS : 18th May - 30 June	Kale	T: 29 June – End of season		
Raised Bed 5	Lettuce	T: 6th May – 6th July	Turnip	DS: 11 July - 30 September		
Raised Bed 6	Green beans	T: 1st June – 20th July	Mesclun	DS: 3 August - 20 September	Mâche (Salad)	
Raised Bed 7	Mesclun	DS: 29th April– 1st July	Lettuce	T:13 August - 13 October		T : 21 Sept. – End of season
Raised Bed 8	Yaya & White Carrots	DS: 10th May – 25th August	Mesclun	DS: 1st Sept. – 1st Nov.		
Raised Bed 9	Lettuce	T: 15th May – 15th July	Chard	T: 17 July - 30 September		
Raised Bed 10	Mesclun	DS: 23rd May – 23rd July	Chard	T: 5 August - 30 October		

Table 14: Rotation plan in the tunnel 1 of prime vegetables

Tunnel 1 : Prime vegetables (6 raised beds)

Raised Bed 1	New potatoes	P: 26 March - 15 June	Mesclun	
Raised Bed 2	Zucchini	T: 2 April - 15 June	Mesclun	DS: Mid of June - beginning August
Raised Bed 3	Spinach	T: 10 March - end May	Mesclun	DS: Beginning July - mid August

Raised Bed 4	Chard	T: 10 March - 15 June	Lettuce	T: Beginning July- mid August
	Cebette Onions	T: 10 March – 1st June		
Raised Bed 5	Crunchy peas	DS: 5 March – 1st June	Lettuce	T: Mid June – beginning August
Raised Bed 6	Nandera Napoli Carrots	DS: 4 March – end May	Lettuce	T: End May- mid July

Table 15: Rotation plan in the tunnel 2 of solanaceae

Tunnel 2: Solanaceae (6 raised beds)				
Raised Bed 1	Lettuce	T: 24 Mars - 20 Mai	Pepper	T: 27,28 et 29 Avril - End October
Raised Bed 2	Lettuce	T: 10 March - 20 May	Eggplant	T: 27,28 et 29 April – End October
Raised Bed 3	Mesclun	DS: 20 March - ?	Eggplant	T: 27,28 et 29 April - End October
Raised Bed 4	Radish	DS: 13 April - ?	Cucumber	T: Beginning May and end June
Raised Bed 5	Lettuce	T: 8 April - ?	Melons	T: Beginning May and end September
Raised Bed 6	New potatoes	P: 11 March - 25 May	Melons	T: Beginning June- end of October

Table 16: Rotation plan in the tunnel 3 of tomatoes

Tunnel 3: Tomatoes (6 raised beds) (raised bed of 17m long)

Raised Bed 1	Cornabel-basil	T: 6 May	Until october
Raised Bed 2	Cindel-celery	T: 6 May	Until october
Raised Bed 3	Cindel-Beans	T: 6 May	Until october
Raised Bed 4 (3/5)	Gourmandia	T: 6 May (3/5)	Until october
Raised Bed 5 (1/2)	Kakao	T: 6 May	Until october
Raised Bed 5 (1/2) down	Fenda	T: 6 May	Until october
Raised Bed 6 (2,5m)	Black cherry	T: 6 May	Until october
Raised Bed 6 (2,5m)	Summer sun	T: 6 May	Until october
Raised Bed 6 (12,5m)	Capriccio	T: 6 May	Until october

4.1.3. Low charges

As it has been said, the charges for the garden are quite low, around 6000 euros per year. It is mainly composed of seed and transplant purchase, water supply, manure supply and treatment costs (copper and sulfur mostly).

Table 17: Annual charges for 2015

Annual charges 2015	
Water	1000
Material	1000
Seeds and plants	2300
Car	1000
Manure	300
Total	*5600*

For the year 2015, the charges total is 5600 euros. It is more or less equal to year 2014. However, for 2016, the seeds and plants expenses will become more important as the garden is going to be extended. Seeds and plants will no longer cost 2300 euros, but 3000 euros, increasing the charge total budget up to 6300 euros.

4.1.4. No mechanization

Due to the important slope in the garden, a tractor use presents more problems than advantages. The small surface (1200m2) is another reason for using other methods than a tractor. The slope makes it poorly stable. A test of passing in between the raised bed with a tractor was made this season in order to define whether or not the use of a tractor could make the filling in of the raised beds easier. It was concluded that even for this task of compost filling in, the tractor was not appropriate. It was provoking soil compaction in the paths, making the planks moving and modifying their dimension of 80cm wide.
This non-efficient result of the tractor use is also due to the fact that the garden was very wet at the moment of the test, in early spring (april). However, as mechanisation cannot be used, the situation means less charge but also more manual work.
(Friedrich, Derpsch & Kassam, 2012)

4.1.5. Year organization

The farming year starts in February until end of November. The idea for the farmers is to have two months holidays in winter. During these two months, the farmers are in holidays, they work partly on farm, to the renovations that are necessary. For the rest, they leave the farm for traveling abroad.
This break is also obliged due to the tough winter in the Chartreuse mountain range that makes the production not possible during winter, at least with the current techniques of the farmers of l*a Berthe*.

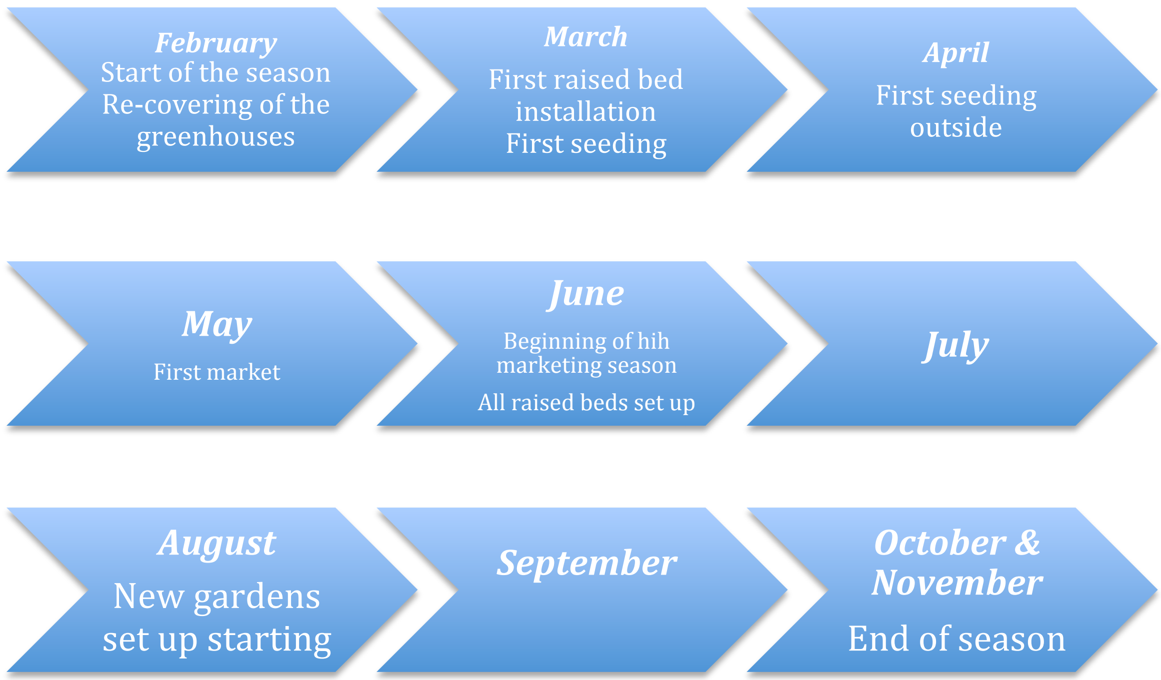

Figure 9: calendar of the season 2015

4.1.6. Early crop start in the year

One main factor to improve the productivity of year 2015 would be to start planting and transplanting earlier, planting the first crops in february. This has not been possible this year, as the garden had to be prepared first. The raised bed had to be set up, the planks made and planted and the compost filled inside the planks. This made the season starting later than next year, when nothing will have to be made in terms of garden set up.

