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Comparison of food security in ASEAN countries using composite indicator

Diploma Thesis

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Finally, I must express my very profound gratitude to my boyfriend and to my family for providing me with unfailing support and continuous encouragement.

Abstract

Topic of this thesis is a preview for food security in the ASEAN. The goal is to compare the nine countries of the ASEAN and assess which country achieved success in the implementation of food security policy. To achieve these results the composite indicator will be used to analyze this issue. The purpose is to create a suggestion that would help improve the situation of regions which have greater problems with food security.

Keywords: ASEAN, region, food security, composite indicator, developing country, nutrition

Abstrakt

Tématem diplomové práce je náhled na potravinovou bezpečnost v ASEANu. Cílem je porovnat devět zemí a vyhodnotit, která země dosáhla úspěchu při implementaci potravinové bezpečnosti. K dosažení výsledků bude provedena analýza pomocí kompozitního indikátoru. Účelem je vytvořit návrh, který by pomohl zlepši situaci těch regionů, které mají větší problém s potravinovou bezpečností.

Klíčová slova: ASEAN, region, potravinová bezpečnost, kompozitní indikátor, rozvojová země, výživa

List of abbreviations

AEC	ASEAN Economic Community
AFSIS	ASEAN Food Security Information System
ASEAN	Association of Southeast Asian Nations
CI	Composite Indicators
EC	European Commission
EFSA	European Food Safety Authority
EU	European Union
FAO	Food and Agriculture Organization
FVO	Food and Veterinary Office
GDP	Gross Domestic Product
HDI	Human Development Index
IPGRI	International Plant Genetic Resources Institute
MAFF	Ministry of Agriculture, Forestry and Fisheries
OAE	Office of Agricultural Economics
SD	Statistics Department
UN	United Nations
WHO	World Health Organization

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Introduction

Eating is a basic need of every human being without distinction of sex, race, age or nationality. Therefore all countries in the world deal with the issue of food security regardless of whether they are developed or developing. Areas of interest for national food security will vary according to maturity of state. Less developed countries are dealing matters such as how to eradicate malnutrition and poverty. While developed countries deal for example with processes in food production or with matters whether imported goods from developing countries is subjected to certain quality. Developed countries are not only focused on their well-being and are aware of interdependence of global food security, therefore they focus on third world countries and their development too. There are several world and European institutions that deal with issues of food security and create various projects to support the development of food security in less developed countries.

This thesis will examine food security in the ASEAN region. Although some of the ASAEN countries belong among the countries called "Asian Tigers" whose economy is growing rapidly, they still belongs among the developing countries. Rapid economic growth for a developing country is typical as well as high rates of poverty and enormous differences between rich and poor people. With this issues is ASEAN struggling as well. The aim of this work is to map the ASEAN and to determine which countries have food security better or worse. This phenomenon will be analyzed by using composite indicators, which are considerably more popular in recent years because they are easily readable even for the ordinary public in case they are well and accurately processed and interpreted. The great advantage of the composite indicator is that they can summarize large number of indicators in one index. After conducting analysis follows the proposal part, in which I will try to propose solutions to improve food security in those regions that were assessed as worse or the worst in food security.

Theoretical part

1 Basic terms

1.1 Region

Region is part of Earth`s surface with some typical characteristic. There are two basic types of regions:

A. Physical-geographic, defined on the basis of physical geographic features (relief, climate, soils, waters, etc.), that is characterized by a high degree of homogeneity.

B. Socio-geographic, defined on the basis of relatively closed spatial relationships (especially commuting).[1]

There are several other possible definition. For example economic definition of the region takes into account joint production patterns, market linkages, economic dependence direction or nature of the labor market. According to the functional approach, regions are evaluated and based on cultural or linguistic criteria or on the patterns of social communication. From an institutional point of view region can be considered a regional institutional structures, either historically constituted, or created artificially with a specific role in relation to the administration of higher unit.[2]

1.2 State

State is basic territorial unit of power, the institution or organization possessing the power to govern, judge and create laws of society (the state). The state is defined by state power, citizens and state territory. The sovereign state is not subordinate to any other (state) power, both external and internal.

According to this international convention is a state a subject of international law that meets these criteria:

• constant population

• defined national territory

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[1] *Encyclopedia Diderot, p.657*

[2] *DOČKAL, Vít. Ústřední pojmy regionální politiky EU[online].*

- state power (the government and state apparatus)

- ability to enter into relations with other states (ex. international law)[3]

1.3 Developing country

A developing country is a term generally used to describe states, characterized by a low level of material prosperity. There is no single globally accepted definition of condition where the state is "mature" and the level of economic development may also vary greatly within the group of developing countries. In the past, the emphasis was primarily on economic growth and the degree of industrialization of the country.

Typical features of developing countries are:

- migration to the cities

- lower consumption and higher population growth

- higher rates of poverty and low levels of education

- In general, mainly underdeveloped heavy industry and growing pollution

- poorly functioning public administration, public goods (education, health, defense) are low and insufficient levels

- relatively young population, the average age of bellow 30 years

- the outflow of talented and university-educated population into developed countries (brain drain)

- often high national debt

- faster economic growth than in developed countries

Available data assume that more than 700 million people in the developing world lack the food necessary for an active and healthy lifestyle.[4] The world has plenty of food.

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[3] *PALMER, Tom G. The Origins of State and Government [online].*

[4] *Poverty and hunger: issues and options for food security in developing countries, page 1-5 [online].*

The growth of global food production has been faster than the population growth in the past years. Prices of crops on world markets have even been falling down. Enough food is available therefore countries that do not produce all the food they want or need can import whatever if they can afford to. Still many poor countries and hundreds of millions of poor people do not share in this abundance. They suffer from a lack of food security, which is caused mainly by a lack of purchasing power. Trying to ensure food security can be seen as an investment in human capital that will become more productive society. A properly fed, active and healthy, population contributes more effectively to economic development than one which is physically and mentally weakened by in-adequate diet and poor health.

1.4 Developed country

Developed country is that one which has hight GDP per capita, developed power sector, engineering and chemical industry. It has low share of mining and quarrying. Processing industry predominates and science and technology are being developed. Agriculture is secondary but not negligible with modern base. Among other characteristic of the economically developed countries include:

- hight employment in services

- uneven distribution of economy

- focus on science and research

- development of tourism and transportation

- high economic potential

Developed countries deal for example with processes in food production or with matters whether imported goods from developing countries is subjected to certain quality. Developed countries are not only focused on their well-being and are aware of interdependence of global food security, therefore they focus on third world countries and their development too. There are several world and European institutions that deal with issues of food security and create various projects to support the development of

food security in less developed countries. More detailed description of these institutions are in chapter 2.[5]

1.5 ASEAN

This community called literarily the Association of Southeast Asian Nations, or ASEAN, was established on 8 August 1967 in Bangkok, Thailand. There was sign the ASEAN Declaration (Bangkok Declaration) by the Founding members of ASEAN, namely Indonesia, Malaysia, Philippines, Singapore and Thailand. Other countries joined gradually: Brunei Darussalam, Viet Nam, Lao PDR, Myanmar and Cambodia created what today is the ten Member States of ASEAN.

ASEAN aims and purposes are for example: to accelerate the economic growth, social progress and cultural development in the region through joint endeavors, to promote regional peace and stability or to maintain close and beneficial cooperation.[6]

ASEAN had Food Security Information System AFSIS. This project was implemented under ASEAN + 3 Cooperation and led by Thailand, in particular, the Office of Agricultural Economics (OAE), Ministry of Agriculture and Cooperatives. The Statistics Department (SD), Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan is the donor through ASEAN Trust Funds.

Due to the growing concern on food security in regional communities, the Ministers of Agriculture and Forestry of the ASEAN Member States plus China, Japan and Korea approved the AFSIS Project during the meeting held in October 2002 in Lao PDR. The overall objective of the Project is to strengthen food security in the region through the systematic collection, analysis and dissemination of food security related information.[7]

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[5] *NIELSEN, Lynge. Classifications of Countries Based on Their Level of Development: How it is Done and How it Could be Done [online].*

[6] *Association of Southeast Asian Countries, About ASEAN, [online].*

[7] *ASEAN Food Security Information System [online].*

1.6 Human Development Index

Today is one of the most recognized standards Human Development Index (HDI) which takes into account both economic and social aspects of development. HDI is mean for comparing the key dimensions of human development, including: a long and healthy life, access to education and standard of living. HDI is the geometric mean of the indices that express each of the three dimensions.

*HDI = (LEI * EI * II) * 1/3*

LEI - Life Expectancy Index

EI - Education Index

II - Income Index

1.7 Gross Domestic Product

GDP is the total monetary value of goods and services produced in a given period in a given territory. This indicator is used in macroeconomics for determining economic performance of states. Time period is usually a year. In international comparison is also used GDP per capita (GDP per capita). GDP can be defined in three ways:

1. **Production method**

   Gross domestic product consists of the sum of all final goods and services that were produced for a certain period and provided in its territory.

2. **Expenditure method**

   Another way to determine GDP is to quantify the costs of individual sectors for the purchase of final goods and services.

   HDP = C + I + G + X

   C - household consumption expenditures

   I - gross private domestic investment

   G - state spending on purchases of goods and services

   X - net exports, respectively export minus import

3. Income approach

GDP is the sum of national income (GNI), which is represented by the sum of earnings (income) of households, amortization and indirect taxes.

$$HDP = w + r + z + i + y + a + n$$

a - amortization

n - indirect taxes

w - gross wages

r - rents

z - gross profit corporations

i - net interest

y - pensions

Using any of these methods always leads to the same result.[8]

1.8 Human Nutrition

Human nutrition is dependent on the intake of nutrients from food. Nutrients which human body needs to produce energy, growth and repair of cells, tissues and organs. Nutrients are received in food and must contain protein, carbohydrates, fats, vitamins, minerals, fiber and water. The energy value of food is usually expressed in kilocalories or joules. Generally, people can survive up to 40 days without food, a period largely depending on the amount of water consumed, stored body fat, muscle mass and genetic factors.

Poor nutrition is a chronic problem often linked to poverty, poor nutrition understanding and practices, and deficient sanitation and food security. Lack of proper nutrition contributes to lower academic performance, lower test scores, and eventually less successful students and a less productive and competitive economy. Malnutrition and its consequences are immense contributors to deaths and disabilities worldwide. Promoting good nutrition helps children grow, promotes human development and advances economic growth and eradication of poverty.

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[8] *HOBZA, Vladimír; Dora ASSENZA a Jaroslav ZLÁMAL. Základy ekonomie*

1.9 Sustainable development

Sustainable development is development of human society, which harmonizes economic and social progress with full preservation of the environment. Between the main objectives of sustainable development belongs the preservation of the environment for future generations at least modified form from now.

Food composition provides an important link for biodiversity and nutrition. Biodiversity at three levels—ecosystems, the species they contain and the genetic diversity within species—can contribute to food security and improved nutrition. The Food and Agriculture Organization of the United Nations (FAO) and the International Plant Genetic Resources Institute (IPGRI) are leading a new international initiative on biodiversity for food and nutrition under the umbrella of the Convention of Biological Diversity. The overall aim is to promote the sustainable use of biodiversity in programs contributing to food security and human nutrition, and to thereby raise awareness of the importance of this link for sustainable development.[9]

1.10 Globalization

Globalization is a process of increasing dependence of national economies and markets, triggered by high dynamics of trade in goods, capital, services and technology transfer and know-how. The driving force is the globalization of economic activities which connects production and markets of different countries through trade in goods and services, movement of capital and information, and interconnected network ownership and management of multinational companies. The company/society initially united on the national level, then regional, international, and currently at the global level.

