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Diploma Thesis

Analysis of Three Dimensions of Food Security in Relation to Possibility of Energy Crops Cultivation: Case Study in North Sumatra Province, Indonesia

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DECLARATION

I hereby declare that I have written presented master thesis ***"Analysis of Three Dimensions of Food Security in Relation to Possibility of Energy Crops Cultivation: Case Study in North Sumatra Province, Indonesia"*** by myself using only the literature listed in references.

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Bc. Šárka Dědková .....

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ABSTRACT

The study focuses on discussed issue of food versus energy security. Due to the rapid increase in population in Indonesia, the matter of food security as well as energy security is very urgent. This paper discusses three dimensions (food availability, food access, food utilization) characterizing food security among the small-scale farmers. Depending on the level of mentioned aspects, the potential for energy crops cultivation for biofuel production is evaluated. The survey was carried out in North Sumatra province in Indonesia, where 75 farmers were interviewed. To obtain information, the participatory research methods were applied; these included semi-structured questionnaire, semi-structured interview and observation. Several indicators were used for assessment of each of food security dimension. The survey ascertained that the local farmers are secured at all three dimensions of food security. However, a certain part of farmers lives closely above the poverty line. It also denotes moderate expenditures on food. Furthermore, certain aspects leading to food security (such as access to education or drinking water) should be improved. The research also showed that the farmers are not familiar with the possibility of growing crops for energy purposes, although they have capacities for such cultivation. Due to the fact that farmers' agricultural production is primarily used for sale and not for subsistence, there is a potential for change in the composition of farmers agricultural production in favour of energy crops. Therefore, the higher capacities should concentrate on spreading and strengthening knowledge among the farmers about the possibility of energy crops cultivation in the context of enhancing biofuel policy. Thus, the energy security, especially at local level, could increase.

Key words: *food security, food availability, food access, food utilization, biofuel, Indonesia*

ABSTRAKT

Práce se zaměřuje na aktuálně diskutovanou problematiku potravinového zabezpečení a výroby energie. Vzhledem k rychle narůstajícímu počtu obyvatel v Indonésii, je otázka jak potravinového, tak energetického zabezpečení, velmi naléhavá. Studie vyhodnocuje tři základní parametry charakterizující potravinovou bezpečnost (dostupnost, přístupnost a využití potravin) mezi drobnými farmáři. Dále se dle úrovně jednotlivých parametrů zhodnotí potenciál k pěstování energetických plodin určených k výrobě biopaliv. Výzkum byl realizován v provincii Severní Sumatra v Indonésii. Průzkumu se zúčastnilo 75 farmářů. K získání informací se užilo participativních metod průzkumu, které zahrnovaly polostrukturovaný dotazník, polostrukturovaný rozhovor a pozorování. K vyhodnocení každého aspektu potravinové bezpečnosti bylo užito několik indikátorů. Výsledky studie dokazují, že tamní farmáři maji dobrou úroveň potravinového zabezpečení ve všech třech parametrech, přesto určitá část žije těsně nad hranicí chudoby. Od toho se odvíjí omezené výdaje za potraviny. Dále bylo zjištěno, že je potřeba zlepšit určité aspekty vedoucí k potravinovému zabezpečení (přístup ke vzdělání, přístup k pitné vodě). Výzkum dále ukázal, že farmáři nejsou obeznámeni s možností pěstovat plodiny pro energetické účely, ačkoliv disponují kapacitami pro jejich produkci. Vzhledem k faktu, že jejich zemědělská produkce je určena především k prodeji a ne k vlastní obživě, nabízí se potenciální možnost začít pěstovat tyto plodiny. Proto by se tamní představitelé propagující výrobu biopaliv měli zaměřit na posílení vědomí mezi farmáři o možnosti pěstovat energetické plodiny, a tím přispět k energetickému zabezpečení, především na lokální úrovni.

Klíčová slova: *potravinová bezpečnost, dostupnost potravin, přístupnost potravin, využití potravin, biopalivo, Indonésie*

CONTENT

LIST OF ACRONYMS

BP	British Petroleum
BPS	Badan Pusat Statistik
DES	Dietary Energy Supply
FAO	Food Agriculture Organization
GHG	Greenhouse gas
IPC	Integrated Food Security Phase Classification
IPCC	Intergovernmental Panel on Climate Change
SD	Sekolah Dasar
SMA	Sekolah Manengah Atas
SMK	Sekolah Menengah Kejuruan
SMP	Sekolah Manengah Pertama
UN	United Nations
USAID	United States Agency for International Development
WB	World Bank
WFP	World Food Programme

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Indonesia is a vast country, which is currently distinguished by huge potential in field of market development and economy level. Furthermore, Indonesia has been endeavoring to penetrate into the global economy. Along with the gradual, but still rapid development, the amount of the population is increasing as well. However, a concern about the security of the population in terms of food and energy is related to that. Food and energy represent essential elements of livelihood and well-being.

Nowadays, the question of food security is widely discussed problem across the world. Moreover, this issue is often related to the energy sector through the production of biofuels. That is caused on the basis of competition about crops intended either for the production of human food or as a feedstock for biofuel production. Energy supply is an important factor for the overall development of Indonesia. In view of the fact that the energy sector is based on fossil resources which bring negative aspects mostly in terms of environment, Indonesia strives to expand the structure of energy supplies. Thus, Indonesia puts emphasis on biofuel policy.

However, if Indonesian government wants to focus an agricultural production on energy purposes, firstly it is necessary to determine whether the local inhabitants are secured in terms of food. On the basis of this evaluation, it can be considered if there is any potential for growing energy crops for biofuels, especially among the small-scale farmers.

2. LITERATURE REVIEW

2.1. Overview of Food Security

Although the matter of food security is greatly discussed issue across the today world, the entire conception of food security had begun in the mid-1970s. Not only the issues of famine and hunger in the world were stimulating aspects (FAO, 2003), but also the oil and food crisis between 1972 and 1974 ignited to solve that problem (McKeown, 2006; Sage, 2013). Moreover, as FAO (2003) pointed out, neither successes of the Green Revolution in Asia had not brought a long-term reduction of hunger and poverty. All these features led to adjustment of food security as one of the measures for malnutrition.

The World Food Conference in 1974 in Rome established a thought of food security on the basis of the efforts to maintain stable food prices and ensuring long-term access to food supplies, all at both national and international levels, as FAO (2003) described. At that time, the definition of food security was conceived as "*availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices*" (UN, 1975). Since then there have been registered several expressing definitions of food security (table 1), of which the most recent and recognized was accepted in The State of Food Insecurity in 2001: *"Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"* (FAO, 1996).

Food security can be simply considered as one of the indicators of living standard criteria, which purely reports enough food for an active and healthy life. According to FAO (2003) and WFP (2009) it is multi-dimensioal phenomen, which should include both short-term acute hunger and chronic malnutrition. Moreover, food security balance contributes to social, economic, environmental and political stability as well (FAO, 2003; WFP, 2009).

Table 1: Food Security definitions (McKeown, 2006; FAO, 2003)

Definitions of Food Security	Organizations
"availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices"	World Food Summit (1997)
"ensuring that all people at all times have both physical and economic access to the basic food that they need"	FAO (1983)
"access of all people at all times to enough food for an active, healthy life"	World Bank (1986)
"Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life"	World Food Summit (1996)
"Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"	The State of Food Insecurity (2001)
Community food security is a strategy for ensuring secure access to adequate amounts of safe, nutritious, culturally appropriate food for everyone, produced in environmentally sustainable way and provided in a manner that promotes human dignity.	Ontario Public Health Assocciation (OPHA) (2002)
Community food security exists when all citizens obtain a safe personally acceptable, nutritious diet through a sustainable food systém that maximizes healthy choices, community self-reliance and equal access for everyone.	Public Health Assocciation of British Columbia (PHABC) (2004)

2.1.1. Dimensions of Food Security

On the basis of FAO interpretation of food security it is necessary to focus simultaneously on four important aspects: (i) food availability, (ii) food access, (iii) utilization and (iv) stability (FAO, 2008; FAO, 2006; Oxam, 2008). From the point of view of Koc *et al.* (1999), it is about four key "A" aspects: availability, accessibility, acceptability and adequacy. Each dimension is evaluated by group of certain indicators. Although many surveys establish the concept of food security at three features

(availability, access and utilization), nevertheless, the groups of indicators are needed for their evaluation may vary.

2.1.2. Food Availability

Availability constitutes an adequate supply or quantity of quality food which is physically available to people through a domestic food production, net stock level, net import trade or humanitarian aid (USAID, 1992; Oxfam, 2008; WFP, 2009; Renzaho and Mellor, 2010). As Ruane and Sonnino (2011) suggested the food availability should be secured from all three spheres of local, national as well as international level. Mainly it is necessary to focus on a household level (FAO, 2008).

2.1.3. Food Access

Accessibility means not only physical, but also economic access to sufficient resources of food. In a case of food access, people have the financial means through which they can afford to buy adequate nutrition food (USAID, 1992; Oxfam, 2008). According to Ruane and Sonnino (2011) this aspect includes a tangled organization of food marketing, food market as well as food distribution.

As WFP (2009) described, access to food is more or less about an ability of households to secure the food by any way (e.g. purchase, aid, self-production, barter and so forth).

2.1.4. Food Utilization

To meet the well-balanced dietary requirements of human body, particularly with the respect to nutrient intake, the right food utilization is required. All of this is linked to the appropriate procedure of food handling and preparation, food storage, sanitation and use of clean water as well (USAID, 1992; Ruane and Sonnino, 2001; FAO 2006; Oxfam, 2008). Whole food processing up to consumption should be made in proper conditions.

Renzaho and Mellor (2010) divide food utilization into physical and biological type. Physical utilization lies in the ability to prepare a meal through available physical means such as kitchen tools, knowledge, convenient environment, kitchen patterns and so forth. Biological utilization focuses on the human body from the perspective of digested food and subsequent nutrient intake - body's ability to properly assimilate nutrients (Oxfam, 2008; WFP, 2009; Renzaho and Mellor, 2010). After logical consideration, it is clear why a safe access to drinking water along with sanitation is key element of food utilization.

2.1.5. Food Stability

Stability can be achieved only by assuming of balance fulfillment of all three previous components. This is the only way to reach a stable food supply for all people at all the times. People can be food secured only if the actual access to food would not be influenced by unexpected events or periodical fluctuations such as issues of food price volatility, political instability or natural disasters. (Koc *et al.*, 1999; FAO, 2006; Coates *et al.*, 2007; FAO, 2008; Ruane and Sonnino, 2011). Renzaho and Mellor (2010) introduced the term of ***asset creation*** instead of stability. This concept represents systems helping to resist to sudden economic shocks as well as environment problems affecting household food security.

2.2. Role of Agriculture in Food Security Sphere

There is no doubt that agriculture presents a significant role in a field of food security, especially at household level. Agriculture represents a source of income for many people, particularly with regard to rural areas. It is not only a source of finance, but also of household food as well (Zezza and Tasciotti, 2010; Gasparatos, 2011). Thus it also contributes to the secure dietary balance in household (Zezza and Tasciotti, 2010).

Increase of agricultural productivity goes hand in hand with a rise of income (FAO, 2003), which is so important for access to food (Fengyinga *et al.*, 2010; WFP, 2012). Increase in production contributing to food security could be managed by modification of cropping framework, in term of intensification of agricultural production trough a use

of fertilizers and agrochemicals, using crop mixes, better water and soil management or expansion of agricultural land (FAO, 2003; Carvalho, 2006). In the opinion of Islam (1994 in FAO, 2003) the cultivation of non-food oriented cash crops would not be a favourable way how to contribute to food security at the national level. These crops cultivated for industry utilization are usually grown for the capital investment purposes. That means cultivation in a large scale, especially in the name of monoculture plantations. Nevertheless, Govereh *et al.* (1999) claim there exist a certain synergy between the cash crops and food crops cultivation. According to his opinion, cash crops marketing can support a production of food crops among the small-scale farmers.

However, with the increasing number of inhabitants on the Earth, a greater pressure is pushed on food security. This leads to a certain pressure on agricultural production as well along an associated intensification. It is related to a higher proportion of inputs. Unfortunately, this process is at the expense of quality. To achieve higher production, the various agrochemicals are used (Carvalho, 2006). Unhappily, this situation is more critical in the developing world, where a common use of harmful substances is contrary to developed countries. Based on that fact, it leads to a contamination of not only agricultural products but also underground water and environment in general (Carvalho, 2006). Additionally, agriculture production and thus food production is influenced by several elements such as climate conditions, soil type, technology used for tilling, irrigation, farmer's knowledge and other inputs (WFP, 2009).

2.3. Food Security Status in Indonesia

There is a special food law (No.7/1996) in Indonesia characterizing food security as: *"a condition when all people in the households have sufficient food at all times, represented as sufficient quantity and quality of food in safe and achievable conditions"*.

According to study mapping the Indonesian food security status (WFP, 2009) a concept of food security is based on the same three dimensions mentioned above (food availability, food access and food utilization).

Important parameters relating to the food security status in Indonesia are described below.

2.3.1. Access to Main Dietary Components for Indonesian Population

Access to food is one of the crucial key factors to understanding food security at the local level. Regardless of the various national, international, governmental or non-governmental food programs and aids, the most important way to get the food is still a self-production capability according to UN (2010). Household production of corn and cassava accounts for more than 60% based on a study published by UN (2010). These crops present important components in Indonesian dietary (Van der Eng, 1998; Howeler, 2006; WFP, 2009). Another way, that should not be ignored, is simply a purchase process. Moreover, 70% of respondents in the study (UN, 2010) declared that they purchase the main dietary foodstuffs (presenting mainly by rice) in market. Furthermore purchase procedure is gaining significance at the level of local market and the household income.

To a standing balanced access to food it is necessary to have a continuous income, put in other words - to be secured financially. The Indonesian government established the national level of poverty to $26.79 per capita per month (BPS, 2013). According to the official Indonesian statistical database[1], 11.66%[2] of population lives under this limit. In fact, this proportion represents 28,594,700 inhabitants. Nevertheless, there are significant differences between urban and rural population. While urban poverty line was $28.63 per month, where 10,507,800 million people lived in poverty, the value for rural areas was $24.82 with 18,086,900 million people. The comparison of progressive development of poverty line between urban and rural populations as well as the changes in amount of population living under the poverty line is shown in figure 1.

[1] Badan Pusat Statistik is Non-departmental Government Institution directly responsible to the president.

[2] All these values come from Badan Pusat Statistik. Data are related to 2012.

