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Bachelor Thesis

Cultivation of Maize for Energy Purposes in the Global Context

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Declaration

I declare that I have worked on my bachelor thesis titled "Cultivation of Maize for Energy Purposes in the Global Context" by myself and I have used only the sources mentioned at the end of the thesis. As the author of bachelor thesis, I declare that the thesis does not break copyrights of any other person.

In Prague on 20.4.2018 ______________________________

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Cultivation of Maize for Energy Purpose in the Global Context

Annotation

This bachelor thesis deals with problems with the growing of maize (Zea mays L.) as a renewable source of energy and its impact on the environment and society. Especially repercussion cultivation of this crop has an influence on climatic changes that affects not only the rising greenhouse gases, but also the formation and the irreparable damage of groundwater sources and hyperacidity of arable fields due to over fertilizing of crops. Cultivation of energy maize can also cause rising prices in the food sector and using maize as a biofuel takes the opportunity to use this crop as food for the world's poor. The thesis is done in the form of literary research based on information from books, professional publications and other articles.

Keywords: maize, energy, poverty, society, market, world

Pěstování kukuřice pro energetické účely v globálním kontextu

Anotace

Práce se zabývá problémy s pěstováním kukuřice (Zea mays L.) jako zdroje energie v dopadu na životní prostředí a sociální aspekt. Obzvláště kultivace této plodiny má vliv na klimatické změny, které ovlivňují nejen vzrůstající skleníkové plyny, ale i vznik nenapravitelného poškození zdrojů podzemních vod a překyselení orné půdy v důsledku nadměrného hnojení plodin. Pěstování energetické kukuřice také způsobuje rostoucí ceny v potravinářském odvětví a produkce biopaliv naopak bere příležitost lépe využívat tuto plodinu jako potravu v rozvojových zemích. Práce probíhá formou literárního výzkumu založeného na informacích z knih, odborných publikací a dalších článků.

Klíčová slova: kukuřice, energie, chudoba, společnost, obchod, svět

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1 Introduction

The energy crisis that hit the world in the 70s of the last century has increased interest in bioethanol as a renewable energy source that could replace fossil fuels.

Over past couple of decades when the energy consumption rapidly increase and fossil fuel reserves are reducing, it was necessary to start exploring other sources of energy supply. The source of renewable energy got to the scene. The energy of biomass has been in use for thousands of years, mainly in the form of wood burning, which is still use, but more popular became energy crops with the use for biofuel.

Nowadays around 7 million of biogas stations are operated worldwide. The development of anaerobic digestion of organic biomass with phytomas has also occurred in the EU. The European Union has determined that by 2020 renewable energies should account for 20% of total energy consumption and biofuels should reach 10% of the total fuel consumption in transport section.

The most energy efficient biomass is produced in agriculture. These are mainly excrements of farm animals, byproducts from crop production and specially grown energy crops.

From the cereals, ethanol is obtained by performing the enzymatic hydrolysis of starch on fermentable sugars. Thus, it is clear from the technological process that the limiting factor determining the suitability of the cereal is mainly the content of starch in the grain.

Maize one of the main energy crop has a very wide use throughout the world. It is mostly used and traded as a leading feed crop but is also an essential food source. In addition to food and feed, maize has wide range of industrial applications from food processing to manufacturing of ethanol. That because human and animal nutrition is impossible without maize, it was considered as a third millennium crop. Maize is primarily an economically profitable crop. One option for using corn as an energy crop is to produce bioethanol or biogas. Maize is a plant with enormous yield potential, its cultivation technology for grain and silage production is optimized, and agricultural businesses are already fully equipped with all the mechanization to grow it. As a C4 plant, maize has the ability to produce large amounts of biomass, and this is also related to the high possibility of methane formation from biomass. For the production of bioethanol, the aim is to produce a homogeneous stand with a maximum starch content in the grain to achieve the highest yield. When using maize for biogas production, it is also important to ensure homogeneous and balanced growth. In practice, the most used dry process is the burning of biomass and the wet process is alcoholic fermentation and the production of biogas by anaerobic fermentation. In 2003, biomass accounted for 10.6% of global primary energy sources, which is 79.9% of all renewable sources.

To get the highest yield of grain is important to set the right condition for the grow and with it is connected many of key factors which really affecting the environment and social aspect.

World production is a variety, influenced by climatic, consuming and eventually also using fossil fuels and the accession of the state, and especially the pros and cons of burning biofuels.

2 Objective of thesis

The aim of this work is to point out the risks which are created as a result of negligent agricultural management of maize. Recently, there has been a significant development in the cultivation of energy crops, for biogas production in biogas station or for direct combustion purposes to produce electricity.

In the conditions of the Czech Republic and almost all over the world, it is mainly the maize set, which is the most used raw material for biogas station in the plant production.

This report discusses the significance of maize in the global context. It begins by providing an overview of the maize, different types, increasing market demand and usage as an energy.

Energy crops can generally be characterized as undemanding, but it's definitely not a maintenance free or weedy crop. It is therefore necessary to devote certain care, protection against diseases and pests, sufficient nutrient supply, preset soil treatment and proper planting.

3 Literature Review

In further subchapters is a summary of the available literature on the given topic. It contains detailed description of maize as a crop, utilization and is mainly listed here how cultivation of maize for energy purposes negatively affects the environment.

3.1 Maize

Maize (*Zea mays L.*), also called corn, is one of the three main crops cultivated in the world together with wheat and rice. It is grown throughout the world, with the United States, China, and Brazil being the top three maize producing countries in the world, with productions of approximately 563 of the 717 million metric tons/year (Ranum 2014).

Primarily it was processed for humans food product, later we started to use it as a livestock feed especially for cattle. In addition to food and feed, in the couple last decades we started to use maize in industrial applications where it has a wide range of use as a renewable source of energy for manufacturing of ethanol. This report discusses the significance of maize in the global context.

Maize is a plant that creates a large amount of matter in the short run with high energy content. For the successful development and growth, corn needs the harmonic effect of individual vegetation factors, including light, soil, heat and water (Doležal et al. 2006).

Maize is a warm weather crop and is not grown in areas where the mean daily temperature is less than 19 ºC or where the mean of the summer months is less than 23 ºC. Although the minimum temperature for germination is 10 ºC, germination will be faster and less variable at soil temperatures of 16 to 18 ºC. At 20 ºC, maize should emerge within five to six days. The critical temperature detrimentally affecting yield is approximately 32 ºC. Frost can damage maize at all growth stages and a frost-free period of 120 to 140 days is required to prevent damage. While the growth point is below the soil surface, new leaves will form and frost damage will not be too serious. Leaves of mature plants are easily damaged by frost and grain filling can be adversely affected (du Plessis 2003).

3.1.1 Origin and the history of the crop

Maize (*Zea mays L.*), is believed to have originated in South and Central America 7000 years ago from a wild grass, and Native Americans transformed maize into a better source of food. Its origin and development has not yet been elucidated. However, several hypotheses have been developed. Corn probably originates from the crossing of a wild corn with wild-growing closest relatives form as an annual teosinte (Euchlaena perennis Hitchc.) or several species of the genus Tripsacum and mutations due to the environment and selection it affected (Hruška 1962).

In Europe and the rest of the world, maize came after the discovery of America. Maize is expanded both in the northern hemisphere and in the southern hemisphere, in tropical areas with eternal summer and in cooler temperate zones with a short summer, in areas with excess water and in places where crops without irrigation can not be grown.

3.1.2 Utilization

In developing countries of Latin American and Africa, maize is predominantly consumed as a great source of calories, carbohydrates, protein, iron, vitamin B, and minerals for the population. In Asian developing countries, its use is roughly balanced as food and as feed. In its home country of Mexico, corn is an integral part of culture and is not only present in almost all foods, but dry stalks are used as a building material for fencing and roofing, sheets for matting etc. In developed countries, maize is grown predominantly as a feed for livestock either in the form of grain or silage or as a raw material for the processing industry. Its direct consumption as food is marginal, although the importance of sweet corn as a vegetable grows (Ranum 2014).

All aboveground parts of plants, and even wastes from industrial processing, are used for feed. Mainly silage is used for cattle breeding and kernels feed is used for poultry and pig breeding. There is also a great value as a feed for straw and bracts from corn sticks. These are used as emergency food if not used for industrial processing. Sticks and a finely chopped spindle are good feed for horses. It is possible to feed on various wastes of corn processing (Hruška 1962).

We also use corn for silage. Maize is considered to be a significant energy bulk feed. Maize power is obtained by fermenting water-soluble carbohydrates containing silage biomass. During the fermentation process, lactic acid and fathers are obtained and also small amounts of alcohol occurred (Zimolka 2008).