Food systems are being transformed at an unprecedented rate as a result of global economic and social change. Urbanization, foreign direct investment in markets of developing countries and increasing incomes are prime facilitators for the observed changes, while social changes, such as the increased number of women in the workforce and rural to urban migration, provide added stimulus. Changes are also facilitated in concrete ways by food production based on intensive agriculture, new food processing and storage technologies, longer product shelf-life, the emergence of food retailers such

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[9] *Journal of Food Composition and Analysis [online].*

as fast food outlets and supermarkets and the intensification of advertising and marketing of certain products. The sum of these changes has resulted in diverse foods that are available all year for those who can afford them, as well as a shift in home-prepared and home-based meals to pre-prepared or ready-to-eat meals, often consumed away from home. These food system and lifestyle changes are in turn having an impact on the health and nutritional status of people in developing countries. There is an indication of rapid increases in overweight and obesity, particularly among adults, and an increasing prevalence of diet-related non-communicable diseases. At the same time, social inequalities are increasing, particularly in urban areas. [10]

Globalization and global change have amplified traditional food security concerns such as chronic malnutrition but have also given rise to new forms of challenges from biotechnology, bioterrorism, and emerging infectious diseases. Food security challenges are made more complex in that they impact and interact with other global security concerns such as reducing conflict and instability, maintaining economic prosperity, and ensuring human rights. [11]

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[10] *Globalization of food systems in developing countries: impact on food security and nutrition. p. 9-12.*

[11] *MCDONALD, Brayn. How does globalization affect food security today? [online].*
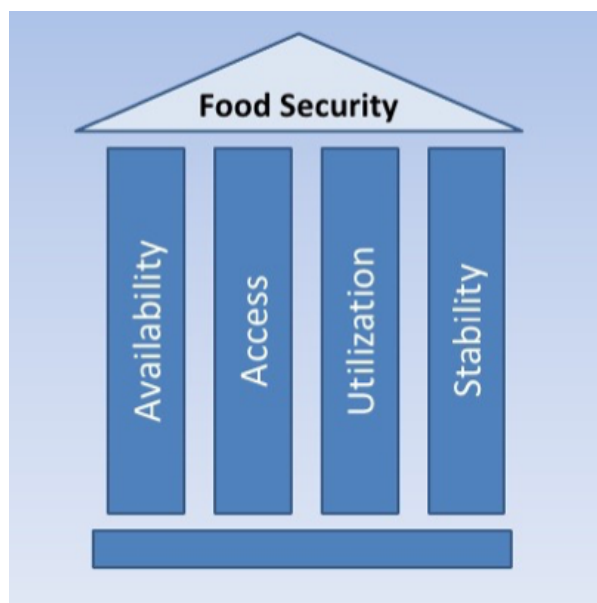
2 Food security

Food security has to do with access by all people at all times to enough food for an active and healthy life.The most widely used definition of food security comes from the World Food Summit in 1996 which defined food security as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life". The concept of food security is defined to include not only physical and economic access to food that meets people's dietary needs but also their food preferences.

Food security is built on four pillars:

1. **Food availability:** means the availability of a sufficient quantity of food of appropriate quality, supplied by domestic production because import (including food aid). It is still a problem in areas where food production does not meet population needs, thus raising the question—does our planet have the capacity to feed the growing millions whose consumption habits are on the rise?

2. **Food access:** individuals' access to adequate resources to obtain appropriate foods for a nutritious diet. In other words it refers to the ability to produce one's own food or buy it, which implies having the purchasing power to do so.

3. **Food utilization:** utilization of food through adequate nutrition, clean water, sanitation and health care to achieve a sense of nutritional well-being where all physiological needs are met. This increases the importance of non-food inputs to food security.

4. **Food stability:** to achieve food security must population, household or individual have an access to adequate food at any time. Access to food cannot be jeopardized as a result of sudden shocks (eg. economic or climatic crisis) or cyclical events (eg. seasonal food shortages). The concept of stability can therefore refer to both the availability and access dimensions of food security.[12]

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[12] *CIRAD Agricultural Research for Development [online].*

Figure 1. Four pillars of food security
Source: www. slidesharecdn.com/pr, 2016

Food security is a complex of sustainable development which is linked to health through malnutrition, but also to sustainable economic development, hight nutritional value of food, environment, and trade. [13]

The availability of food in given territory is influenced by its own production, import, food storage and role of the state. Even though the food is available it does not mean that people can access it. Food accessibility depends on household income, ability to grow own crop, infrastructure and physical geography. And finally even people have access to the food there is also important quality, nutritional balance, source of drinking water and proper hygienic conditions.[14]

With growing population there is great deal of debate around food safety. The main questions are: Is there enough food in the world to feed everyone adequately or the problem is distribution? Can or cannot be future food needs met by current levels of production? May or may not globalization lead to the persistence of food insecurity and poverty in rural communities?

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[13] *World Health Organization: Food Security [online].*

[14]*KUSTROVÁ, Milota. Základné atribúty potravinovej bezpečnosti , p.37-42*

2.1 Actors in the global food security

With food security deals several World and European organizations. These organizations issues documents, compose strategies , monitor food intake or health and in some cases prepare regulations. These activities allow them to have an impact on food that reach consumers.

2.1.1 World Health Organization

World Health Organization was found on April 7, 1948, when 26 states ratified their signatures and deposited founding treaty with the UN Secretary General. Since then, this day is celebrated worldwide as World Health Day.

Since its foundation in 1948, the World Health Organization (WHO) supports international technical cooperation in health, implements programs to combat and complete elimination of certain diseases and seeks to improve the overall quality of life. The aim of the organization is to achieve the best possible health for all.

WHO main strategic objectives are:

1. Restriction of mortality and disability, particularly among poor and socially disadvantaged population groups;

2. support of healthy diets and reducing health risks from environmental, economic and social conditions;

3. the development of more equitable and efficient health systems that will meet the legitimate needs of the people and for them to be financially reasonable;

4. the development of appropriate health strategies and institutional structures and the integration of health aspects in social, economic, environmental and development strategies. [15]

2.1.2 Food and Agriculture Organization

Food and Agriculture Organization (FAO) is specialized agency of United Nations based in Roma and founded in the 1945. The aim of this organization is to ensure

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[15] *World Health Organization: Food Security [online].*

enough food and drinking water to people in developing countries. FAO focuses on helping these countries particularly in technical, technological, financial and educational matters. It seeks to achieve country's self-sufficiency in nutrition and thus reduce the problems with food shortages and improve the living conditions of the rural population dependent on agriculture. In connection with this efforts are directed to increase agricultural productivity in developing countries which should ensure sufficient food production and secondly it should ensure access to harmless drinking water. In relation to the sustainability of farming in the countryside they are trying to introduce methods that prevent erosion and limit further occupation of forest land, which commonly occurs due to use of farming methods that deplete the soil.[16]

2.1.3 European Union

The European Union (EU) policy contributes to health protection throughout "Agri-food chain" (all phases of food production from farming to consumption) by preventing contamination of food, by promotion food hygiene and by the dissemination of information about food, health of plants and animals and their welfare.

The EU is working with international organizations and trade partners to support its food safety policy and to ensure that all imports from third countries meets the same standards. These include the WHO, with which is the EU working on a project of the International office network for food safety (INFOSAN). This network consists of national contact points in more than 160 countries. These contacts point receive information about food safety issues from WHO and pass them on into different countries.

The EU is also a large contributor in reliable food supply at the global scale. In particular, it seeks to ensure that matters of nutrition will be part of the development, education and health policies. The EU works with developing countries in creating effective systems of food supply management which can improve food security for the poorest and the most vulnerable people in the world. Other examples of EU

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[16] *Food and Agriculture Organization of the United Nations: Our strategic objectives [online].*

development and humanitarian aid measures are expert veterinary advice, training programs and funding of control programs.[17]

The European Commission (EC) is the prime source of food regulations across the EU, the role of Member States is rather enforcement of their interests than the creation of laws. This concerns the origin, authenticity, addition of nutrients, nutrition allegations, health claims, additives and permitted ingredients.

Food security and nutrition is included within the EC in the scope of three Directorates General: Health and Food Safety, Agriculture and Rural Development and Environment wherein their services mutually overlap.

EC enforces EU law in the area of food safety by checking whether all EU countries integrate relevant EU legislation into their national laws and ensure its implementation. **Food and Veterinary Office (FVO)** helps to EC carry out on-site inspections, in both Member States and outside the EU.[18]

Worth for mentioning is also **European Food Safety Authority (EFSA)** which is keystone in risk assessment regarding food and feed safety. EFSA provides independent scientific advice and clear communication on existing and emerging risks. All is done in close collaboration with national authorities. EFSA provides independent scientific advice and clear communication on existing and emerging risks. This authority is an independent European agency funded by the EU budget that operates separately from the European Commission, European Parliament and EU Member States. [19]

Finally EU continues to work closely with FAO. The two share lot of partnerships working many years with the common goal of eliminate extreme poverty and hunger around the world. This working relationship was further in July 2015 consolidated following the launch of two new partnership projects in 35 countries as is in FAO website mentioned:

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[17] *Politiky Evropské unie: Bezpečnost potravin [online].*

[18] *Evropská unie: Bezpečnost potravin v EU [online].*

[19] *European Food Safety Authority: About EFSA [online].*

"FIRST - the Food and Nutrition Security Impact, Resilience, Sustainability and Transformation project - that will strengthen the enabling environment for food and nutrition security and sustainable agriculture in selected organizations. It will contribute directly to FAO's Strategic Objective 1.

INFORMED - the Information on Food Security, Nutrition and Resilience for Decision Making project - that will contribute to the increase of the resilience of vulnerable people's livelihoods to threats and crises, envisioned under FAO's Strategic Objective 5."

It is hoped these two initiatives will join a number of others promoting stronger policies to achieve sustainable rural development in the field thanks to the EU and FAO's collaboration to date.[20]

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[20] *Food and Agriculture Organization of the United Nations: FAO and EU partnership [online].*

3 Composite indicators

3.1 Composite indicators in general

In recent years composite indicators (CI) received lot of attention nevertheless this concept is not something new. Its basic lies in the methods of multilateral comparisons using multiple indicators which are compiled into single index.[21] All variety of comparisons and rankings often use some form of CI, although it is not obvious at first sight. A mathematical combination (or aggregation as it is termed) of a set of indicators is most often called an "index" or a "composite indicator": Composite indicators are based on sub-indicators that have no common meaningful unit of measurement and there is no obvious way of weighting these sub-indicators.[22] Among the regularly published CI is included for example ranking of universities, best cities for life according to the country standard of living, competitiveness, environmental quality and so on. A major advantage of composite indicators is the possibility of summary of complex phenomena, providing big picture, attracting public interest and reduce the size of a list of indicators or to include more information. CI can be more easily interpreted than collection of many indicators and its results can be served as basic for decision-making (eg. political) and the results are easily explainable for general public. On the other hand CI may send misleading non-robust policy message and the simple "big picture" results which composite indicators show may invite politicians to draw simplistic policy conclusions.

Finally good quality data and methodology are the main prerequisites for right construction of CI. Each indicator must be meaningful, credible and legitimate .[23]

3.2 Construction of composite indicators

Construction of CI is not straightforward process, it involves certain assumptions that must be taken into account. Their construction depends more on the art of their creator than on generally accepted scientific rules. CI is very complex and wide method therefore it is possible to write a lot of pages about it. Nevertheless this thesis is focused

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21 *OECD: Glossary of Statistical Terms: COMPOSITE INDICATOR [online].*

22 *COIN: Composite Indicators Research Group: What is a composite indicator? [online].*

23 HUDRLÍKOVÁ, Lenka. *Kompozitní indikátory: konstrukce, využití, interpretace. p. 21-22*

more on results of given indicators therefore in this chapter will be construction of CI describe only briefly to outline the process for better understanding.

3.2.1 Selection of indicators

When determining indicators we have to know the theoretical framework at first. The objective is to accurately define the problem which will be measured. In my case I chose food security in the ASEAN regions nowadays. Further follows selection of variables or sub-indicators. Strengths and weaknesses of the overall composite indicator depends on the quality of selected indicators because if something is defined wrongly, it is probably measured wrongly as well.[24] Therefore it is necessary to understand the definition of measured phenomenon, its structure and the relationship between variables.

Values of indicators must be comparable between entities in spatial and temporal comparison before standardization and transformation of data. As an example might be used a comparison of small and large countries. This might be very confusing if the units are not properly adjusted to the size of the country (eg. it is correct to use per capita GDP instead of only GDP). Indicators must therefore be in properly comparable units. The level at which we want to measure indicators (country, region, school…) should be also based on already defined theoretical framework.

Great attention should be paid to the sources from which data originates. The used data should come from certified institutions such as statistical offices, national banks, international organization, etc. When merging data from different data sources, mistakes or methodical differentiates can appear, therefore it is necessary to prepare data properly. Selected variables should be reliable and clear, so we can check how the indicators were created. [25]

3.2.2 Missing values

For each analysis and modeling arises problem when certain values are not available. There are several methods for handling missing values. A simple way is to remove a

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[24] *HUDRLÍKOVÁ, Lenka. Kompozitní indikátory: konstrukce, využití, interpretace. p.26*

[25] *HUDRLÍKOVÁ, Lenka. Kompozitní indikátory: konstrukce, využití, interpretace. p.27*

missing indicator or unit. However this might not be always desirable as by this step we get rid of opportunity to compare some index. Another way to deal with missing data is to replace them. Missing data can be replaced with the average, median, the closes similar value (substitution value corresponding to the most similar unit in the file) or for instance by using values obtained from regression. Data imputation these above mentioned methods can minimize distortion. [26] There are three type of missing datas:

A. *Values missing completely at random (MCAR)*. Missing values are neither dependent on variable nor the action of other variables represented in the indicator.

B. *Values missing at random (MAR)*. Missing values are not directly dependent on the variable but are subjected to some other selected variable.

C. *Not missing at random (NMAR)* thus missing data that are dependent on variables. [27]

3.2.3 Multivariate analysis

It is appropriate to analyze the structure and relationship between the selected indicators by using mathematical and statistical methods. The first step is to assess the correlation between indicators.