4.1.7. Greenhouse seeding

The greenhouses are uncovered during winter, from December until February and they are recovered around mid-february. The use of greenhouses in this region of Mid-range Mountain is really helpful as the temperature inside the greenhouse is higher than outside and enables a quicker start of the season.

4.1.8. Marketing and communication

The farmers of la Berthe understood since the beginning the importance of a good marketing for selling their products. This is why they developed a website www.fermedelaberthe.fr on which people can see what kind of begetable are available and book a box with what they wish every week. Three points of delivery exist in the towns around the farm. In addition, the farmers make two markets and deliver

restaurants. A good marketing point is that la Berthe's offer is pretty complete with cheese, honey and vegetables.
This work of marketing seems to be efficient as the vegetable growers are selling for 1000 euros per month since June.

4.1.9. Conclusion of economic performance

This economic performance strategy with high crop density, high rotation speed, and low charges is the best strategy for being economically efficient on such a small surface in slope. The farmers have few expenses and this is why their income can rapidly become sufficient to make a living.

4.2. Data analysis

4.2.1. Harvest results

The main data measured was the vegetable weight. The harvest data have been collected on farm all along the season.
At every harvest, the vegetables from each raised bed were separated by raised bed origin. Afterwards, they were weighted and the weight was written on a board, which was representing a schematic view of the gardens. This board was enabling to keep track of the rotation for each raised bed and to know the weight harvested for every harvest date.
Afterwards, those data were compared to two different sources. One of them is the data of Jean-Martin Fortier, the Canadian gardener that was used as model by *la Berthe* farm in terms of rotation speed and crop density. The other source is ADABIO, which is the association involving the organic farmers of four departments of the Rhône-Alpes region (Ain, Isère, Savoie, Haute-Savoie).
Data have been collected all along the season per crop and per raised bed. For instance, for the beetroots here below, for every raised bed planted, the location was written.
For the location, abbreviations have been used:
-TP: Tunnel Primes
-TS: Tunnel Solanaceae
-TT: Tunnel Tomatoes
-GGRI: Garden Green and Roots 1
-GGRII: Garden Green and Roots 2
-GA: Garden Alliaceous

-GC: Garden Cucurbitae

Afterwards, the varieties were written too, the seeding date and /or transplantation date. Indeed, some vegetables were first planted in the nursery of the farm and afterwards transplanted (beet roots, spinach). Some were directly bought and transplanted (onions, tomatoes), and some were sown immediately on field (carrots).

The date of first harvest and end of harvest were also noted in order to define how long is remaining on the raised bed and how long the harvest lasts. The growth time, indeed, is defined as the period of time between the crop is present on raised bed until the first harvest.

Afterwards, a comparison has been made between la Berthe and Fortier in terms of growth time and yield. A column delta (B/F) in % is also present, with Delta=(B-F)/B*100. This Delta shows the difference of yield between la Berthe and Fortier. If it is positive, it means that la Berthe yield was higher than Fortier's.

The data have been collected from beginning of March until Mid-August.

Table 18: Table of the beetroots production

Beetroots											
Raised Bed	***Location***	***Variety***	***Seeding date***	***Transplantation date***	***1st harvest date***	***End of harvest date***	***Growth Time***	***Yield La Berthe***	***Growth Time for Fortier***	***Yield Fortier adapted at La Berthe***	***Delta B/F (%)***
1	GG RI9	Alvro - Mono	20-Apr	20-May	17-Jun	16-Jul	58	**73**	60	**142**	-94
2	GG RI4	Alvro - Mono	1-Jun		24-Jul	5-Aug	54	**90**	60	**142**	-58
3	GG RI1	Alvro - Mono	10-Jul								

For the beetroots, the raised bed 1 presented red leaves at the beginning because of a transplantation at midday a hot day. A veil called P17 was enveloping the crop during the first months (April and May) to increase the temperature from 2 or 3 degrees, especially at night, and than increase slightly the yield.

The difference of yield observed for raised bed 1 (-94%) between la Berthe and Fortier can be explained by different ways.

First, the bunch weight of Fortier and the one of la Berthe could be different. At la Berthe, bunches of 400g are used; maybe Fortier is using lighter ones. Another reason of this important yield difference could be the transplantation conditions at la Berthe that were pretty inadequate and that could have decreased the yield quite a lot.

Raised bed 2 shows a better yield than the first one. This could be explained by better transplantation conditions and also by the fact that it has been planted later in season, which is supposed to show a lower delta compared to Fortier's average results.

Table 19: Table of the tomatoes production

Tomatoes										
Raised Bed	***Location***	***Variety***	***Transplantation date***	***1st harvest date***	***End of harvest date***	***Growth Time***	***Yield La Berthe (kg/week)***	***Growth Time for Fortier***	***Yield Fortier (kg/week)***	***Fortier results adapted at La Berthe***
1	TT1	Black cherry 2,5m	6-May	22-Jul		120		120	70	**62**
		Summer Sun 2,5m								
		Capriccio 12,5m								
		Bern rose	6-Ma	29-Jul						

			y							
2	TT2	Kakao 9m	6-May	17-Jul		115		120		
		Fenda 9m	6-May							
		Corrazon	6-May	5-Aug						
3	TT3	Gourmandia	6-May	17-Jul		115	**31**	120		**62**
4	TT4	Cindel	6-May	17-Jul		115	**30**	120		**62**
5	TT5	Cindel	6-May	17-Jul		115		120		
		Celery								
6	TT6	Cornabel	6-May	20-Jul		118	**33**	120		**62**
		Basil								

Tomatoes are one of the crops that make the gardeners at la Berthe proud of their work. Indeed, growing tomatoes at 550m of altitude in the pre-Alps is a challenge.

Mid of May, Didymella appeared on some plants. This is a fungi that is responsible for the black foot. Therefore, some plants had to be taken off. Afterwards, some downy mildew appeared at the beginning of June, and this had to be treated with sulfur (in total 3 treatments).

Around the end of June, an important pruning has been made at the bottom of the plants in order to increase the aeration and avoid the development of powdery mildew, which is a big threat for tomatoes. Indeed, the 10th of July, powdery mildew appeared, which had to be treated by copper.

Furthermore, nettle manure and comfrey manure have been used, once a week, for boosting the plants.

Despite these manure and the treatments that have been applied to prevent from disease to spread and decrease the production, the yield from la Berthe is only half of Fortier's. This could be explained by the lack of fertilizer. As the crops are planted in compost at la Berthe, they benefit from much less nutrients than in a regular soil as Fortier's that has been enriched progressively since 10 years. Therefore more manure should be added and this situation should improve progressively along the years.