In the food industry, corn is used as a source of oil, starch, sweetener as a glucose-fructose syrup, beverages, glue, industrial alcohol and bioethanol. Also contemplated is the use of maize for the production of paper, biodegradable plastics, chemicals and proteins for medical purposes.

In industrial processing, it is mainly use of starch, which is found in plants as a reserve substance in the form of starch grains, mainly stored in seeds, tubers, roots and leaves. Obtaining starch from corn grain is most effective because it has the highest grain starch content about 75-86% also contain 10% protein, and 4% fat, supplying an energy density of 365 Kcal/100 g. Recently, it has been highly valued by the chemical industry as a raw material for the production of plastics with a view to solving the waste problem, or their degradation. The use of natural starch in the non food sector is in the manufacture of paper, cardboard, textile starch, adhesives, gypsum boards etc. Modified starch is used in the production of chemicals, plastics, polyurethanes, polyphenols, organic acids and pharmaceuticals (Ranum 2014).

In addition to the use of starch, much attention is now paid to its processing into ethanol.

3.1.3 Soil as an essential material

Soil as one of the main sources for proper growth. Healthy soil is essential for healthy growth and development of plants and is an integral part of agro-ecosystems. When evaluating soil it needs to be viewed in a wider, respectively in environmental contexts. Besides production it has a number of other functions, such as function of filtering, buffering, transformation, the environment of living organisms and also socio-economic functions are significant.

To keep the soil in a good condition for the future, crop rotation is the cornerstone of management because it is provides an efficient supply of nutrients, plant protection and cultivation.

In addition to the interaction between plants and soil, we should take note of the activities of beneficial organisms living in the soil environment. This is the only way to ensure proper soil fertility and optimal conditions for growing crops. Thanks to the favourable interaction between the different crops grown in time and place, this increases the overall performance of the rotation system and improve the soil conditions for future crop production.

Main goals of crop rotation are maintaining and improving soil fertility and structure, soil protection against erosion and possible disturbance, weed control, prevention of the spread of diseases and pests and protection against possible environmental pollution.

Some plant species take a huge amount of nutrients from the soil. Long-term cultivation of such species significantly reduce soil nutrient levels and future yields. Monocultures cause unilateral use of soil nutrients and moisture, which leads to soil depletion. On the contrary, biodiversity and the diversity of crop production (whether artificial or natural) ensure the most balanced composition of the ecosystem.

3.1.4 Requirements of maize for soil conditions and nutrients

Maize is a plant that creates a large amount of high energy mass in a short time. For successful development and growth, corn needs a harmonious effect of individual vegetation factors, including light, soil, heat and water (Doležal et al. 2006).

As a crop, maize is very demanding for soil preparation. The most suitable are deep, well-treated, adequately aerated, well-supplied with humus and calcium, neutral to weak acid reactions such are the soils of the chernozem and the browns in protected and southern slopes.

On the contrary, the extraneous desiccant soil is unsuitable, which does not allow sufficient supply of plants with water during vegetation and soil compacted, clayey, stony, pre-ground and peaty. Unsuitable for eradication of corn land threatened by erosion. In the basic preparation of the soil, there must be view taken on the pre-crop, the need to incorporate manure, the repeated cultivation of maize, the requirement to retain in the soil the maximum moisture from the extra-vegetation period, the soil type and the date of the intervention. In the case of maize, it is possible to use traditional plowing technology as well as minimization technology without the use of plowing. Unfortunately, corn does not only have benefits. Several risks are associated to the growing of corn. It is known that the risk of growing maize in succession on the for several years in a row causes a reduction in the yield of biomass, because crops need to be rotated. This fact reduces the usable potential of soils for the cultivation of maize. Corn must be adequately protected to prevent overgrowth. Revenues depend on the weather in a given year, yield per hectare and the closely related price of corn on the market depends on what the weather was in that year. It is also appropriate to mention the risk of erosion.

3.1.5 Fertilizing

Nitrogen is involved in growth and assimilation. Nitrogen fertilization is most affected by the number of grains in the stick (especially the number of grains in the row - stick length) and the weight of thousands of seeds. Nitrogen in industrial fertilizers is fertilized either once before sowing, up to a maximum of 100 kg N.ha-1.

Maize has considerable phosphorus demand. In particular, corn is responsive to deficient phosphorus deficiency in the early stages of growth (until 5th leaf) when a very spicy root system has been created (Šreiber, 2000).

For fertilization it is necessary to use NP fertilizer with a high proportion of water-soluble phosphorus with ratio N: P = 1: 4. From this point of view, it is desirable, in particular, to have lower doses of acceptable phosphorus in at least part of the necessary doses to be applied prior to sowing or to apply a specific application "under the heel".

Fertilization of phosphorus under the heel influences the establishment of a larger number of grains in the sticks, faster storage of starch in grains and early ripening. It reduces negative stress and the weight of thousands of seeds is higher. The second critical period is the flowering phase. For maize, it is especially advantageous for plants to receive sufficient phosphorus until then, because then they are translocated into the sticks (Lošák, 2006).

Well potassium supplementation increases the plant's dryness, increases the stalk's firmness and resistance. Furthermore, potassium interferes with sugar production and starch synthesis. The decrease of potassium is accompanied by its elimination through the root system into the soil. Potassium intake is significantly influenced by antagonistic interactions (Lošák 2006).

Corn belongs to C4 plants and therefore uses solar energy very well, associated with efficient use of nutrients to generate yields. The nutrient content of plants is affected mainly by soil climatic conditions, levels of fertilization and cultivated maize. It is characterized by an initial slow growth with low nutrient intake. In the date to 8th leaf stage the maize generally accepts 35 kg of oxygen, 10 kg of P_2O_5, 50 kg of K_2O and 5 kg of MgO per 1 hectare of area. Then there is a period of very intensive intake of nutrients. In 35-45 days (10-15 days prior to the discovery of lata and 25-30 days after the discovery of lata, corn receives 75-80% of all its nutrients (Balík 2001).

3.1.6 Production in the Czech republic

The largest harvest of maize is dated in 2013, when the sowing area was to about 110 thousand ha. After that, areas were gradually decreasing year after year. In 2015, maize was grown to 93.6 thousand. ha with a yield of 5.54 t.ha-1 and reached production of 442.7 thousand. A year later (2016) there is an increase in harvest by 199.8 thousand. tons, climbed to 642.5 thousands. In the long run, this harvest became the tenth highest harvest of grain maize in the Czech Republic since 1990, a similar harvest in 2002, when production reached 616.2 thousand. pool. In the production of maize, the Czech Republic is fully self-sufficient and has the possibility to export this crop (Kůst, Stehlíková, 2016; Mládková et al., 2016).

Euro deputies from the influential environmental commission want to end the addition of the first generation of biofuels to fuels. They say that biofuels made from rape, maize, or sugar beet should end in 2030. Again, biofuel from palm oil is to be banned already in 2021.

3.1.7 Global production

Corn is the most produced grain in the world. The biggest world production is in the USA, Brazil and China. The world's production of corn for grain is consumed directly as a food about 21%. In the last 10 years, the use of maize for fuel production significantly increased, accounting for approximately 40% of the maize production in the United States. With the USA producing nearly 377.5 million metric tons of corn, the crop definitely plays a very significant role in the country’s economy. The United States is the worldwide leader in corn production, and 20% of its annual corn production is exported. At about 96,000,000 acres of land in the USA are dedicated to corn production.

Annual production in 2008 was 822,712,527 tons, and average yield in the same year was 5.1 tons/hectare. At around 700 million tonnes, world maize production represents over one-third of world cereal output. Over the past two decades, global maize production has increased by nearly 50 percent. Most of the increase in world maize production during the past decade can be attributed to a rapid expansion in Asia. Asian maize production grew by nearly 35 percent during the past decade. Both area and yield increases contributed to this high level of growth, with China making the most significant advance by contributing to as much as 60 percent of the total (Ranum 2014).

After feed and exports, the third use of maize in the United States has become ethanol, production of which has quadrupled since the start of the decade.

In 2005/06, over 40 million tonnes, or 14 percent of domestic maize production was fermented into fuel alcohol or ethanol. Increase in oil prices coupled with rising demand for "green" fuel from renewable resources following the phasing out of Methyl Tertiary Butyl Ether, a rival additive have boosted maize-based ethanol production and has turned the United States to the world's leading maize-based ethanol producer.

3.1.8 Factors promoting yield and cultivation of maize

Corn becomes an increasingly profitable crop primarily in areas suitable for its cultivation. There are several reasons to explain this trend. In the first place, it is the fact that maize offers a great energy potential, namely 324,000 Mi / ha. If we compare this figure with grains that produce 216,000 Mj/ha, then the energetic contribution of corn is unambiguous. On the other hand, it is necessary to carefully assess the costs of growing individual crops, because the overall view of the energy balance can fundamentally change. Last but not least, many agronomists now know that in the years of significant climate fluctuations we are witnessing, maize is a very flexible crop, tolerant of weather conditions and possibly minor mistakes in agro-technology (Iwuoha 2014).