Information acquired from multivariate analysis the most frequently analyses data file from two perspectives: individual indicators and countries for which this indicator is generated.

A. For insight into the structure of the data file of the composite indicator and for the information on individual indicators and the relationships between them, we can use factor analysis or principal component analysis.

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[26] *HUDRLÍKOVÁ, Lenka. Kompozitní indikátory: konstrukce, využití, interpretace. p.28*

[27] *PELIKÁNOVÁ, Radka. Kompozitní indikátory životní úrovně. p.9*

B. For summary of information on the country can be used for example cluster analysis detecting the similarity of individual countries in various indicators.

In this step the basic data structure should be checked with respect to both points of view (index, countries), identified groups of indicators or group of countries which are statistically similar and analyzed the overall structure of data file and its comparison to the theoretical framework.[28]

3.2.4 Data normalization

It can be expected that the individual indicators CI will not be listed in the same units, even their direction is not always the same. The higher value of the indicator does not always correspond to better situation (eg. higher value of poverty indicator mean worse living conditions). Therefore data must be by some way transformed or normalized. Different methods of data normalization lead to different values of parameters, but the order of the comparison unit always remains the same. It should be kept that in mind that the data normalization significantly affect the values of the final CI, because standardized indicators are then aggregated and weighed if necessary.[29] There are several methods to perform normalization:

A. The simples one is the normalization according to the order. This method is not burdened by outliers and lets you track the location of each country in time for the relative position (order).

$$I^t_{qc} = Rank\ (x^t_{qc})$$

Where x^t_{qc} is the variable value at time t for the indicator q and country c. I^t_{qc} is resulting value of indicator after normalization.

B. Standardization is another method which converts values of the indicators on normal range with mean 0 and standard deviation 1.

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[28] *PELIKÁNOVÁ, Radka. Kompozitní indikátory životní úrovně. p.9-10*

[29] *HUDRLÍKOVÁ, Lenka. Kompozitní indikátory: konstrukce, využití, interpretace. p.30*

$$I_{ij}^t = \frac{x_{ij}^t - x_{ij=\bar{j}}^t}{\sigma_{ij=\bar{j}}^t}$$

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Indicators with extreme values might have undesirable effect on the overall composite indicator. This can be avoided when aggregating indexes (either by removing the indexes with extreme values, or assigning different weights to different indicators).

C. Method min-max normalize indicators so the value of the indicator will be in range 0-1 by subtracting the minimum values and by dividing the total range of the indicator. However, indicators, where higher value does not mean better score, standardization is done by opposite way (from maximum value is subtracted variable and further is divided by the variation range.

$$I_{qc}^t = \frac{x_{qc}^t - \min_c(x_q^{t_0})}{\max_c(x_q^{t_0}) - \min_c(x_q^{t_0})}$$

Other methods include for example normalization by using distance from the reference value which is trying express how far are individual countries from goal they have to achieve. Another method might be based on assigning values of the indicators. Number between -1 and 1, depending on which direction and how far they are from the average value (average value is assigned by number 0). This standardization method is very simple and moreover is not affected by outliers. Another method normalizes indicators by using categorical scales. These categories might be quantitative or qualitative. They are often used by percentile range. The disadvantage of categorial scales is that they reduce amount of information regarding the variation between variables. There are few other method used for normalization of indicators. [30]

3.2.5 Weighting and aggregation

After normalization of each indicator we are moving towards summarizing into one single index. This is done by assigning weights to indicators so that together give 100%

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[30] *PELIKÁNOVÁ, Radka. Kompozitní indikátory životní úrovně. p.10-11*

of total composite indicator. There are several methods for allocation of weights. Some of them come from statistical models (such as factor analysis), other are based on subjective evaluation of experts or public (for example from the analytical hierarchical or budgetary allocation processes).

Most composite indicators are based on a uniform weighting. In other words, all variables are assigned the same weight. However some elements might be counted twice in case of collinear indicators. Therefore it is very important to select only indicators that show a low degree of correlation (between them does not exist statistically significant linear relationship) or adjust the weights accordingly (indicators with higher correlation coefficient assign lower weights). Weights may also be assigned in accordance with data quality. This method however tempts to select indicators with easily available data.

Aggregation methods are also numerous. If we have indicators with the same units of measurement, it can be used so-called linear aggregation. Geometric aggregation is used when there is undesirable ability to compensate the sub-indicators or ability to compensate between groups of these indicators. In both cases, the weights reflect a compromise between indicators, but in the linear aggregation there is possibility of constant compensation while in the geometrical aggregation with lower value indicators there is lower compensation. In other words when geometric aggregation is used then countries with low score in one indicator will need a much higher score in the other indicators that could improve their situation. Thus countries with lower results in partial indicators prefer liner aggregation because of these losses before geometrical aggregation.

In case it is found that the increase of value in a single index can under no circumstances compensate loss in another index (indexes are very different and compensation is undesirable) then none of the above mentioned aggregation methods is appropriate. At this moment can be used for example a multi-criteria approach which does not favor outliers as it works only with ordinal information. This method is computationally difficult.[31]

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[31] *PELIKÁNOVÁ, Radka. Kompozitní indikátory životní úrovně. p.11-12*

3.2.6 Robust and sensitivity analysis

As previously mentioned, during the construction of the composite indicator there is many decisions regarding the selection of indicators, standardization of methods or methods of weighting and aggregation of indicators. These decisions may distort robustness of created multicomponent indicator. Therefore, it is good to use sensitivity and uncertainty analysis and thus help to improve transparency. Uncertainty analysis assesses the uncertainty which is brought by input factors that affect the structure of composite indicator.

Sensitivity analysis assesses individual sources of uncertainty in the output. Then ideally should be discovered and identified all potential sources resulting uncertainties or inaccuracies. It may be for example the wrong choice of partial indicators, poor quality data, selection of inappropriate standardization methods, wrong choice of weights or poorly chosen method of aggregation. Approaches used to identify sources of uncertainty include the following: removing or adding individual indicators, the use of other methods when adjusting missing data (single or multiple imputation), using an alternative normalization scheme, using different methods for weighing or any other scheme for aggregating indicators. The results of the sensitivity analysis are then published for each source of uncertainty separately. So-called scatter diagrams are often used for better readability when on the x-axis are different sources of uncertainty and on the y-axis are values of the composite indicator for the country. All this analysis thus helps mainly to the creator of composite indicators to reflect the original framework and to assess whether the indicator really meets the expectations and measure what was intended.[32]

3.2.7 Decomposition of indicator

Although the aim is to get an aggregate indicator for the comprehensive assessment of measured phenomena in conclusion it is useful to decompile CI into individual components. Confrontation of CI with input data can help reveal whether CI is not strongly influenced by a few indicators, and also assess the contribution of individual sub-components of the overall value of CI.

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[32] *PELIKÁNOVÁ, Radka. Kompozitní indikátory životní úrovně. p.13*

3.2.8 Relations with other indicators

Valuable information about CI can provide analysis of relations with other indicators (either with CI or with other simple indicators eg. from national accounting). However interpretation of the results, can be tricky. If CI has a strong relationship to other indicators, then it is correct to ask whether the indicators actually do not measure the same thing, and if the CI was ever needed. Conversely, if expected relationship is not proven, it may be an error in the design of CI and one needs to think whether CI actually measures what was intended.[33]

3.2.9 Presentation and visualization of results

Composite indicator should be correctly interpreted and used. CI should have detailed methodology which describe its creation, interpret both CI and its sub-indicators behavior, describe its strengths and weaknesses too. CI must be above all intelligible for the user to he has all necessary information to take decision based on its results. Well-arranged visualization can bring better understating of the construction and outcome of CI, thereby leading indicator for acceptance by the public. Results should always be presented in a comprehensible form, for example graphically. Nowadays are possibilities of presentation of results CI very wide thanks to websites and various applications (Hurdlíková 2014, p. 33).[34]

3.2.10 Summary

Construction of CI is quite a long process, which involves a series of subjective decisions regarding the selection of indicators and used methods. These decisions should be transparent and based on data and results obtained by quantitative methods.

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[33] *HUDRLÍKOVÁ, Lenka. Kompozitní indikátory: konstrukce, využití, interpretace. p.32*

[34] *HUDRLÍKOVÁ, Lenka. Kompozitní indikátory: konstrukce, využití, interpretace. p.33*

Analytical part

5. Construction of food security indicators

In this part will be analyzed four pillars of food security: availability, access, utilization and stability. The analysis will conducted on datafile of 9 ASEAN states according to methodology described in theoretical part.

5.1 Region rewiev

ASEAN was in the process of creating a single market and production base, called the ASEAN Economic Community (AEC), which allow the free flow of goods, services, investments, and skilled labor, and the freer movement of capital across the region. Representatives of the Association of Southeast Asian Nations formally created AEC in Kuala Lumpur on Sundays 22 November 2015. [35]ACE became legally effective from the end of the year 2015. To the full functionality of this economic zone is still a long way to go. AEC should become a counterweight and economic competitor growing markets of China and India.

This can significantly contribute also to improve policy on food security because products and foods will be imported and exported without tariffs. On the other side although ASEAN has canceled many tariff barriers and visa restrictions in key sectors opened their labor markets to people from the Member States, but remain sensitive issues closed sectors such as steel, agriculture and car manufacturing.[36]

Another things worth to mention about ASEAN is for example that if ASEAN were one economy, it would be seventh largest in the world. It could be fourth largest by 2050 if growth trends continue. Further with over 600 million people, ASEAN's potential market is larger than the European Union or North America. Next to the People's Republic of China and India, ASEAN has the world's third largest labor force that remains relatively young.[37]

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[35] *Invest in ASEAN: Single Market and Production Base [online].*

[36] *Novinky.cz: ASEAN vytvořilo ekonomické společenství, má být konkurentem Číny a Indie [online].*

[37] *Asian Development Bank: ASEAN Economic Community [online].*

5.2 Theoretical framework

The problem which will be measured is food security in the region of ASEAN. Countries which will be taken to closer look are: Brunei Darussalam, Cambodia, Indonesia, Lao People`s Democratic Republic, Malaysia, Myanmar, Philippines and Thailand. Singapore was deliberately omitted because it is highly developed and it would exceeded all countries in the most cases in the graphical representation. Further variables will be selected, specifically two indicators from each pillar of food security (all together 8 indicators). Development in individual countries is very significant. This is shown in time period of 6 years from 2006 to 2012. Objective has been to record development of food security in time period of 10 years to we could compare previous situation with the present time. Nevertheless the data were hardly to find therefore has been chosen shorter time period in order to maintain more accuracy.

5.3 Selecting variables

Indicators to measure food security have been suggested over decades: from narrow measurement on specific variables (e.g., percent of undernourished or underweighted children) to complex indexes which aimed is synthesizing the multiple dimensions that characterize food security such as Global Food Security Index, Global Hunger Index, etc. It was adopted several classifications to organize indicators:

1. Indicators of food security may synthesize information at different levels (global, national, household, and/or individual);

2. indicators may be oriented to one or more dimension of the food security (availability, access, utilization, and stability);

3. indicators might be distinguished in static and dynamic (the former take into account only current statistics; the latter summarize time-varying statistics);

4. indicators may privilege a particular type of information (proxies associated with the status of food security, with the processes or interventions implemented to target food security or with the determinants or sources of risks associated with food security). [38]

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[38] *Fabio Gaetano Santeramo (2015) On the Composite Indicators for Food Security*

Table 1. Indicators of food security in pillar of Availability
Source: (Fabio Gaetano Santeramo, 2015)

Availibility
Average dietary energy supply adequacy
Average value of food production
Share of dietary energy supply derived from cereals, roots, and tubers
Average protein supply
Average supply of protein of animal origin

Table 2: Indicators of food security in pillar of Access
Source: (Fabio Gaetano Santeramo, 2015)

Access
Percent of paved roads over total roads
Rail-line density
Road density
Domestic food price level index
Prevalence of undernourishment
Share of food expenditure of the poor
Depth of the food deficit
Prevalence of food inadequacy

Table 3: Indicators of food security in pillar of Utilization
Source: (Fabio Gaetano Santeramo, 2015)

Utilization
Access to improved water sources
Access to improved sanitation facilities
Percentage of children under 5 years of age who are stunted
Percentage of children under 5 years of age affected by wasting
Percentage of children under 5 years of age who are underweight
Percent of adults who are underweight

Table 4: Indicators of food security in pillar of Stabilization
Source: (Fabio Gaetano Santeramo, 2015)

Stabilization
Domestic food price level index volatility
Per capita food production variability
Per capita food supply variability
Political stability and absence of violence/terrorism
Value of food imports over total merchandise exports Percent of arable land equipped for irrigation
Cereal import dependency ratio

Based on this methodology will be selected two indicators of each pillar and created composite indicator. In some cases recorded years differ depending on the availability. Each indicator will be focused on the chosen ASEAN countries. For simplification and clarity countries will be labeled with their international country codes in graphs. The chart of country codes is displayed in Table 5.