Table 20: Table of the eggplant production

Eggplant													
Raised Bed	***Location***	***Variety***	***Seeding date***	***Transplantation date***	***1st harvest date***	***End of harvest date***	***Yield (kg)***	***Growth Time***	***Yield La Berthe (kg/week)***	***Growth Time for Fortier***	***Yield Fortier (kg/week)***	***Fortier adapted at La Berthe***	***Delta B/F (%)***
1	TS 3	Bonica (1/2), Chiara (1/2)		6-May	16-Jul		48	100	**14**	100	29	**26**	-86
2	TS 2	Bonica		6-May	9-Jul		95		**13**				

Raised bed 1 has been planted in a former raised bed of radishes and the association has been followed during three weeks. Raised bed 1 had a net over it while raised bed 2 had 3 ropes going from each eggplant to the top of the greenhouse in order at make them grow around it. Once again, the yield at la Berthe is half Fortier's.

Table 21: Table of the melon production

Melon													
Raised Bed	***Location***	***Variety***	***Seeding date***	***Transplantation date***	***1st harvest date***	***end of harvest date***	***Yield (fruit/plant)***	***Growth Time***	***Yield per raise bed at La Berthe***	***Growth Time for Fortier***	***Yield per raised bed for Fortier (fruit/plant)***	***Fortier results adapted at La Berthe***	***Delta B/F***
1		Delfrisco	2 April		13-Aug		**3**			80	1.25	**1**	6
2		Artemis	14 April										

Surprisingly, for the melons, la Berthe's yield is higher than Fortier's.

Table 22: Table of the cucumbers production

Cucumbers													
Raised Bed	***Location***	***Variety***	***Seeding date***	***Transplantation date***	***1st harvest date***	***end of harvest date***	***Yield (units/week)***	***Growth Time***	***Yield per raise bed at La Berthe***	***Growth Time for Fortier***	***Yield per raised bed for Fortier (units/week)***	***Fortier results adapted at La Berthe***	***Delta B/F (%)***

1		Paladium/Flamingo	19-Apr		2-Jul		**50**	72	**50**	50	115	**102**	-

Again for cucumbers, the same proportion is present.

Table 23: Table of the potatoes production

Potatoes											
Raised Bed	***Location***	***Variety***	***Transplantation date***	***1st harvest date***	***End of harvest date***	***Growth Time***	***Yield La Berthe***	***Growth Time for Fortier***	***Yield Fortier***	***Fortier results adapted at La Berthe***	**Comparison ADABIO**
1	JA8	Linzer delikatess	28-Apr	9-Jul	16-Jul	71 days	50 kg	X	X	X	45 kg
2	JA9	Linzer delikatess	28-Apr	24-Jul	30-Jul	86 days	55 kg	X	X	X	45 kg

For potatoes, Fortier do not grow them, considering that it is very time and energy consuming compared to a mechanized vegetable grower. However, at la Berthe, the "new potatoes" have been planted. The aspect of harvest is a less important point as it is planted in compost. Indeed, harvesting potatoes in compost that has been set up on the raised bed just some months ago makes the work much easier than harvesting directly on the ground. The compost is much less compact, and it did not require a specific effort to harvest the potatoes compared to the other vegetables.

In addition, an experiment has been made on the two raised bed planted.

Raised bed 1 has been mulched with straw while raised bed 2 hasn't been covered in order to define wether or not the yields would be different, expecting a higher yield on raised bed 1, as the straw added could possibly offer more volume for the potatoes to grow.

At the end, the yields were pretty much similar, raised bed 2 had even a higher yield, that could be explained by the fact that the harvest started 2 weeks later than on raised bed 1. The straw seems than not to have any effect on the yield.

The comparison with ADABIO seems interesting. Indeed, on a same surface, ADABIO yield is 45 kg, which do not seem very far from la Berthe yield, although the density used by ADABIO is 30cmX70cm while la Berthe's is 30cmX25cm. Apparently, la Berthe yield could be much higher compared to ADABIO if it was optimal. For ADABIO, however, the potatoes are regular ones, not new ones.

Table 24: Table of the chards production

Chards										
Raised Bed	***Location***	***Variety***	***Transplantation date***	***1st harvest date***	***End of harvest date***	***Growth Time***	***Yield La Berthe (units/week)***	***Growth Time for Fortier***	***Fortier results adapted at La Berthe (units/week)***	**Comparison ADABIO**
1	TP3 (half raised bed)	Jessica	10-Mar	6-May	25-Jun	60	**41**	60		
2	JVRI8	Jessica	20-Apr	19-Jun	2-Jul	60	**77**	60		

133	**60**

Again for Chard, la Berthe's yield is about 50% of Fortier's.

Table 25: Table of the peppers production

Pepper										
Raised Bed	***Location***	***Variety***	***Transplantation date***	***1st harvest date***	***End of harvest date***	***Yield (kg or bunch)***	***Yield La Berthe (units/week)***	***Growth Time for Fortier***	***Fortier results adapted at La Berthe***	**Comparison ADABIO**
1	TS1	Sonar (1/2), Black (1/2)	6-May	9-Jul		76	**57**	120	**107**	**17**

Table 26: Table of the turnips production

Turnips											
Raised Bed	***Location***	***Variety***	***Seeding date***	***1st harvest date***	***end of harvest date***	***Yield (kg or bunch)***	***Growth Time***	***Yield La Berthe (bunches)***	***Growth Time Fortier***	***Fortier results adapted at La Berthe***	**Comparison ADABIO**

1	JVRI2	Snowball and Petrovski	24-Mar	27-May	10-Jun	50 bottes	60	**50**	40	**178**	450
2	JVRII2	Snowball and Petrovski	21-Apr	17-Jun	23-Jun	40 bottes	60	**40**			

The turnip harvest was pretty deceiving this year. Many of them were partly eaten by insects that provoked a consequent loss.

Table 27: Table of the onions production

Onions											
Raised Bed	***Location***	***Variety***	***Transplantation date***	***1st harvest date***	***End of harvest date***	***(1bunch=400g)***	***Growth Time***	***Yield La Berthe (kg)***	***Time for Fortier***	***Fortier results adapted at La Berthe***	***Comparison ADABIO (kg)***
1	TP1	Cébette	10-Mar	15-Jun	25-Jun	27.2		**54**			**70**
2	JA2	White	21-Apr	19-Jun		301		**120**	120	**160**	400
3	JA3	Yellow	21-Apr	19-Jun							
4	JA4	Shallot	21-Apr	10-Aug							
5	JA5		21-Apr	19-Jun							
6	JA6		21-Apr	19-Jun							
7	JA7		21-Apr	19-Jun							

Table 28: Table of the garlic production

Garlic									

Raised Bed	Location	Transplantation date	1st harvest date	End of harvest date	Yield per raised bed at La Berthe	Growth Time for Fortier	Yield per raise bed for Fortier	Fortier results adapted at La Berthe	Comparison ADABIO
1	JA1	22 march	20-Jul	10-Aug	10	undefined	600 units	533	45

Table 29: Table of the carrots production

Carrots										
Raised Bed	Location	Variety	Seeding date	1st harvest date	End of harvest date	Growth Time	Yield per raised bed at La Berthe	Growth Time for Fortier	Fortier results adapted at La Berthe	Comparison ADABIO
1	TP1	Nandera+ Napoli	4-Mar	4-Jun	18 juin		**120**	55	**160**	300
2	JVRII6	White Snow+Yaya	14-May	16-Jul						
3	JVRII10	Yaya+White	25-May							
4	JVRI2	Nandera+ Napoli	24-Mar	24-Jun			**39**			
5	JVRI6	Nandera+ Napoli	13-Apr	25-Jun			**126**			
6	JVRI3		17-Jun							
7	JVRI5		24-Jun							