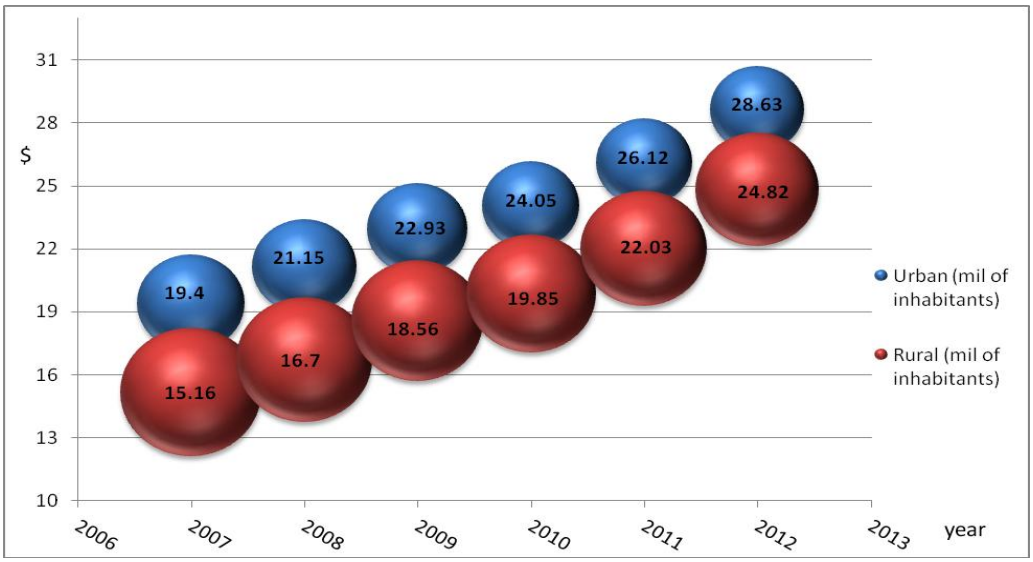

Figure 1: Gradual changes of poverty line comparing rural and urban population in Indonesia (based on data from BPS, 2013)

As it has been already mentioned above, rice is the most fundamental and important component of the Indonesian dietary, followed by corn and cassava (UN, 2010; Dyck *et al.*, 2012). The graph (figure 2) below denotes national production of these three crops.

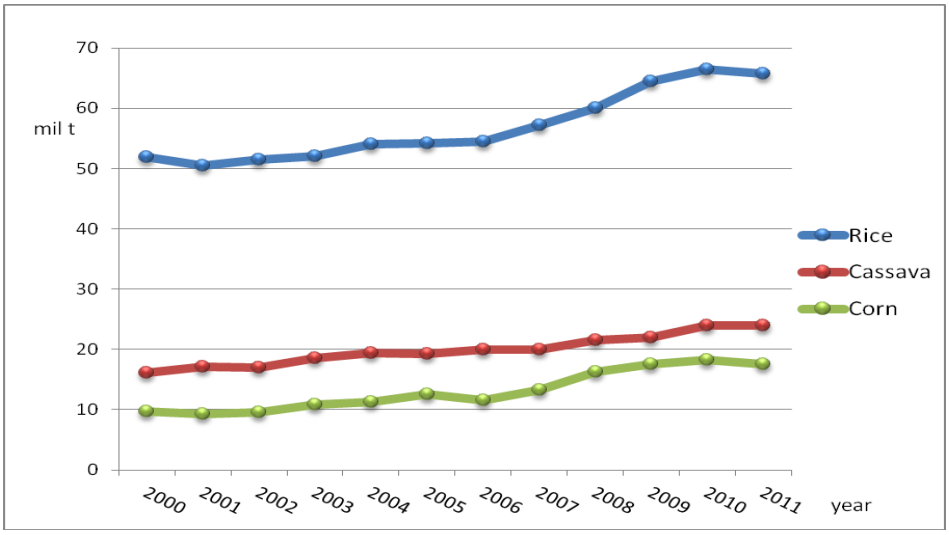

Figure 2: Rice, cassava and corn production in Indonesia (based on data from Faostat, 2013)

2.3.2. Food Expenditures in Indonesian Households

As UN published (2010), the relation between spending for food and food access can be determined. In addition, UN (2010) described in that study the lower-income households have mostly a lack of means for own production. Based on that fact, households are dependent on market, on purchase. Therefore, most of household income goes for food spending. No matter whether it is food secured or food insecured household, the expenditures on food are the same proportion from general income. People usually spend one third of household income for food (WFP, 2012). The difference is in a quality of the purchased food. The less secured household with lower income spends on less quality meal with limited food composition.

Furthermore, amount of expenditures on food can be apparently influenced by level of education according to Fengying *et al.* (2010).

2.3.3. Illiteracy Rate in Indonesia

In general, education contributes positively to the overall issue about food consumption (Fengyinga *et al.*, 2010). One of the means to assess the education situation in a determined country is the illiteracy rate.

The illiteracy rate represents the percentage of illiterate people older than 15 years in the population who are not able to manage the basic literacy skills such as writing, reading, and comprehension in general, inability to do simple calculations as well as the inability of critical thinking or overall interest (WB, 2013; 2012; Hardy *et al.*, 1993).

According to the World Bank (2013), the proportion of illiteracy was 7.4% in 2009 in Indonesia. However, based on Badan Pusat Statistik[3], this value was 7.1% in 2011. The illiteracy rate for North Sumatra province was 3.17% for 2011. Following figure 3 denotes the gradual development of illiteracy monitored since 2003 until 2011 in Indonesia in general as well as in North Sumatra province. The lower level of illiteracy

[3] Badan Pusat Statistik is a Non-departmental Government Institution directly responsible to the president.

in the province of North Sumatra compared to the national average may consist in the better access to education in that region in general according to ICMC (2003).

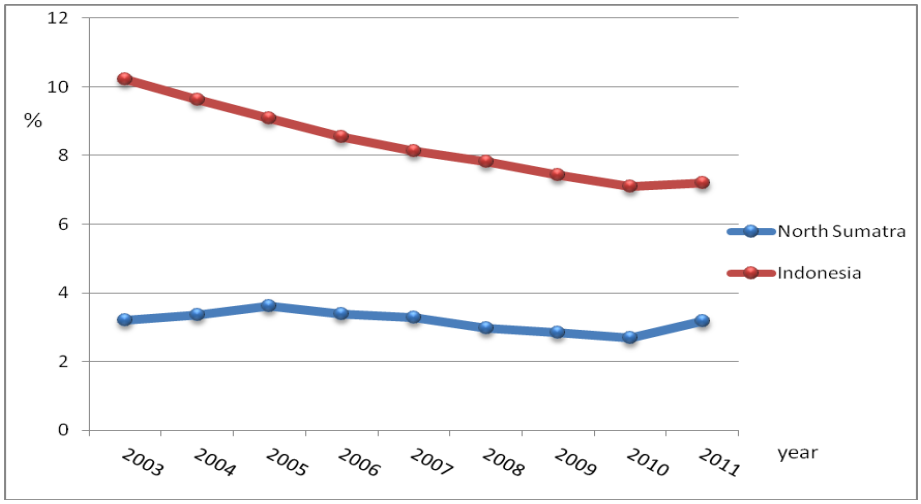

Figure 3: Development of illiteracy in North Sumatra province and Indonesia (based on data from BPS, 2013)

2.4. Influence of Biofuel Production on Food Prices

Nowadays, a question of attacking the food price by biofuel production is extremely debated. Between 2007 and 2008 there was a vastly price hike in foodstuffs. For certain grain crops the price jumped up to twofold (Mueller *et al.*, 2011). Guilty of that price increase is often attributed to the biofuel production. There are two different opinions which are discussed by Ajanovic (2011) and Zhang *et al.* (2013). Firstly, using crops for fuel is the main factor for an increase in food prices. The food price increase in the last few years has been mainly explained as a result of the expansion of biofuels. Secondly, rising food prices are primarily caused due to other factors such as oil price development, financial speculation and recent strong economic growth of China.

According to several studies (Mueller, 2011; Ajanovic, 20011; Janssen and Rutz, 2011; Zhang, 2010) there are other several reasons for food price increase. Chiefly it is the increasing number of population in the world. Surely, it is strongly influenced by price of oil (Timilsina *et al.*, 2011). The other reason is a rise of meat consumption (Tilman *et al.*, 2009). The protein food is still more popular. Meat production has a much greater

demands on the soil than the direct consumption of plant foods. For each kilogram of beef requires 6 kg of plant feed, for each kilogram of pork it is necessary 4 kg of plant food (Smrž, 2009). In the near future, a higher consumption of meat can be expected because of living standard rise; particularly in China, India or South Korea, where the middle class is constantly growing.

Probably one of the most serious factors that may also affect the food price is a yield decrease caused by climate change (Mueller *et al.*, 2011). According to expert studies it can be expected a 10% yield drop for every degree of increase in a temperature average (Smrž, 2009).

The next threat, especially for rapidly growing developing countries, is the decline in agricultural areas at the expense of new industrial, commercial or residential constructions. That means the vast area losses formerly used for agricultural production.

On the other hand, based on the stated studies (Piesse and Thirtle, 2009; Gilbert, 2012; Benson *et al.*, 2013), a certain biofuel influence on food prices should be admitted. Anyway, it would be very easy to blame biofuel production from increases in food prices. Here, one offers a logical explanation. If the agricultural areas will be occupied with energy crops, the fewer amount of food crops would be cultivated. Thus the price of final commodities will lift up. Naturally, the biggest impact of the increase in food prices would affect poor inhabitant in developing countries, which spend most of their income on food (Janssen and Rutz, 2011).

Anyway, on the ground of above information it has to be taken other aspects in consideration such as environmental, which can damage harvest, an increase of population, a higher demand from countries, oil prices, business speculation or climate changes.

2.5. Biofuels

Nowadays, it is clearly obvious that use of fossil fuels is running out. Because of an increasing rate of the population on the globe and consequent increasing consumption of energy supply, the best alternative to fossil fuels is being very intensively looked for.

A wide variety of alternative sources for energy production exists. It is possible to get hydro, wind, solar, geothermal energy or energy from biomass. The huge benefit of the last one is not only an effortless generation, but even the calorific value is significant. As Valíček (2006) reported, the average of calorific value of biomass ranges from 17 MJ to 18 MG. That is comparable to the coal calorific value (Hezký, 2008; Valíček 2006).

Biofuels are divided into several generations (table 2), depending on type of used feedstock and processing technology. The table 2 below clearly displayed each classification.

Table 2: Classification of biofuels based on their generation technologies (Demirbas, 2011)

Generation	Feedstock	Examples
First-generation biofuels	Sugar, starch, vegetable oil, animal fats	Bioalcohols, vegetable oil, biodiesel, biosyngas, biogas
Second-generation biofuels	Non food crops, wheat, straw, corn, wood, solidwaste, cellulosic biomass	Bioalcohols, bio-oil, bio-DMF, biohydrogen, bio-Fischer-Tropsch diesel
Third-generation biofuels	Algae	Vegetable oil, biodiesel
Fourth-generation biofuels	Vegetable oil, biodiesel	Biogasoline

The relationship between the energy industry and agricultural sphere is closer than just satisfying the supply by feedstock. There is a certain competition among energy or food crops cultivation in inputs represented by workforce, available land, water sources and a capital of course (Ewing and Msangi, 2009; Norgrove, 2010).

Many countries are encouraging the biofuel industry. This is how they want to contribute to a larger share in use of the renewable energy sources, reducing greenhouse gases in the atmosphere and consequently to protect the environment. Furthermore, as Sorda (2010) reported, to consider the goal of encouraging a farm income and in general to increase the economic growth, new job opportunities and reduce the oil dependece as well (Raswant *et al.*, 2008; Lorat *et al.*, 2011).

Despite the low current share of biofuels in the world market, a rapid rise can be expected in the near future as Zhou and Thomson (2009) predicted. Therefore the governments, in support of the biofuel production and consumption, have introduced several measures. For instance, they are exemptions from taxation, mandatory blending

standarts, a subvention, a support of intermediate inputs or subsidizing the labour, land etc. (Raswant *et al.*, 2008; Sorda *et al.*, 2010). However, a permanent important question must be posed: *What would happen to the biofuel industry unless it will be supported by government policies?* As stated by Lamers *et al.* (2011), it is estimated that particularly the developing countries hold a great potential to produce biofuels, which surpasses the national demand.

The largest amount of fossil fuels is consumed by the transportation industry (Demirbas, 2011). Therefore it is also a big producer of GHG emissions and thus a large polluter of environmental conditions. As Lora *et al.* (2011) published, this situation could be treated by replacing fossil fuels with biofuel use in the transport sector. Therefore, all researches across the world lead to the discovery of new technologies to produce alternative fuels from renewable sources, which would be particularly friendly to environment.

In particular, biodiesel and bioethanol are the most widespread types of biofuels as Dillon *et al.* (2008) stated. It is planned (Nigam and Singh, 2011; Demirbas, 2011) that they could be a suitable replacement for the current liquid biofuels such as a diesel or petrol. However, for their production the input material as a feedstock is required. That is biomass with valued energy potential represented by energy crops. This group of crops has a simple cultivation and processing technologies. They have been started to cultivate with the intention to contribute to the energy resources supplies in the world market. Therefore a claim for biofuel production primarily drives the higher demands on agricultural crops formerly grown just for food and feed purposes (Naylor *et al.*, 2007) and consequentially it pushes on prices of crops (Zhang *et al.*, 2013). Additionally, as Ewing and Msangi (2009) reported, whereas the energy market is more voluminous than the agricultural one, it is able to influence the prices in agriculture. But the problem is, that most of crops intentionally cultivated as biofuel feedstock creates a principal dietary part of poor, food-insecured people. For clarification, these are predominantly corn, cassava, sugar cane or palm oil (Naylor *et al.*, 2007; Zhang *et al.*, 2013). This clearly corresponds to the statement of Golub and Hertel (2011), who asserted that biofuel production is a complex set of trade involving not only land, livestock, crops and energy but also food market.

According to Skolou *et al.* (2011), energy crops can be divided into three groups: (i) oilseed crops, (ii) cellulose-based plants and (iii) crops contain a starch. The importance of oil crops consists in providing not only edible fats and oils for the food industry, but also valuable resources for the technical purposes as Valíček (2006) reported. These purposes may represent a branch of biodiesel production.

The vegetable oils or animal fats are used as input to the reaction to generate a fatty acid methyl ester, also know as biodiesel. However, the most common vegetable oils suited for biodiesel production are palm oil, rapeseed oil, coconut oil, sunflower oil or soybean oil (Shahid and Jamal, 2008; Basha *et al.*, 2010; Demirbas, 2011). The last mentioned, soybean oil - is currently the most widely used feedstock for biodiesel production. Due to its valuables as edible oil, biofuel production stands for challenging issue (Demirbas, 2008). Nevertheless, processing of oilseeds became rather profitable business via tax incentives and subsidies (Rathmann *et al.*, 2010). Therefore, concentrate on the crop cultivation for energy purposes is worth it to farmers.