The fact that today's farmers have a range of hybrids that provide a good return even in areas where maize has been grown rarely or unsuccessfully is an important reason for increasing the promotion of maize in our fields. Also, corn harvesting technology gives a wide potential to use corn energy to meet optimal needs for further use (Šedek, 2006).

Over the last few years, GMOs have been discussed, including a large proportion of genetically modified maize Bt-hybrids. One way to increase profitability is to grow Bt-maize. The United States has announced a ten-year plan to reduce the country's dependence on oil imports, to be carried out by massive increases in domestic biofuel production. American farmers, however, were in favor of their European protection. The commercial cultivation of Bt maize began in 1996, when it was preceded by a roughly 10-year period of thorough verification. Progress has gone on and currently hybrids with 2-3 genes have been tested and cultivated, including corn rootworm resistance, maize scab resistance, and total herbicide resistance. The producers of these new technologies make good use of and thus reduce the cost of production. In 2006, varieties with a combined resistance of 20% of all GM crops occupied, in the United States, even 28%.

Nowadays GMO maize is prohibited in the Czech Republic and almost in whole European countries, but for example in Spain GMO could be cultivated and disributed to the Czech republic.

3.1.9 Importance of maize as energy crop

From the agricultural crops grown for energy purposes, the highest potential for producing biogas is maize. As a C4 plant, maize has the highest yield potential compared to other plants in our country. Cultivation of maize for the production of biogas is not an obstacle in agricultural enterprises, which would not make it possible to increase the areas for maize. The existing silage gutters can be used to store the silage mass (Amona and Col., 2004) states that the production of biogas from maize biomass most depends on the protein, fat, cellulose, hemicelluloses and starch content.

According to (Amon and Col., 2003), the quality of maize for the production of biogas is mainly formed in the field, but in addition to the site conditions, the content of substances suitable for fermentation (proteins, lipids, sacharides) determines the conservation measures, such as hybrid selection, cultivation and plant phase of the harvest. The yield of methane depends on the corn harvest, whether the whole plant is harvested, only the stick or the grain. At present, the question of how maize is suitable for biogas production should be looked at is very intensively discussed. Primarily it was processed for human food product, later we started to use it as a livestock feed especially for cattle. In addition to food and feed, in the couple last decades we started to use maize in industrial applications where it has a wide range of use as a renewable source of energy for manufacturing ethanol. This report discusses the significance of maize in the global context.

This is due in particular to the high hectare yield of biomass, the high content of dry matter in biomass (on average 32%) and the high content of organic matter in the dry matter (96%). Maize has proven to be the most suitable raw material for biogas production (silage maize) in our conditions and is the most common. It accounts for about 35% of the total amount of all substrates used.

Several sources located on the farm can be used as inputs to a biogas plant. In particular, plants rich in slightly soluble sugars are desirable. These plant types are increasingly used as a substrate for biogas production. Biogas productivity significantly increases the potential for mixing into slurry. One of the crops that meet these energy parameters is corn which, thanks to high photosynthetic activity, generates a large number of soluble sprouts as a source of microorganisms for the fermentation process and methane a basic raw material for the production of electricity in a biogas plant. If we rank the field crops according to the direction of use, the best assumptions for this purpose are for silage maize, which is a stable crop in the primary production, bringing permanent and regular income to the cash desk.

As the ethanol industry absorbs a larger share of the maize crop, higher prices for maize will intensify demand competition and could affect maize prices for animal and human consumption. Low production costs, along with the high consumption of maize flour and cornmeal, especially where micronutrient deficiencies are common public health problems, make this food staple an ideal food vehicle for fortification. On the 1 kg of bioethanol is needed to use 2,74 kg of maize, that is mean 2,13 kg on a 1 l of bioethanol.

The slurry is also used, but in particular as the transport and inoculums material of the base substrate.

High starch content is not a very good source of energy in the fermentation process. When feeding cattle, starch is important. In this case, the silage is processed in approximately 24 hours. However, for a biogas station, the process takes longer, about 40 to 100 days, and therefore enough leaves and stems are important. Maize can be harvested slightly earlier than in optimum silage maturity, with a dry matter content of about 26 to 32%. It depends pretty much on the type of hybrid in the area. Care should be taken to ensure that the body is as homogeneous as possible.

Corn appreciates, due to its high yield, which can be achieved by new cultivation practices, the soil factor is better than other crops. Subsequently, the process is the same way as in the production of silage for feeding. The basic premise is also the harmlessness of matter - no mould or damage to the breeze, where the subsequent fermentation processes would reduce methane production and the profitability of electricity production.

Generally, 1 g of plant biomass dry matter averages 16.74 kJ of energy (Kulovaná 2011).

3.2 Bioethanol generally

Bioethanol is a term used lately to designate fermented alcoholic fermented beverages. It has a high heating value (27.8 MJ / kg) and can be combusted with good efficiency. When burning, there is no heat loss to the cave and the ash, only the chimney losses occur. In the world, however, bioethanol is used exclusively as motor fuel, mostly in the form of a low-volatile component in a gasoline mixture. Spirits of alcohol do not contain ash and sulfur and have a lower proportion of carbon dioxide and nitrogen oxide than petrol. The raw material for the production of bioethanol is starchy or sugar-based agricultural crops, which are processed into the final product by distillery processes. Nowadays, it is most supported for the production of bioethanol from wheat and corn. Agricultural crops for the production of bioethanol are the most important potatoes, sugar beet and grain (starchy wheat varieties, triticale and maize) that best meet the requirements for sufficient hectare yield of alcohol at reasonable cost. So far, maize has been grown mainly for feed purpose. Maize has the largest hectare yield of cereals, theoretically in our conditions it can be grown anywhere and it is an excellent and very resistant crop, and some hybrid varieties have a very high starch content over 70% (Kunteová 2006).

3.3 Energy sources

Permanently recovering natural resources can be considered as renewable energy sources. The sun is the main source of direct and indirect renewable energy. Renewable sources of energy are direct solar energy, energy of watercourses, wind energy, energy of the external environment, and biomass energy. For agriculture, livestock breeding is specific treatment of their excrements, burning of straw and wood for energy purposes, and re-use of heat generated by livestock during ventilation of stable air (Moudrý and Strašil 1998).

Energy is the most important part of the economy of all countries. Energy consumption has a growing trend in the world. Today's energy sources, which are mostly used, are largely non-renewable and gradually exhausting. Global research says, that both oil and coal consumption are increasing, and the question is how these resources will be replaced in the future. By the world´s data, the population increases regularly by 80 million inhabitants per year (Anonym 2017).

3.3.1 Fossil fuel

Fossil fuels are currently the world's primary energy source that is including coal, oil and natural gas. Formed from organic materials over the millions of years, fossil fuels have fulled global economic development over the past century. Nowadays fossil fuels are finite resources and they can also irreparably harm the environment. According to the Environmental Protection Agency, the burning of fossil fuels was responsible for 76 percent of U.S. greenhouse gas emissions in 2016 (Anonym 1).

But global warming has already hit us, and it is beginning to hit us harder. It has also produced another monster that may be even more destructive than temperature rise—ocean acidification (Abbasi and Abbasi 2011). Given that 70% of the world is covered by oceans, any disturbance in oceans can have bigger and deeper effects on Earth than the disturbances in the other 30% of the world. The most visible agent of global warming as well as ocean acidification being CO_2, which is released due to the burning of billions of tons of fossil fuel, the world is desperately trying to reduce fossil fuel consumption.

3.3.2 Sources of renewable energy

Renewable energy is derived from resources that are replenished naturally on a human timescale. Such resources include biomass, geothermal heat, sunlight, water, and wind. All of these sources have their strengths and weaknesses. Some are more suited to certain locations than others, for instance. Some only produce electricity intermittently (when the sun is shining in the case of solar), though they can be paired with energy storage solutions to provide reliable electricity 24 hours a day throughout the year. Others, such as biomass, hydropower, and geothermal, can be used as baseload generation, producing a constant, predictable supply of electricity. None of these sources can meet all of our electricity needs effectively. But, together, they can completely displace fossil fuels without increasing the cost of electricity(Anonym 1).

While some bioenergy sources and technologies offer significant advantages over fossil fuel-based systems, others lead to environmental concerns. This is particularly the case where bioenergy involves using agricultural land to cultivate energy crops, since it often results in changes to land use, including expanding or intensifying agriculture at other locations. This can have significant implications for the natural environment, such as biodiversity and the water, nutrient and carbon cycles, affecting ecosystem functioning and resilience in diverse ways.