Table 30: Table of the kohlrabi production

Kohlrabi								
Raised Bed	***Variety***	***1st harvest date***	***end of harvest date***	***Yield (kg or bunch)***	***Yield per raised bed at La Berthe***	***Growth Time for Fortier***	***Yield per raise bed for Fortier***	***Fortier results adapted at La Berthe***
1	Chorist F1 + Azur Star	4-Jun	25-Jun	97 kg	**291**	60	420 units	**373**

Table 31: Table of the spinach production

Spinach									
Raised Bed	***Location***	***Variety***	***Transplantation date***	***1st harvest date***	***End of harvest date***	***Yield (kg or bunch)***	***Yield per raised bed at La Berthe***	***Growth Time for Fortier***	***Fortier results adapted at La Berthe***
1	TP4	Corvair F1	10-Mar	6-May	15-May	24 kg	**24**	40	**31**
2	JVRI4	Corvair F1	1-Apr	20-May	29-May	16 kg	**16**		

Table 32: Table of the radish production

Radish											
Raised Bed	*Location*	*Variety*	*Seeding date*	*1st harvest date*	*End of harvest date*	*Yield (kg or bunch)*	*Notes*	*Yield per raised bed at La Berthe*	*Growth Time for Fortier*	*Yield per raise bed for Fortier*	*Fortier results adapted at La Berthe*
1	TT3	Raxe 1/2	31-Mar	6-May	29-May	91 bunches	Mixed with eggplant at the end	**91**	30	300 bunches	**267**
		Raxe 1/4	13-Apr	29-May	4-Jun	18 bunches	Important losses	**18**			
		White 1/4	13-Apr								
2	JVRII3	Raxe	29 avril								
3	JVRII9		25 mai								

Table 33: Table of the crunchy peas production

Crunchy peas											
Raised Bed	*Location*	*Variety*	*Seeding date*	*1st harvest date*	*End of harvest date*	*Notes*	*Growth Time (days)*	*Yield La Berthe (kg/week)*	*Growth Time for Fortier*	*Fortier results adapted at La Berthe*
1	TP2	Norbu NT	4-Mar	4-Jun	25-Jun	4 harvests on raised bed in 3 weeks	90	**10**	55	**11**
2	JVRI1	Norbu NT	23-Mar	17-Jun	25-Jun	Mices, loss of 10% on the raised bed, compensated by CP seeded in nursery 28 March, T 20		**12**		

						April (Win of around 2 weeks) de				
3	JVRI7	Norbu NT	15-Apr	2-Jul	3-Jul	Diseases: too late in the year?		**16**		

Growth time at la Berthe seems much longer (90 days) compared to Fortier (55 days). This is due to the fact that the varieties used are not the same. For la Berthe, it is crunchy peas, but Fortier is using snow peas.

Table 34: Table of the zucchini production

Zucchini									
Raised Bed	***Location***	***Variety***	***Transplantation date***	***1st harvest date***	***End of harvest date***	***Yield (kg or bunch)***	***Yield per raised bed at La Berthe***	***Yield per raised bed for Fortier***	***Fortier results adapted at La Berthe***
1	TP5	Parthénon	2 avril	5 juin		**44**	**44**	100	**89**

For the zucchinis too, the yield obtained by la Berthe is half the one of Fortier.

4.2.2. Comparison with Jean-Martin Fortier

One main interest of this work is to compare the data of la Berthe farm with the ones of its main model, Jean-Martin Fortier. Indeed, this enables to see the difference of yield between a new farm, at its second year of production, compared to an experimented farmer such as Fortier, who has been farming since 15 years, and settled at its current farm, the *Grelinette* farm, since 10 years.

The data presented by Jean-Martin Fortier are the ones present in his book *Le jardinier-maraîcher*.

As we can see when we compare la Berthe's results with Fortier's, the yield is almost always lower at la Berthe. La Berthe yield is almost always around 50% of Fortier's. This could be explained by different factors.

The climatic conditions are pretty similar between Canada and France.

Table 35: Table of climate comparison between la Berthe and Fortier

Comparison climate	**La Berthe**	**Fortier**
Location	Saint-Franc, Savoie, France	Saint-Armand, Québec, Canada
Latitude	45°29'N	45°02'N
Annual Precipitation	1221mm	929mm
Average temperature (°C)	6.5	6.7
Annual sun hours	1870	1904
pH (soil)	5.54	6.5
Soil	Silt and sand	
Altitude	550m	
Liming and Fertilization	Gross carbonate in 2014, Guanor (N6-P3-K1) in 2015, 3kg/raised bed before first rotation, 4kg/raised bed before second rotation	Chicken manure (N4-P4-K2) (5 to 7 liters/raised bed) and marine compost

Indeed, the latitude, temperature, annual precipitation and annual sun hours are pretty much similar.

The **pH** is a little higher for Fortier (6.5) compared to la Berthe (5.54). Fortier's soil has been enriched by liming (input of Ca) along the years up to reach this ideal state of 6.5. His soil was presenting a lack of Magnesium in the first years of vegetable growing. He compensated this lack by the addition of lime.

At la Berthe, in 2014, when they started the garden, the pH was still lower than the current result of the table (5.54). They decided not to add lime, which they thought, would be too aggressive for the soil. They preferred to add gross carbonat.

In addition, we need to consider the time of settlement difference. Fortier has been growing vegetables in his gardens since 10 years while at la Berthe they have only started since two years (2014).

Furthermore, the kind of fertilization used is different for Fortier compared to la Berthe. Indeed, at la Berthe, organic guanor is used (birds excrements developed by Frayssinet fertilizer company, N-P-K 6-3-1) when Fortier is using chicken manure pellet (N-P-K 4-4-2) and marine compost.

At la Berthe, 3 kg of Guanor per raised bed have been applied before the first rotation, followed by 4kg per raised bed in between the first and second rotations. For the highly consuming vegetables, Fortier is using 5 liters of chicken manure per raised bed (converted in 25m raised bed instead of 30m) and 3.5 wheelbarrow of marine compost. For the less consuming vegetables, Fortier is using 7 liters of chicken manure pellet per raised bed and no marine compost.

4.2.3. Comparison with organic farming in Rhône-Alpes Region (ADABIO)

This comparison has been difficult to develop due to the differences of initial conditions. Indeed, ADABIO, the association involving the organic farmers of those four departments including Savoie department, where la Berthe farm is located, is based on vegetables produced in regular fields. To make the comparison feasible with Fortier's system of raised bed that has been followed by la Berthe farm, we need to convert a field surface (given by ADABIO) into a raised bed surface.

The results I had until did not seem significant. While the results I had from Fortier's comparison seemed all to be around the same proportion, the ratio resulting from ADABIO's comparison is too variable. Maybe, this is due to a wrong method of conversion or too much difference in operating conditions.