Table 5: Country codes
Sources: (https://countrycode.org)

Country codes			
Brunei Darussalam	BN	Myanmar	MM
Cambodia	KH	Philippines	PH
Indonesia	ID	Thailand	TH
Malaysia	MA	Viet Nam	VN
Lao People`s Democratic Republic			LA

Further For clarity, all indicators are put in order. Sequence numbers of indicators are from A1 to A8. See Table 6.

Table 6: Marking order of indicators
Source: (own work, 2016)

| Mark	Name of the indicator	Unit
A1	Average dietary energy supply adequacy	%
A2	Average protein supply	g/capita/day
A3	Road density	per 100 square km of land area
A4	Depth of the food deficit	kcal/capita/day
A5	Access to improved water sources	%
A6	Access to improved sanitation facilities	%
A7	Percentage of arable land equipped for irrigation	%
A8	Cereal import dependency ratio	%

The following graphs 1-8 show the six-to-ten year development of selected indicators. In general it is possible to say that indicators for which grow is desired are gradually rising and the indicators for which is desirable decrease are decreasing over the time period as well. This phenomenon clearly shows that development and food security in these countries is getting better.

Under the each graph will be in detail explained the meaning of the indicator and its eventual calculation for deep understanding of surveyed phenomenon. Further the displayed waveform of developments or decrease in individual countries will be described. Description will consider both growth and decrease of indicators in individual countries considering their situation.

Average dietary energy supply adequacy

Dietary energy supply is food available for human consumption, expressed in kilocalories per person per day (kcal/person/day). At country level, it is calculated as the food remaining for human use after deduction of all non-food utilizations (i.e. food = production + imports + stock withdrawals − exports − industrial use − animal feed – seed − wastage − additions to stock). Wastage includes losses of usable products occurring along distribution chains from farm gate (or port of import) up to the retail level. Finally dietary energy supply is a percentage of the average dietary energy requirement.[39]

Graph 1. Average dietary energy supply adequacy
Source: Food and Agriculture Organization

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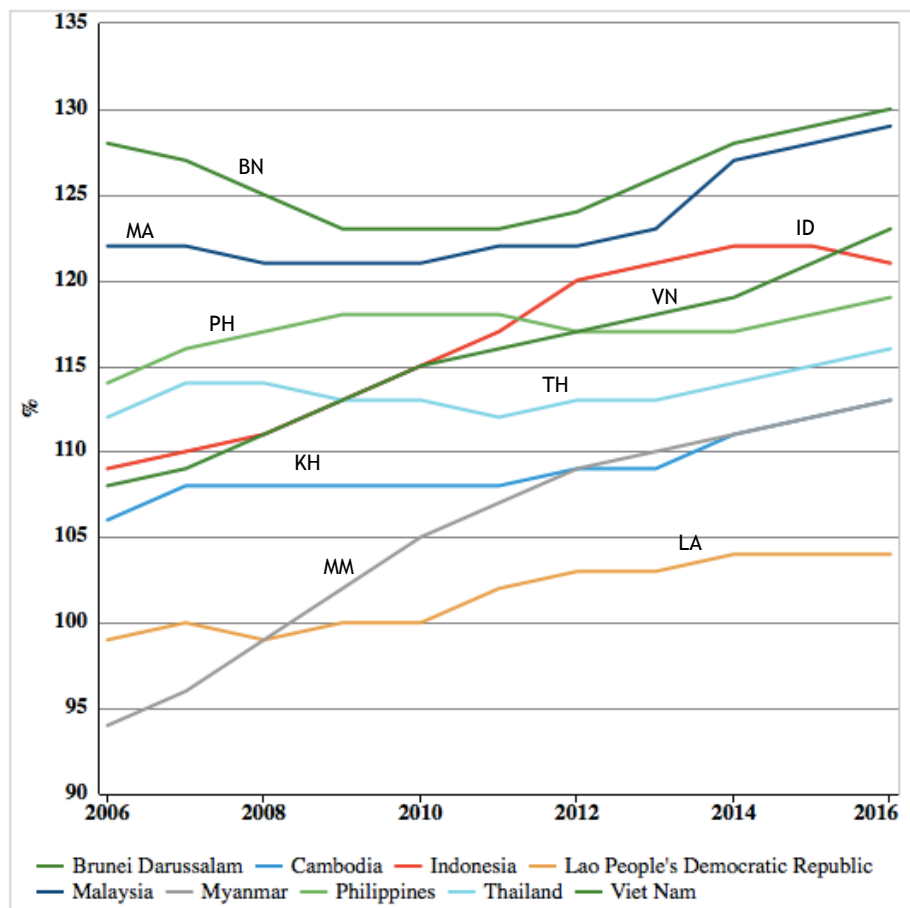
[39] *Our World in Data: Food per Person [online].*

In the graph 1 we can see that even thought countries belong among developing countries none of them suffer from hunger. According the graph the citizens of all countries eat more that 100% dietary energy requirement. Year by year average dietary requirement is gradually increasing in all countries. Only Indonesia has small decrease nowadays. However the dietary energy requirements of Indonesia did not fall even under 100% therefore we cannot assume this phoneme particularly threatening. Chart shows that the greatest affluence has Brunei which belongs between richest countries in ASEAN thanks to its oil reserves. Worst position between 2006 and 2008 had Myanmar whose position got better and had overrun Laos and nowadays is comparable with Cambodia.

Average protein supply

Dietary energy intake is essential. But nutrient composition of food is also very important. Proteins are essential for the formation and repair of tissues of the organism in human nutrition, they are part of enzymes and hormones, provide transport of substances in the organism and are a source of energy. Developing countries in general suffer from lack of protein. The recommended daily intake is gram of protein per kilo of human weight. This information will help us to evaluate whether the daily intake of protein in the graph 2 is sufficient or not. The average weight of an adult human being without distinction of sex is 62 kilograms.[40]

First and foremost, it is important to mention that dataset in graph 2 is reduced concerning the years 2012-2016. During compilation of composite indicator will be missing data replaced with the average, median, the closes similar value as is described in chapter 3. We can see that the best position has Brunei then follows Malaysia. Third and fourth position take Viet Nam and Myanmar which recorded the biggest increase of protein supply from all countries over recorded years. Laos is holding the edge of optimal protein intake during all year. Finally the bottom lines representing Thailand, Philippines, Cambodia and Indonesia shown low intake of protein which is very slowly increasing.

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[40] *Procproto: Kolik váží světová populace? [online].*
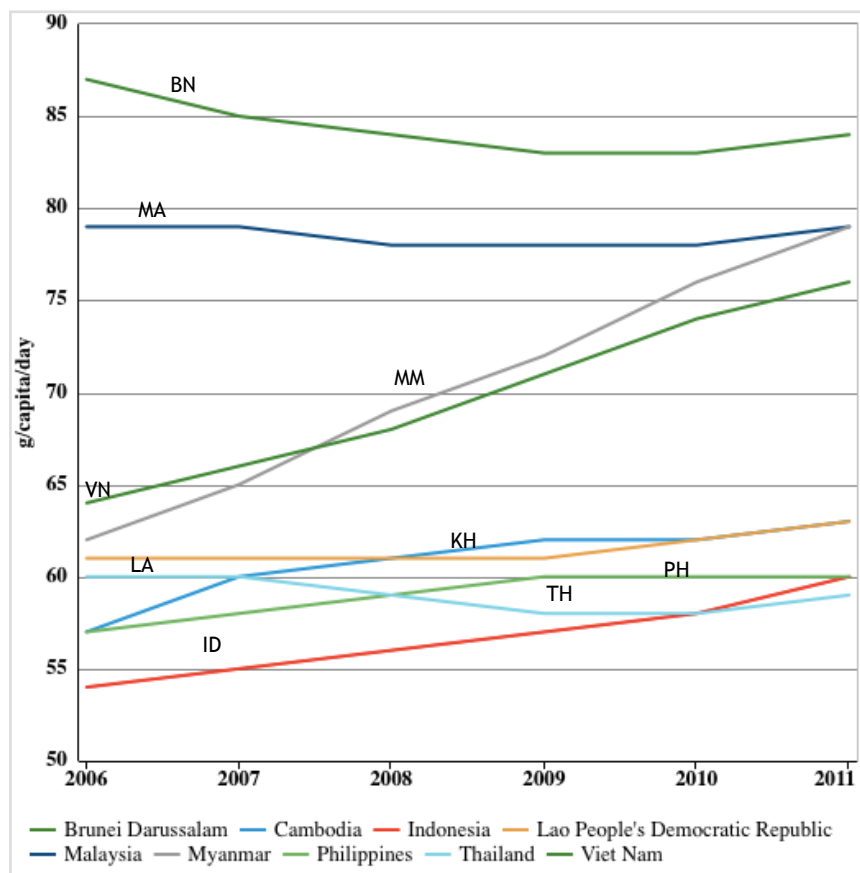
Road density

Road density is the ratio of the total road network of the country in land area. The road network includes all types of roads in the country: highways, roads, main or national roads, secondary or regional roads, and other urban and rural roads. [41] This index is included in food security because road density is important for food transportation to the regions which are unable to grow own crops or get crops by another way. We can say that the more road density is denser the better is connection between different regions. This is undoubtedly true but we also have to taken account the natural environment. The denser road density the higher probability of air pollution. In the following graph 3 will be shown how are countries standing in road density.

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[41] *NationMaster: Transport [online].*

Graph 3. Road density
Source: Food and Agriculture Organization
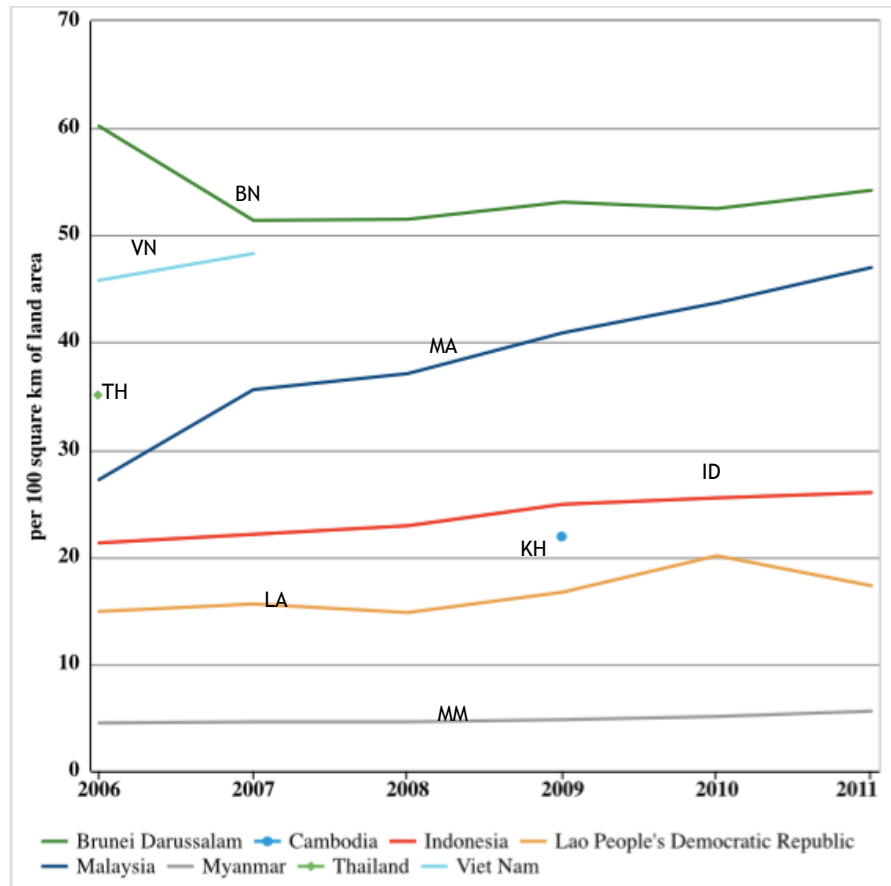
In the graph 3 Brunei has unquestionably the best road density. Viet Nam is on the second positions but its data are recorded only in 2006 and 2007. Nowadays has Vietnam probably denser traffic network just because it has become a popular travel destinations and proper traffic network is one of the important prerequisites for tourism. Thailand has almost absence of data, record is only in 2006. At least we have one point from which is possible start to analyze preconditions. Malaysia recorded a steeper increase traffic network, while Indonesia slower. Cambodia as well as Thailand has absence of data only record is in 2009. Then follow Laos which has only between 15 and 20 km square per 100 square km of land area. At the lowest position is Myanmar. Philippines is missing in this chart, however it is said that Philippines has the most traffic in the world but still belongs above average in the world.[42]

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[42] *Worldstat Info: List of countries by Density of road network [online].*