3.3.2.1 Biomass

Biomass comes from organic material. It is a renewable source of energy that is absorbed and stored from the sun. Plants absorb the sun's energy in a process called photosynthesis. When biomass is burned, the chemical energy in biomass is released as heat. Biomass can be burned directly or converted to liquid biofuels or biogas that can be burned as fuels (Anonym 2017).

Although biomass is a so-called green energy source, its use can have a negative impact on nature. The European Environment Agency has highlighted this in its study. According to its conclusions, the current way of growing energy crops is not environmentally friendly. "There are a number of risks associated with the use of biomass. In particular, the cultivation of certain types of energy crops may have negative consequences for the country, "commented Dalibor Dostal, director of the Czech Landscape Protection Society. The study highlights the risk of soil erosion in the cultivation of energy crops and the country's ability to retain water, thereby increasing the risk of flooding. Moreover, there is a reduction in biodiversity, especially in field birds. According to the authors, the increase in pressure on soil, forests and water resources is due to the intensive use of this renewable energy source. The economic pressure on energy crops can also lead to an increase in greenhouse gas emissions that cause global warming. Soil-based land uses less carbon than forests or natural meadows. According to the findings of the Global Carbon Project (2012), 10 percent of global greenhouse gas emissions in the period 2002-2011 account for just the expansion of agricultural land. One reason for deforestation is the need for new land for energy crops. Another risk associated with growing biomass for energy purposes is, according to the EEA report, a number of scientific studies of recent years on the spread of dangerous, invasive plant species. Combustion of biomass also leads to emissions of fine dust particles that pose a risk to human health. Earlier studies from Germany have highlighted that air pollution has increased in areas where natural gas has been replaced by subsidized biomass burning. "Some regions of the Czech Republic hold sad records of the effects of air pollution on human health, especially children. That is why biomass combustion should be treated with extreme caution. It is precisely because of the subsidization of biomass as a renewable energy source that in the Czech Republic there are situations where modern gas boilers, which do not produce virtually any dust particles, are replaced by biomass incinerators. They pollute the air, on the one hand, in the production of heat or electricity itself, but also the transport of biomass to the place of use. For example, launching a biomass incineration plant in Kutna Hora brought about three to four thousand trucks a year, according to local activists (Anonym 2013).

The most discussed area of biomass utilization is the production of fuels - biofuels. For the production of bioethanol and biodiesel, they used crops whose primary use was in the food industry (corn, sugar beet, potatoes and others), the so-called first generation of biofuels. The direct impact on food prices (or hunger issues in Third World countries) has meant a shift towards the use of waste and energy plants. Unfortunately, even the so-called second generation of biofuels did not get rid of negative ratings (Václavíková 2017).

3.3.2.1.1 Anaerobic digestion

In the English speaking countries and in the Czech literature a combination of anaerobic digestion is used. Another commonly used phrase is anaerobic fermentation (Slejška, Váňa 2002).

"Anaerobic digestion is a multistage natural process of decomposition of natural substances by certain groups of microorganisms without oxygen access. It provides the technological basis for the efficient use of biodegradable waste from various branches of agriculture, industry and waste management as renewable sources of raw materials and energy "(Usťak, Váňa 2006).

Biogas is essentially gas produced in an anaerobic environment by decomposition of organic matter. The whole process takes place in four phases of organic matter decomposition. The result is a gas containing 2/3 methane, 1/3 of CO2, or other gases, which are negligible throughout the process (Černý, Kulíšková 2003). For a medium-sized 1 MW power station, there is a need for 300 to 400 hectares of maize, which can cover electricity consumption up to 2000 smaller apartments and can provide waste heat for roughly 1000 flats. In order to ensure a high quality and sufficient raw material, a corn hybrid must be chosen correctly. Not every silage hybrid is suitable for a biogas plant. The basic assumption is high yield of matter, strong and brittle resistant stem, strong and deep roots preventing the plant from being deflected.

The main products are biogas and digestate. The term biogas is called any gaseous mixture that arose from microorganisms. It is a mixture of methane, carbon dioxide, nitrogen, hydrogen and others gases. Primarily, therefore, it is a product that is produced in controlled anaerobic reactors, but also includes gases that occur under the surface of the earth, in swamps and peat bogs, rice fields, animal digestion and landfills (Pastorek 2004).

The digestate is an organic residue, in solid or liquid consistency that remains after the fermentation of the material. It is used as a good fertilizer.

3.3.2.2 Biomass as a propellant

The most discussed area of biomass utilization is the production of fuels are biofuels. For the production of bioethanol and biodiesel, they used and exploited crops which were primary used in the food industry (corn, sugar beet, potatoes and others). The direct impact on food prices (or hunger issues in Third World countries) has meant a shift towards the use of waste and energy plants. Unfortunately, even the so-called second generation of biofuels did not get rid of the negative (emission issue). Great hopes are being put into new eau-based fuels from algae or bacteria.

Within the European Union, and hence also in the Czech Republic, the share of biofuels in petroleum fuels is set per cent. It is expected to increase to 10% by 2020, with this year increasing with petrol by 1% (from 3.5 to 4.5%) and diesel by almost 2% (from 4.5 to 6.3 %). Increasing the percentage of biofuels, unfortunately, also means the increase in the price of fuel. Recycling has caused another negative reaction, so biofuels for petrol and diesel engines are still a black sheep in the use of biomass.

Each grower should respect local conditions and choose a hybrid that is able to mature into silage quality until frost comes in, which can significantly reduce the quality of the harvested material. It is possible to maintain the same principles as for intensive silage maize.

It is possible to slightly increase the stocking density and get as much green matter as the source of slightly soluble sugars.

3.4 Negative impact on the environment

The relationship between the climate and agricultural production is of considerable importance to global food security.

It critically evaluates the environmental impacts of major renewable energy sources. It then comes up with the broad conclusion that renewable energy sources will not heal-all and they are popularly perceived to be; indeed in some cases their adverse environmental impacts can be as strongly negative as the impacts of conventional energy sources. The paper also dwells on the steps we need to take so that we can utilize renewable energy sources without facing environmental backlashes of the type we got from hydropower projects (Abbasi and Abbasi 2000).

As it is known, all things have two sides of a coin. It also applies for renewable sources of energy.

The prediction was that the ethanol would become the world's fuel supply. When it was discovered that fossil fuel reserves were running low due to population growth and energy consumption, some look to corn-based ethanol as the solution for cleaner, renewable energy. However, even though corn ethanol is renewable, there are many cons to consider before adopting it as a staple fuel source. Alternative energy sources should be very important to the scientific research community today. However, researchers should be aware of the many complications of ethanol, instead of investing in this controversial energy source right away. Should the American population really be wasting their money on corn-powered machines if they are paying too much money and burning up a huge portion of their own food. "Using corn as a fuel source seems to be an easy path to renewable energy," said Richard Yuretich, the National Science Foundation programme director for Critical Zone Observatories. "However, this research shows that the environmental costs are much greater, and the benefits fewer, than using corn for food" (Yoksoulian 2017).

The future of farming and how technology can enable new approaches in agriculture towards solving the world's food and biofuel crisis is a key area which engineers are addressing, with both research and practical applications (Lamb 2017).

3.4.1 Corn prices

Advantages of maize that it is included in a seasonal commodity that affects the growth cycle and harvest. From this seasonal cycle you can benefit from investing.

The disadvantage is the state subsidies for the production of renewable sources, because they distort the price.

One of the biggest issue about cultivation of maize for ethanol production is about the raising up of food prices. These trends mean that market demand for food would continue to grow. Demand for cereals, for both food and animal feed uses is projected to reach some 3 billion tonnes by 2050, up from today's nearly 2.1 billion tonnes. The advent of biofuels has the potential to change some of the projected trends and cause world demand to be higher, depending mainly on energy prices and government policies. The demand for other food products that are more responsive to higher incomes in the developing countries (such as livestock and dairy products, vegetable oils) will grow much faster than that for cereals.

As mentioned Havlíčková et al.(2010), with growing demand for biomass, the issue of its possible price in the future is of importance. The price of biomass distinguishes its theoretical and economic potential. The theoretical potential, which may be relatively large in a given situation, is often not economically viable because of the cost of biomass generation. It is important to distinguish the costs of obtaining biomass and its cost. Actual biomass prices affect supply-side factors, of which the most important are as a price development of individual inputs to biomass cultivation (prices of services in agriculture, wages, etc.) It include taxes and overall business support, a system of aid that excludes or reduces the risk of doing business, subsidies for the cultivation of different forms of biomass.

So these numbers can easily say that the demand for food will increase a lot and problem with the fields which are planted with energy maize instant of maize for consumption will show up as a big problem in the future.

In 2008, global food prices increased 83% in one year, with biofuel production as a main contributing factor and the 60% of the world’s population is malnourished.