Bioethanol is produced by fermentation of starch–rich or sugar-rich plants in the name of first-generation technology (Dillon *et al.*, 2008). In the presence of yeast enzymes, the carbohydrates are transformed into ethanol (Dillon *et al.*, 2008; Nigam and Singh, 2011). The most common feedstock for ethanol production is represented mostly by food crops such as sugar cane, sugar beet, wheat or corn (Endo *et al.*, 2008; Balat and Balat, 2009). This represents one of the reasons, which could contribute to the crops competition between production of biofuel purposes or agricultural commodities used for human consumption.

To summarize the situation, there are several concerns about competition of agricultural land between food and energy crops cultivation. Since the capacity of the land is usually limited, subsequently that kind of competition would influence its price at the market. If farmers will benefit from the energy crops growth for biodiesel or bioethanol production, the cultivation of food crops will fall back. Consequently it would reduce the food quantity and at the same time increase food price, which will affect food security. Thus, one of the solutions would be to grow biodiesel and bioethanol crops such as oilseeds and starchy crops on marginal lands.

2.5.1. Costs of Biofuel Production

The biggest influencer of the final total biofuel production costs is the feedstock (Dermibas, 2009; Bell, 2011). The impact on social, economic as well as energy security, counting the impact on food security is driven primarily by the type of feedstock crop and its way of production; it includes all used inputs (Norgrove, 2010). As Demirbas (2009) stated, this is the main economic factor that shares on the total costs by 75% to 80%. This fact affects the entire competitiveness of biofuels in relation to fuel market (Bell, 2011). Of course, besides the above mentioned feedstock, also the processing technology, labor, production range and territory participate in the total operating costs. And it should not to be omitted to mention a political engagement as the other important factor influencing biofuel costs (Ajanovic, 2011).

The fundamental question of biofuel profitability lies in the following: *Who will be the ultimate beneficiary?*

Anyway, the initial inputs to the production of biofuel or food crops are more or less the same. Demand on human capital, land, water, fertilizer and so on. The questions are, from which production the farmers will have a greater profit and thus that, what is more attractive to them? Due to the promotion of biofuel production through subsidies provided by the Indonesian government and subsequently attracting higher income, it is worth to farmers to concentrate on energy crops cultivation. Taken this matter into consideration, other issue will be brought along. That is a query, *who would remain at crops cultivation for food purposes?* This issue will be discussed more in the chapter 3.

2.5.2. Benefits of Biofuels

Biofuels bring many positive effects on social, environmental and economic sphere. Additionally it can be assumed, the technology will be more advanced and sophisticated over the time and those effects will grow stronger. The main benefits of biofuels are summarized in table 3.

Table 3: Major benefits of biofuels (Demirbas, 2009)

Economic impacts	Environmental impacts	Energy security
Sustainability	Greenhouse gas reductions	Domestic targets
Fuel diversity	Reducing of air pollution	Supply reliability
Increased number of rural manufacturing jobs	Biodegradability	Reducing use of fossil fuels
Increased income taxes	Higher combustion efficiency	Ready availability
Increased investments in plant and equipment	Improved land and water use	Domestic distribution
Agricultural development	Carbon sequestration	Renewability
International competitiveness		
Reducing the dependency on imported petroleum		

Contribution of Biofuel Production to Rural Society Development

Given that the agricultural production is concentrated in the rural areas, a cultivation of energy crops as feedstock for biofuel production brings the job opportunities to there (Dillon *et al.*, 2008). If the poor rural population will get the job, not only agricultural also the family income would increase as well (Gasparatos *et al.*, 2011; Ravindranath *et al.*, 2011). That will contribute to food and health security of the people as well. Norgrove (2010) suggested that if the farmers cultivated energy crops alongside food crops, they would increase their cash flow and subsequently gain additional financial means for extra agricultural inputs.

Consequently, due to better economic security the development indicators such as literacy, life expectancy and living standards will rise (Gasparatos *et al.*, 2011). Moreover the access to energy security will increase and this will enable to live a dignified life through the basic needs performance at the household level. And the Norgrove (2010) added that through affordable energy a household semi-mechanized agricultural system can be boosted and thus demands on limited human labor performance should be reduced. Furthermore, if the households would have had an access to energy (whether for cooking, heating or lighting), there could be a positive impact on gender matter. As Raswant *et al.* (2008) stated that might reduce women's domestic work load. All of these aspects contribute to poverty alleviation of the rural population.

Environmental Benefits of Biofuel Utilization

There is no doubt that biofuels originate from renewable sources, whose huge advantage is the availability throughout the world (Demirbas, 2009). Moreover, biofuels contribute to climate change mitigation due the GHG emission reduction (Zhou and Thomson, 2009; Bringezu *et al.*, 2009). This is one of their benefits against fossil fuels. Along with that, a reduction in the dependence on fossil fuels as well. Another positive point is the carbon neutral behaviour[4].

In terms of agriculture, Norgrove (2010) suggests to farmers to apply an intercropping system, where food and energy crops could be cultivated together. Because agro technical measures such as fertilizer or irrigation system can be applied simultaneously, or better yet, biofuel crops can benefit from post effect, meaning residual fertilizer which was initially applied in food crops cultivation.

2.5.3. Risks of Biofuels Crops Cultivation

It is clear that biofuel production also entails a number of negative impacts in the social, economic and environment forms. A perceptible threat may be especially the unfavourable impact on the natural environment.

Biodiversity Changes

There is an increasing rate of deforestation observed in tropical countries to accelerate by the efforts to free up fertile land for cultivation of energy crops. If there is a lack of the agricultural lands, it is necessary to create another. Hence, in tropical areas is constantly reached a cutting down of primary rainforests. This will solve two problems simultaneously - releasing new areas for the agriculture production and guarantee of access to fertile soil with high nutrient content.

[4] That means that during the biofuel combustion only the same amount of carbone dioxide is released into the air, which was absorbed by plant for the period of growth (Raswant et al., 2008; Kumarappan and Joshi, 2011). It can be described as a closed loop.

The cutting down of 18 million hectares of rainforests was approved in Indonesia, primarily in Sumatra, Kalimantan, Sulawesi and West Papua, to make way for purposes of palm oil plantations as Colchester *et al.* (2006) reported. As a consequence of rainforests eradication is the loss of unique biodiversity which affects the animal variety section as well as the plant one. Obviously this is not just a forest clearance in the name of the plantations. Crops must be somehow transported to a processing site. That is possible just in case of availability of an accessible road. Surely those roadways are built at the expense of nature as well. Furthermore, the rainforests perform as the biggest carbon sinks on the globe. Their destruction would mean a big disaster in the form of a large increase in emissions (FOE, 2007; Zhou and Thomson, 2009) into the air, mainly carbon dioxide.

Smrž (2009) expressed an accurate thought that only way how everyone will benefit of biofuel is to not cultivate biofuel feedstock at the expense of the original habitat.

Monoculture Risk of Energy Crops Intended for Biofuel Production

Moreover, the conversion of a widely diverse ecosystem into the monotonous monoculture plantation contributes to problems such as soil erosion, a higher use of fertilizers or reduction of landscape biodiversity[5] (Colchester *et al.*, 2006; Zhou and Thomson, 2009).

It is well known that oil-rich plants considerably deplete the soil nutrients. Thus the need for intensive fertilization with synthetic fertilizers is necessary. In addition, there is a greater potential of nearly 10-100 times more of greenhouse gas release (IPCC, 2001) from chemical fertilizers which contain high nitrogen content in tropical climatic regions. Being as Indonesia is located in the tropics; there is a high risk of nitrous oxide leakage into the atmosphere. Fortunately, the opposite is true for *Jatropha curcas*. On the contrary this plant can improve soil properties, because it does not exhaust the soil nutrients as much as other crops; besides that jatropha prevents the soil erosion (Raswant *et al.*, 2008).

[5] Especially in Indonesia, the orangutans, tigers, rhinoceroses or elephants and others are very sensitive to the loss of their habitats. For the sake of the natural habitat loose, these animals become endangered species very fast (WRM, 2006; Zhou and Thomson, 2009).

Water Security

Right after the man, the agriculture is the second largest consumer of water, where water plays the most important role along with the soil. And what amount of water the biofuel production consumes, depends a lot on the type of input crop to be cultivated and on choice of appropriate methods of operations (Ajanovic, 2011).

Associated with fertilization in monoculture plantations it leads to the so-called process of eutrophication, which means an increase of chemical particles in the aqueous sector (Zhou and Thomson, 2009; Ravindranath *et al.*, 2011). Those are mainly the growth of nitrogen and phosphorus (Anderson *et al.*, 2002; De Vries *et al.*, 2010). That contributes to hypoxia and subsequent overall reduction in water quality and water population.

2.6. Biofuels in South-East Asia

In general, the biofuel production is much more cheaper in developing countries compared to developed countries. Mainly due to the strong agricultural base and the cheap labor (Jayed *et al.*, 2009). On the grounds of lower cost, biofuel become more competitive to conventional fuels in those regions (Demirbas, 2011).

As a demand for biofuel production rises in Asia as a number of population grows. In addition to that, also a sudden increase in oil price in 2007-2008 contributed to the demand, as Prabhakar and Elder reported (2009). In order to achieve satisfactory level of energy security, Asian countries should learn how to make the use of natural resources more effective. According to Prabhakar and Elder (2009), it is still ineffective and unsufficient.

Despite the fact that biofuel development is still at the beginning in the Southeast Asia, it has a strong base in that region. As Goh and Lee (2010) noted, the situation is based on the prudent and cautious planning, targeted effort and endeavor and intensive monitoring. Given these facts, it can be inferred the Southeast Asia could establish a strong position in the biofuel sector one day.

One of the intentions of focus on biofuel production in that region is the government's effort to satisfy demand for energy, economic development and poverty

reduction. Given the production of biofuels, it creates (i) making accessible a labor market, (ii) profits and (iii) other prospects for farmers, this sector is often related to rural areas (Yan and Lin, 2009; Zhou and Thomson, 2009). In rural areas, this business issue can completely change the lives of poor farmers and uplift their living standards and pave the way for trade market. Moreover, the biofuel market is very closely linked to agriculture, which represents the most important role in such a region (Lamers *et al.*, 2011).

The creating of new job opportunities and thereby contribution to improving the quality of living standard is the main benefit from biofuel production in developing countries. That is not the same reason for developed countries. For them, the climate change mitigation and the associated emission reduction are at the first place according to Dillon *et al.* (2008).

The Asian market of biofuels is in its infancy and it is mainly driven by China, India, Indonesia, Malaysia, Thailand and Philippines (Zhou and Thomson, 2009). In these countries, fuel consumption particularly in the transport sector rises as fast as the number of people increases (Yan and Lin, 2009). On the other hand, Jayed *et al.* (2009) asserts that just Malaysia, Indonesia and Thailand are leaders in the biofuel production in that region. On the top of that, they are as only ones which also profit from it. That is thanks to the support of local governments and a flawless process infrastructure. It is possible to see palm oil production of that powerful trio in figure 4.

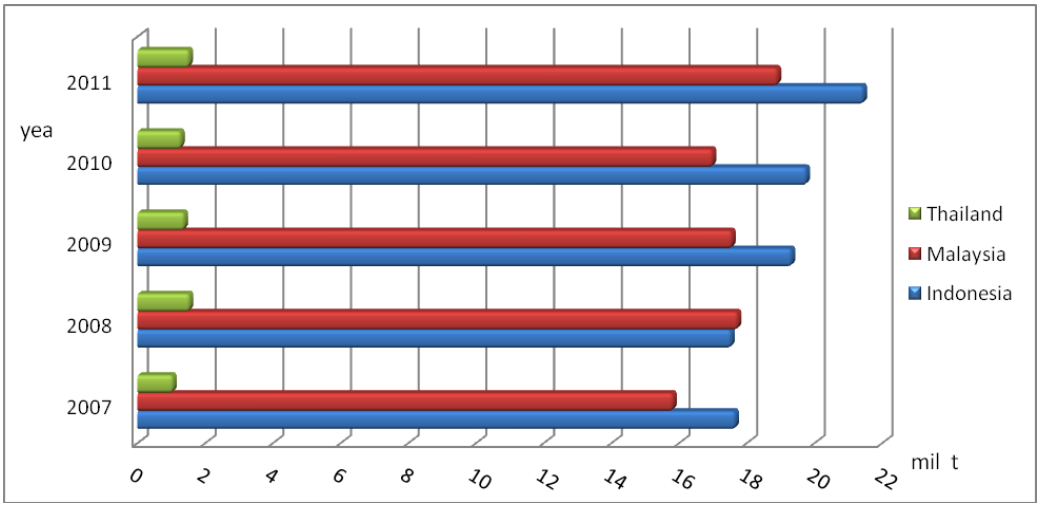

Figure 4: Palm oil production in Southeast Asia (based on data from Faostat, 2013)

Insofar as the region has been highly dependent on the oil import, it is entirely clear why these countries are trying to make a quick progress in development of alternative fuels. It can be said, it is one of the way, how to ensure the energy security. Unfortunately, the weakness is a use of first generation biofuels[6] only (Zhou and Thomson, 2009).

However, with growing biofuel production, the requirement of agricultural feedstock rises as well. Specially, poor Asian countries should be careful about potential price growth of food crops. At the same time, the attention should be concerned about agricultural lands initially intended for the cultivation of food crops, which newly are reorienting to plantations of energy crops. Especially in the future, this could be one of the serious problems for overpopulated Asia. It is quite simple consideration: a higher potential for biofuel development will cause the higher demand of food crops as feedstock (Yan and Lin, 2009). The treatment could be cultivation of non-edible crops on marginal lands (Ewing and Msangi, 2009; Yan and Lin, 2009) such as sorghum (*Sorghum vulgare*), jatropha (*Jatropha curcas*), karanja (*Pongamia glabra*) and neem (*Azadirachta indica*).

2.7. Energy Security in Indonesia

Indonesia is the 4th most populous nation in the world with 242.3[7] million of inhabitants (WB, 2013). Therefore, it is not surprising that total annual energy consumption increases by 2.9% every year. Energy consumption value jumped from 300,147 GWh in 1980 to 1,490,892 GWh in 2009 (Silitonga *et al.*, 2011). The biggest consumer of fossil fuels-based energy from overall energy consumption was the industry section with 48%, followed by the transport sector with 33% (figure 5) (Silitoga *et al.*, 2011). It is worth mentioning the fuel is the third highest expenditure for Indonesians. This is not surprising at the price of petrol $ 0.46 per 1 liter (Beaton and Lontoh, 2010; Vaswani, 2012.)

[6] The disadvantage of first generation biofuels is their production from food crops such as sunflower, rape, soya, sugarcane and others. This may encourage a competition between food and energy crops. That leads to the question whether it is moral to make use of crops for energy purposes while millions of people suffer from hunger.