Furthermore, we did not have access to all initial conditions to verify if the comparison was valid (fertilization and soil conditions for instance)

4.2.4. Expected income 2015

Table 36: Table of the expected income of la Berthe vegetable growers for 2015

Expected Income 2015

Planted vegetables	Nb of plants 2015	Distance on the row in m	Length row in m	Length of raised bed in m	Number of raised bed (25m)	Surface in m2 cultivated	Surface in m2 occupied	Production (kg)	Income/raised bed (euros)	**Income 2015 (euros)**
Zucchinis	294	0.6	176	176	7.1	141	212	294	400	2822
Squashes	200	0.5	100	100	4	80	120		600	2400
Onions	4100	0.15	615	154	6.2	123	185	933	400	2460
Leaks	2600	0.15	390	78	3.1	62	94	455	350	1092
Garlic	650	0.15	98	24	1	20	29		400	390
Carrots	50000	0.04	2000	200	8	160	240	1200	300	2400
Turnips	7500	0.1	750	125	5	100	150	833	300	1500
Beetroots	1700	0.15	255	51	2	41	61	272	300	612
Spinaches	5000	0.15	750	150	6	120	180	175	200	1200
Lettuces	3600	0.25	900	300	12	240	360	104	300	3600
Mesclun	165000	0.02	3300	275	11	220	330	183	350	3850
Radishes	20000	0.03	600	100	4	80	120	1000	300	1200
Green beans	750	0.1	75	25	1	20	30	50	300	300
Cracking peas	10000	0.015	150	75	3	60	90	88	400	1200
Chards	875	0.3	263	88	3.5	70	105		625	2188
Kale	250	0.3	75	25	1	20	30		200	200

Kohlrabi	1000	0.2	200	50	2	40	60		600	1200
Rutabaga	1000	0.15	150	25	1	20	30		800	800
Pointed cabbage	120	0.4	48	24	1	19	29		360	345.6
New potatoes	500	0.3	150	50	2	40	60		300	600
							79.8	**920**	**1400**	**30360**
Tunnel Solanaceae										
Cucumbers	110[3]	0.23	25	25	1	20		193	1000	1012
Eggplants	220	0.45	99	50	2	40		220	743	1470
Peppers	220	0.23	51	25	1	20		220	500	506
Basil	75	0.2	15	5	0.2	4		38	500	100
Melons	160	0.23	37	37	1.5	29		600	883	
							5.68	**114**	**255**	**3971**
Tunnel Tomatoes										
Tomatoes cindel	148[4]	0.23	34	34	2.0[5]	27			1330.4	2664
Tomatoes gourmandia	52	0.23	12	12	0.7	10			1330.4	936
Tomatoes corazon	22	0.23	5	5	0.3	4			1330.4	396
Tomatoes Kakao	37	0.23	9	9	0.5	7			1330.4	666
Tomatoes Cornabel	37	0.23	9	9	0.5	7			1330.4	666
Tomatoes Fenda	37	0.23	9	9	0.5	7			1330.4	666
Cherry-tomatoes	34	0.23	8	8	0.5	6			1330.4	612
							5	**68**	**170**	6606
Total Income (euros)										**40937**
Total m2 cultivated	**1101**									
Total m2 occupied	**2075**									

The farmers were expecting in an optimal case to get around 41000 euros according to their prevision of production.

4.2.5. Critics of economic data

Table 37: Investment and income along the two years of the garden

Economic data- Investment and income (euros)			
	2014	2015	Total
Investment	12000	13000	25000
Gross Benefit	10000	25000	35000
Net Benefit	-2000	12000	10000

The economic results seem very promising. Indeed, while the vegetable growers of la Berthe were in negative last year, they will produce a real income this year, if the forecasted benefit of 25000 is verified at the end of the year (beginning of December). At the middle of August, they already had a gross benefit of 10000 euros. The sales started at the beginning of May. So this gross benefit has been generated in 3 months and a half. Mid-August was than the middle of the sales year for la Berthe. Indeed, there had already been 3 months and a half of sales, and it remains still 3months and a half of production. Therefore, we could assume that the growers could at least double their gross benefit and get to 20000 euros by the beginning of December. However, we could assume that the growers will have slightly improved their production methods compared to the beginning of the year. The work of settling the gardens with the wooden planks and the compost has been made; the irrigation is also in place. The garden does not require so much work of preparation as it was the case during spring. The growers could be able to spend much more time to take care of the production. However, growing vegetables is an exigent work intellectually and physically as it means working outside manually an important part of the time and being involved personally as any entrepreneur has to be. We could than suppose that the growers will be a little more tired than at the beginning of the year and the yield reached will be lowered by this understandable factor.

5. DISCUSSION

5.1. Year 2014

For year 2014, despite a late start in end of April and no experience at all, the vegetable growers succeeded in producing for 10000 euros of vegetables.

5.2. Year 2015

5.2.1. Up to mid-August

In mid of August, the income of the year was already of 10000 euros. 25000 euros is the prevision for the end of the year, which is a promising result for a second year of vegetable farming.

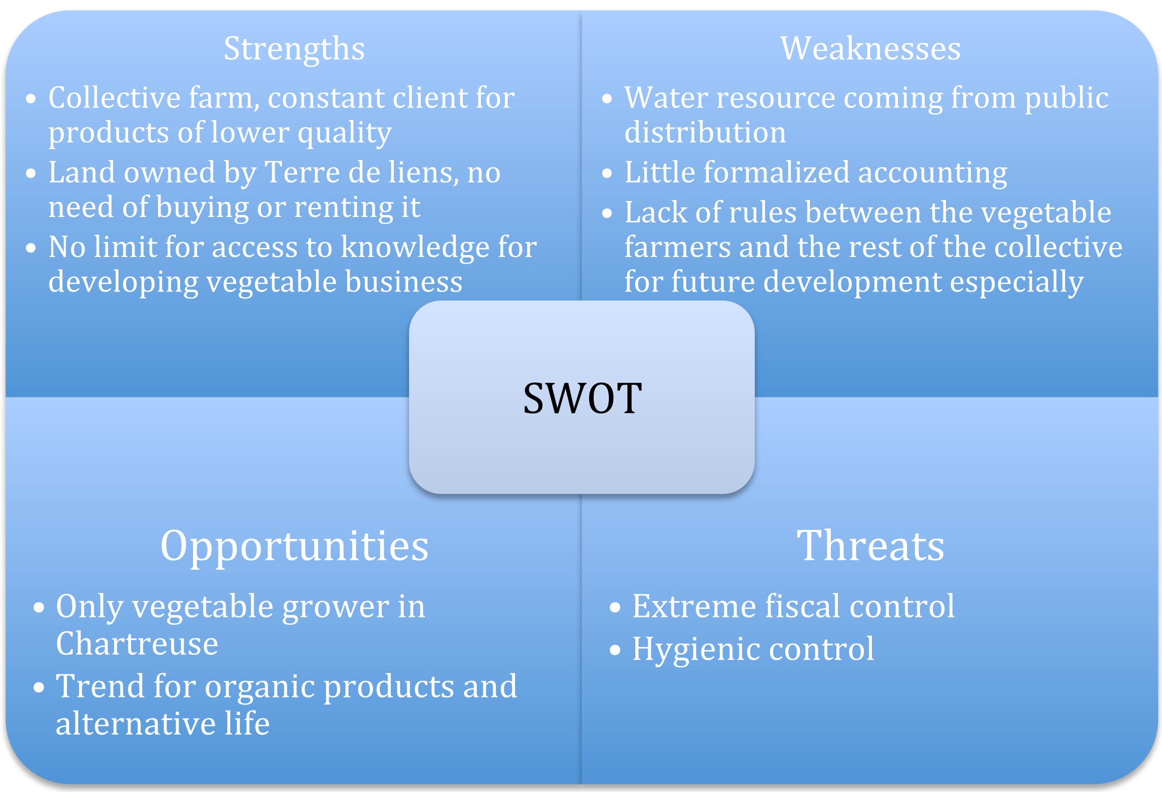

Figure 10: SWOT analysis of the vegetable farming at la Berthe farm

The main strengths of the vegetable farming at la Berthe is that the vegetable business takes part inside a collective farm where around 15 people live permanently and are non-exigent clients for the products of lower quality. The land is owned by the French organization Terre de liens, which is a great chance for the farmers. They did not have to buy the land or to rent it. In addition, there is no limit of access to knowledge in term of developing the vegetable business, especially with Internet.