According to the middle prognosis of UN in 2006, the planet's population will increase from 6.6 billion in 2007 to 9.2 billion in 2050, with an overwhelming majority of about 2.5 billion of it going to developing countries. That means the malnourished population increase in those countries and on the other part of the world population will spend money to feed their cars from food (Mittal 2009).

And also demand-side factors, the higher the use of biomass is more advantageous than conventional fuels. These factors include ecological taxes imposed on fossil fuels, the development of world prices of the key energy commodities (natural gas, oil), the development of coal prices as a decisive domestic energy source and the price of emission allowances.

Jelínek and Medonos (2011) state that the cultivation of energy crops that are destined for combustion does not appear to be profitable without public support. Only fast-growing trees (willows and poplars) showed a positive profit without grant. The decisive factor in the competitiveness of energy crops against coal or fuel wood is the transport costs of these crops.

Although most biofuels are not yet able to be marketed without subsidies, their support leads to sustainable energy production. Havlíčková et al. (2010) believe that since the price of biomass is a local matter, which more than other fuels affect the transport costs, this will be accompanied by large price differences between the different forms of biomass in the future.

3.4.2 Erosion

Farming exposes soils to water and wind erosion, and can lead to soil compaction and salinization if inappropriate farming practices are used. All these factors contribute to soil loss, declines in soil organic carbon content and productivity as well as other environmental impacts. To keep water in the countryside, it is best to start directly in the fields where all waterfall should be kept as far as possible. Of course, this is also important to supplement the general water deficit in the soil. To reduce water erosion, the type of vegetation cover is particularly important, especially in hilly terrain and sloping land. Therefore, the choice of the crop is decisive. Not particularly suitable are the one year crops, especially the so-called wide rows crops (Urbánková 2015).

According to Janeček (2007), out of 11 592 cadastres in the Czech Republic, 25,46% of it was extremely threatened and 32,23% of severely endangered by erosion were found. Now, 50% of arable land is threatened by erosion.

Due to soil erosion, maize is the most vulnerable crop (8-10 days after sowing does not cover with the soil), the risk occurs on sloping lands. In the Czech Republic, approximately 42% of agricultural land was affected in 2008, 31% of it by a water erosion (54% of arable land is the most vulnerable) (Žalud et al. 2008).

At the same time, however, it is necessary to find a suitable substitute for the mentioned wide rows crops. The main representative of wide rows crops is maize. Generally widespread in a variety of areas, including higher positions and often even on sloping land. Therefore, it will not be easy to find a full-fledged substitute crop for it.

One of the most effective means of soil protection against erosion is the maximum land cover. When composing a future crop production, it is important to keep in mind these two factors, such as the time and amount of land coverage.

In terms of time, the goal is to create such a plantation that covers most of the land for as long as possible. Winter crops protect the soil from autumn until spring. Crops planted very densely (several hundreds or thousands of individuals per square meter), such as legumes and grasses provide greater protection for the soil than species planted in the number of four to ten individuals per square meter. In order to limit the erosion in sloping areas, it is mainly the crops that create a dense, full-grown early spring. Of course, the crops are multi-annual and perennial, where there is no need for plowing and plowing of the soil layer to ensure good pre-seed preparation. In our country, as a rule, arable land grassing is chosen to limit erosion, as in the present, essentially, anti-erosion measures. In that case, on the order to grow there is the not a really known **Chinese silver grass** in Latin name (*Miscanthus giganteus*) or for example (*Panicum virgatum*), commonly known as **switchgrass**.

In the Czech Republic, almost half of the arable land areas are of varying degrees threatened by erosion and requires consistent anti-erosion protection. This is especially necessary on the slopes with a shallow rock bed or a high gravel content. Threatened by wind erosion is 7.5% of arable land. Conditions for the occurrence of erosion processes are specific, as the transition to a large scale management method and the further intensification of agricultural production, the problem with erosion in our country was greatly underestimated together with the consequences of accelerated erosion of agricultural land, which seriously threatens their fertility.

Furthermore, underestimated damages in urban areas of municipalities were caused by surface runoff and soil washing of agricultural land. In areas susceptible to wind erosion they are damaged due to agricultural production, environmental degradation, clogging of roads, endangering the health of the population. Partial or total loss of soil fertility, both in terms of quality and quantity, occurs as a result of many different processes as salinization, wetting, nutrient removal, soil compaction and decay, desertification, pollution and deposition of waste or mining.

Research has shown that yields decreased by 77%. after removal of the humus layer from the soil.

3.4.3 Irrigation, use of water and water system

Agriculture is the major source of nitrogen pollution of European water bodies, including lakes, rivers, ground water and the European seas. The agricultural sector also accounts for a large proportion of water use across Europe, particularly in southern countries where the importance of irrigation means that agriculture can account for as much as 80 % of total water use in some regions (Anonym 2013) .

New research from the University of Minnesota drills down to the county-level impact of corn production, connecting it for the first time to where corn likely winds up – based on the facility-specific demand of large-scale U.S. corn consumers, which include meat and ethanol producers. Published in the Proceedings of the National Academy of Sciences, the innovative research reveals that the environmental impact of corn varies significantly across geographic consumption locations of sectors and individual producers. Below, in Fig. 1 differences between year 2007 and 2012 are shown, increasing greenhouse gas emission and irrigation use in the USA. Connecting this data to corn consumers through a newly developed NiSE, revealed insights into the impacts of corn consumption across counties, states, industry sectors, and meat and ethanol companies, as well as individual facilities. While the upstream impacts of major commodities such as corn are largely outside the direct control of the downstream companies that purchased them, large buyers do have significant power to influence how their purchase inputs are produced. “Downstream consumer-brand companies are increasingly making commitments to reduce environmental impacts across their supply chains, and they need better information to target their efforts toward meeting them,” Smith said. “This work not only helps companies report supply-chain impacts more accurately, but also helps identify hot spots across their networks for intervention.”

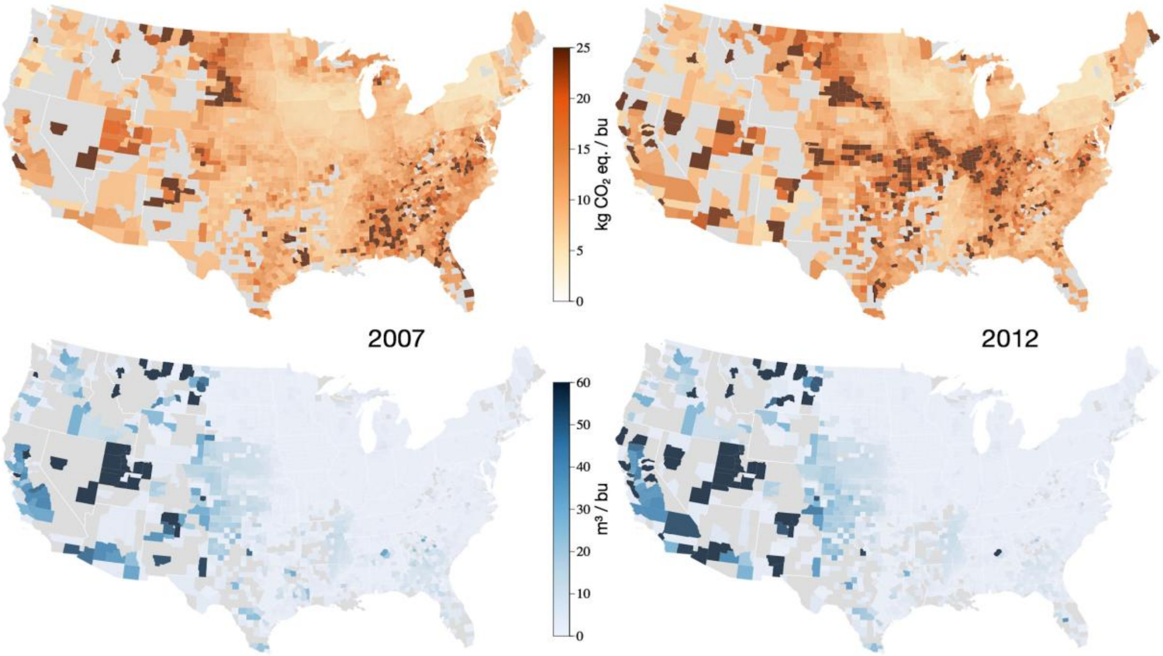

Figure 1: Variations in the greenhouse-gas emissions (kilograms per bushel) and irrigated water use (cubic meter per bushel) of U.S. corn production. Image courtesy of the Proceedings of the National Academy of Sciences

It’s well known that meat has a high environmental impact, largely because of the amount of corn animals are fed, in contrast to the protein they yield . And yet not all corn is created equal – water and fertilizer use varies, along with the greenhouse-gas emissions associated with its production are shown in the Fig. 2. The table content main corn consumers and companies and their consumption of maize, total CO_2 production and used water.

