

# Sustainable Horticulture and Agriculture Crop Production in the Czech Republic

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## Introduction to the Czech Republic

The Czech Republic was chosen as the subject of this paper because it is located in a very vibrant



Central Europe surround by Germany, Poland, Slovakia, and Austria as shown in the Figure 1. In Europe, greenhouse production seems to be very prevalent especially with The Netherlands situated in the center of Central Europe. There was not a lot of information about

sustainability in crop production in the Czech Republic so that was another reason that this paper was written. Further information of sustainability practices is important not only in Minnesota where I am from, but for places all around the world.

Like previously mentioned, the Czech Republic is a small country located in the center of the European continent bordered by the countries of Austria, Slovakia, Germany, and Poland.

The total amount of land that borders these countries is 1,989 km. There is 0km of coastline

located throughout the country, as it is situated in the center of Europe. Land area for the Czech Republic is 78,867sq km with its size ranking 115 out of all the countries in the world. 1,620sq km is the total amount of land that is covered in water and 77,247sq km is land covered. The amount of arable land in the Czech Republic is 38.82% with another 3% belonging to permanent crops. The climate consists of temperate, cool summers along with cloudy, cold, and humid winters (C.I.A., 2010).

The Czech Republic has 10,211,904 residents in a very small area of land, and is comparable to the area of North Carolina, USA (C.I.A., 2010). This high population density has caused problems with providing enough natural resources for everyone in the country. Czech is the most common nationality (94% of the population); Slovak, Roma, Silesian, Polish, German, Ukrainian, and Vietnamese make up the other 6% of the population (D.O.T. 2009). The majority of the population is between the ages of 15-64 years of age with them accounting for 71% of the population (C.I.A., 2010).

The Czech Republic is a reasonably prosperous and stable country compared to other post-Communist countries of Central Europe. Their key to success has been holding an open investment climate, being a member of the European Union (EU), and having an advantageous location in the center of Europe (C.I.A., 2010). The Gross Domestic Product (GDP) of the Czech Republic is 256.7 billion dollars (1.4 trillion kroners) is ranked number 42 in the world. GDP for agriculture is set at 2.8% for the Czech Republic with 35% and 62.3% accounting for industry and service, respectively (C.I.A., 2010).

Prior to World War II, the Czech Republic was a much more prosperous nation. Not until after the Velvet Revolution in 1989 was the country able to turn around not only their whole economy but also their agriculture/horticulture market. Today, the agricultural production

of the Czech Republic is typical for that of a temperate European climate. In 1997, more than half of the arable land in the country was used to sow annual crops. These crops were mostly cereals (54.9%) while another 25.4% was used for forage crops. Other crops that are grown in the Czech Republic are rape seed (*Brassica napus*), sugar beets (*Beta vulgaris*), and potatoes (*Solanum tuberosom*) (Casaki, 1999). Another list suggested that fruits, pigs, and poultry were also majorly grown products in the agricultural industry (C.I.A., 2010). A few of the most important cereals produced in the country (winter wheat and barley) are used for other big industries in the country including brewing and livestock production (Casaki, 1999). Fruit production is very prominent in the Czech Republic because of the temperate climate that is unlike other countries of the Middle-European countries. The main fruits produced in the country are pears (*Pyrus communis*), apples (*Malus sp.*), cherries (*Rhagoletis cingulata*), and apricots (*Prunus armeniaca*) (Casaki, 2009).

### **Sustainability in the Czech Republic**

The Czech Republic has made tremendous leaps in terms of the sustainability used in the country. Not only has it changed incredibly in the past 20 years by cutting down on greenhouse gas production and use of natural resources that are very harmful to the environment, but it has also integrated programs that will help protect the magnificent landscape of the Czech Republic. Overall, the changes that were implemented in the early 1990s have had been incorporated into the landscape in recent years making the Czech Republic one of the forerunners in sustainability agriculture and economy.

As a member of the Organization for Economic Co-Operation and Development (OECD), the Czech Republic has been provided with a very broad definition of sustainability according to the committee. Their definition was:

Sustainable development has been defined a variety of ways, but in practice it has come to mean development that achieves a balance among economic, environment and social objectives for both present and future generations. [And]...most national strategies have a greater focus on environmental issues with some attempts to incorporate economic aspects (OECD, 2006).