[7] Value is related to 2011

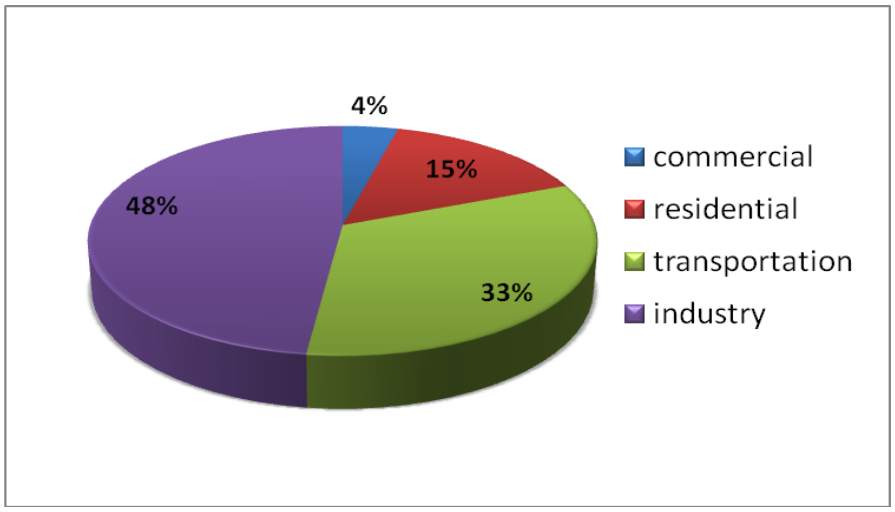

Figure 5: Indonesian energy consumption by sector in 2007 (based on data from Hilmawan and Said, 2009)

2.7.1. National Energy Policy in Indonesia

The most important reasons, why Indonesia is interested in the production and local use of biofuels are follows (i) to reduce dependence on imported oil, (ii) to ensure energy security and (iii) to contribute to a better environment, particularly with regard to large cities as Wirawan and Tambuan (2006) noted.

The first national biofuel policy in Indonesia was established in 2006 by the Government (Zhou and Thomson, 2009; Jayed *et al.*, 2011). The main objective of the Indonesian National Energy Policy is to reduce a dependence on fossil fuels, which now stands at 66% of total energy requirements to 53% until 2025 (Zhou and Thomson, 2009). Since Indonesia became a net oil importer in 2004 (Jupesta, 2012) due to the growing number of people and effort to achieve energy security. Therefore there is a plan to substitute the 5-10% of conventional fuels by biofuels until 2025 (Wirawan and Tambunan, 2006; Jayed *et al.*, 2009; Goh and Lee, 2010) (see annex III). If the compensation by 5-20% of biofuels would be obtained as Jupesta (2012) noted, it will reduce the oil consumption by 1.5 or even 6 billion liters per year. Major and minor objectives of National Energy Policy can be seen in table 4.

Table 4: National Energy Policy (DESDM 2006 in Wirawan and Tambunan, 2006)

Category	Supply Side	Utilization Side
Main Policy	• Production Exploration • Energy Conversation • Production Optimatization	• Energy Efficiency • Energy Diersification
	• Energy price will gradually change to the economical price • Consider the environmental factor	
Supporting Policy	• Energy infrastructure development • Subsidy policy for poor people • Government and private sector partnership scheme • Public environment • Research and development promotion • Coordination between related stakeholders	

2.7.2. Indonesian Biofuel Production

Given the growing dependence on fossil fuels and the higher price plus increasing palm oil production (Wirawan and Tambunan, 2006; Lamers *et al.*, 2011), Indonesia has introduced some measures as a support tool for biofuel policy promoting. These are as research follows a development, a training, infrastructure improvement, improving of the plantation system and even the promotion of biofuels at filling stations.

The governmental fuel subsidies are an important brake of biofuel boom according to Indonesia‘s National Action Plan for Addressing Climate Change (Beaton and Lontoh, 2010). There was a significant increase in fuel price twice during 2005 (see table 5). The protests by local people followed and the government was pressured to re-subsidized fuel[8] again. The subsidies not only inhibit the development of alternative energy sources, but moreover they obstruct a certain energy diversification and support the constant use of fossil fuels.

[8] Subsidy is related to difference between international benchmark price and the price set up by the government; it is assessed for each year (Beaton and Lontoh, 2010).

Table 5: Development of fuel price per liter in Indonesia ($) (Beaton and Lontoh, 2010)

	January 2005	March 2005	October 2005	May 2008	1st December	15st December	2010
Premiun brand gasoline	0.19	0.25	0.46	0.62	0.57	0.52	0.46
Solar-brand diesel	0.17	0.22	0.44	0.57	0.57	0.50	0.46
Kerosene	0.07	0.07	0.21	0.26	0.26	0.26	0.26

Indonesia belongs not only to the greatest exporters of vegetable oils (Lamers *et al.*, 2011), but also to the greatest exporters of biodiesel, as mentioned above. Primarly with the regard to palm oil, Indonesia is the greatest palm oil producer (Zhou and Thomson, 2009), which represents nearly 21.45 milion tonns in 2011 based on Faostat database (2013). Indonesia together with Malaysia have produced almost 85% of palm oil of the world's total stock (Jayed *et al.*, 2009). Apart from palm oil, sugar cane and cassava represent other significant feedstock to produce biofuel in Indonesia. Nevertheless, oil-rich plant jatropha comes at the forefront as well (Jupesta, 2012).

Despite the long tradition of oil palm production, Indonesia has entered to the world biodiesel market relatively recently. Domestic consumption in Indonesia is not as significant as most of the production goes to USA or EU (Lamers *et al.*, 2011; Sorda, 2010).

CO_2 Emission in Indonesia

Given the large number of inhabitants and fuel consumption, there is no surprise that Indonesia is among the top fifteen countries with the highest emission value of carbon dioxide. International oil and gas company BP (2012) states that Indonesia emitted 284.6 million tons of CO_2 in 2000. But in 2010 this figure has already stood at 424.1 million tons of CO_2 (see annex IV) and the total world share of CO_2 emissions of Indonesia accounted for 1.3%. A comparison of selected Asian and other countries with regard to CO_2 emissions is illustrated in annex (V).

To sum up the literature survey, the importance of food security cannot be doubted. Likewise the importance of biofuels production in terms of energy security cannot be ignored, especially in specified region. Moreover, the literature review highlights a certain connection between growing energy crops for biofuel production and food security.

Therefore the next chapter will be dedicated to determining the parameters leading to evaluate the food security of small-scale farmers. Subsequently, the potential for energy crops cultivation by these farmers will be evaluated.

3. OBJECTIVES

The objectives are set up based on the currently discussed issue of food security in relation to energy sector. Due to the rapid increase in Indonesian population, which amounted to more than 240 million in 2011 (WB, 2012), and this number is still growing, the issue of food security is very urgent. On the other hand, Indonesia makes efforts to establish a highly efficient biofuel policy.

The main objective of this thesis is to analyze the current situation of three main dimensions of food security among the small-scale farmers in North Sumatra province, in Indonesia. Specifically, draw an assessment of the food availability, food access and food utilization. Furthermore, evaluate the possibility of energy crops cultivation by farmers with regard to the level of each aspect of food security.

The specific objective of the thesis is to compare Tapanuli Utara regency with Simalungun regency in terms of education, income and expenditures on food.

Two hypotheses were established for this study:

Hypothesis 1:

H_0: There is a relation between degree of attained education and level of household income.

Hypothesis 2:

H_0: The expenditures on food are related to level of income.

4. METHODOLOGY

The chapter methodology is concerned about a detailed description of the whole process of research performance (figure 6). Starting from the literature overview of related issues, description of research location through the questionnaire structure up to way of collecting data and information, thereafter the subsequent data analyzing along with proccesing (figure 6).

The literature review reports on issue of food security. Based on the secondary resources, the first part of study offers a comprehensive description through the basic dimensions of food security. It characterizes the parameters defined for the detection of food security level. The second half of the literature part focuses on the matter of biofuels. This is connected to a concise overview of the energy status of Indonesia based on information gathered from secondary sources. To obtain data from secondary sources, primarily scientific articles such as *Food Policy, Biomass and Bioenergy, Energy Policy, Applied Energy*, were used, supplemented by evaluation reports, academic publications and other sources of this sort. Databases used for data search were mostly the S*cience Direct*, the *Web of Knowledge*, *Faostat*, *World Bank* or *Badan Pusat Statistik*. To find the information, keywords such as *food security, food availability, food access, food utilization, Indonesia, energy security, food policy, biofuels, education impact, income impact* were used.

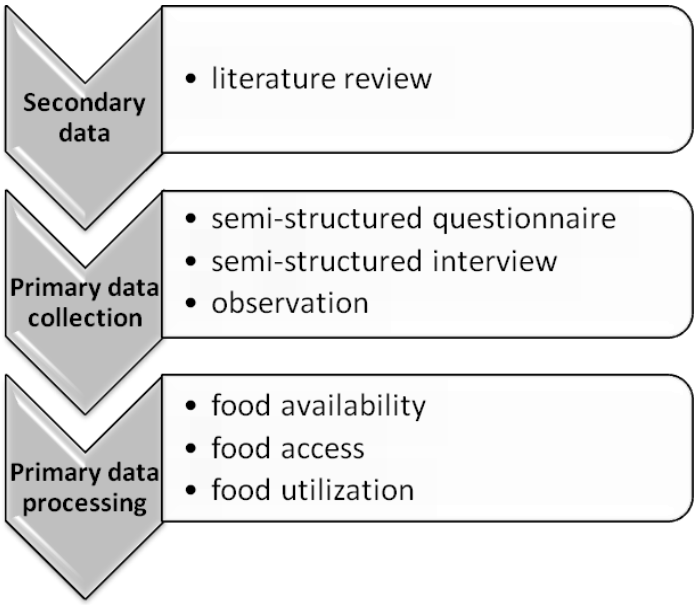

Figure 6: Research structure of the survey

4.1. Location of Research Performance

The practical part of the research was conducted on the Sumatra Island, in Indonesia. Data collection was carried out in the province of North Sumatra, specifically in two regencies: Tapanuli Utara and Simalungun (figure 7). The process of data gathering ran continuously during the period between July and September 2012.

This area was chosen primarily due to the actual cooperation between the CULS Prague and local educational as well as agricultural institutions. Moreover, the region is endowed with plenty of farmers focused on small-scale crop farming system, who were suitable for the target group of respondents. In addition, the area is recognized for convenient natural conditions for cultivation of energy crops.

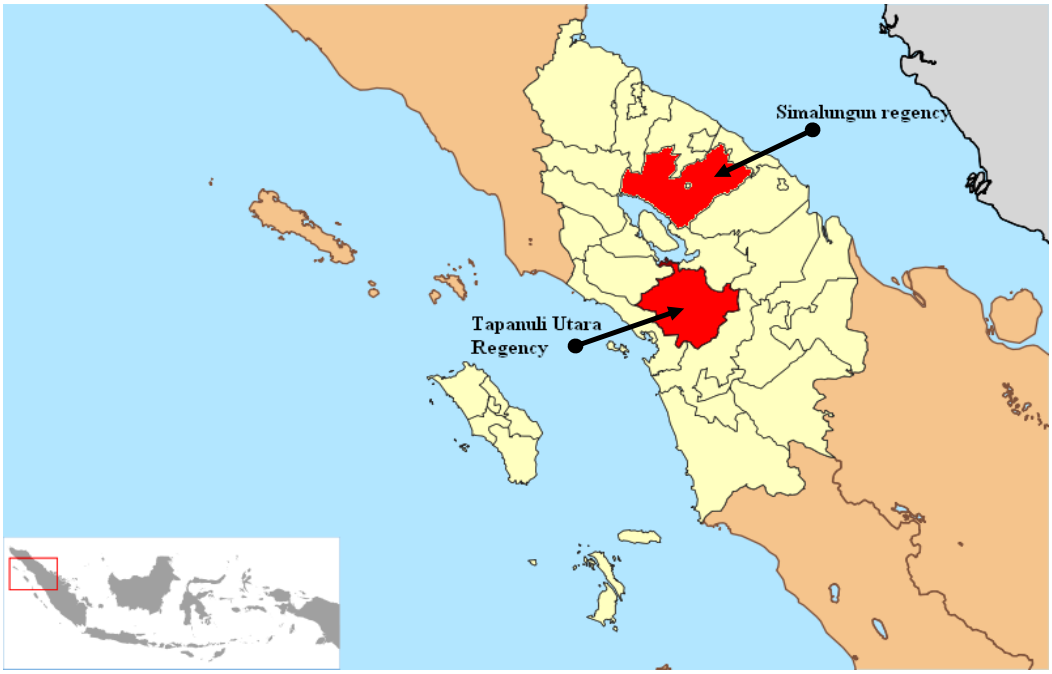

Figure 7: Location of Tapanuli Utara and Simalungun regencies in Sumatra Island

The target group comprised of small-scale farmers. They were selected based on the size of the owned field. In this research, small-scale farmer presents farmer, whose field size does not exceed 5 hectares. The expected number of respondents was 100. However, the final sample consist 75 respondents: 40 farmers are from villages, which are located in Tapanuli Utara regency and the remaining 35 farmers come from Simalungun regency´s villages. There occurred several restrictive factors causing an unfulfilled limit of respondents: limited technical conditions for access to farmers, unexpected time demands for individual applied research methods, and eventually farmers' willingness to participate in research. There was not any other criterion for selection of targeted farmers except field size and condition to cultivate food or cash crops[9].

4.2. Data Collection

Several research methods were used for data collection and information receiving according to studies (WFP, 2012; Oxfam, 2008; Nastasi and Schensul, 2005; Chung *et al.*,

[9] gender, age or education played no role in the selection of respondents

1997; Teff *et al.*, 1990) mainly related to food security measurement. Triangulation method was used as a tool for testing the data validity. The use of multiple methods through triangulation led to mutual supplement by information from the individual methods. Moreover, the triangulation contributes to facile comprehension of issue and subsequently to deeper understanding.

The greatest emphasis was put on semi-structured questionnaire survey and observation. Besides using these two methods, the research was extended through semi-structured interviews and discussions. Rationale leading to the use of selected research methods is presented through their advantages in the below sections.

All data collection methods were implemented in the Indonesian language. Besides the official Indonesian language, few cases were realized in the local Batak ethnical language. Interpreter from the local school served as a medium for more accurate translations of all questionnaires and interviews. Thanks to the interpreter a more detailed information and understanding of respondents were obtained.

4.2.1. Questionnaire Design

Due to the gained information about issue of current food security in the world, specially in Indonesia, by using scientific articles and statistic databases, the questionnaire was drawn up.

Pilot testing

After a complementation of draft concept, the questionnaire was able to approach to pilot testing. Five questionnaires were tested by respondents. Consequently, structure of questionnaire was modified. The changes have taken place in improving a certain formulation of the questions; strike out the useless questions and vice versa addition of missing information. After adjusting the pilot questionnaire, the final model of questionnaire was designed.