Depth of the food deficit

The depth of the food deficit indicates how many calories would be needed to lift the undernourished from their status, everything else being constant. The average intensity of food deprivation of the undernourished, estimated as the difference between the average dietary energy requirement and the average dietary energy consumption of the undernourished population (food-deprived), is multiplied by the number of undernourished to provide an estimate of the total food deficit in the country, which is then normalized by the total population.[43]

Graph 4. Depth of food deficit
Source: Food and Agriculture Organization

[43] http://data.worldbank.org/indicator/SN.ITK.DFCT
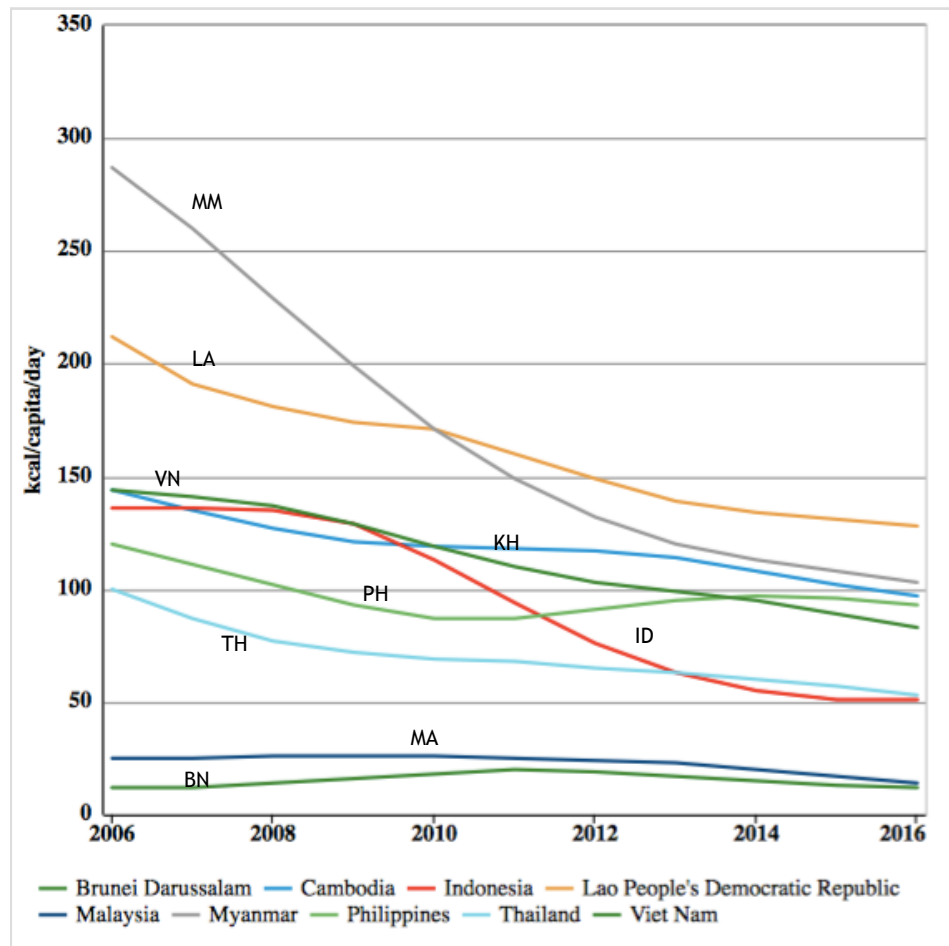
In the graph 4 is visible that in all countries is Depth of food deficit improving. The biggest improvement is experiencing Myanmar, further Laos. In the third position is Indonesia. Philippines, Thailand, Cambodia and Viet Nam`s deficit of food is slowly improving over decade, but they had never such big depth of food deficit as for example Myanmar. Brunei and Malaysia are in the best position. They hardly at all suffer from food deficit. Worth mentioning is that the total food deficit in the country is normalized by the total population. This measuring blurs the differences between poor and rich people which often tremendous in these countries.

Access to improved water source

This indicator refers to the percentage of the population using an improved drinking water source. The improved drinking water source is related to piped water on premises such as piped household water connection located inside the user's dwelling, plot or yard, and other improved drinking water sources. There belong public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection.[44]

Water resources are important for both drinking regime and food preparation and washing. In the graph 5 we can increasing access to improved water sources in all countries. Malaysia has the best position over years, almost 100 percent of population has access to water source. Thailand is in second place, then follows Philippines and Viet Nam where around 90 percent of population has access to water sources. In all these countries, tourism is a significant part of total GDP. Water source is not only in this respect a very important. In the worst position is Cambodia and Laos. These two countries belong among the most poorest countries in the ASEAN. Cambodia sadly gained fame mainly because of Khmer Rouge who ravaged this country and slaughtered 2 millions inhabitants (roughly quarter of former population). Myanmar and Indonesia are doing tolerably where around 80 percent of population has access to improved water resources. Better access to improved water source has usually population living in the cities weather population living in the provinces has sometimes more problems to get good water.

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[44] *The World Bank: Improved water resource [online].*
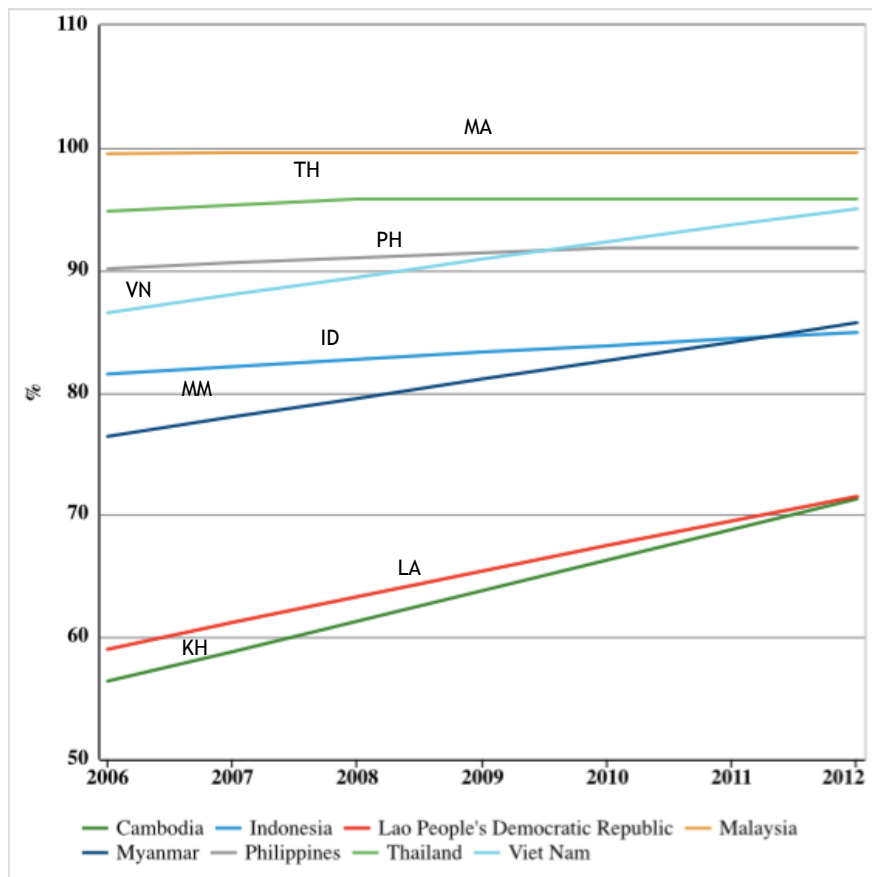
Access to improved sanitation facilities

"Access to improved sanitation facilities refers to the percentage of the population using improved sanitation facilities. Improved sanitation facilities are likely to ensure hygienic separation of human excreta from human contact. They include flush/pour flush (to piped sewer system, septic tank, pit latrine), ventilated improved pit (VIP) latrine, pit latrine with slab, and composting toilet."[45]

In Thailand and Malaysia in the graph 6 is reaching almost 100 percent population to access to improved sanitation facilities. In Philippines, Myanmar and Viet Nam between 65 and 80 percent population has access to improved sanitation facilities. Laos experienced bigger increase from 45 to 65 over 6 years. While only from 25 to 35 percent of population in Cambodia has access to improved sanitation facilities.

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[45] *The World Bank: Improved sanitation facilities [online].*

Graph 6. Access to improved sanitation facilities
Source: Food and Agriculture Organization
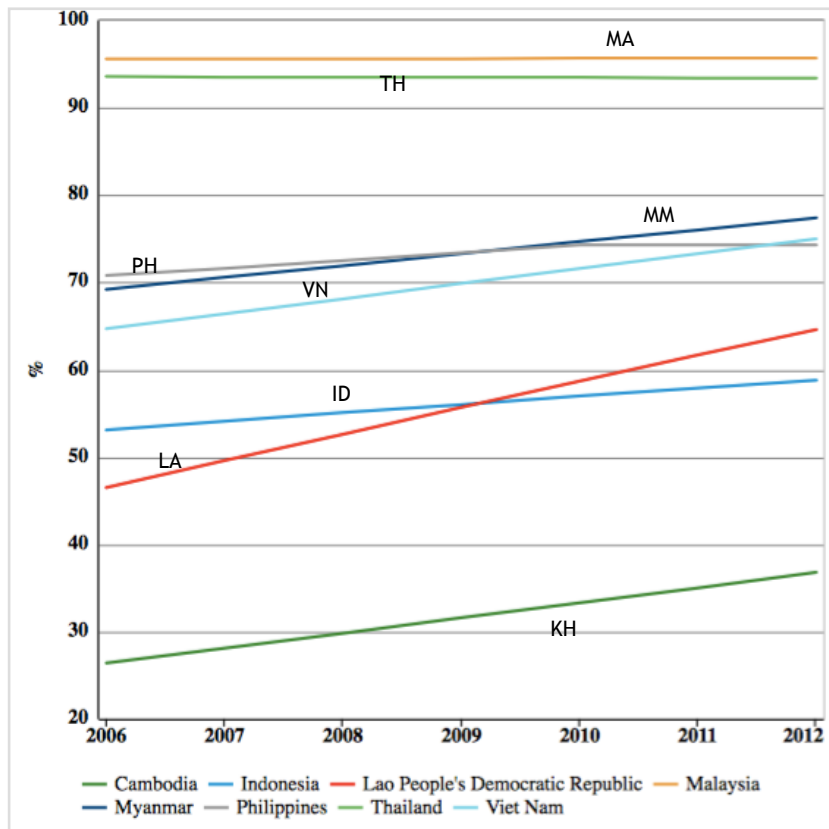
Percentage of arable land equipped for irrigation

Irrigation is the replacement or supplementation of rainfall with water from another source in order to grow crops or plants. Water source for irrigation may be near or distant lake, river, spring, aquifer, well or snow. Depending on the distance and frequency resources rainfall water can be ducted directly to the field or stored for later use in tanks or tanks. Depending on the resources distance and frequency of rainfall can be water ducted directly to the field or stored for later use in tanks. Various types of irrigation techniques differ in how the water obtained from the source is distributed on fields. Generally the aim is to supply field uniformly in water so that each plant had a quantity of water that needs without having too much or too little. Especially in Asian countries is irrigation important for rice growing. Rice is one of the basic everyday food and make up a large portion of carbohydrate intake.
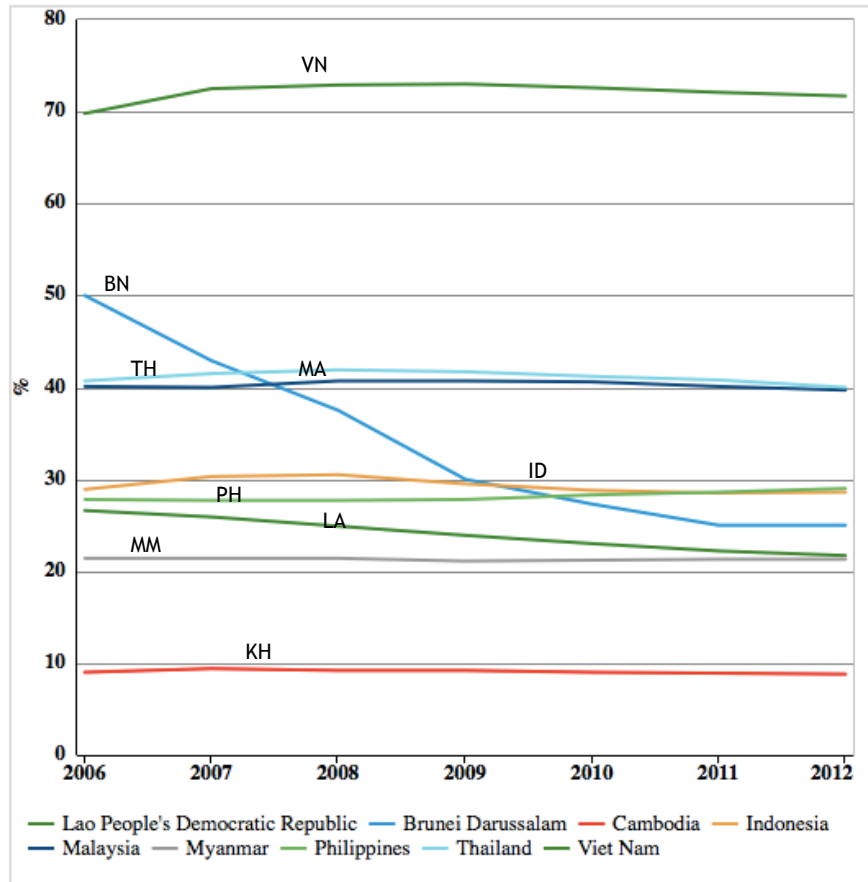
Viet Nam`s main agricultural crop is rice (Vietnam is the world's second largest exporter of rice), which is grown on about 80% of cultivated land. This information is corresponding with the graph 7 above. We can observe a big drop of arable land equipped for irrigation in Brunei which may be given by construction of new buildings and the shift from agriculture to industry and services. Thailand and Malaysia are having 40 percent of arable land equipped for irrigation. Indonesia, Philippines, Laos and Myanmar have between 22 to 30 percent of arable land equipped for irrigation. Cambodian crop production is almost absolutely dependent on rainfall therefore performances of Cambodian agriculture significantly affected by the weather. Cambodia is also lacking agricultural equipment for processing production, part of its harvest is exported in border areas for processing into neighboring countries at very low prices.