The weaknesses are that the water resource is coming from the public distribution. When summer is very dry, as it was the case this summer 2015, the water can lack. The Saint-Franc commune manages this public water, and as several farms are present on the commune, the water is very much used during summer. A water spring is present on farm and it could be used in the future in order to decrease the reliability on the public network. The accounting is not very defined and precise yet. More work should be done, as incorporating the salaries that the farmers should pay to themselves. There is still a lack of clarity in terms of future plan for all farming activities at la Berthe. Indeed, there is very little communication about this issue, which should be discussed more clearly for avoiding any kind of conflict in the future.

The opportunities for the vegetable growers are that they are the only vegetable grower in Chartreuse, which is a good point for marketing as the trend for organic products and alternative life is increasing.

The potential threats are the risk of having a strict fiscal control for a young enterprise starting. The rules applying to bigger enterprises cannot be the same than the ones for small entrepreneurs just starting.

Hygienic control could be problematic. The farmers do their best to make their vegetable room clean, but there are still improvements to make the floor and walls clean.

5.2.2. Prevision for the end of the year

15000 euros should still be made by the end of the year, from mid August until beginning of December.

5.3. Critics of data

The waste has always been included in the harvesting results, and has not been withdrawn from the results. We could consider that 10% of the harvest has been wasted because it was not sellable on market.

5.4. Suggestions of improvements

- Drainage of the garden

Drainage has already been made in between the greenhouses and the external gardens. However, a part of the external gardens is still continuously wet. Another drainage at the top of the gardens would be a good way of drying up the land. This could enable to improve the working conditions, as the path in between the raised bed would be dried. In addition, this could certainly enhance the vegetable yield as we could clearly see during the season that the vegetables growing in the wet parts of the garden were always lower than the ones in the dry parts of the same raised beds.

- Starting the production earlier and in bigger quantity

This will be possible from year 2016, as the main works have been made for the garden during spring 2015.

- Irrigation in order

The irrigation has taken time during spring 2015 to be set up; this meant that most of the raised bed had to be irrigated by hand at the beginning of the season. The human factor means a lower efficiency in the irrigation quality than a program that runs frequently. The yields have been affected by this fact.

- Better choice of varieties

As it was only a second year for the farmers, they were still experimenting with many varieties and some were not adapted. Year 2016 will be their third year and they will have gathered more experience by this enriching year 2015.

- Better organization, separation of tasks, schedule

The organization was not optimal during year 2015 yet. The separation of tasks was not clear and the working schedules neither. With time, the farmers will become more efficient; each of them specialized in one particular activity. They are three people now, two of them working full time and one of them working a third time. One of them, the woman, is getting specialized in seeding preparation, inside the nursery and straight on field too. One man is specialized in the garden maintenance and marketing and the other in the general planning and organization. This year, this repartition was still a little fuzzy, but we can hope than next year this will be clearer and make them more efficient while improving their working quality.

5.5. Projection for 2016 and next

Next year, in 2016, the farmers should be able to produce for 40000 euros as the gardens of 2015 are settled and as they also undertook since this autumn the building of two new external gardens. For 2017, the idea would be to build two other new gardens to get to 8 external gardens. The farmers are aiming to get to 50000 euros a year for two people, as the study from the Bec Hellouin showed (Morel, 2015).

5.6. Short analyze about the collective

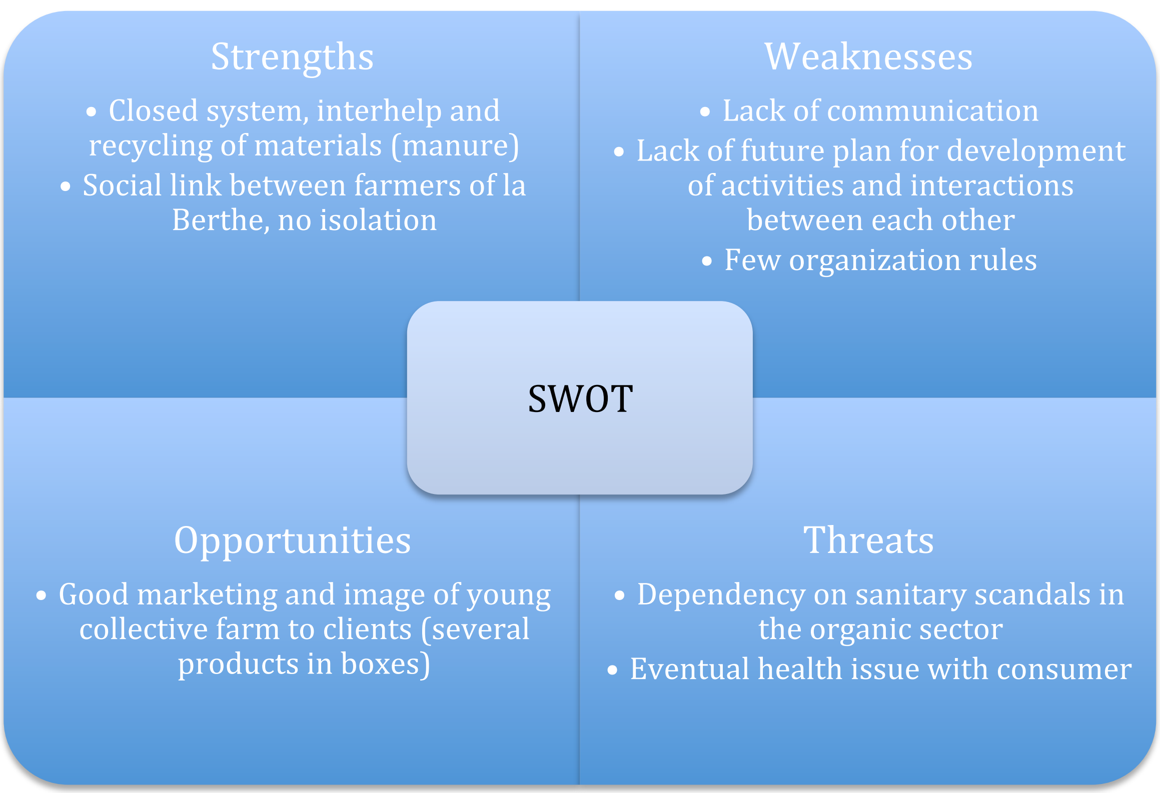

Figure 11: SWOT analysis of la Berthe farm collective

The main strength for the people living in la Berthe Intentional Community is that they live in a closed system, where they can help each other, avoiding the problem of isolation many farmers face. The different activities can help each other. For instance, the manure of the goats can be reused in the gardens as fertilizer.
The main weaknesses is the lack of future plan for the farmers who haven't developed any action plan for the different activities development and their good collaboration, this has to be brought on the table by frequent meetings, which is not the case yet due to the lack of communication in between the people living there.
The main opportunity is the good marketing that is made by the farmers of la Berthe. Thanks to their website, they succeeded in reaching 1000 euros per week in September just with the boxes of vegetables.
The main threat is based on the dependency to the organic sector and on the risk that a health problem related to a product of la Berthe could make them in trouble if it ever happens that a consumer would get sick and would complain that it is the farmer's fault.