The semistructured questionnaire consisted 28 questions, of which 21 represented open-ended questions and 7 were close-ended questions. Questions were designed to relate to information concerning current situation about following topics (fig 8):

- **Socio-economic**: In the area of socio-economic issues, questions were focused on determining the access to basic social services such as education, safe drinking water, health care and so on. Next, the involvement in agricultural associations or possibility of government support was inquired.
- **Financial**: Questions related to financial sphere focused on income and expenditures.
- **Self-sufficiency in a supply from own agricultural resources:** This group of questions was primarily aimed at information linked to agricultural production.
- **Food**: There was a wide range of questions focusing on access to food, the composition of dietary, frequency of food purchase and so forth.

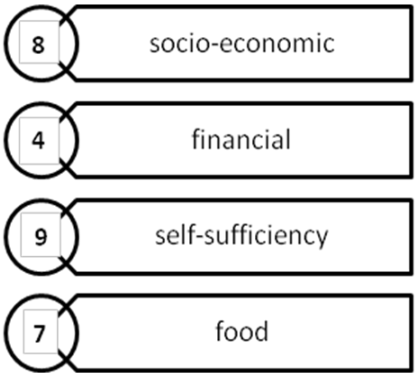

Figure 8: Number of questions related to topic

The sequence of questions was ordered in a logical way. Firstly, the general information were received, so that the interviewee was not under the pressure and felt comfortable. Gradually it was approaching to more specific alongside sensitive questions (e.g. questions focused on funding). Filling out the questionnaire was carried out under the supervision of researcher. Due to that, no debasement of questionnaires was occurred. As a result, all the questionnaires were adequate for further processing Fulfillment of one questionnaire took approximately 30 minutes.

The whole concept of the used questionnaire can be observed in annex (I). The questionnaire was worked out in the Indonesian language (see annex II). It allowed to easier communication with the participants.

4.2.2. Interview Course

Usually, completed questionnaire was followed by natural changeover to the semi-structured interview phase. On the basis of the set schemes the topics were discussed in the relaxed atmosphere among the respondent and researcher. Respondent was filling the gaps in the information obtained by a questionnaire thus this method. That was a scope for triangulation utilization. Interview contributed to the received answers from a deeper perspective of the respondent, when he allowed for greater flexibility in the response.

4.2.3. Observation

The method of formal observation was chosen with regard to enable to supplement the survey information that the interviewee mentioned. Information obtained by attentive and observant perception of respondent surroundings made it possible to add a more realistic picture of the farmer's real household situation.

4.3. Data Processing

Measurement of current situation of food security among the small-scale farmers in this research is based on a concept of three dimensions that the FAO and other scientific sources (Riely *et al.*, 1999; FAO, 2006; FAO, 2008; Fengyinga *et al.*, 2010; WFP, 2012) consider as characterization of food security. Computation of food security corresponds to measuring of food availability, food access and food utilization. Each of these three features of the assessment is established on the calculation of certain indicators group based on the studies mentioned above. The indicator system judges each aspect in proper way.

In addition to calculation of main three segments of food security, the other parameters such as farmer’s income, land area, age and education level are measured.

These factors contribute positively to food consumption (Fengyinga *et al.*, 2010; UN, 2010).

Indicators applied to evaluate three aspects of food security were selected from the methodologies of several scientific articles. Parameters are combined in a way that simply reported the information related to the characterization of food availability, access and utilization. Through this information, it is contributed to the overall food security identification. In addition, the parameters utilized to evaluate each of food security dimensions were selected based on the field availability of data needed for their calculation. This is the information provided by respondents.

There exist several methodologies to assess the food security. However, as FAO (2013) admitted, the currently used methods tend to focus on the national level of food availability and are unable to comprehensively deal with many dimensions of hunger. Hence, there is a gap for missing complementary approach for assessment of food security on local as well as individual level.

The concept of the methodology used in this research is a unique pattern. Selected parameters to determine the dimensions of food security were chosen to near the individual farmers' level.

All computations and statistical calculations of the above mentioned indicators were performed with programs such as Microsoft Word Excel and Statsoft Statistica version 10 through descriptive and inferential statistics.

4.3.1. Food Availability

Two indicators are used for a determination of food availability: (i) dietary energy supply, (ii) origin of food production.

The first indicator is the average dietary energy supply (DES) adequacy. DES represents daily energy consumption per capita, expressed in kilocalories. It expresses energy value to be contained in daily food. The value is just average energy per capita from the overall population per a day. The value does not describe the real quantity and type of consumed food. It only specifies the recommended amount of calories that should be consumed per day by individuals. Each country has its DES value. Based

on this value, it can be estimated the food supply to humans from an energy point of view. Moreover, this indicator suggests if malnutrition is caused due to insufficient food supply or to poor distribution (FAO, 2012).

The result for value of DES was received from FAO statistical data sources. According to FAO, the value of DES account for 2,646[10] kcal for one Indonesian inhabitant from the overall population.

The second indicator corresponds with the origin of food, whether it comes from farmer's production or from local sources.

4.3.2. Food Access

Food access is composed of three indicators: (i) income per capita, (ii) distance to the market, (iii) food expenditures.

In this work, income per capita is simply measured on a household level as it was done by Fengyinga *et al*. (2010) in his study. It is counted for each household individually, as a sum of farm and off-farm income, which represents the total income. Each household total income was divided by a corresponding number of household members. This provided a total income per capita in each household. These values of total income per capita of each household were converted to one average value.

It is counted as the total income of the family divided by the number of family members in this paper. It is one of the indicators that allow characterizing a well-being as Riely *et al*. (1999) reported in the study.

Another indicator determines a physical distance between the household and the market the respondent must travel to buy food (Riely *et al*., 1999; Fengyinga *et al*., 2010). It is measured in kilometers.

The third determinant represents total expenditure on food per capita (Riely *et al*., 1999; Fengyinga *et al*., 2010; UN, 2010; WFP 2012). Again, it is calculated at the household level, per one family member.

[10] Data based on Faostat (2013), the value was calculated for 2009.

4.3.3. Food Utilization

For calculation of food utilization three parameters were selected: (i) illiteracy rate, (ii) difficulty to obtain energy, (iii) difficulty to access to drinking water.

The illiteracy rate was 7.12%[11]. This figure is taken out of the Indonesian statistical database[12].

The remaining two parameters - access to drinking water (IPC, 2008; Fengyinga *et al*., 2010) and fuel (Fengyinga *et al*., 2010) as energy source - are indispensable features to food utilization. Without these two parameters it would be difficult to achieve proper food utilization. Both values are determined from a three-point scale by a respondent. The respondent determined a difficulty of service access from the point of personal experience.

4.4. Limiting Factors of Research

Research was limited to many restrictions. The intercultural difference belonged to fundamental intercultural limitations due to different way of thinking and dissimilar perspective. Besides that fact, many respondents were suspicious and cautious about researcher's presence. However, it is understood that they were not willing to share answers about sensitive issues. After all, the researcher was someone completely stranger to them, and thus they shared the answers only those they wanted or conversely answered partially.

Undoubtedly a level of literacy was a crucial limiting factor playing important role. The ability to understand the asked issues, the ability to express and estimate correctly the answers are derived from a brainpower. That supposed to mean, if the researcher asked for quantitative question, interviewee could not estimate rightly the answer. A respondent was not able to count it, because he had no idea of the numbers and the answers might be misleading.

[11] Value is calculated in relation to 2011.

An exemplary case for the respondent's deceptive answer was in issues such as evaluation of certain services. Taking into consideration the interviewee did not have the opportunity of comparing with a certain standard, he was not able to assess appropriately the real conditions of the situation.

Naturally, the language barrier is always counted as a typical constraint. As a matter of fact, the process of data gathering was sometimes translated in two parts: from (i) English to Indonesian and from (ii) Indonesian to the local Batak ethnic language and vice versa. It was trying to eliminate all losses in translation by using a local interpreter.

Moreover, another limitation was a necessary presence of an Indonesian guide who acted as intermediary between researcher and farmer. Thanks to him the barriers were broken and the initial contact, without which the farmer would have hardly willing to cooperate, was made. Unfortunately, the guide was not always available. From that reason the field work was pressed for time during the survey period.

5. RESULTS AND DISCUSSION

This chapter is concerned with three sections. The first part describes the results of a socio-demographic survey of the respondents. The following section focuses on the results determining the indicators required for assessment of each pillars of food security. This section is pivotal to characterize food security dimensions and thus determine the research target. The last part analyzes the potential of biofuel crops cultivation.

5.1. Socio-Demographic Results of the Target Group

The conducted survey included 75 small-scale farmers, of whom 83% (62) were males and 17% (13) were females. This information indicates the role of gender in local society. After asking for owner of a farm, a man came in majority of cases. Thus, mostly men are owners of fields, the farmers with the decisive word, whereas women practically do more work in the field compared to men.

The average age of farmer was 50.2 years. The average family consisted of 6 members, which represents the most frequent family size in fact. The calculations also reveal an average of field size, which amounts to 1.7 hectares.

5.1.1. Farmers Education Level

The Indonesian education system is based on several degrees. Children are required to complete nine years of schooling. Starting the elementary schools alias Sekolah Dasar (SD), lasting 6 years. Subsequently they are required to accomplish three years of attendance at a junior high school - *Sekolah Manengah Pertama* (SMP). After that children can decide whether to continue in education or not. It is possible to continue with the next 3 years at senior high school, either on *Sekolah Menengah Atas* (SMA) or *Sekolah Menengah Kejuruan* (SMK). The second one represents the school with specific focus - preparing for a certain profession, in simple terms a pre-professional education. Afterwards the students can continue with a university education, bachelor or diploma degree.

The figure 9 demonstrates the results of educational attainment of interrogated farmers. The graph shows that the most common degree of education attained by farmers is senior high school (SMK/SMA) with 41%, then junior high school (36%) followed by elementary school (17%).

The level of education is often linked to the logical reasoning. The observation has shown that level of education corresponds to the willingness to learn new things, to find new information and be open to new possibilities. In practice, this represents a willingness to try new working methods and technologies in the field of agriculture and thus increase the agricultural productivity and consequently also the final income. Benin *et al*. (2011) draw the same conclusion in Uganda as well as Weir (1999) in Ethiopia or Pudasaini (1983) in Nepal.

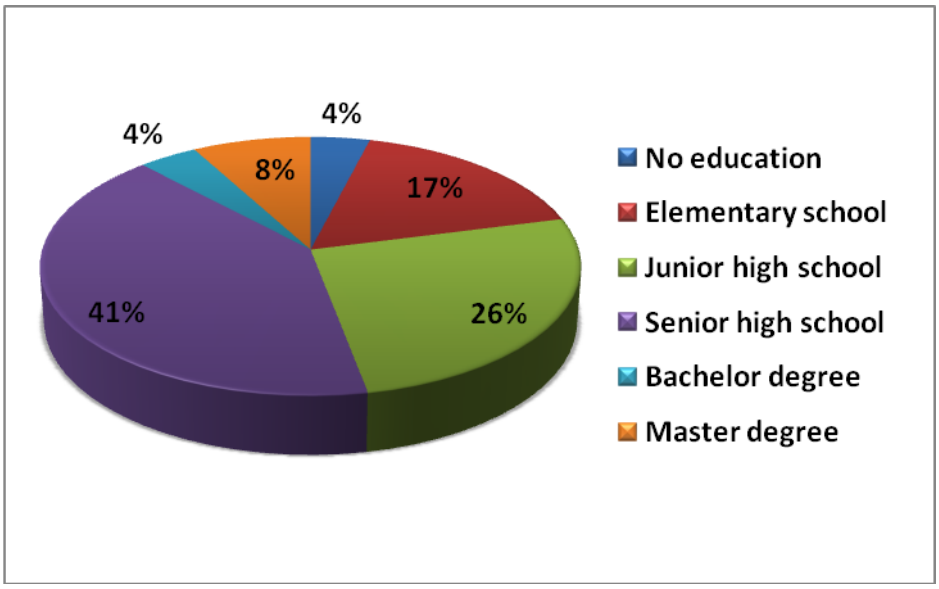

Figure 9: Attained education levels by farmers

5.2. Food Availability

Here is delineated the result for energy supply of dietary in general and food origin for farmers' consumption. This determines whether the food came from own production or from market. These indicators are used to assess the overall situation of local food availability for the community.

5.2.1. Dietary Energy Supply

The result describing a recommended daily amount of energy contained in food (DES) is stated above (see chapter 4.3.1.). However, value of DES in Indonesia was the 2,646[13] kcal per capita. Compared to Southeast Asia in general, where DES is 2,386 kcal[14], Indonesia is slightly above the average of Southeast Asia region. Anyway, it still does not reach such values as Europe[15]. Nevertheless, the total world average of DES is 2,831[16] kcal. It is important to remind that Indonesia still remains as developing country. Despite a growing urban life style quality, the average level of that is kept downwards by rural population, where food is not available at a scale and variety as in cities[17]. One of the polemical facts may be the reality that Indonesia has been opening up a world. The country is building a place in the international trade (especially in the field of energy development; see chapter 2.7.2.). Anyway, this brings the impact on the local population, for instance adoption of western eating habits. It is an actual trend: to eat more, to consume a wide range of unhealthy caloric foods, thereby increasing the dietary energy supply. It is one of the consequences of globalization as well as urbanization (Traill, 2006). Moreover as Traill (2006) pointed out, these phenomena are evident in the form of supermarkets expansion in developing countries, which with cheap junk food products crushes a local market with fruits and vegetables. Again, more or less, it is case of urban society.

5.2.2. Origin of Food for Household Consumption

Matshe (2009) published the majority of starving population across the world inhabits rural areas. This sort of population is by 50%[18] represented by the small-scale

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[13], [14] Values related to 2009 (Faostat, 2013).

[15] For interest of comparison European average value of DES is 3,362 kcal (Faostat, 2013).

[16] Value related to 2009 (Faostat, 2013).

[17] Information based on field observation.

[18] The rest is covered by fishermen, woodmen, pastoralists and poor urban inhabitants (Matshe, 2009).

farmers. Therefore he believes that household agricultural production is a crucial influencer of food security and contributor to the local prosperity through the food availability as well as income.

As it can be seen from the graph (figure 10), almost 89% of the respondents use their agricultural production not just for business purposes but also for own consumption. It can be inferred an importance of agricultural production at the household level and subsequent strong dependence on self-supplying. The agricultural production of the rest of farmers is set just for sale purposes.