The OECD has provided important programs for numerous countries throughout the world to implement sustainability practices. Most of the countries, including the Czech Republic, had originally used *Agenda 21* to start sustainable development. *Agenda 21* was implemented by United Nations for participating nations wanting to develop more sustainable practices throughout their countries. Furthermore, the Czech Republic has a medium time-framed program for sustainability in which changes will be made from the year 2004-2014. This time frame allows for the program to make mistakes if they are to happen (OECD 2006).

The Czech government, according to the United Nation's *Agenda 21*, also has a broad but somewhat similar idea of sustainability written into law for their country.

In its preamble this law speaks of 'a human's right to transform nature in accordance with principle of sustainable development,' 'the responsibility for maintaining a healthy environment for future generations' and of 'the right to a favorable environment as one of the rights of a human being (Agenda 21, 2007).

The law is used in the Czech Republic to remind its citizens to take care of the land that they have. One of the main goals of most sustainable programs for countries who agreed to *Agenda 21* was that there would be a protection for human health by providing changes with chemical and physical aspects of the environment that may be harming them and the landscape (Agenda 21, 2007).

"The Czech Republic ranks 4<sup>th</sup> among 133 countries (after New Zealand, Sweden, and Finland) in terms of its environmental performance, according to a 2006 report from the Yale center for Environmental Law and Policy" (Molden, 2007). Because of this agriculture, output for the GDP decreased by 9% and allowed for 28% fewer fertilizers per hectare in the country.

Numerous committees are providing the Czech Republic with policies to protect their country and keep it a sustainable land area. This is important because the Czech Republic is going to need several steps to make it a more leading country in agriculture. “The country’s strategy of environmental protection is based on the ‘State Environmental Policy of the Czech Republic’ (SEP) (Ensure, 2002). This committee is hoping all of this will lead to high efficiency in resource use, less pollution, conservation and enhancement of biodiversity, and in the end better living for the residents of the Czech Republic (Millennium, 2002). Again, providing environmental production will not only benefit the population of the Czech Republic, but the agriculture industry as well.

There are numerous reasons why the Czech Republic has become a prototype in the development of sustainability. There are many institutions throughout the country that help implement policies. These include: The Ministry of the Environment of the Czech Republic, Agency for Nature Conservation and Landscape Protection, Research Institute of Ornamental Gardening, and the Czech Environmental Institute (Agenda 21, 2007). With these agencies and others the Czech Republic has been able to gain important knowledge for what it needs to become a more sustainable country. These four agencies, along with countless others are also dedicated to helping the country lower the use of fertilizers and pollutions that are present in the Czech Republic (Agenda 21, 2007). Funding has also been an important issue for the programs. The National Property Fund supports several project hosted by these bureaus on air protection, waste management, and landscape and soil restorations (Agenda 21, 2007).

A particularly clever idea currently used for a sustainability practice in the Czech Republic is the use of waste wood as a renewable energy source. This is particularly interesting because it could be used to heat greenhouses therefore making them sustainable and using this to

increase their exports of ornamental horticulture goods. According to an article in Energy Policy, wood has been used to heat homes throughout the country because of the abundance of the resource. The ability to use wood for greenhouses would not only help the clean air acts implemented in the Czech Republic but will also provide a beneficial way to reuse the abundant amount of lumber that is present in the country (Jehlickova, 2007). The only problem that may present itself with this is the pollution caused from burning the wood itself, more research needs to be done in order to conclude whether or not this could be a sustainable practice.

### **Historical Production Practices of the Czech Republic**

Historically, agriculture has only played a very small role in the economy of the Czech Republic due to the small amount of natural resources present in the country (Food & Agriculture book). There were times throughout its history where the country had some positive production of crops. In the early 1930s, agriculture in the Czech Republic was well developed and a primary importer of crops from neighboring countries (Caski, 1999). After the socialist regime, the former Czechoslovakia was split into the current Czech Republic and Slovakia. After this, agriculture took a turn for the worse by falling behind newer technologies and standards that were being developed in both Western and neighboring countries (Caski, 1999).

As mentioned earlier, there was a time when agriculture was more abundant in the region, particularly vegetable production. A wide range of vegetables are sold at farmer's markets and along the roadsides. In addition, during the summer-fall months blueberries, cranberries, and other cane fruits are harvested in the wild and sold by the roadside. During the former socialist rule of Czechoslovakia, 5 or 6 major agriculture firms produced about 70% vegetables grown in the Czech Republic (Caski, 1999). Most of the crops produced during that time were onions, potatoes, cabbage, and root vegetables. These crops have continued to be important for the

Czech economy along with a few added others. During the 1980s, the average consumption annually was estimated to be about 700,000 tons of vegetable per year for the entire country's population.