6. CONCLUSION

The collective dimension of the farm has been one of my main motivations for undertaking this internship. I had the idea of experimenting the learning of vegetable gardening inside a collective project, which is making the farming system more complete as the gardening activity is connected to other farming activities.
The job of farmer is nowadays in Europe considered as a hard and isolated job and which is fled by most of the youth. Nevertheless, la Berthe farm seemed to me an inspiring counter example since I visited it for the first time in November 2014. However, rules have to be clarified to make the collective sustainable, by frequent meetings.
The vegetable farming activity demonstrated that the growers are able to produce 25000 euros in a second year of activity out of 1200m2. However, this requires having some funds available, as around 25000 euros of investment in two years were necessary. This has been possible thanks to the fact the land is rent to Terre de liens at low price, to the partners savings and to the technics of intensive vegetable growing

mostly based on Jean-Martin Fortier. The two partners, at the end of the second year, would be able to generate 10000 euros of net benefit. However, a part of it, around 2000 euros, will be reused for investment for next year. 8000 euros remain, which is 4000 euros per partner. This is around 320 euros a month. At la Berthe, the average cost of living is between 600 and 900 euros a month. Furthermore, they were helped this year by a volunteer, an intern and other people. They could count on other labor than themselves. This shows that the farmers still have to increase their benefit to make their business profitable. This has clearly been shown by the comparison with Fortier's result. They only reached half of Fortier's yield. With starting the year earlier, with a garden ready at the beginning of the year and with improving the growing methods used as it was developed previously, the farmers can increase the yield obtained and they could possibly reach the same results as it was proved at the Bec Hellouin Farm that 50000 euros can be made out of 1000m2 on an organic vegetable farm with no use of mechanization (Morel & al, 2015).
The farm cannot be considered as economically viable in its current state, but a profitable state could be reached in the third year (2016) or fourth (2017).

This analysis has to be followed in the short-term future to draw further conclusions.

7. REFERENCES

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8. APPENDIXES

8.1. Result of soil analysis by the CESAR laboratory

CESAR

Centre Scientifique Agricole Régional

Laboratoire agréé par le Ministère de l'Agriculture
agrément type 1, 2 5

BULLETIN d'ANALYSE de TERRE

Intermédiaire :

Vos références :

Parcelle : **PN BAS LA BERTHE**
Commune :
Sol :
Utilisation : **Prairie**
Coordonnées Lambert :
Tx apparent de cailloux :

SCHAMASCH THOMAS
LA BERTHE

73360 ST-FRANC

Nos références :

N°échantillon : **TER-15070025** *Reçu le :* **03/07/2015** *Date envoi bulletin :* **22/07/2015** *1er envoi :* **22/07/2015**

CONDUCTIVITÉ NFX 31-113

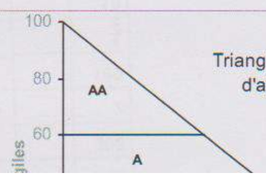
Conductivité : *Résistivité :* **Ω.cm**

HUMIDITÉS

À 105°C : NFX 31-102 *Équivalente :*

GRANULOMÉTRIE NFX 31-107

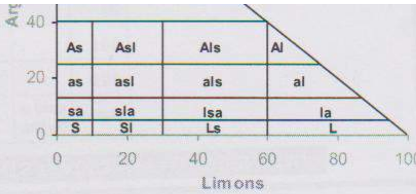
Refus : *Terre fine :*	*g / Kg*	*%*
	de terre fine	
Sables grossiers		*Sables :*
Sables fins		



Triangle des textures d'après Hénin

Page 1/2

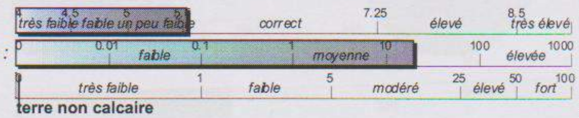
Limons grossiers		Limons :	
Limons fins			
Argiles			



Type de sol :
Texture :
Pierrosité :
Structure :
Risque d'asphyxie :
Aptitude fissuration :
Indice de battance :

STATUT ACIDO-BASIQUE

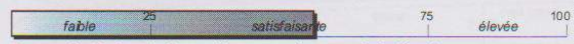
pH eau : NFX 31-117	**5.54**	sol acide
pH KCl : NFX 31-117	**4.69**	acidité potentielle :
Calcaire total : NFX 31-105	**0** g/kg	
Calcaire actif : NFX 31-106	g/kg	
Indice de pouvoir chlorosant :		



terre non calcaire

STATUT ORGANIQUE

Carbone organique : ISO 10694	**31.7** g/kg
Matière organique :	**54.6** g/kg
Azote total : ISO 13878	**3.0** g/kg
Rapport C/N :	**10**



Bonne évolution de la matière organique ; minéralisation correcte

...hantillon : TER-1507025
Date de réception échantillon : 03/07/2015
Date envoi bulletin : 22/07/2015