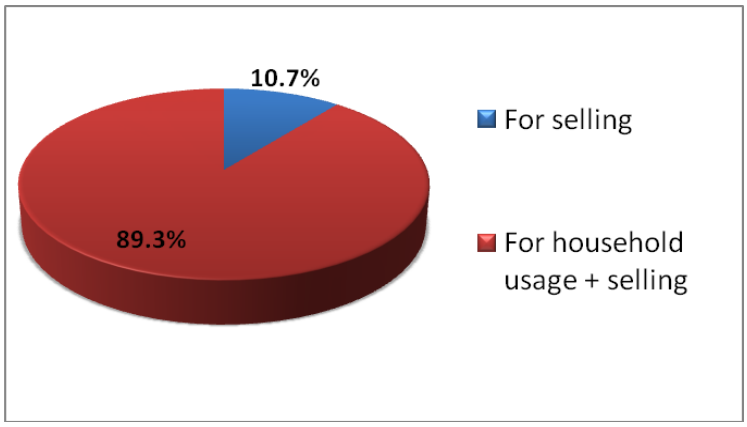

Figure 10: Use of farmer's agriculture production for own consumption

On the other hand, as the figure 11 shows, nearly half of the respondents admitted that most of their daily rations came from the market. Only a small percentage of respondents are entirely dependent on own production as only source of food. This suggests that farmers cultivate only a certain sort of crops that are unable to cover the entire dietary. In practice, it usually looks the following way: farmers grown few kinds of commodities; a large portion of it is supposed to be sold. Due to that they earned money and it was enable to them to buy products that they did not produce. The field survey showed that this process is quite common among small-scale farmers.

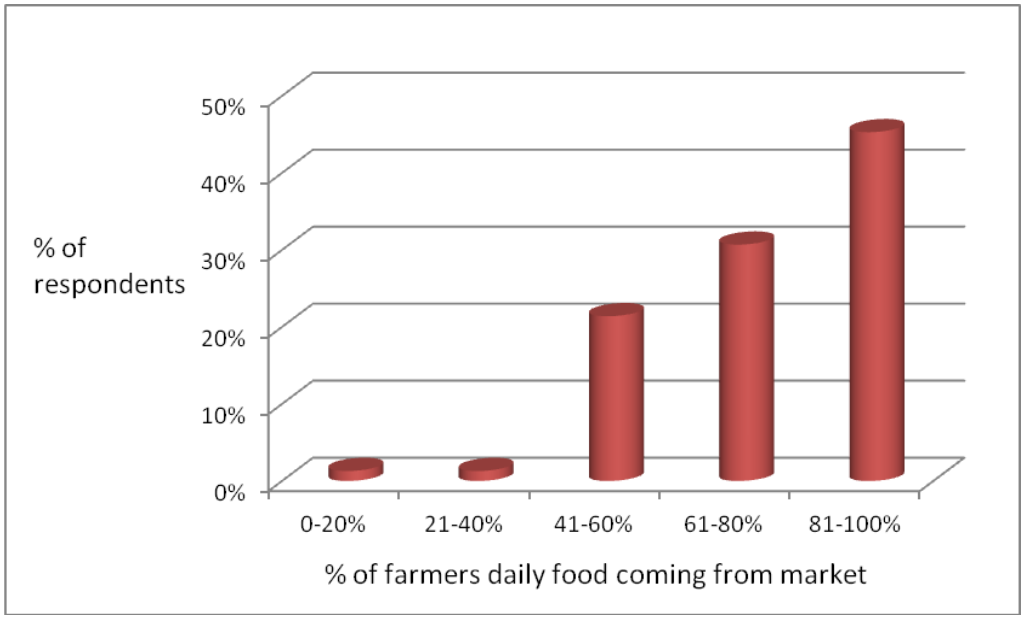

Figure 11: Percentage of farmer's daily food coming from market

Further, the survey shows that although domestic agricultural production serves for household consumption as well, it does not constitute such a large percentage of overall food consumption, such as food purchased in the market. That is clearly linked to importance of a market distance. The market distance such as one of the food access parameters is discussed more in the section of food access results (see chapter 5.3.2.).

5.3. Food Access

The chapter presents the results to determine the physical access to food through the parameters such as income and market distance. The income further serves as a need mean for food purchase. Actually, the second parameter, physical distance to market, plays relevant role for receiving of food.

5.3.1. Total Income per Capita

The average family size counts 6 members. After the overall calculating of a farm as well as an off-farm income, the average value of total income per capita was calculated. That is $34.23 per one month. It should be noted that this is the total income and not

the net income. Thus, the living costs and expenses necessary for the household and farm running are not subtracted. For the comparison, as mentioned above, the national poverty line is $26.79 (BPS, 2013), while the poverty line established for the province of North Sumatra is $27.91 (BPS, 2013). Based on that fact, average value of total income per capita of respondents in the Tapanuli Utara and Simalungun regency lies above the balance limit of national as well as regional poverty. It means that inhabitants of these two regencies are not so much attacked by poverty and lack in general, as they could be compared with the inhabitants of other regions. Hence, if the ability to have secured access to sufficient and adequate food is derived from income, it can be deduced that these regencies do not suffer hardship and thus do not suffer from hunger.

The total income is a very meaningful indicator for determining the level of food security. Even, this indicator influences the food security in a significant way. Based on the responses of the interviewees, it could be statistically inferred a close relationship between the total income and the level of access to enough food of a certain quality. The correlation coefficient between these two variables is equal to 0.53 and determination coefficient equal to 0.28[19]. This means that income influences access to enough and quality food by 28%. Despite the moderately strong dependence of this relationship which was determined from this survey, this fact is also confirmed by and Riely *et al.* (1999). In addition, Babatunde and Qaim (2010) inferred the same surmise based on survey in Nigeria and also Miller *et al.* (2011) in Malawi.

Naturally, respondents with higher incomes spend more money on food compared to average value. This relationship is even confirmed by Fengying *et al.* (2010) in his study on China. The existing relationship between household income and expenditures on food accepts a confirmation of hypothesis 2. Based on survey data, a correlation between food expenditures and household income is statistically expressed with r = 0.55[20]. Determination coefficient is qual to 0.30. Thus, income determines the expenditures on food by 30%.

Furthermore, it was found that the higher level of income reached by farmers caused the ability to be able to buy what they need and want. The relationship between

[19] Marked correlations are significant at $p < 0.05$

[20] Marked correlations are significant at $p < 0.05$

income and fulfillment of the basic needs is presented by correlation coefficient r = 0.56[21]. The coefficient of determination is R^2 = 0.31 and thus income affets the basic needs by 31%. Streeten and Burki (1978) together with Iceland and Bauman (2004) published the coincident assumption.

5.3.2. Distance to Market

The value of an indicator, which specifies the distance that must be traveled by respondent to get the access to food availability, is 5.23 km. Based on observation, almost all of the population used a motorcycle or local public transportation as a mean for transport to market. This saves time, which can be used for more important purposes such as work at field. Moreover, due to the ascertained average distance, the access to market can be evaluated as no obstacle to purchase the foodstuffs. In the figure 12 the percentage representation of distances that farmer passes on the way to market is shown. As already mentioned, the market distance indicator is a quite important parameter of foodstuffs accessibility. The fact, that the majority of respondents stated that the market was the dominant source of food, is an important aspect for determination of access to food. Likewise Hyman *et al.* (2005) appeal to the importance of the market proximity. Especially from the time perspective; the more distant and thus more time-consuming and more costly way will have to be traveled by farmer to obtain food, the less time will leave for field operations. This is further amplified by technical conditions of roads or even by climatic conditions. Rainy or dry season plays an important role especially in tropical regions (Hyman *et al.*, 2005).

[21] Marked correlations are significant at $p < 0.05$

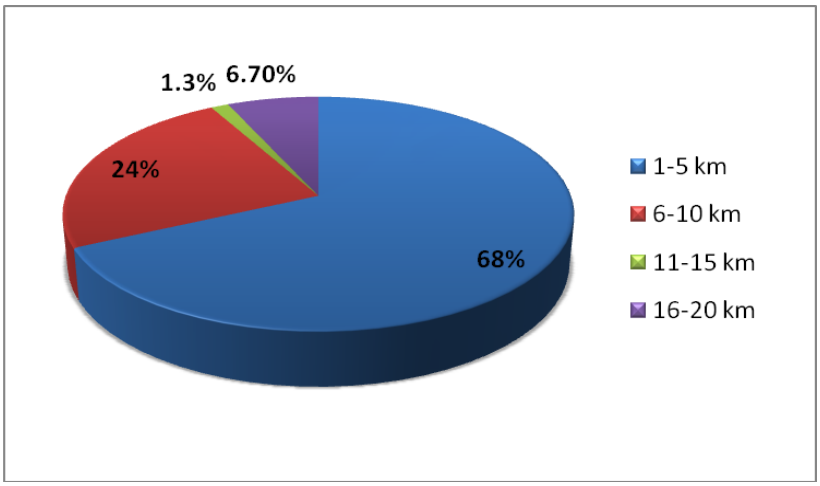

Figure 12: Percentage of distances between farmer household and market

5.3.3. Food Expenditures

The amount equal to $1.48 was calculated as the average spending for a full day meal, including breakfast, lunch and dinner as well as snacks, per one member of the household. However, a significant percentage of respondents (34%) was spending less than 1 dollar per day.

By easier mathematical calculations it is possible to get the monthly expenditures per capita on food which presents $44.4. If the fact, that total average monthly income per capita makes $34.23, is connected to previous information, it is clear, there is a certain discrepancy. Therefore it is quite desirable to realize that a large part of the respondents is below the average expenditures on food by almost 62.7%.

Besides that, the quality of the dietary is associated with the value of food expenditures (Lo *et al.*, 2012). The respondents with lower incomes generally spend less on food. That is related to not just a buying less quantity of food, but even to a purchase of worse quality food (Fengying *et al.*, 2010), leading to lower dietary diversity (Gundersen and Ribar, 2005). Subsequently, a nutritional security of people is connected and thus a well-being as well. Moreover, a correlation between level of education as well as total income and frequency of meat consumption was determined as r = 0.68. Thus, frequency of consumed meat is influenced by both education and income by 48%.

People with higher education realize the importance of the presence of any meat[22] in dietary composition. And given the findings of close relationship between education and income and consequently the food expenditures, it is understandable that certain sort of people will be able to indulge more expensive foodstuffs such as meat. These facts are affirmed by Fengying *et al.* (2010) as well. Additionally, FAO (2012) indicated that household vulnerable to food insecurity is distinguished by low consumption of meat.

Results of frequency of meat consumption among farmers are shown in figure 13. The graph indicates that the most often the respondents indulge meat once a week. It is worth noticing that 23% of farmers do not buy the meat at all because it represents an expensive item for their household budget. Most of these respondents, which did not buy a meat, consume meat only occasionally - few times a year at family gatherings, where they will receive it. There is an assumption, if the income will increase along with expenditures on food, subsequently people would begin to consume more meat. Hutasuhut *et al.* (2001) presupposed the same fact in case of Indonesia in his study.

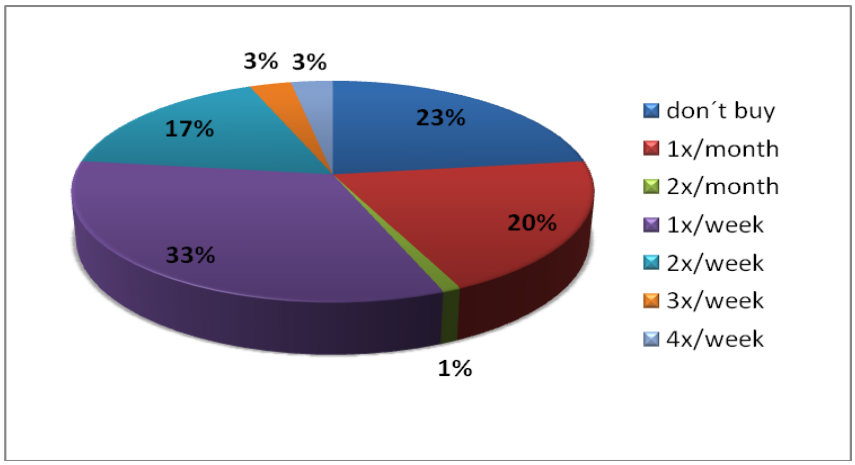

Figure 13: Percentage of farmers according to frequency of meat consumption

[22] Except the fish. Based on gathered data, the local people do not consider fish as meat. Contrary, the consumption of fish is high in target region, especially due to the presence of Lake Toba.

5.4. Food Utilization

Below the results of parameters identifying practices needed to food utilization are discussed. Literacy level along with access to drinking water and fuel are disscused as the key factors for the food utilization standpoint.

5.4.1. Illiteracy Rate

The results of the illiteracy rate are received from the governmental Indonesian statistical database (2013). In 2011, this rate stood for 3.17% for North Sumatra province. Even though a degree of literacy is rising according to official sources, on the basis of field survey, it can be meet with illiterate people in rural areas. Moreover, as described above, there is a certain link between the literacy degree through education accessibility and income (Sylwester, 2002). It should be explained that low educational attainment contributes to a higher rate of illiteracy (WFP, 2012). However, it is quite understandable if people are more educated, they have a willingness to learn new things such as new trends and techniques in agriculture. The innovation of educated farmers could be reflected in their total incomes (Turčínková and Stávková, 2012), which also affect food purchases (Fengying *et al.*, 2010). Statistical calculation confirmed the hypothesis 1 that the educational level has an influence on the future household income by 28%. This expressed correlation as r = 0.53 and determination R^2 = 0.28. It implies that education is an important aspect for determining future lifestyle and affects the overall household status.

5.4.2. Difficulty of Access to Drinking Water

With regard to access to safe drinking water, it cannot be clearly stated whether this access is easy, normal or difficult according to perception of respondents. On the basis of respondents' assessments, access to drinking water seems to be very equal at scales ranging from easy through medium (see figure 14). Almost half of the respondents considered this access as difficult. On the other hand, 31% of respondents indicate access to drinking eater as easy and rest of respondents appears it as medium. It is not possible

to infer easily a difficulty of obtaining drinking water. The relativity of evaluations should be mentioned. The respondents, who were not familiar with modern sanitation system and did not have the opportunity of comparison, then they evaluated twenty-minute long way toward the source of polluted water as easy access. This kind of assessment could be misleading. However, as it appears from the study carried out by Tolossa and Tafessa (2008), access to drinking water has a significant impact on food security. Moreover, in general access to water affects agricultural production. Furthermore, the study indicates that limited access to water involves the expansion of human diseases such as diarrhea, cholera, skin diseases, and so forth.

5.4.3. Difficulty of Access to Fuel

It is obvious that access to the fuel as a base of energy is crucial, especially for food utilization such as meal preparation in the form of cooking or boiling. Particularly in rural areas, proper cooking of certain foodstuff is essential. Access to the fuel is not only fundamental in sphere of food preparing, but for general household usage as well (Fengying *et al.*, 2010), especially in transport. The survey results showed (fig. 14) that more than half of the respondents considered access to energy as easy. Only 10% of interviewees assessed energy access as difficult. This fact might be particularly related to the low fuel price (see chapter 2.7.2. and table 5).