Greenhouse production was also more prominent in the Czech Republic at one point in its history. In 1984, 220 hectares (ha.) of greenhouses and 200 ha. of plasticulture were present in the nation at the time for creation of vegetables, seedlings, and flowers. During this era, there was somewhat of an interest in the practice of greenhouse growing. However, by 1989 the number of greenhouses dropped dramatically down to around 64 ha (Caski, 1999). There were numerous reasons for the decrease in the number of the greenhouses in the Czech Republic. The primary reason was there were other warmer countries in Europe and North Africa that were more suitable for greenhouse production. Another reason was that the greenhouses were often inefficient and poorly made so they did not last long (Caski, 1999).

### **Current Production Statistics**

As stated previously, the total amount of land area used for crop production in the Czech Republic is 38.82% of the total land mass. This land is used for growing a wide variety crops for the Czech Republic. Not only, does it provide the population with a food source, but some are also becoming bigger commodities which may eventually lead to a source of income for the country.

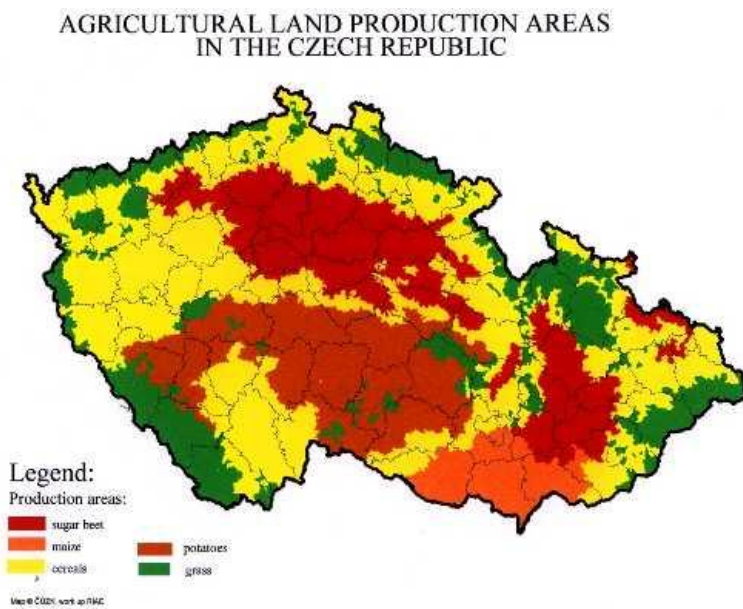


Figure: Czech Fig. 2—Production Areas in the Czech Republic  
(<http://www.fao.org/ag/AGP/agpc/doc/Counprof/Checkrep/czechfig2.jpg>)

Current production statistics in the Czech Republic are somewhat varying. Overall, the country is an importer of several agricultural goods and they rarely are growing enough to be an exporter of any particular crop. However winter wheat, barley, corn, sugar beets, and corn are produced quite regularly to provide for the Czech population; the meat industry provides as well. Winter wheat may also be produced abundantly enough to become a main export for the country as well. Czech Fig. 2 shows that the main crop produced in the country are cereals: wheat, barley and other similar grain species. The second most prevalent crop is that of sugar beets which are grown in the center of the country. The smallest amount of arable land is dedicated to the production of corn.

A few statistics for winter wheat, barley, and corn will be expressed from the year 1991. In that year, the Czech Republic produced 6200 metric tons (MT) of wheat with a steady increase over the past 30 years, 3790 MT of barley also with a steady increase, and 860 MT of corn with varying quantities over the past 30 years (Indexmundi, 2009). Looking at these



numbers, it is obvious that the agricultural crop produced in the Czech Republic is that of wheat. Another common commodity present in the Czech Republic is that of sugar beets, the Czechs use this product to produce a sugar that is then used to make rum. Fruits and vegetable production play a small role in the agricultural production of the Czech Republic. The main fruits produced are pears (*Pyrus communis*), apples (*Malus sp.*), cherries (*Rhagoletis cingulata*), and apricots (*Prunus armeniaca*) (Casaki, 2009). Potatoes also play somewhat of a large role for the country.