Cereal import dependency ratio

Cereals include wheat, rice, maize, rye, sorghum, millet, barley, oats, and mixed grains. Cereal import dependency ratio refers to the extent of dependency on importation in relation to domestic consumption. Foreign trade in Economy should be stabilizer in supplying the domestic market, raw materials and consumer goods. To avoid debt economies should have essentially zero or better positive balance in the currency of a country, or at least for those commodities which can be used in local production conditions to produce.

Graph 8. Cereal import dependency ratio
Source: Food and Agriculture Organization
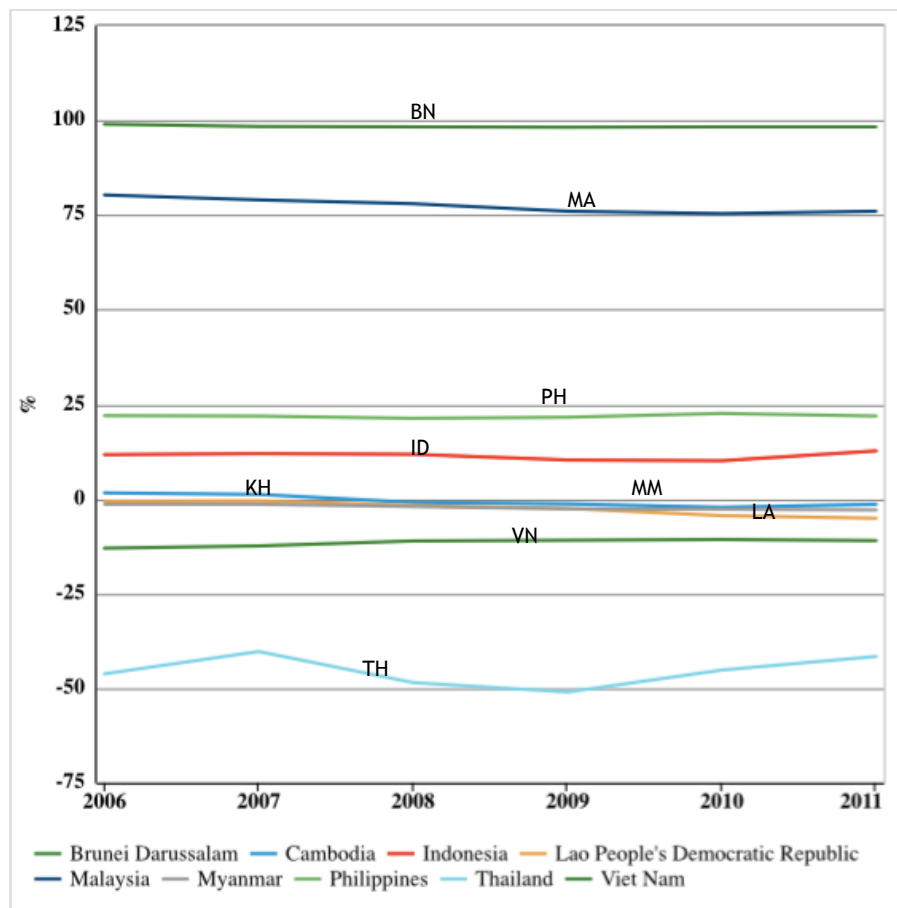
In the graph 8 we can see that Brunei is 100 percent dependent on cereal import. This was quite predicable because developed countries are very often dependent on import of raw materials, which are subsequently processing to food products. In the last 25 years, Malaysia is experiencing a boom, which allowed them to be changed from Third World

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countries dependent on exports of rubber and tin in a predominantly industrial country. Therefore is Malaysia importing 80 percent of cereal. Interesting information is that Philippines was the second biggest importer of rice in 2010. [46] As well as Malaysia are Philippines and Indonesia experiencing economical boom and are moving from agricultural to industrial sector. Laos and Cambodia are more or less self-sufficient therefore they do not import cereals. While Thailand and Vietnam have abundance of cereals and are exporting them.

5.5 Imputation of missing data

In the graphs above are selected sub-indicators hereinafter indicators. Composite indicator itself will be constructed only from datas 2011. Long-term survey would contain a large amount of missing data. Then the most important data are consider the latest, as are showing the current situation in the countries. Some would argue that 2011 is not current. This year was chosen because there are data the most available. In another more recent years were data missing a lot. Further when we look at the graphs, the data tend increase mostly evenly. Data in other years will be used for counting average, median or closes similar value of missing values in 2011. Values which were missing are completed and highlighted in red in the table 7 bellow. Data were missing especially in road density indicator in Philippines, Thailand, Viet Nam and Cambodia. Further Brunei has missing data in two indicators: Access to improved sanitation facilities and Access to improved water sources. All data presented in this thesis are gathered from database of Food and Agriculture Organization, which is from my point of view the most complete and comprehensive.

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[46] *Reuters: Factbox - Top 10 rice exporting, importing countries [online].*

Table 7. Imputation of missing data
Source: Own work

	A1	A2	A3	A4	A5	A6	A7	A8
BN	123,00	84,00	54,20	20,00	99,80	99,80	25,00	98,30
KH	108,00	63,00	23,90	118,00	68,80	35,00	8,90	-1,40
ID	117,00	60,00	26,00	94,00	84,40	57,90	28,50	12,70
LA	102,00	63,00	17,30	160,00	69,50	61,70	22,20	-5,10
MY	122,00	79,00	47,00	25,00	99,60	95,70	40,10	76,00
MM	107,00	79,00	5,60	149,00	84,10	76,00	21,30	-2,90
PH	118,00	60,00	37,60	87,00	91,80	74,30	28,60	21,90
TH	112,00	59,00	45,60	68,00	95,80	93,40	40,80	-41,60
VN	116,00	76,00	50,60	110,00	93,70	73,30	72,10	-11,00

5.6 Correlation

Moreover correlation of indicators was completed to find out whether they are too similar or not. Similarity is not desirable because when the data are nearly the same then it is as we used the same data twice. The table 8 gives some values with high correlation marked in red. In this case, the correlation is higher. It is not entirely correct but other data were not available. In table 9 is described level of dependence according to value of correlation.

Table 8: Correlation of indicators
Source: own work

Variable	A1	A2	A3	A4	A5	A6	A7	A8
A1	1,000							
A2	0,375	1,000						
A3	0,706	-0,010	1,000					
A4	-0,890	-0,323	-0,751	1,000				
A5	0,835	0,447	0,592	-0,803	1,000			
A6	0,579	0,506	0,393	-0,684	0,882	1,000		
A7	0,450	0,215	0,479	-0,309	0,711	0,613	1,000	
A8	0,710	0,619	0,338	-0,698	0,455	0,448	-0,024	1,000

Table 9: Values of correlation
Source: (Geoinovace, 2013)

Value of correlation	Level of dependence
0,01-0,09	trivial, no connection
0,10-0,29	low to medium
0,30-0,49	moderate to significant
0,50-0,69	significant to very strong
0,70-0,89	very strong
0,90-0,99	almost perfect

5.7 Basic characteristics of indicators

After complement of missing data and correlation statistical criteria alike are to be satisfied. In this sense, sub–indicators with right-skewness or extreme values are subjected to log-transformation. A fundamental task in many statistical analyses is to characterize the location and variability of a data set. A further characterization of the data includes skewness and kurtosis. These characteristics help us determine how much the distribution of the data that we got, like, or vice versa differs from the normal distribution, i.e.. Gauss.

Skewness is a characteristic that gives us the direction in which our variable is asymmetrically distributed. We distinguish between positive skewness, also a right-sided, where most of the values obtained are below average and negative skewness (left-sided), when most values are above average. The degree of this asymmetry distribution determines the skewness. Zero value of this coefficient indicates the symmetric distribution, positive value of rightward asymmetry and the negative of leftward.

Kurtosis indicates if the distribution of frequencies occur in very high or low values. Even this state is possible indicate using the coefficient for the calculation of which will again use central moments and on the basis of the results suggests more pointed than a normal distribution or less pointed than the normal distribution.[47]

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[47] *Engineering statistics handbook: Measures of Skewness and Kurtosis [online].*

*Table 10. Skewness and Kurtosis of
indicators, Source: own work*

Variable	Skewness	Kurtosis
A1	-0,363036	-0,94063
A2	0,362808	-2,03565
A3	-0,471044	-1,04471
A4	-0,252591	-0,82756
A5	-0,769900	-0,75608
A6	-0,573061	0,07701
A7	1,430896	3,01170
A8	0,985236	0,38614

The table 10 shows that variable A7 > 0 which means that it has right-sided asymmetry. A7 is also greater than normal kurtosis (peaked distribution). This is graphically represented in the graph no. 567. Further kurtosis of A2 and A3 < 0 which means lower than normal kurtosis (flat distribution) is shown in graph no. 454. The closest is symmetry and kurtosis relative to the gaussian distribution the better as the distribution is getting close to normal distribution.

*Graph 9. Flat distribution of A2
Source: Own work*
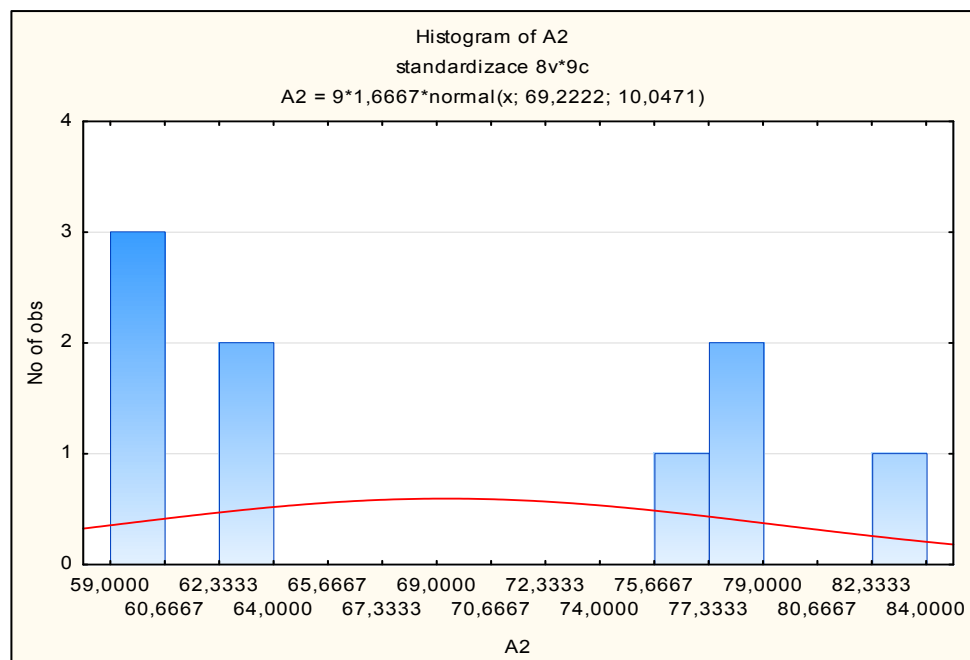
Graph 10. Flat distribution of A3

Source: Own work
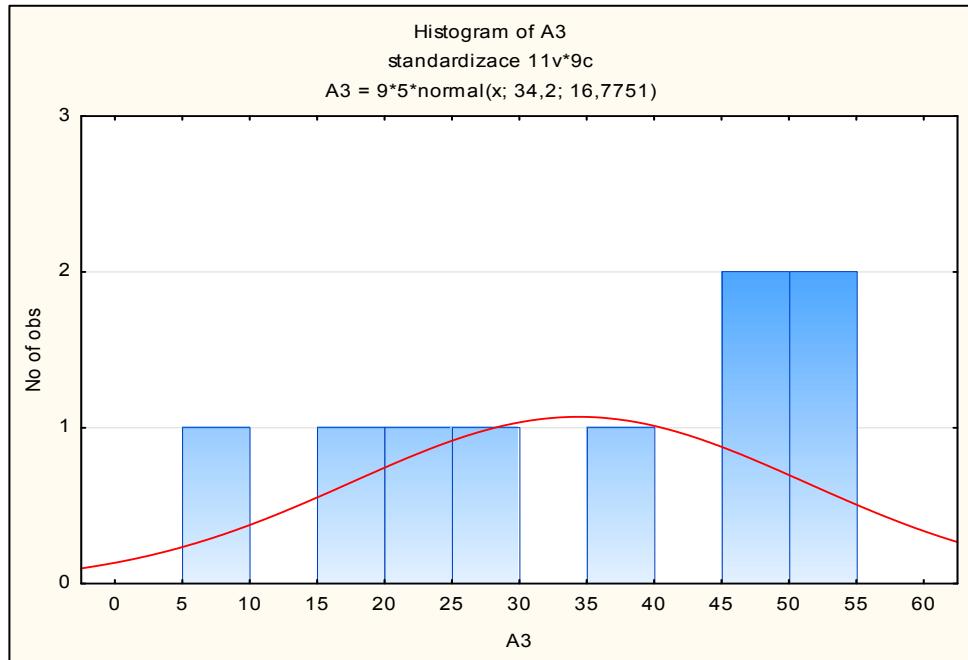
Graph 11. Right-sided asymmetry of A7

Source: Own work

Indicators with right-skewness or extreme values are subjected to log-transformation. See bellow in chart no.