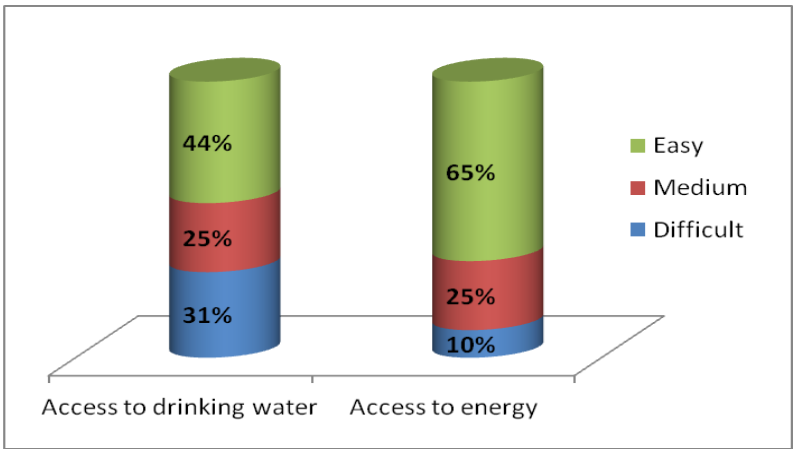

Figure 14: Access to drinking water and energy as perceived by farmer

5.4.4. Comparison between Tapanuli Utara and Simalungun regencies in selected variables regarding education level, total income and expenditures on food

The previous results prove a strong relationship between the educational level, total income and expenditures on food. Statistically distinctions exist at all these parameters (see figure 15, 16, 17) related to regencies Tapanuli Utara and Simalungun.

One possible explanation why Tapanuli Utara regency has a higher average in all measured aspects compared to Simalungun regency may lie in better accessibility to education. The above results has shown that income and expenditures on food depends are derived from the attained level of education. It is a question suitable for further investigation. Another potential aspect affecting higher income in Tapanuli Utara over Simalungun could be grounded in a production of coffee. There was statistically confirmed a difference between the regencies. Nearly three-quarters of farmers (73%) from total of respondents from Tapanuli Utara cultivated coffee, while in the second regency it was approximately one-third (31%) of target respondents. Due to the fact that coffee has a higher purchase price compared to other crops, it could be possible consequence of higher average income in Tapanuli Utara. This region has the advantage of suitable natural conditions for growing coffee, in contrast to the region Simalungun.

Expenditures on food are based on income and that is clearly confirmed in this case. Nevertheless, in both regencies, one man spends averagely less than $ 2 per all-day food. Even in the region Simalungun, this value is below $ 1 per day.

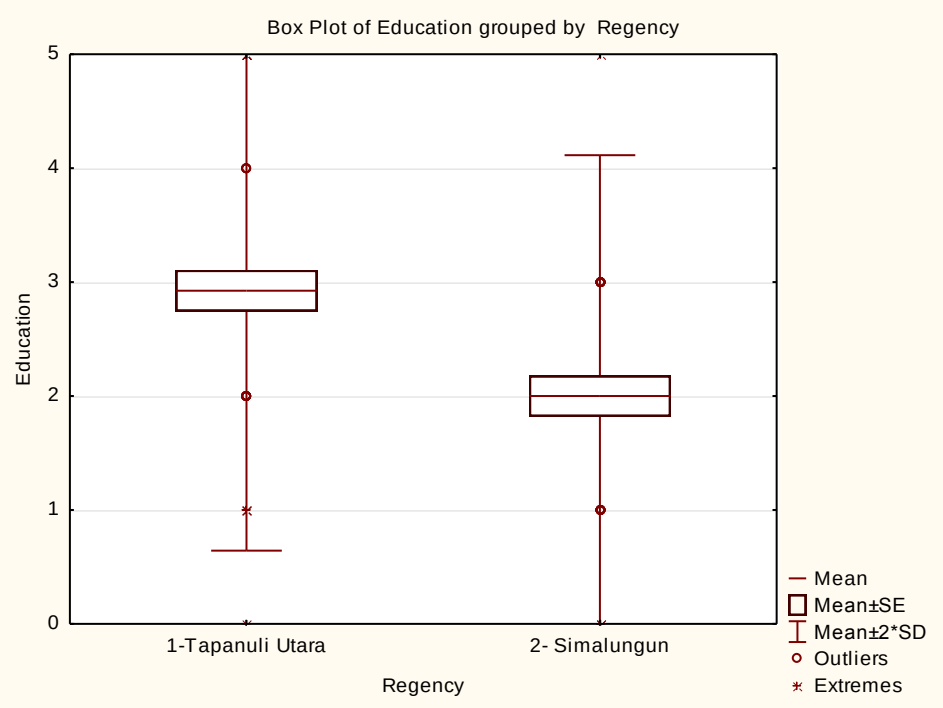

Figure 15: Comparison of attained education level between Tapanuli Utara and Simalungun

The explanation of encoded values in figure 15:

	Encoded education level					
code	0	1	2	3	4	5
education level	no education	SD	SMP	SMA/SMK	bachelor	master

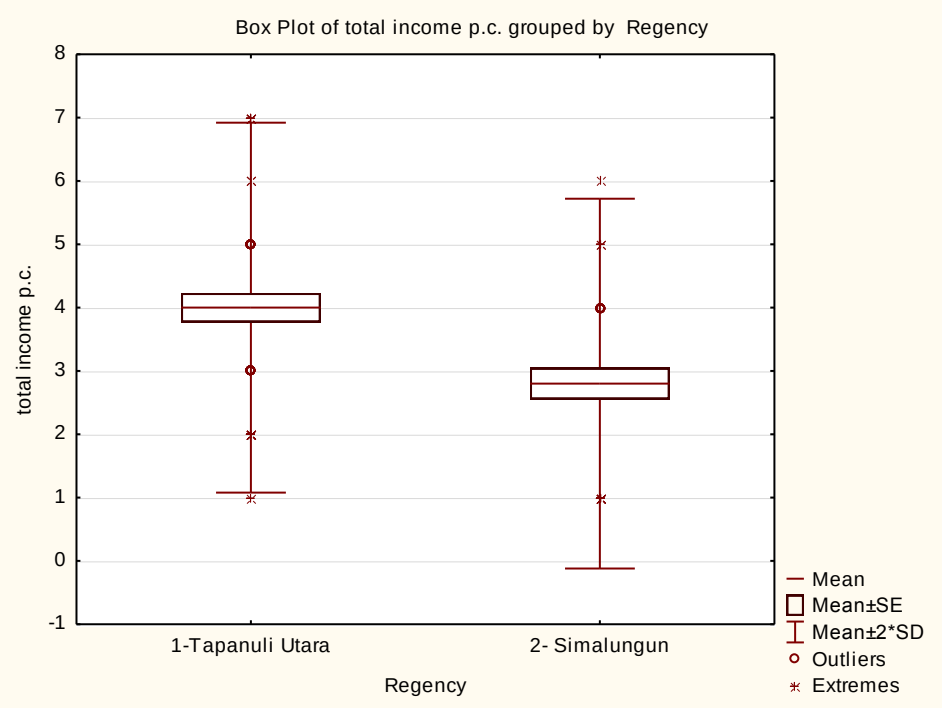

Figure 16: Comparison of total income average between Tapanuli Utara and Simalungun

The explanation of encoded values in figure 16:

	Encoded income per capita						
code	1	2	3	4	5	6	7
income per capita	< 6.84	6.84 - 11.97	11.98 – 17.11	17.12 – 22.24	22.25 – 27.37	27.38 – 32.50	> 32.51

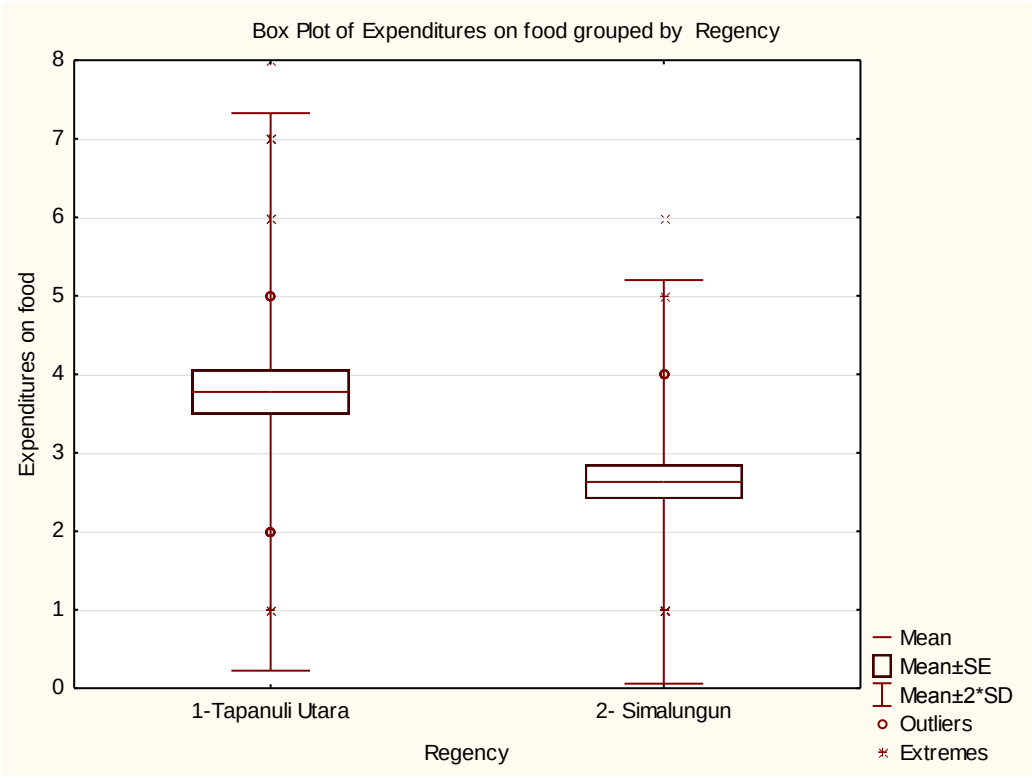

Figure 17: Comparison of average of expenditures on food between Tapanuli Utara and Simalungun

The explanation of encoded values in figure 17:

	Encoded food expenditures							
code	1	2	3	4	5	6	7	8
$	< 0.52	0.52 – 1.03	1.04 – 1.54	1.55 – 2.06	2.07 – 2.58	2.59 – 3.10	3.11 – 3.61	>3.62

5.5. Potential for energy crops cultivation

Although farmers grew crops potentially suitable for biofuel production such as corn or cassava, almost none knew that crops might be sold for such a purpose. 100% of farmers replied that they sell crops for food purposes.

Despite the fact that maize and cassava figured among the most cultivated crops by farmers[23], they were not mentioned on the list of the most sold commodities in the local markets. 43% of the grown crops were sold at the local market and 45% were sold

[23] 32% of target farmers cultivated cassava; 47% of them cultivated corn as well.

to middlemen as it is obvious in figure 18. The question is *to where do middlemen resell the grown the crops?* A certain clarification might be that middlemen sell the commodities to processing plants, either for food or energy purposes. This would mean that farmers themselves do not have access to the energy market. *Is there any higher purpose on such a speculation?*

According to a report published by Daemeter Consulting (2012)[24] the local mediators have better access to information and capital and especially to larger processing plants to which small farmers cannot. Moreover, the report argued that there are unofficial ban for local farmers to sale the commodities directly to processors. That would be definitely a safeguard of required use of middleman which can enrich himself through the mediation between farmers and large enterprises.

Figure 18: The place of sold commodities by farmers

The purchase price of commodities is unique regardless of the purpose of selling. Due to that fact, farmers do not pay an attention to purpose of crops purchase in the terms of energy or food. That could be broken in the case of setting the special price for energy purchase. The question is *what would happen if any energy concern would enter to market with attractive higher purchase price for energy crops?* Based on fact that purchase price

[24] a company that falls under the Indonesian government laws

played an important role in farmer decision making on what to grow (as obvious in figure 19), assumption could be clear.

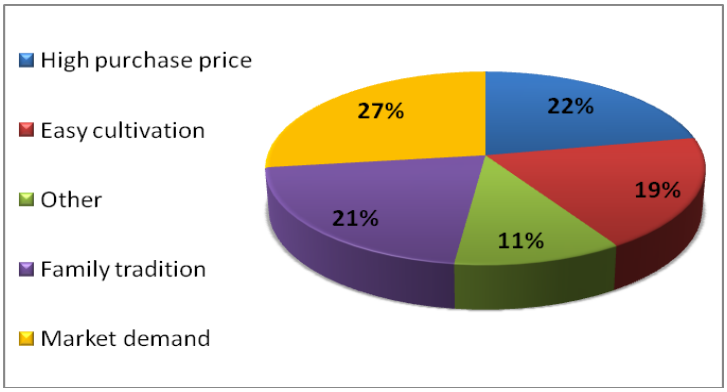

Figure 19: Reason of farmer's decision making what to cultivate

In comparison with other crops, the purchase price of both maize and cassava is relatively low (table 6). Still, maize with cassava belong to the most frequently grown crops among the local farmers. One of possible explanations might be that these crops are more resistant against various plant diseases compared to crops that have higher purchase prices such as coffee or chilli. That could be definitely an advantage of these energy crops for widespread cultivation.

Table 6: Average purchase prices of cultivated crops according to farmers

Crop	$/kg
corn	0.23
cassava	0.1
coffee	1.86
chilli	2
cacao	1.63
ginger	1.12

Despite the fact that purchase prices of crops are the same regardless of the future utilization, subsidies to promote biofuel production will push for purchase of energy crops for energy processing. Even Rathmann *et al.* (2010) concurred with such a speculation in his study. This will be attractive to processing plants due to those subsidies. However, the final benefit will not come into the hands of the farmers.

To summarize, the farmers got most of their food consumption at the market. Thus, in terms of food ensuring, farmers are not dependent on their agricultural production. Practically, they have capacities required to energy crops cultivation. However, farmers will not unreasonably change the composition of its production. The only aspect, that could revise it, is the attractive purchase price.

6. CONCLUSION

All three dimensions of food security can be assessed on the ground of results determining each specific indicator.

Regarding the food availability, farmers have access to adequate supply of food. Mostly due to the market; household production does not play such a huge role as the market does. Farmers also obtain a sufficient energy intake from food.

From the food access point of view, farmers from target regencies live closely above the poverty line and they have a sufficient income for expenditures on food. However, farmers do not spent money for food more than is necessarily. Also the physical access to food obtaining is in attainable extent.

The ability of farmers for proper food utilization was evaluated through literacy as satisfactory along with access to drinking water and energy. Nevertheless, in the case of drinking water, the improvement of ingenious sanitary system is highly required in rural areas.

Evaluation of the three dimensions provides evidence of sufficient food security among small-scale farmers. Hence, there is a possibility to concentrate agricultural production in another direction.

Farmers have the ability to produce energy crops. Based on fact that farmers do not use their current agricultural production as a main source of diet composition and primarily they buy the food at the market, they are able to offer the land for energy crop production. Entirely an attractive purchase price could bring such a change. However, that is currently the same value for food as well as energy purposes. Farmers are not aware of the potential for growing energy crops. Therefore, it can be recommended to higher capacities, in the context of enhancing biofuel policy, to concentrate on spreading and strengthening knowledge among farmers about the possibility of energy crops cultivation; to familiarize them with the concept of biofuel production and thus to contribute to the energy security, especially at the local level.