### **Current Production Practices**

Agriculture and crop production has never really been a primary source of revenue for the Czech Republic. However, more and more policies of sustainability are being introduced in order to help with the current production practices. The current farming structure consists of three categories: the first making up 38.7% of the agriculture business, belongs to cooperatives in an assortment of forms, based on mostly privately owned land leased from the companies. The second major forms of farming are incorporated privately-owned larger farms operating on leased land from the state or private owners, accounting for 35.4%. Finally, individual private farms account for 25.1% of agriculture land with the land they lease (Caski, 1999). This indicates that the majority of the country may eventually turn to larger run companies to do all of the agriculture crop production for the Czech Republic.

As of the 2008 year, organic farming has become increasingly important in the agriculture landscape of the Republic. In June of 2008, 7.84% of arable land was used for organic farming (Ministry of Agriculture, 2008). There was a steady increase from 2007 to 2008 with the number suspected to increase. The yearbook also stated that from year 2006 to 2007, the number of organic vegetable production was suspected to increase by 56%. This is an important concept considering organic production may lead to a more sustainable way to process

food crops for the country making it appealing as a sustainable landscape. The most common crops produced organically in the country are common wheat, spelt, oats, and rye (Ministry of Agriculture, 2008). All of these are used as cereal products and are very important to the economy. Along with those cereals, field peas, carrots, cabbage, and greenhouse crops fall among the top products produced organically (Ministry of Agriculture, 2008). For the country, the appeal of these products can be seen through the abundance of them appearing in markets throughout the landscape. Organic farming in the Czech Republic does not stop at vegetable/fruit production but also involves livestock and domestic animal products. The top organically produced livestock are beef, sheep, cow's milk, and also chicken's eggs. Overall, the Czech Republic is taking several strides into becoming an organic crop producing country.

Fruit and vegetable production in the Czech Republic is also essential to the economy (fruit more so than vegetable). Production of vegetables has included almost 18 cultivars of main vegetables that take over 400 ha. to grow. Furthermore, some areas of the country are very adapted to growing vegetables in those regions. However, even with favorable areas that are able to grow vegetables there are still many details that need to be fixed in order to make vegetables a higher priority commodity in the country. These elements include the current vegetable production problems including: improving genetic material, improved crop production, and also improvement of packaging and shipping (Caski, 2007). Fruit, on the other hand, has become a very important commodity for the Czech Republic. Because most of the fruit grown there is in need of a temperate climate, fruit has become almost abundant enough to become a major export of the country (Caski, 2007). This could not only help the country transform from a leading importer to exporter but provide numerous jobs for people.

The current state of greenhouse and wholesale production is far from dominant but still present in the Czech Republic. Many of the greenhouses are owned by the government and were once connected to large power companies that offered warm water and electrical power from the plant (Jensen, 1995). The increasing strength of the Dutch floriculture industry has caused greenhouse production in the country to decrease. As of today, there are only about 20 ha. of greenhouses used in the Czech Republic to produce ornamentals (Jensen, 1995). As for wholesale growers, they are also there but very small in number. About 500 inexperienced, wholesale fruit and vegetable organizations registered with government in 1992. The reason why wholesalers are not making an impact on the economy is because the competition from bordering countries is making it hard to make a substantial difference between net imports and exports (Caski, 2007).

### **Integration of Historical and Current Production Practices; Ranked Strategies**

Due to the overwhelming amount of imported crop products into the Czech Republic, it is hard to begin a process of integrating both current and historical production practices. To better understand the agricultural economy and find a way to better it, the main focus will be on the current and past production of apples in the Czech Republic. Although the product is not grown in greenhouses, the ability for the Czech Republic to make this a major export may allow them to grow more of their own crops while not relying on the Netherlands and other neighboring European countries.

Current studies on varieties of apples grown in the Czech Republic are being conducted at Penn State University. This research consists of producing apple varieties organically that are both disease and growth-defect resistant. The apples that the institute is considering to be promising are from the Czech Republic and Germany. Fruits in the study are grown to be scab

resistant and produce almost perfect apples that would do very well in the market (White 2009). Apples from the Czech Republic are being used for this research project which could help turn them into a more widely produced crop in the area because the research could be used as a marketing tool. This could be important for the people of the Czech Republic because it can provide a means of living for many families and help bring the country into an important role as distributor and grower of organic products.