Corn consumers	Corn, million bushels	CO_2e, million kg	Irrigated water, million m^3	CO_2e, kg/bushel	Irrigated water, m^3/bushel
Sectors					
Ethanol	2,780	27,029	5,877	9.72	2.1
Beef	1,565	15,710	10,871	10.04	7.0
Pork	1,354	13,799	2,147	10.19	1.6
Broilers	854	8,240	2,076	9.65	2.4
Companies					
Tyson*,†,‡	907	8,498	3,379	9.4	3.7
JBS*,†,‡	686	6,551	3,156	9.6	4.6
Cargill*,†,§	534	6,197	3,061	11.6	5.7
ADM§	361	3,390	529	9.4	1.5
Smithfield†	352	3,593	459	10.2	1.3
POET§	327	3,504	79	10.7	0.2
Valero§	249	2,352	230	9.4	0.9
Green Plains§	202	1,929	711	9.6	3.5
National Beef*	178	1,848	2,085	10.4	11.7
Flint Hills§	153	1,232	208	8.1	1.4
Hormel†	121	1,038	144	8.6	1.2
US total	11,082	109,489	30,684	9.9	2.8

*Beef processor; †pork processor; ‡broiler processor; §produces ethanol.

Figure 2: Estimated 2012 corn supply-chain CO2e (carbon-dioxide equivalent) emissions and irrigated water use for ethanol and animal protein sectors and large downstream companies. Table courtesy of the Proceedings of the National Academy of Sciences.

Many agricultural staples have enormous environmental consequences. Corn’s side-effects — fertilizer use and emissions, transportation pollution, water uptake, land change — are particularly noteworthy given the enormous scale of U.S. production. Satellite chlorophyll-sensors can “see” plant growth in the U.S. Corn Belt from space (New study, 2017).

3.5 Concerns over biofuels

Nearly one-third of all U.S. cropland is used for corn — but it's not all the type you eat off the cob. More than a third of U.S. corn is used for animal feed, with another third grown for ethanol for cars. Growing corn uses a lot of water and fertilizer, and some of these production techniques, coupled with the effects of climate change, are threatening U.S. corn production.

The United Nations, abbreviated (UN), has released a report calling for the creation of an international bio-energy certification scheme to ensure that products meet environmental standards. The report entitled Sustainable Energy: A Framework for Decision Makers, released by UN - Energy, warns that energy crops could have negative environmental consequences if they replace forest, or divert land, water and other resources away from the production. The report also warns that the biofuel industry raising the price of food. According to UN figures, global production of biofuels has doubled in the past five years, and is likely to raise more and more again in the next year. In the US production of ethanol is set to double, reaching more than 12 billion gallons a year.

In 2013 one third of US maize already goes to distil ethanol. In addition to the uncertainty of meeting future needs should there be a poor season in a major grain producing country or region, current availability of grain falls short of needs. Where populations already spend 50 per cent or more of income on food, further price increases can only lead to more hunger. Brown writes, "As a result of chronic hunger, 48 per cent of all children in India are undersized, underweight and are likely to have IQs that are on average 10-15 points lower than those of well-nourished children." Whereas average grain consumption in India is 380 pounds annually, in the US it is 1,400 pounds, 80 per cent of which goes to produce meat, milk and eggs. Over consumption has become a major health issue in the US and EU.

The Daily Telegraph's news website has revealed that "cars, not people, are responsible for most of the increase in the world cereal consumption". From twenty million tons in the US will be fourteen used for the production of bioethanol in cars. "Robin Maynard has quite clearly concluded his article on this topic "When deciding whether to fill up if bellies or highways, it is worth considering this: the grain needed to fill up one hundred car fuel tank with a bioethanol would feed one person for one whole year. In the USA the new energy act is expected to increase by five times to 36 billion gallons of ethanol per year in 2022 (Lehman 2008).

In contrast, (Martin et al. 2010) are convinced that the growing world population will increase the need for food production, by 2050 to twice as much. Therefore, this should be ensured by means of increasing production per unit of land and efficiency of crop utilization. Greater environmental and greenhouse gases are also needed, adds Popp (2011).

Biofuel production based on agricultural commodities increased more than threefold from 2000 to 2008. In 2007-08 total usage of coarse grains for the production of ethanol reached 110 million tonnes, about 10 percent of global production. Increased use of food crops for biofuel production could have serious implications for food security. A recent study estimates that continued rapid expansion of biofuel production up to 2050 would lead to the number of undernourished pre-school children in Africa and South Asia being 3 and 1.7 million higher than would have been otherwise the case. Therefore, policies promoting the use of food based biofuels need to be reconsidered with the aim of reducing the competition between food and fuel for scarce resources.

The world has the resources and technology to eradicate hunger and ensure long-term food security for all, in spite of many challenges and risks. It needs to mobilize political will and build the necessary institutions to ensure that key decisions on investment and policies to eradicate hunger are taken and implemented effectively. The time to act is now. Moreover, it is to be noted, that the future total demand for agricultural commodities may exceed the demand for food and feed more or less significantly, depending on the expansion of demand for biofuels and on the technology used for the conversion of agricultural biomass into biofuels. Hence, the development of the bio-energy market will also determine how far it will be possible to meet the growing demand with the available resources and at affordable prices.

Much of the natural resource base already in use worldwide shows worrying signs of degradation. According to the Millennium Ecosystem Assessment, 15 out of 24 ecosystem services examined are already being degraded or used unsustainably. These include capture fisheries and water supply. In addition, actions to intensify other ecosystem services, such as the ecosystem service ‘food production’, often cause the degradation of others. Soil nutrient depletion, erosion, desertification, depletion of freshwater reserves, loss of tropical forest and biodiversity are clear indicators. Unless investments in maintenance and rehabilitation are stepped up and land use practices made more sustainable, the productive potential of land, water and genetic resources may continue to decline at alarming rates.

3.5.1 Risks

Numerous studies have recognised that the changes to water tables, soil structure and the destruction of habitats that occur where land is converted to agricultural uses can have negative impacts on biodiversity.

Intensification is often cited as a means of avoiding the expansion of agricultural land use but it can work against efforts to mitigate climate change. Intensifying output by applying more fertilisers increases emissions of nitrous oxide. Generally, such increases are less (in CO2 -equivalent terms) than agricultural land expansion. They are not negligible, however, and in some cases might equal the effects of agricultural expansion, so it should not be ignored. Agricultural intensification can also lead to additional environmental impacts. These are often linked to reduced crop variety (as only very productive crops are grown) and the increased use of external inputs as a fertiliser, pesticides, water. Past intensification processes in European agriculture have had significant environmental impacts and further agricultural intensification is likely to increase such pressures.

It is precisely because of the subsidization of biomass as a renewable energy source that in the Czech Republic there are situations where modern gas boilers, which do not produce virtually no dust particles, are replaced by biomass incinerators. They pollute the air, on the one hand, in the production of heat or electricity itself, but also the transport of biomass to the place of use.

Burning biomass also leads to emissions of fine dust particles that pose a risk to human health. Earlier studies from Germany have highlighted that air pollution has increased in areas where natural gas has been replaced by subsidized biomass burning.

The ability of the global food and agricultural system to meet future demand for food, feed and fibre could be severely limited by a number of risks and challenges. The most important risk is that hunger and malnutrition could persist or even continue to rise in spite of food supplies that are sufficient at aggregate levels. Another increasingly worrisome challenge is climate change, affecting developing countries disproportionately. A third challenge that has been emerging with the rise in energy prices is a rapid increase in the use of agricultural feedstock for biofuels, causing additional scarcity on markets for food and feed.

3.5.2 Facts about ethanol in the USA

Corn is also used to produce ethanol (ethyl alcohol), a first-generation liquid biofuel. In the United States corn ethanol is typically blended with gasoline to produce “gasohol,” an automotive fuel that is 10 percent ethanol. Although corn-based biofuels were initially touted as environmentally friendly alternatives to petroleum, their production diverts arable land and feedstock from the human food chain, sparking a “food versus fuel” debate. Cellulosic ethanol, which is made from no edible plant parts such as agricultural waste, has a smaller impact on the food chain than corn ethanol, though the conversion technology is generally less efficient than that of first-generation biofuels (Anonym 3).

According to Renewable Fuels Association, there are now 211 bioethanol refineries in the US. Most of these are in the Corn Belt which is the part of the Midwest USA. Most factories use maize as the main raw material, but sorghum is added sometimes.

Amount of drinkable water is getting low in the USA. It is starting to be more and more serious every year. A big portion of water is taken to irrigate agriculture sector which include not only crops as a food and feed for animals but also energy crops.

Today there are filtration equipment to deal with the wastewater, but ever since the middle of the last century, an even larger factor has emerged as a used of too much artificial fertilizer in commercial agriculture that crops cannot absorb it all and it winds up in the ocean (Merchant 2013).