Table 11. Log-transformation
Sourec: Own work

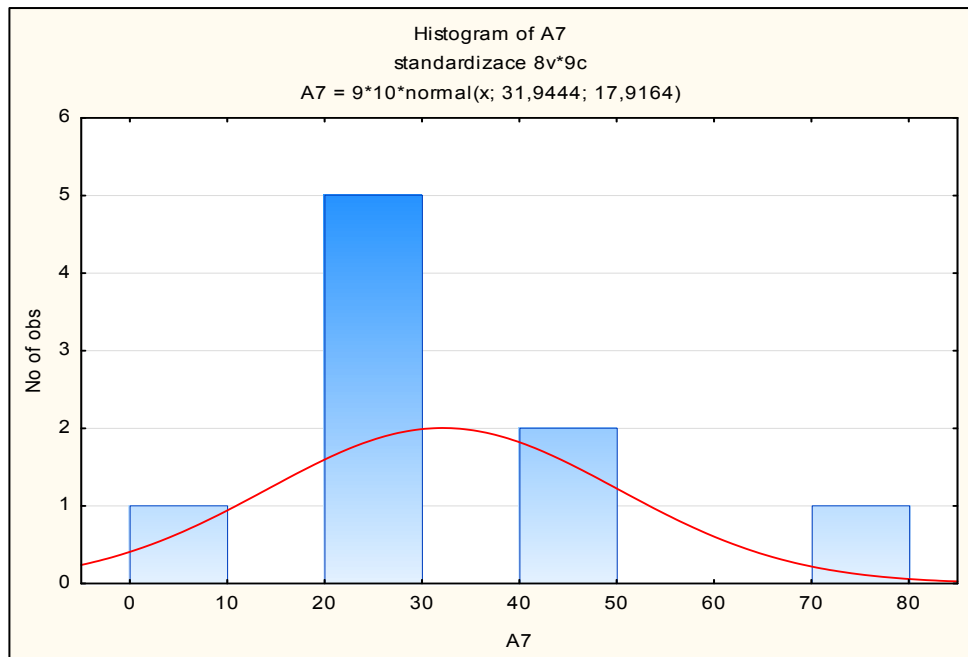| country	A1	A2	log A2	A3	log A3	A4	A5	A6	A7	log A7	A8
BN	123	84	1,924	54,2	1,734	20	99,8	99,8	25	1,398	98,3
KH	108	63	1,799	23,9	1,378	118	68,8	35	8,9	0,949	-1,4
ID	117	60	1,778	26	1,415	94	84,4	57,9	28,5	1,455	12,7
LA	102	63	1,799	17,3	1,238	160	69,5	61,7	22,2	1,346	-5,1
MY	122	79	1,898	47	1,672	25	99,6	95,7	40,1	1,603	76
MM	107	79	1,898	5,6	0,748	149	84,1	76	21,3	1,328	-2,9
PH	118	60	1,778	37,6	1,575	87	91,8	74,3	28,6	1,456	21,9
TH	112	59	1,771	45,6	1,659	68	95,8	93,4	40,8	1,611	-41,6
VN	116	76	1,881	50,6	1,704	110	93,7	73,3	72,1	1,858	-11

5.7 Normalization

The next step is standardization to transformation original values into a form of dimensionless, and thus, easily aggregated variables as they have different units. For this standardization was chosen method Z-scores.

For further work is necessary to determine whether the type indicator is min or max. This means whether the increasing number has beneficial or not. When determining the types of indicators we must think locally not globally. What is seen as a negative phenomenon in Europe may be positive in (i.e., Average Protein Supply). Whereas it is subjective distribution of indicators, it is not possible to consider this step as a template for other work. Below the tables 12 and 13 is described reason of chosen values.

Table 12. Maximum and minimum of indicators
Source: Own work

country	A1	log A2	log A3	A4	A5	A6	log A7	A8
BN	123	1,924	1,734	20	100	100	1,398	98
KH	108	1,799	1,378	118	69	35	0,949	-1
ID	117	1,778	1,415	94	84	58	1,455	13
LA	102	1,799	1,238	160	70	62	1,346	-5
MY	122	1,898	1,672	25	100	96	1,603	76
MM	107	1,898	0,748	149	84	76	1,328	-3
PH	118	1,778	1,575	87	92	74	1,456	22
TH	112	1,771	1,659	68	96	93	1,611	-42
VN	116	1,881	1,704	110	94	73	1,858	-11
MIN	102	1,771	0,748	20	69	35	0,949	-42
MAX	123	1,924	1,734	160	100	100	1,858	98

Table 13. Normalization of indicators
Source: Own work

	A1	log A2	log A3	A4	A5	A6	log A7	A8
	max	max	max	min	max	max	max	min
BN	100	100,000	100,000	100	100	100	49,370	0
KH	29	18,568	63,928	30	0	0	0,000	71
ID	71	4,757	67,638	47	50	35	55,633	61
LA	0	18,568	49,691	0	2	41	43,692	74
MY	95	82,629	93,721	96	99	94	71,956	16
MM	24	82,629	0,000	8	49	63	41,714	72
PH	76	4,757	83,890	52	74	61	55,801	55
TH	48	0,000	92,389	66	87	90	72,783	100
VN	67	71,670	96,972	36	80	59	100,000	78

Average dietary energy supply adequacy

Most countries in ASEAN are rather classified as a developing country. As mentioned earlier developing countries have problem with malnutrition. From this reason is growth of values desirable therefore we are speaking about **MAX** indicator. For example, if we were focused on America it is likely that we would used type indicator MIN because America is struggling rather with obesity than malnutrition.

Average protein supply

Proteins are very important in nutrition. People are its shortage replacing mainly with carbohydrates. Carbohydrates ensure average dietary energy supply though but that's not enough for proper development of the body. Therefore, in this case a type indicator is **MAX**.

Road density

For this indicator is very confusing if its growing value is beneficial or not. It can be said that the denser transport network the worse for the environment. Many countries have not implemented sufficiently dense road network yet. Therefore, it happens that in cities tend to be traffic jams and this is for the environment in terms of exhaust emissions worse. Further transportation of people and fresh food is important. Therefore this indicator was considered to be marked as **MAX**.

Depth of food deficit

For this index is always desirable that value is minimized, therefore was designated as **MIN**. The smaller is depth of the food deficit the less malnutrition.

Access to improved water sources

Water is an essential prerequisite for compliance with appropriate hygienic conditions not only for food. Preparing meals, washing and storage cannot go without water. Therefore this index is marked as **MAX**.

Access to improved sanitation facilities

As was mentioned above improved sanitation facilities are likely to ensure hygienic separation of human excreta from human contact. This means that, for example, human excreta come not into contact with drinking and sanitary water thanks to piped sewer

system, septic tank, pit latrine etc. Thanks to this systems drinking and sanitary water will not be contaminated and will not contain bacteria which could fully expand diseases. The bigger access to improved sanitation facilities the better for everyone. This index is marked as **MAX**.

Percentage of arable land equipped for irrigation

If we take in account that the basic crop of Asia is rice which need irrigated land then this indicator must be definitely marked as **MAX**.

Cereal import dependency ratio

Asian countries are large producers of cereal crop. Therefore they should export more than import. If these countries are importing cereal crop that means that their production is insufficient for their population. For developed countries is import of raw materials and crops common because their economy is not focusing on agriculture but on the processing of raw material. In this case, I deem it desirable that the value of the indicator is in decreasing therefore the indicator is marked as **MIN**.

5.8 Weighting

For weighting was used Matrix of pairwise comparison. The process of pairwise comparison refers to comparing indicators in pairs as follows – if row indicator is deemed more important than column indicator, we assign "1" to row indicator (and "0" to column indicator). If, on the contrary, row indicator is less important than column indicator, we assign "0" to row indicator, and if indicators are deemed equally important, we assign "0,5" to both of them. Cells below main diagonal are filled in inverse fashion, that is, "0", "1" and "0,5", respectively (see *tab.* 1). The on-diagonal elements remain empty (it is pointless to compare indicator with itself).

A1 - Average dietary energy supply adequacy

A2 - Average protein supply

A3 - Road density

A4 - Depth of the food deficit

A5 - Access to improved water sources

A6 - Access to improved sanitation facilities

A7 - Percentage of arable land equipped for irrigation

A8 - Cereal import dependency ratio

Table 14. Weighting of indicators
Source: Own work

	A1	A2	A3	A4	A5	A6	A7	A8	sum	weight
A1		1	1	0,5	1	0	0	0	3,5	0,125
A2	0		1	0,5	1	0	0	0	2,5	0,089
A3	0	0		0	0	0	0	1	1	0,036
A4	0,5	0,5	1		0	1	0	0,5	3,5	0,125
A5	0	0	1	1		1	1	1	5	0,179
A6	1	1	1	0	0		0	1	4	0,143
A7	1	1	1	1	0	1		1	6	0,214
A8	1	1	0	0,5	0	0	0		2,5	0,089
									total sum 28	1,000

In the table is shown that Percentage of arable land equipped for irrigation is the most important. The second most important indicator is Access to improved water sources and then follows Access to improved sanitation facilities. As the least important index is Road density then Cereal import dependency ration and Average protein supply. In the middle of importance is Average dietary energy supply adequacy and Depth of the food deficit.

The result of the most important indicator (Percentage of arable land equipped for irrigation) is in my opinion corresponding with he importance of independence in imports. These countries are focused more on export of crops than import and should be more self-sufficient. This correlates with the result of Cereal import dependency ratio which has the second lowest importance. Access to improved water sources in second place can be startling. To remind you this index is not considered to be a main source of drinking water. It is improved water sources in the way that people can drink tap water.

5.9 Evaluation of the analysis

Based on the results of the previous tables, it is possible to make the following assessment of the situation, which relates to a composite indicator of food security in

the ASEAN countries. Evaluation of composite indicator is shown in the table 15. In the first column is sum of values of all indicators. The higher is the sum of a country the better food security country has. In the second column is ranking of individual countries. Malaysia takes the first place in ranking, second is Brunei, third place occupies Viet Nam. The worst position has Cambodia, Laos and Myanmar. Countries are for clarity ordered from best to worst food security in the table 16. Graphical display of result is in the bar graph no. 12.