Areas of to become more sustainable	Benefits	Downfalls	Ranking
Use of insecticides that are organically compatible	Less harmful to than environment than previously used insecticides. Biological control will be used more	May not always work and could affect an entire apple crop if not conducted in the right manner	1 <sup>nd</sup> most important aspect of developing a sustainable apple production facility
Planting trees that are already scab/disease resistant	No need to spray for diseases later in production and can worry about growing the plants to their full potential  Provides an areas of research for the Czech Republic to explore to further their exports of apples	If scab/disease resistant prove to be unsuccessful in the region of the Czech Republic  Research is a long process in the field of apple breeding; can take up to 50 years to get to a desirable cultivar	2 <sup>nd</sup> most important development into a more sustainable production of apples
Promotion of a agriculture that is organically produced by Czech Government	The Czech Republic already has numerous classes/advertisements on organic food, so adding on to it would not be hard  Postcards, billboards, commercials could all be ways to promote small operation	The price of organic food is on average 80% higher than that of non-organic food  Promotion would need to be directed to a customer base that understands that buying from small farmers is the only	3 <sup>rd</sup> most important factor when considering sustainable apple production in the Czech Republic

	growers into the market	way to go	
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Table 1: List of Ranked Strategies to Develop Sustainable/Organic Apple Production in the Czech Republic

The next step in turning apple production into a higher commodity as a sustainable production practice is figuring out what areas need to have more improvement; these production practices can be summarized in the **Table 1** above. The biggest that must be dealt with when beginning to grow apples is site analysis and dealing with the problem of insects in a way that would provide the most sustainability and still be considered organic in practice. The most important issue affecting the Czech Republic in making apples a marketable product would be that of location which will be discussed further into the paper.

Location for growing apples requires careful consideration of several growing aspects. Site assessment, orchard design and tree quality, orchard preparation, and tree planting are the four main subjects to be considered when starting an orchard. For the Czech Republic, soil and land maps would be useful in setting up areas that could be turned into organic apple orchards. The ideal land area would consist of an upper side of a gradual slope, rolling or elevated land, and soil that is well-drained. Once this area has been found, soil quality tests should be done. The orchard should maximize efficiency in all aspects of growing, which means that maximum light should be intercepted in the areas that are growing the apple trees. Finally, trees need to be ordered and planted properly. When ordering trees considerations should be made for trees that virus-tested, have a strong root system, and are well feathered.

The next common problem for organically or sustainably producing apples is the problem of pest management. The next strategy that would have to be considered in implementing an apple production facility in the Czech Republic would be introducing organically certified ways to control pests. These pest management schedules will consist using biological controls to

control pests and using available organic compounds to control pests. Some examples of the pests and the control methods that could be used are: codling moth could be controlled by Cyd-X, or horticulture oils, Apple Magot controlled by Entrust, European Apple Sawfly by Surround, and Japanese beetle by Aza-Direct.

### **Finalized Sustainable Development Strategy**

To incorporate all of these ideas into a brand new facility the factor of cost would be the only shortfall. Purchasing of land, trees, hired help, and the time it takes to begin an orchard is time consuming and could turn away potential participants. The cost of trees and land is minimal in comparison to the amount of labor that is required to prune and train trees at young ages. However, with the high price of labor and the cost of building such a facility there would be a benefit for the country as a whole and provide a way for the Czech Republic to find its place in the European horticulture market. Also, the cost of labor should decrease over time as the trees begin to fill out and become larger.

Rewards of beginning large production of apples in the Czech Republic are much more outstanding than the negative effects of opening apple orchards throughout the country. With the world continually looking for sustainable development, crops and “organic” foods are becoming more and more frequent and popular, organic apple production may be the way for the Czech Republic to become an exporter of an agriculture product. Money that will be spent on pesticide management, purchasing of trees, and building of facilities will easily be paid off once the apples are presented to the market granted there is good marketing and promotion.

By growing apples that are already disease and scab resistant production managers would be able to avoid some costs of pest management. There are also other ways in which costs could be cut when beginning an apple orchard business. Making sure that soil, land, and area are

suitable enough for growing apples before beginning will help save time and money when starting a large production of apples. To prevent major economic loss of poor soil the first ten years of production will need to be on a smaller scale and soil tests throughout the growing facility will need to be done. This will ensure healthy growing and eliminate any problems that may occur with poor soil quality.

Although the Czech Republic is not at the forefront of horticultural produced crops, the development of apple orchards would be attractive to the country because it would provide an economic boost. A good marketing tool that could be used to have people support the production of apples in the Czech Republic is the idea that in the past each family of the Czech population had an apple tree that was specifically theirs. They could eat the fruit and do what they pleased with tree and each tree belonged to one family. With that little history, the population of the Czech Republic should be excited to begin a much more vigorous production of apples.