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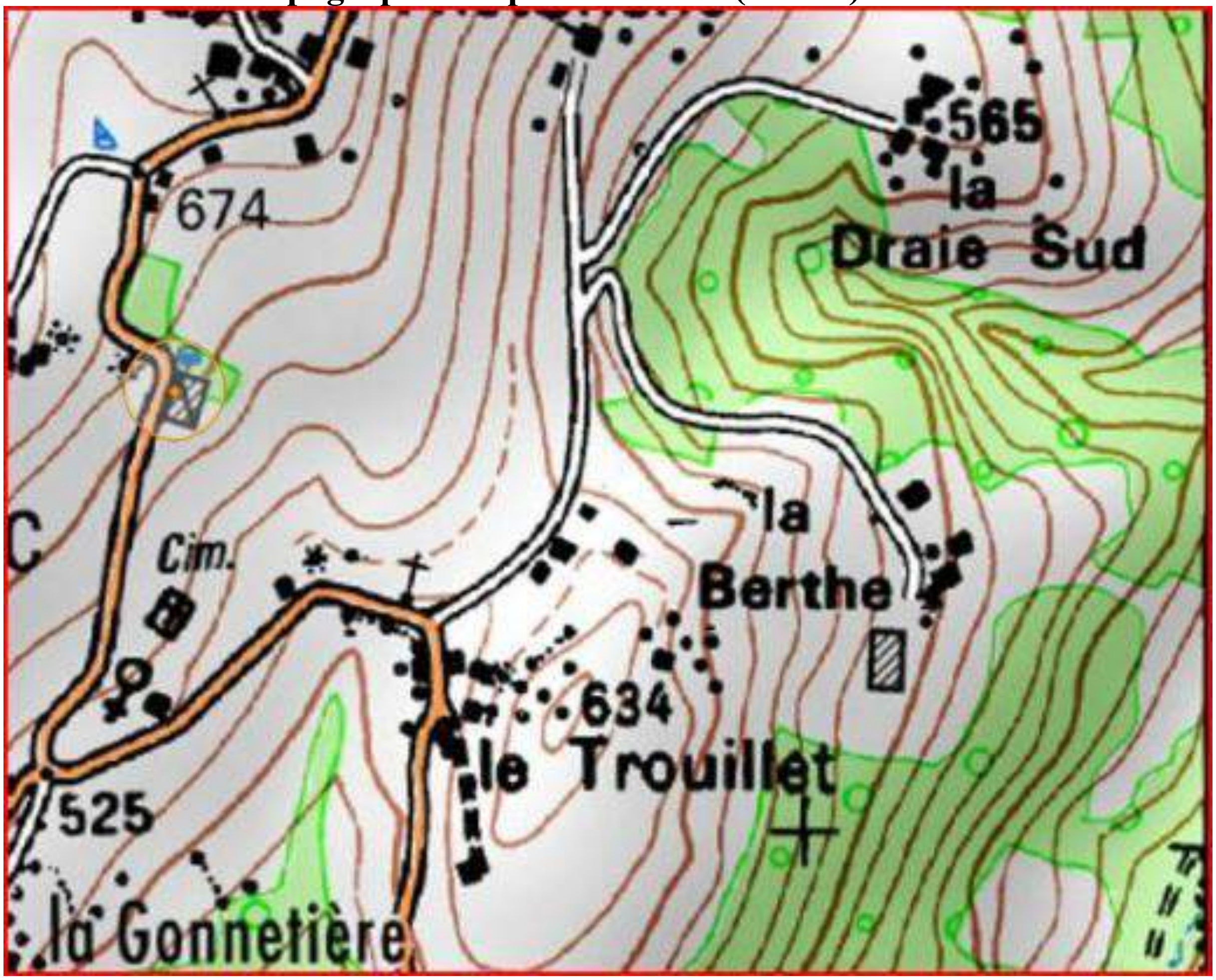
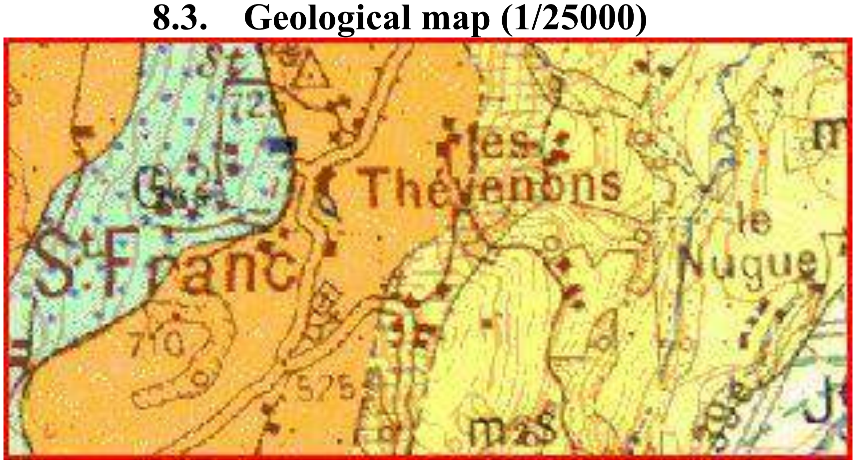
Tél. : 04 74 25 09 90 - Fax. : 04 74 25 09 95
Site Internet - Email : www.labo-cesar.com - cesar@labo-cesar.com

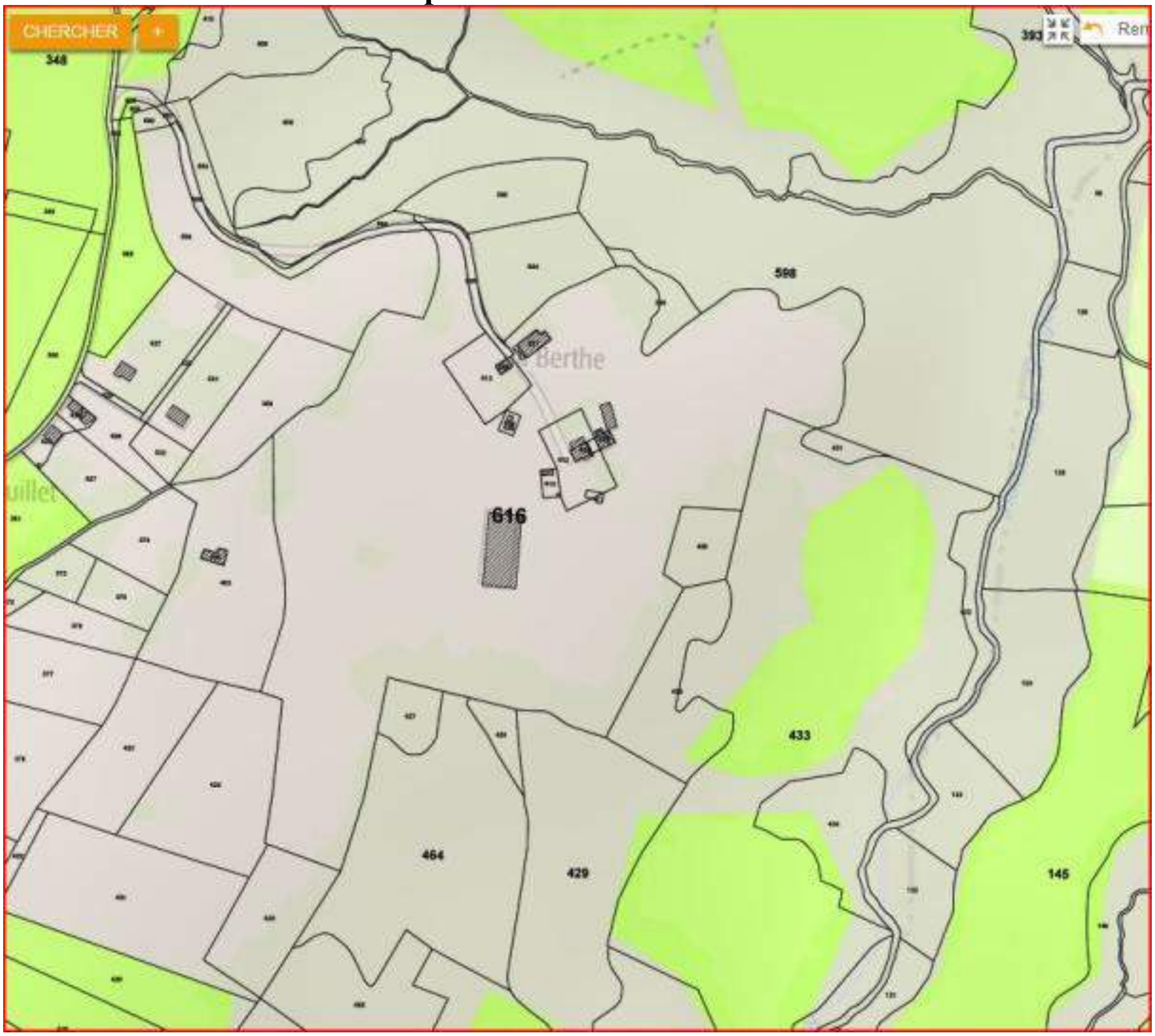
8.2. Topographic map of la Berthe (1/8500)



8.3. Geological map (1/25000)



8.4. Schematic map of la Berthe



8.5. Visit at the Bec Hellouin farm

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