Maize requires fertilization and a sufficient amount of nutrients. Due to higher consumption of meats, crops and also energy crops is rapidly increasing use of fertilizers, pesticides and other chemicals in the USA every year. Dead zones occur around the world, but primarily near areas where heavy agricultural and industrial activity spill nutrients into the water and compromise its quality accordingly. Perhaps the most infamous U.S. dead zone is an 8,500 square mile swath (about the size of New Jersey) off the Gulf of Mexico, not far from the nutrient-laden Mississippi river, which drains farms up and down the Midwest. Fertilizer runoff and fossil-fuel use lead to massive areas in the ocean with scant or no oxygen, killing large swaths of sea life and causing hundreds of millions of dollars in damage. This fertilizer runoff, instead of contributing to more corn or wheat, feeds massive algae blooms in the coastal oceans. This algae, in turn, dies and sinks to the bottom where it is consumed by microbes, which consume oxygen in the process. More algae means more oxygen-burning, and thereby less oxygen in the water, resulting in a massive flight by those fish, crustaceans and other ocean-dwellers able to relocate as well as the mass death of immobile creatures, such as clams or other bottom-dwellers. And that's when the microbes that thrive in oxygen-free environments take over, forming vast bacterial mats that produce hydrogen sulfide, a toxic gas (Biello 2008).

The world's largest bioethanol producers are Brazil (40% of global production) and the USA (45% of world production). Brazil uses sugar cane for its production, thanks to which hybrids from 1 ha of cane grown can produce 6 ths. - 8 ths. liter of bioethanol.

In the United States, corn is used more, but fossil fuels are used in ethanol processing, and intensification of production requires rising water consumption, which is currently scarce in many areas (Doucha, 2010).

3.6 Views of biofuel

"Using corn as a fuel source seems to be an easy path to renewable energy," said Richard Yuretich, the NSF program director for Critical Zone Observatories. "However, this research shows that the environmental costs are much greater, and the benefits fewer, than using corn for food" (Yoksoulian, 2017).

As the world population grows and how technology evolves, every person naturally wishes to have more energy services. The overall world energy consumption is thus rising and will continue to rise. Estimates suggest that energy consumption will be 40 percent higher in 2030. Much worse is the situation of wind energy, flowing water or biomass energy, that is, energy generated by the transformation of the incident solar energy. The efficiency of conversion of solar radiation to these sources is low and as a result the area density of these sources is so small that they can cover only a minor part of the consumption with the current population. This is undoubtedly related to the fact that until the renewable energy sources contributed only a fraction of a percentage to the energy balance, and the technical problems associated with their use had to be addressed, the above limitations did not play any role. Today, however, we are in a situation where we want renewable energy sources to cover a significant proportion of energy consumption (best of all) and that is already a problem.

The world's population is expected to reach 9 billion by 2050. Climate change, population, and income growth will drive food demand in the coming decades. Baseline scenarios show food prices for maize, rice, and wheat would significantly increase between 2005 and 2050, and the number of people at risk of hunger in the developing world would grow from 881 million in 2005 to more than a billion people by 2050. Food Security in a World of Natural Resource Scarcity: The Role of Agricultural Technologies examines which current and potential strategies offer solutions to fight hunger (Rosegrant 2014).

A great pressure to support non petroleum sources to reduce dependence on oil imports and slow global warming due to fossil fuel emissions manz of countries are promoting biofuels made from food crops. Ethanol production (mainly in the United States and Brazil) tripled from 4.9 billion gallons to almost 15.9 billion gallons between 2001 and

2007. During that same period, biodiesel production (mainly for sale in the European Union) rise up almost 10-fold, to about 2.4 billion gallons, although further expansion is now uncertain. Biofuel production has been prodded by government initiatives such as subsidies and tax incentives. But action is not necessarily the same thing as progress, say some experts. The United States, in a misguided effort to reduce oil insecurity by converting grain into fuel for cars, is generating global food insecurity on a scale never seen before. Even as growing quantities of corn and other grains are being diverted for use as biofuel feedstocks, newly affluent people mainly in Asia, are eating more meat and dairy, which puts a further demand on animal feed supplies. The United Nations Food and Agriculture Organization (UN FAO) calculated that world food prices grew 40% up in one year prior, and the price hikes affected all major biofuel feedstocks, including sugarcane, corn, soybean, rapeseed and palm oil. Jacques Diouf warning of "a very serious risk that many people will not be able to get food," particularly in the developing countries. To be fair, no one is blaming the rapid price increases solely on biofuels, hunger and malnutrition were widespread before the biofuels boom. According to the UN World Food Programme, 854 million people were undernourished in 2001–2003, and about 10 million people die of hunger and hunger-related diseases in an average year. However, demand for biofuel feedstocks is overwhelming a food supply system that was already overextended by surging demand. Moreover, the demand for biofuel affects even non feedstock crops, such as rice and wheat, as farmers plant feedstocks instead of food. High prices are also pinching food aid. According to rising food prices intensify food insecurity in developing countries, the global food aid budget would need to rise about 35% over the next decade. Meanwhile, biofuel production is booming around the world. Brazil, the United States, and Europe account for the lion's share of today's biofuel production and consumption. However, developers are beginning to take advantage of many crops grown elsewhere that can be converted into fuels. In Malaysia and Indonesia, where vast palm oil plantations are being established in cleared rainforests, biodiesel refineries have created a palm oil shortage. The 19 January 2008 *New York Times* reported that the price of palm oil for cooking has risen by 70%. The ability for farmers to earn money by selling biofuel feedstocks it sounds very good on the surface, but biofuels can replace existing production patterns of small farmers with large-scale monoculture plantations and the people who used to be farmers are turned on the second train. For this reason, she says, critical civil society observers and organizations around the world prefer the term agrofuels over biofuels to reflect that these fuels are a product of corporate industrial farming, driven primarily by large international agribusinesses. With a focus on small-scale farming and relevance for the poor the focus would be less on biofuels but more on biomass use as an energy source for the poor. Even without ethanol and biodiesel, its need to motivate farmers around the world to expand production, and this can only be done through price incentives. Now that food crops can be converted into fuels, a new factor must be considered, the link between the price of food and the price of petroleum. As petroleum fuels get more expensive, biofuels become more profitable, therefore, biofuel producers can afford to pay more for their feedstock. This new relationship puts hungry people in direct competition with empty gas tanks. "Historically the food and energy economies have been largely separate, but now with the construction of so many fuel ethanol distilleries, they are merging," says Brown. "If the food value of grain is less than its fuel value, the market will move the grain into the energy economy. Thus, as the price of oil rises, the price of grain follows it upward." Most of the 82 countries that import food are also net oil importers, Runge says, so this competition between food and fuel harms people who are already "in a world of hurt" (Tenenbaum 2008).

The key principle in resource management is sustainability which consists of operational robustness, attenuation of environmental footprint and socio-economic considerations. Dependence on fossil fuels is unviable due to their continuous depletion all over the world and also the inexperienced greenhouse gas emissions related to their utilization. Therefore, the continuous initiatives geared towards developing various renewable and probably carbon neutral biofuels as energy resources are being taken up. Alternate energy resources such as 1st generation biofuels derived from terrestrial crops like sugarcane, sugar beet, corn and wheat place a colossal stress on global food markets, but this potential food versus fuel conflict is palliated by using sweet sorghum as a bioenergy crop. It can be processed into both biofuel and valuable co-products, thus meeting the various requirements of food, fuel and fodder (Tenenbaum 2008).

3.7 Illustration of energy grasses

3.7.1 Miscanthus sinensis

Miscanthus, commonly known as Elephant Grass is high yield energy crop, that grows over 3 metres tall produces a crop every year without the need for replanting. The rapid growth, low mineral content, and high biomass yield which is about 15 t / ha, increasingly make it a favourite choice for biofuel. Miscanthus is predominantly used for feedstock. It is a valuable new crop, offering major benefits to many sectors (Anonym 2012).

Attempts at the ATZ Research Institute in Germany have produced about 6000 l / ha bioethanol by thermal-pressure hydrolysis. It's enough for a smaller vehicle for the whole year (Holub 2007).

3.7.2 Energy sorrel

It is commonly name Rumex OK 2, which is hybrid of Rumex patientia and Rumex tianschanicus. Unlike the corn that is sowing at this time, the energy sorrel could be already harvested in green in the first half of May for silage. After this harvest, it grows again and can be harvested green during the summer, for the third time in the fall. It must be harvested very early, young, because it is quickly woody and aged, of course, its feed value is reduced. Once aged and matured, it is then suitable for energy purposes as a dry raw material for fuel production.