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ANNEXES

Annex I: Survey questionnaire in English language

Annex II: Survey questionnaire in Indonesian language

Annex III: Target of contribution to Indonesia energy mix

Annex IV: Development of CO_2 emission releasing in Indonesia

Annex V: Comparasion of selected countries regard to CO_2 emission share of total in 2010

Annex VI: Photo documentary if field survey

Annex I: Survey questionnaire in English language

Analysis of Three dimensions of Food Security in Indonesia – the Survey

The aim of the questionnaire is the survey and analysis of the current situation of food availability, food access and food utilization in Sumatra, in Indonesia among the small-scale farmers. All data collected during the survey will be evaluated and published in my diploma thesis under the Department of Sustainable Rural Development in Tropics and Subtropics, Czech University of Life Sciences in Prague.

Thank you very much for your participation.

Šárka Dědková: sarka.dedkova@gmail.com Tel: +6282365312953

Personal inforamtion:

Name: Gender:

Village: Age:

Number of members in household:

Level of educational attainment:

No. of children up to age of 15 years:

1) How would you evaluate your situation about the following services on the scale 1 to 3?

(where **1 means:** no acces **3 means**: easy acces)

access to drinking water	1	2	3
food security	1	2	3
access to medical care	1	2	3
access to education	1	2	3
access to energy	1	2	3

2) Do you participate in a special program/ kelompok / association for agriculture promotion, which support you? If Yes, please write down, how that is called.

a) yes: .....

b) no

3) Do you recieve subsidies from government? If Yes, please write down what kind and how much.

a) yes: ..... b) no

1

4) What crops do you cultivate? In case of „yes“, please mark (X) which crop is cash or food. Next, write the yield and price.

For Food crops	For Cash/market crops	Area	Harvest/year	Yield (t/ha/year)	Purchase price (kg/IRD)

5) Why do you focus on these cash crops?

a) because of high purchase price

b) because of easy cultivation/production

c) because of market demand

d) because of family tradition to cultivate it

e) other: .....

6) Do you use „your cash crop“ for your household usage?

a) yes b) no

7) Where do you sell „your cash crop“? (more answers are possible)

a) in local market

b) middleman/agent

c) directly to other farmers

d) to processing factory

e) other:.....

8) Do you plan to cultivate „your cash crop“ in future as well?

a) yes b) no

9) What is % of total household income from selling of „your cash crops“?.....

10) Fields which you use are:

a) mine/family b) hired

11) What is the total field area that you have? Is everything culivated?.....

12) Do you use any herbicides, pesticides, fertilizers for cash crops cultivation (costs)?.....

13) Do you breed any animals? In case of „yes", please mark (X) which animal is cash, food. Next, please write the number and price.

For Food	For Cash/market	Number	Purchase price (kg/IRD)

14) Do you hire any seasonal labour (for how long and what is the salary)?.....

15) Do you have any loan? In the case of „yes", what your interest rate is per 1 month

a) yes: ..... b) no

16) For what do you need energy and which source is that?.....

17) What is your total average of farm income per 1 month?

a) < 400 000 IDR

b) 400 000 – 699 999 IDR

c) 700 000 – 999 999 IDR

d) 1 000 000 – 1 299 999 IDR

e) 1 300 000 – 1 599 999 IDR

f) 1 600 000 – 1 899 999 IDR

j) > 1 900 000 IDR

18) What kind of off-farm activity do you run?

a) teacher at school

b) selling of home-made products

c) providing of driving services (taxi, minibus drivers)

d) employment of: .....

e) other:.....

19)What is your total off-farm income per 1 month?

a) < 400 000 IDR

b) 400 000 – 699 999 IDR

c) 700 000 – 999 999 IDR

d) 1 000 000 – 1 299 999 IDR

e) 1 300 000 – 1 599 999 IDR

f) 1 600 000 – 1 899 999 IDR

j) > 1 900 000 IDR

20) How often do you buy food crops at the market?.....

21) Which are the 5 most important food crops you buy at the market + amount?

Crop : *Amount/1week:*

22) How many % of your daily food is (comes) from market?.....

23) Do you have lack of food in your daily consumption?

A) Yes: - Every day enough food

B) No: - every day
- Sometimes during the week
- Sometimes during the month
- Sometimes during the year

24) What do you usually eat for:

a) Breakfast:.....

b) Lunch: .....

c) Dinner: .....

25) How often during the week do you eat meat?.....

26) How far is the closest market?.....

27) How much money do you spent on the food for 1 person per 1 day?

a) < 5 000 IDR
b) 5 000 – 9 999 IDR
c) 10 000 – 14 999 IDR
d) 15 000 – 19 999 IDR
e) 20 000 – 24 999 IDR
f) 25 000 – 29 999 IDR
g) 30 000 – 35 000 IDR
h) > 35 000 IDR

28) Do you think that you can buy every important food, what you need?

a) yes b) no

Annex II: Survey questionnaire in Indonesian language

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Survey Analisys of Three Dimensions of Food Security in Indonesia

Tujuan kuesioner ini adalah survey dan analisis terhadap situasi saat ini dalam ketersediaan makanan di Sumatera, Indonesia, di antara petani lokal. Semua data yang dikumpulkan selama survey akan dievaluasi dan diterbitkan dalam tesis diploma saya di bawah Departemen Pengembangan Pedesaan di Daerah Tropis dan Subtropis, University of Life Sciences di Praha.

Terima kasih atas partisipasi and.

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Informasi Personal: Anda diharapkan untuk mengisi informasi personal yang dibutuhkan di bawah ini.

Nama : Jenis Kelamin : a) Laki-laki b) Perempuan

Nama desa : Umur :

Jumlah anggota keluarga :

Pendidikan terakhir :

Jumlah anak di atas 15 tahun :

Pertanyaan

1) Bagaimanakah menurut anda situasi layanan yang ada di bawah ini?

I.	Akses untuk air minum	a. Akses sulit	b. Biasa saja	c. Akses mudah
II.	Akses dan makanan yang cukup	a. Akses sulit	b. Biasa saja	c. Akses mudah
III.	Akses untuk layanan kesehatan	a. Akses sulit	b. Biasa saja	c. Akses mudah
IV.	Akses untuk pendidikan	a. Akses sulit	b. Biasa saja	c. Akses mudah
V.	Akses untuk listrik, LPG, minyak, dll	a. Akses sulit	b. Biasa saja	c. Akses mudah

2) Apakah anda bergabung dalam kelompok pertanian yang mendukung kegiatan pertanian anda? Jika Ya, silahkan tulis nama kelompok pertanian tersebut.

a. Ya. Nama kelompok pertanian anda : .....

b. Tidak

3) Apakah anda menerima subsidi dari pemerintah? JIka ya, silahkan tulis jenis subsidi dan jumlahnya.

a. Ya : .....

b. Tidak

4) Apakah anda memiliki pinjaman/utang? Jika ya, berapakah bunganya per bulan?

a. Ya : ..... b. Tidak

1

5) **Apakah jenis tanaman yang anda tanam? Silahkan beri tanda X apakah tanaman tersebut untuk dijual atau untuk dimakan. Kemudian tuliskan hasil dan harganya. Apabila tanaman untuk dimakan, harga tidak perlu diisi.**

Nama Tanaman	Untuk dimakan	Untuk dijual	Luas lahan	Jumlah panen/tahun	Hasil (Kg/Ha/tahun)	Harga (Rp/Kg)

6) **Mengapakah anda berfokus pada tanaman untuk dijual tersebut?**
   a. Karena harga yang tinggi
   b. Karena lebih mudah untuk diproduksi atau diolah
   c. Karena kebutuhan pasar
   d. Karena tradisi keluarga
   e. Lainnya:……

7) **Apakah anda menggunakan tanaman hasil pertanian anda untuk konsumsi rumah tangga?**
   A) Ya B) Tidak

8) **Dimanakah anda menjual tanaman hasil pertanian anda? (anda dapat memilih lebih dari satu pilihan)**
   a. Di pasar lokal
   b. Melalui agen
   c. Langsung ke petani lain
   d. Ke pabrik
   e. Disimpan untuk kebutuhan sehari-hari
   f. Lainnya : ……

9) **Apakah anda berencana untuk menanam tanaman yang anda tanam sekarang di masa depan?**
   a. Ya b. Tidak

10) **Berapa persen (%) pendapatan rumah tangga anda dari penjualan tanaman pertanian anda?** ……

11) **Lahan pertanian yang anda gunakan adalah :** a ik saya sendiri / keluarga b. Disewa

12) Berapa total lahan pertanian yang anda miliki? Apakah semuanya diolah/ditanami?

……..

13) Apakah anda menggunakan herbisida, pestisida, atau pupuk untuk mengolah tanaman anda? Biaya yang habiskan per bulan?……

14) Apakah anda memelihara binatang? Jika ya, berilah tanda X untuk binatang yang untuk dijual atau untuk dimakan. Kemudian, tuliskan jumlah dan harganya. Apabila binatang peliharaan untuk dimakan, jumlah binatang peliharaan perlu diisi, harga tidak perlu diisi.

Jenis binatang peliharaan	Untuk dijual	Untuk dimakan	Jumlah	Harga

15) Apakah anda menyewa pekerja untuk panen (untuk berapa lama dan berapakah gaji nya)?

……

16) Untuk apakah anda membutuhkan energi dan apakah sumbernya untuk itu?

Penggunaan energy	Sumber energi (listrik, LPG, kayu, batubara, bensin,...)
Pencahayaan	
Memasak	
Mesin pertanian	
Mengolah produk pertanian	
Sistem irigasi	
Transportasi	

17) Berapakah total rata-rata pendapatan anda per bulan dari pertanian?

a. < Rp. 400 000
b. Rp. 400 000 -- Rp. 699 999
c. Rp. 700 000 – Rp 999 999
d. Rp. 1 000 000 – Rp. 1 299 999
e. Rp. 1 300 000 – Rp. 1 599 999
f. Rp. 1 600 000 – Rp. 1 899 999
g. > Rp. 1 900 000

18) Apakah kegiatan anda selain bertani?

a. Guru sekolah
b. Menjual produk rumah tangga
c. Meyediakan jasa transportasi (supir taxi, angkutan desa, dll)
d. Pegawai dari :……
e. Lainnya : ……

19) Berapakah total pendapatan anda per bulan dari kegiatan diluar bertani?

a. < Rp. 400 000
b. Rp. 400 000 – Rp. 699 999
c. Rp. 700 000 – Rp. 999 999
d. Rp. 1 000 000 – Rp. 1 299 999
e. Rp. 1 300 000 – Rp. 1 599 999
f. Rp. 1 600 000 – Rp. 1 899 999
g. > Rp. 1 900 000

20) Seberapa sering kah anda membeli hasil pertanain dari pasar untuk dimakan?……

21) Tuliskan 5 bahan makanan penting yang anda beli dari pasar yang dikonsumsi dan jumlahnya.

Tanaman hasil pertanian:	Jumlah / 1 minggu

22) Berapa persenkah makanan kebutuhan sehari-hari anda yang dibeli dari pasar?……

23) Apakah anda memiliki kekurangan makanan utuk dikonsumsi sehari-hari?

a. Tidak : - Setiap hari makanan cukup
b) Ya: - Setiap hari
- Beberapa waktu dalam seminggu
- Beberapa waktu dalam sebulan
- Beberapa waktu dalam setahun

24) Apakah yang biasanya kamu makan untuk :

a. Sarapan pagi : ……

b. Makan siang : ……..

c. Makan malam : ……

25) Seberapa sering anda makan daging dalam seminggu? ……....

26) Berapakah jarak pasar terdekat? ……

27) Berapakah biaya yang anda keluarkan untuk makanan untuk 1 orang dalam 1 hari?

a. < Rp. 5 000
b. Rp. 5 000 – Rp. 9 999
c. Rp. 10 000 – Rp. 14 999
d. Rp. 15 000 – Rp. 19 000
e. Rp. 20 000 – Rp. 24 999
f. Rp. 25 000 – Rp. 29 999
g. Rp. 30 000 – Rp. 35 000
h. > Rp. 35 000

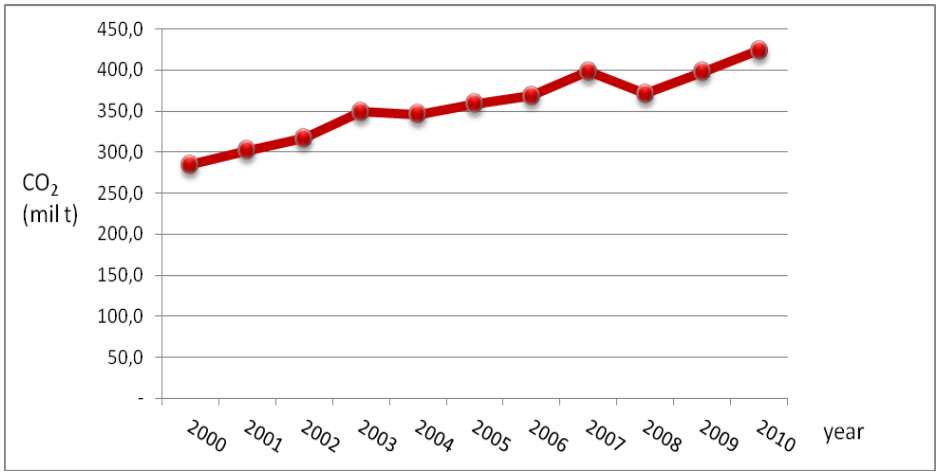
28) Apakah anda dapat membeli setiap makanan penting yang anda butuhkan?

a. Ya b. Tidak

Annex III: Target of contribution to Indonesia energy mix (Perpres 2006 in Wirawan and Tambunan, 2006)

	Contribution on Energy Mix	
Energy	2004	Targeted 2025
Oil	52.50%	≤ 20%
Gas	19.04%	≥ 30%
Coal	21.52%	≥ 33%
Biofuel	0%	≥ 5%
Geothermal	3.01%	≥ 5%
Others renewable energy (biomass, Solar, Wind, Hydro)	3.93%	≥ 5%
Coal liquefaction	0%	≥ 2%

Annex IV: Development of CO_2 emission releasing in Indonesia (BP, 2011)



Annex V: Comparasion of selected countries regard to CO_2 emission share of total in 2010 (BP, 2011)

Country	Share of total CO_2 emissions (2010)
China	25.1%
India	5.1%
Indonesia	1.3%
Japan	3.9%
Malaysia	0.5%
Thailand	0.9%
USA	18.5%
Russian Federation	5.1%
European Union	12.5%

Annex VI: Photo documentation of field survey (Dědková, 2012)