Another reason implementation of an organically produced apple farm would be ideal in the Czech Republic is because the country is already a leader in the organic production industry in Europe. Furthermore, there is currently 711,31 tonnes of apple organically produced in the Czech Republic (Organic, 2008). This fact would help justify the reason for building more organically run apple orchards throughout the country.

Finally, marketing of the organically produced fruit will be very important in the development of the orchard. If consumers refuse to buy the crop because it may be overpriced there is no chance the facility will make it through the first year. Promotion, education, and marketing should be three concerns when making this sustainable idea work for this type of growing facility.

### **Design a Future Sustainable, Controlled Environment Facility**

As mentioned earlier, the main crop that will be focused on is organic apple production in the Czech Republic. Because the organic crop production is already successful in the Czech Republic, implementing sustainability could prove to only be beneficial for the further production of this crop. The reason this crop was chosen to be discussed further in this paper is because apples have had an interesting history in the Czech Republic and could prove to be an important exporting crop in the future for the Czech Republic.

The apple orchard that would be trialed in the Czech Republic would be located southeast of Prague. The reason for this is because the Ministry of Agriculture is located in Prague and being close to the city would prove to be beneficial for further development. The amount of land that would be in production would be small to begin with to test the viability of the production facility. Five hectares of raised, well-drained land would be used to initiate the production of the apple orchard. Five hectares should hold about 1,250 trees, giving the production facility an adequate supply to do research on and use different varieties (Pennsylvania Tree, 2010). Apples that would be used would include several varieties native to the Czech Republic and varieties that are scab resistant.

Several experiments would be done to determine what varieties perform best in the area and also what produces the best fruit. The amount of time to answer these questions will vary depending on how much information is pulled from the trials each year. Rootstocks will be the main way in which varieties of apples will be introduced to the orchard. Based on an article by F. P. Weibel and F. Suter, rootstocks that are grown in organic conditions will perform alright especially with the varieties Supporter 2, Fleuren 56, and Cepiland (Improved, 2008). These varieties will be tested at the orchard. Other apple varieties that could be tested on the orchard



consist of apples that are native and grown in the Czech Republic. These include but are not limited to Goldstar, Otava, Rajka, Resista, Rosana, Rubinola, Selena, Topaz, and Vanda. All of these varieties are not scab resistant but could be genetically modified to make them more appealing to growers. The research conducted on the farm could then be used in other countries therefore making the Czech Republic stand out as a top apple producer in the world.

The production schedule for the crops will have to first consist of a couple years of growing the rootstocks up to a size large enough to support fruit. Not previously mentioned, but the rootstocks that will be used to start the orchard will need to be organically produced prior to coming to the orchard in order to comply with organic standards in the Czech Republic. While the trees are in production, there are several procedures that may need to be done in order to ensure proper growth by the plants. Trees will be grown in a central leader system and there would be about 242 trees per acre in a traditional arrangement providing easy access care for an organically produced apple facility (Tree, 2010). Correct timing of organically approved pesticide/insecticide applications in order to avoid pest outbreaks will be pertinent before producing apples. Biological control to manage pests will be the main focus when dealing with insect outbreaks in the orchard. In order for pollination to occur in apple trees several varieties are needed because often time's trees will only pollinate with pollen from other trees. Also, bees and wasps may aid in the pollination of the trees as well.

To make sure that there is adequate data to support the organic production of apples about 10 years of practice should be implemented. If after 10 years of research and positive feedback is given both from the citizens of the Czech Republic and the government, expansion of the facility may be implemented. In order for this to occur, organic fruit purchasing should increase in the 10 years of production, the fruit that is used should be up to marketable quality.

Organic fruit production in the Czech Republic is already quite expansive and promotion of organic foods is already being done. To greater the value of the organic apples in the newly built apple facility, it would be beneficial for the promotion already directed at organic foods to include the new facility. This can be done in a variety of ways including educating the public on the benefit of purchasing organic, establishing a website, and holding promotional events (Organic, 2009).

Overall, this apple orchard would take almost 15 years to get up and running successfully. With that much time it is hard to predict whether or not it could economically hold up in the Czech Republic. With careful consideration of sustainable production practices and use of new and innovative technology, I believe that the country could become one of Europe's premiere apple growing countries.

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