3.7.3 Reed canary grass

In a Latin name (*Phalaris arundinacea*) is a perennial grass traditionally cultivated for forage, but nowadays it is also burned to produce energy (Lewandowski, Scurlock, Lindvall, Christou 2003).

Now large-scale use of Reed Canary grass, abbreviated RCG, for energy purposes is carried out in Finland and Sweden, but in other European countries interest has also been shown in the cultivation of RCG. Studies on the environmental effects of RCG cultivation have concluded that RCG growths efficiently bind carbon and nutrients and thus decrease nutrient leaching and CO_2 emissions, while increasing the soil's fertility and the lightness of the soil's surface layer (Landström 1996).

Reed Canary grass (it continues as RCG), is harvested after winter as dry hay. In pre-growing season dry material, the energy content is higher than in the growing season's RCG that has fresh green material. RCG grows rapidly during spring and summer and reaches canopy height of 150–300 cm during the growing season (Lewandowski 2003).

Studies on the environmental effects of RCG cultivation have concluded that RCG growths efficiently bind carbon and nutrients and thus decrease nutrient leaching and CO_2 emissions, while increasing the soil's fertility and the lightness of the soil's surface layer.

In North America the red-winged blackbird (*Agelaius phoeniceus*) is more abundant (Landström 1996).

4 Discussion

With the expectation of ending oil extraction in this century, bioethanol is now widely used in many countries as the ETBE component (Ethyl tert-butyl ether). However, there are many other alcoholic motor fuels, especially for diesel engines. When ethanol is used for fuel production, the so called agroalcohol produced by the classic process of sugar or starchy agricultural crops is in the Czech Republic. With respect to the expensive processed raw material, this method is unthinkable without subsidy support programs. In solving the bioethanol waste research project, proceeded from the working hypothesis that bioethanol obtained from the processing of bio waste would be cheaper than the produced agroalcohols in which the raw material price is projected. In addition, environmental effects can be considered as a result of waste treatment. We focused on high-lignocellulosic biowaste, especially plant waste, forestry waste, wood waste and paper and cellulose, and municipal bio-waste on separate collection paper and board, wood containing no hazardous substances and biodegradable waste from gardens and parks.

Cílek (2018, pers. comm.) said "that a person who does not want to change and consume everything like before, is looking for a way to excuse it, to keep conscience and not to lose his habits. And then instead of driving a car just a bit, it will devise energy crops, but then it turns out that all new solutions bring also new, unexpected problems and so it goes on. In the meantime, the only solution can be to start processing petroleum for food and to sterilize cars to repay what they are doing. The subsidies to energy set up relationships that could never arise and prevent competition from energy alternatives."

The efforts to reduce greenhouse gas emissions have led worldwide to support technologies with a closed carbon cycle and reduced dependence on fossil sources. This trend has taken place in many places on the planet (USA, Brazil, Germany, as well as the Czech Republic and other countries) by a significant injection into agriculture, when farmers began to grow crops for energy, in non-food purposes which is looks like a first problem in this connection. The food and feed for cattle should be grown in the land, especially when the billion inhabitants of the planet do not have enough nutrition. Cultivation of energy crops can be a disaster for the developing world if the energy crops are massively grown (occupy the soil and water for food production), local famines may explode in the case of dry or otherwise poor yields. But the farmer is a businessman like every other and grows what is commercially interesting. This is particularly true in a developed world where food is relatively abundant. And subsidized agriculture are definitely with their guaranteed redemption prices. Farmers do not bother to focus on this lucrative business. I also heard the statement: "Until we had a biogas, we did not know what the money was". However, if the area spreads too much (eg. some areas of the USA, UK, Germany), the negative impacts of maize growing will begin to appear. This in itself is an amazing plant. So many biomass, in a relatively short time. But it needs a lot of nutrients (fertilization), protection (pesticides), which is chemistry. And because it is an erosive crop, broad-leaved and grown over spring and summer, the storm season ends with this chemistry often in the waters. Not to mention the loss of land. Especially when moving on slopes and not using special technologies such as mulching. Therefore, it is necessary to keep the number of biogas plants at a reasonable number. Otherwise it will take the landscape (Žalud 2018, pers. comm.).

My view of opinion, as you can see, is not clear. My agricultural self: I am glad that farmers have something to grow and prosper in business. My scientific self: It is not even sure whether this is the right way to reduce greenhouse gases, probably yes, but at the cost of significant subsidies. I am the proponent of the atom. My landscaping self: Strongly drumming on drums in terms of erosion and water pollution. For yourself as a normal person (common sense): I would prefer if a farmer fed us and not cars or electricity, explained Žalud (2018, pers.comm.).

Moudrý and Strašil (1998) reported, that the fossil fuels burden the environment not only by their combustion, but also by their extraction and processing. The reserve of these fuels are irrevocably liquidated and will be exhausted in a few decades.

Usťák and Kavka (2004) the advantages of biomass in saving non-renewable resources, and precisely in that its cultivation limits import dependence. As stated by (Hezký 2011), the basic requirement of farmers operating biogas stations is the highest yield of dry matter per hectare. Consequently, the maximum production of methane from kilogram of dry matter. These conditions are met by new hybrids of corn grown specifically for biogas plants from companies such as Monsanto, Limagrain, RAGT Semences, or KWS Seeds Ltd. These supranational companies actually do not support local agriculture and farming system, they have a wide range of hybrids and GMO maize which are ready to cultivate but is it really useful for our agriculture and develop of the system use these hybrids.

The issue of food safety and greenhouse gases needs to be seen from a global perspective. Many crops grown for the purpose of producing energy are also crops vital to people in other countries or continents. Therefore, we should generally treat with biomass very carefully and consider all for and against in connection with human needs. It is important to realize that everything we have and what we eat comes from nature, and it is not a matter of course that it will be forever. Yes, transgenic crops can help increase food production, but it does not solve the whole situation. People do not choose where and under what conditions they are born and we, who have the opportunity to live in a country where there is so much to do should not close our eyes. With this behaviour, we will not waste water and food unnecessarily. We should behave responsibly towards nature and its sources (Anonym 4).

In the topic about the risk of corn production, Barton says that corn is a thirsty crop, so in parts of the country where we don't have enough rainy days, we're irrigating it, usually with groundwater, from the aquifer that is in the middle of the country called the High Plains Aquifer, which is a tremendous groundwater resource. But the fact is that the amount of water that's required to grow corn is much more than what's required to grow crops like sorghum or wheat. But the high price of corn has driven production. Fertilizer used on corn it is an another big issue we see with this production is the fact that it needs so much more fertilizer than other crops. And in many parts of the corn belt, high levels of fertilizer pollution - that is mean the fertilizers is running off into rivers and streams, and a lot of it is aggregating into the Mississippi river and pouring off into the Gulf of Mexico, contributing to what's been called 'the dead zone.' It's a hypoxic, which means oxygen-deprived area where is no room for aquatic life, and we know from our study that corn production contributes to 40 percent of that nitrogen pollution. The amount of water that's required to grow corn is more than what's required to grow crops that have been traditionally grown in those areas like sorghum or wheat. But the high price of corn has driven production in those areas. The price of corn is so high, because of the drought and other factors and farmers are going to plant more corn because they want to make more money rather than planting something else in their crops. The short-term economics of it makes sense but the long-term economics are a disaster (Hobson 2014).

5 Conclusion

Effective energy use issues are linked to the entire history of humanity. At the forefront of interest, however, they are now becoming particularly active in ensuring the sustainable development of humanity. The limitation of global energy supplies and the need to protect the environment lead to a sustained increase in fuel and energy prices. One of the answers to these questions may be alternative energy sources and their intensive use. Among the alternatives of the energy source we include non-renewable sources of energy produced by human society, eg. energy from wastes, biogas or sewage sludge. The life of a person without energy is unthinkable, and consumption is still rising. However, most current resources are non-renewable and stocks are final. Therefore, it is increasingly necessary to pay attention to renewable resources that do not bring so many environmental problems. Traditional renewable energy sources include wind and water movements (energy from watercourses, water inflows and outflows).

Maize is a very important crop in today's farming industry. Many different varieties, systems and techniques have been developed which makes the topic a very interesting. The quality of the maize that is now being produced is clearly very high which makes its cultivation particularly attractive for farmers, as the returns are desirable, especially when maize is used as a feed supplement for dairy and beef herds.

The use of maize as a renewable source of energy brings benefits, but in mean of long time view more negatives or limitations is related with this theme. The new outlooks with more energy supply is available but the cost of it is more expensive than is shown.

However, maize cultivation contributes significantly to the production of greenhouse gas emissions. One way to reduce these emissions is to replace the corn with another plant suitable for these purposes. Possible alternatives include the cultivation of multi-annual energy plants, including the Miscanthus sinensis or some species of persistent grass.

The only energy solution without side effects on the environment is voluntary modesty.

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