*Table 15. Evaluation of composite indicators,*
Source: Own work

country	sum	rank	index
BN	80,265	2	143,78 %
KH	17,618	9	31,56 %
ID	49,092	6	87,94 %
LA	25,666	8	45,98 %
MY	82,683	1	148,11 %
MM	44,559	7	79,82 %
PH	58,240	5	104,33 %
TH	70,446	4	126,19 %
VN	73,850	3	132,29 %

Table 16. Country ranking
Source: Own work

ranking	country
1	Malaysia
2	Brunei Darussalam
3	Viet Nam
4	Thailand
5	Philippines
6	Indionesia
7	Myanmar
8	Lao People`s Democratic Republic
9	Cambodia

Graph 12. Indexes of individual countries
Source: Own work
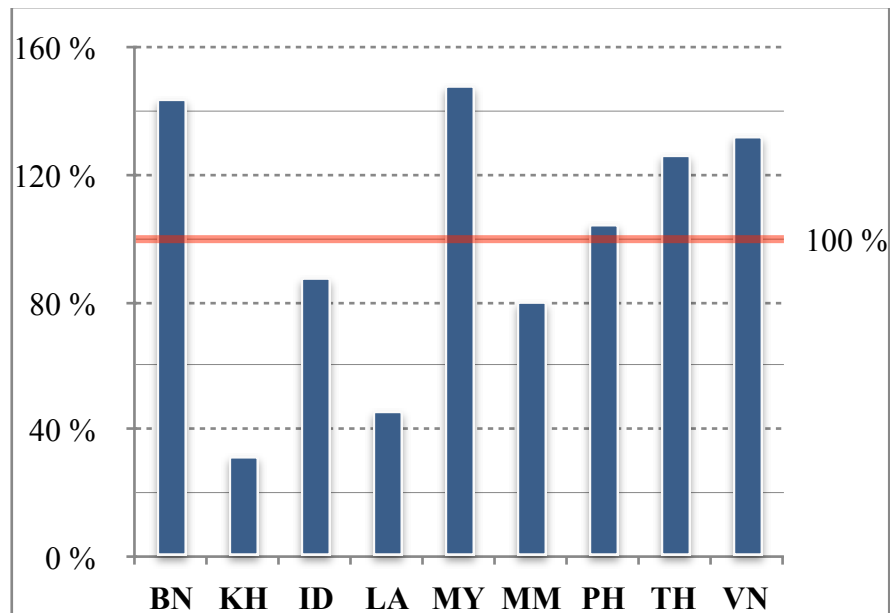
In the graph 12, we see which countries are above and under the limit of 100% food security. Countries that are doing very well in food security are: Brunei, Malaysia, Philippines, Thailand and Vietnam. In the remaining countries is food security at a lower level, therefore, I will deal with them in the proposal part. This countries are namely: Cambodia, Laos, Myanmar and Indonesia. This sequence is listed from worst to best food security in given country.

Proposal part

Cambodia, Myanmar and Lao People`s Democratic Republic are considered to be one of the least developed countries of the ASEAN in general. Although there is lower lever of food security than in other ASAEN countries, none of the country is suffering from hunger. This phenomenon was shown in chapter 5 in graph no. 1. But it is good to take into account the statistical data throughout the country are often taken as the average, which blurs the differences between very rich and very poor. In general in comparison for example with African less developed countries are ASEAN countries doing very well as they are not dealing with malnutrition, lack of driving water and deficiency disease. Even thought this countries have not the most difficult time there is are still possibilities to improve a lot in food security. The following part will briefly describe the most important economic information about all four countries. As is everything interrelated I considered economical information also important which can help me to capture overall picture of food security. Subsequently will be presented a proposal how to improve food security.

6.1 Cambodia

Cambodia gained sad fame mainly owing to the ravages of the Khmer Rouge in the who slaughtered 2 million inhabitants (roughly a quarter of the former population). The main drivers of the Cambodian economy is export, construction, tourism and agriculture. A threat to the sustainable growth is the dissatisfaction of the workers with minimum wages and lending boom in the real estate sector. Any further increase in the minimum wage in the textile sector could seriously endanger the competitiveness of Cambodia. The main growth factor in the future will be diversification of exports in favor of light manufacturing industries. An important role will continue to play tourism. The unstable political situation in Cambodia and neighboring Thailand resulted in a slowdown the number of foreign tourists. Cambodia in early 2016 became like other countries of the ASEAN Economic Community part of ASEAN (ASEAN Economic Community - AEC). However in the near future a common market in goods, services and investments is likely to bring few benefits, because its trade with other ASEAN member countries is very low and its involvement in the dynamic regional sharing of production is limited.

In the analytical part we can see that Average dietary energy supply adequacy is above 113% which means that people are not suffering from hunger. Next indicator was Average protein supply which rich 65 g per person. And as the average weight of an adult human being without distinction of sex is 62 kilograms the protein intake is sufficient. As the Index no. 3 road density comes 20 square km per 100 square km per land area shows that road density is developed in low level. In the graph 5 is shown that Cambodia has the worst position in access to improved water source. On average, 70% of the population has Access to improved water source. Further only 40% of Cambodians have access to improved sanitation facilities. Percentage of arable land equipped for irrigation is also 10% low. In cereal import is Cambodia independent.

Table 17. Recommendations Cambodia
Source: Own work

investment in irrigation systems
agricultural research and techniques for sustainable agriculture
investment in transport and communications infrastructure
investment in tourism
investment in build pipeline

6.2 Lao People`s Democratic Republic

Laos is one of the least developed countries. It has a very simple infrastructure - only basic road network, limited telecommunications, electricity is only available in the cities. Agriculture is still very important sector employing over 70% of the workforce industry is gradually developing and service sector is dominated mainly by tourism.

Currently are being underway gradual decentralization and liberalization of business environment. The aim is to attract foreign investment, which is a key prerequisite for the future development of the Lao economy and its capacity. Laos can offer foreign investors especially important natural resources - forests, minerals and, finally, a huge hydro-energy potential. Opportunities are offered also in areas of intensive human labor, where Laos can compete with surrounding countries especially with its cheaper price.

However, due to the fact that Laos is a landlocked country with underdeveloped infrastructure, remains its potential remains underutilized.

Laos can be seen in the graph 1 as the worst in average dietary energy supply adequacy. But it rich 105% which is completely sufficient. Average protein supply rich 63 g per person per day. Greater portion of protein in the diet would be beneficial. According to graph 3, 15 square km per 100 square km per land is also insufficient therefore investment in transport and communications infrastructure is desirable. As well as Cambodia has Laos around 70 % population who has access to improved water source. In access to improved sanitation facilities is Laos doing much better with its 70%. The percentage of arable land equipped for irrigation is decreasing to 20%. In cereal import is Laos independent.

Table 18. Recommendations Laos
Source: Own work

investment in transport and communications infrastructure
investment in agriculture
investment in tourism
investment in livestock production
investment in irrigation systems

6.3 Myanmar

Myanmar could not benefit from globalization in the field of trade, investment, technology transfer and gaining good experience in a wide range of sectors, including public administration due to long isolation from the global market. This separation resulted in weak institutions, relatively low economic growth and high levels of poverty. The long-term low economic development negatively contributed macroeconomic instability. Maintaining macroeconomic stability - low inflation and a stable exchange rate - is the main task of the government of Myanmar , especially because Myanmar recorded in the last two decades frequent periods of very high inflation, which led to instability in the exchange rate and the creation of unofficial, parallel exchange rate. In recent years, the government managed to reduce inflation below 10%.

Economic reforms initiated nominally civilian government including the Law on Foreign Investment, the establishment of a floating exchange rate, providing independence of the central bank, approval Corrupt Practices Act etc. have led to the start of development of the economy, attracting foreign investment and allow reintegrate the country into the global economy.

To ensure sustainable development necessary is modernization and opening up the financial sector, increase the budget for social services and accelerate agricultural and land reform.

Myanmar`s average dietary energy supply adequacy is getting better and better over this decade and currently is reaching 105%. Interesting is that average protein supply is much higher than in other three countries we are dealing with in this part. The protein supply is even comparable with Malaysia and Brunei. Road density is very sparse 5 square km per 100 square km per land. Access to improved water source has almost 90 % of population whereas access to improved sanitation facilities has 80% of population. Myanmar has around 22 % of arable land equipped for irrigation which is steady. Finally in cereal import is Myanmar independent.

Table 19. Recommendations Myanmar
Source: Own work

opening of economy
land reform
investment in agricultural
investment in transport and communications infrastructure

6.4 Indonesia

Indonesia is a big country, which covers more than 17 thousand islands. Currently they have a great potential in market development and economic level. Indonesia is also trying to break into the international economy. Increasing number of inhabitants comes along with the gradual, yet relatively rapid development of the country. With that, however are associated safety concerns of people in the food and energy sectors. Due to the fact that food and energy are the basic elements of livelihood and well-being, the

issue of food and energy security is more than desirable. Currently, one of the biggest brakes Indonesian economy is infrastructure. In the graph 3 we can see, that Indonesia has around 30 square km per 100 square km of land area what not to much compare to for example Thailand or Viet Nam which are considered to have better food security. Investments in infrastructure, together with the simplification of bureaucracy should enable a more dynamic economic growth. In addition to the lack of infrastructure more dynamic economy is also hindered by high level of corruption, excessive protection of the domestic market, low labor productivity and inadequate educated workforce. Currently, the main engine of economic growth is domestic consumption. Industrial production is the second most important sector of the Indonesian economy.

Among individual sectors of the economy have the greatest growth potential for telecommunications, energy, manufacturing and processing of raw materials. Indonesia is rich in various minerals, hence the processing sector has huge potential. The limiting factor is outdated mining technologies, which do not fully utilize potential of individual sites. The challenge for the Indonesian government in the coming years will further involvement of foreign investors in the sectors of mining and processing.

As for average dietary energy supply adequacy Indonesia is doing very well with 122%. The index average protein supply is not placed the best with result 60 per capita per day. As for road density Indonesia stands around 28 square km per 100 square km per land area and increase is desirable. More that 85% of population has access to improved water source and 60% has access to improved sanitation facilities. Further Indonesia has 30 percent of arable land equipped for irrigation what much better than for example in Cambodia. As for cereal import dependency, Indonesia is dependent from 15%.

Table 20. Recommendations Indonesia
Source: Own work

investment in transport and communications infrastructure
anti-corruption actions
education of work force
investment in livestock production
investment in agriculture

6.5 General recommendations

To improve food security it is necessary to do numerous actions at all levels. At the national level, it is necessary to strengthen food security through programs to support small farmers, who must be the center of interest of their governments. Governments should also ensure that the right to food is enforceable through national judicial systems by each individual. Also provision access to land loans, current information, education, and last but not least health care to small farmers. For emergency situations it is necessary to have a safety net to social support and food aid. Although many countries do not have ownership rights to land, the government must ensure that any lease of land to foreign investors do not disturb the traditional use of the land of the original inhabitants.

It is desirable to do adequate investment in agriculture, for example in irrigation systems, storage facilities for food, agricultural research and techniques for sustainable agriculture, but also in transport and communications infrastructure.

Support for local markets and local basic food production for small farmers is also crucial. Many developing countries have changed from net food exporters to net importers because they have given priority to the cultivation of so-called cash crops (such as tea, coffee, tobacco or flowers) in front of foods that form the basis of the diet (wheat, corn, rice). Due to the adjustment of the international trading system, however, are farmers hardly profiting neither from the production of cash crops. Therefore it is necessity to farmers in developing countries have greater control over production, distribution and consumption of food without depending on international markets.

At the international level it is necessary to change the economic system and the system of trade and agricultural policies of developed countries, which are harmful to the people of poor nations, and set up a fairer trade regime, taking into account the needs of the developing world. Without special treatment for poor countries to protect their farmers, to eliminate hunger also cannot do. Furthermore, the need to ensure greater transparency in world food markets, to avoid the possibility that institutions which have no link with food safety themselves (such as investment funds) could speculate on food

commodities, which leads directly to gamble with people's lives and it is not just financial gambling.

In order to promote direct changes where they are most needed, it is good to support the efforts of producers to grow rice sufficient quantity of the crop locally (this is one of the basic foods) to reduce its dependence on imports. The aim of our is strengthening the ability of producers to influence the value chain of rice production and also to assert themselves on a regional and national level. The graph 8 show us that Laos, Myanmar and Cambodia are at 0% of Cereal import dependency ratio. It means, that they are self-sufficient in cultivation of cereals and they do not need to import. Nevertheless some countries in the graph 8 are in sub-zero values, which means that they have an excess of cereals and are exporting. Therefore if Laos, Myanmar and Cambodia would focus more on the increase of volume production to be able also to export, it might economically help them. Countries that are economically developed import many basic materials, but it is not the case for Laos, Myanmar and Cambodia as they are considered to be developing countries. Next is Indonesia which is according the graph 8 importing 12% cereals of total consumption of population.

Conclusion

The aim of this thesis was comparison of food security in ASEAN countries using composite indicators. In the first theoretical part were described basic terms that appear throughout the work. Further food security theory was described including political and nonpolitical organizations which deal with this issue. Finally the creation of composite indicator was fully explained.

In the practical part were chosen individual indicators and performed a complete analysis as described in theoretical part. The result was ranking of countries by level of food security, thus the first goal of this work has been met. The second objective was to create a suggestion that would help improve the situation of countries which came in analysis as the most weak in food security compare to other countries in ASEAN. These countries namely were: Cambodia, Laos, Myanmar and Indonesia.

In the last part of this thesis was created proposal for this countries to improve food security. Proposal was drawn up for each country separately. Since these countries are similar in many ways, suggestion for improvement are similar as well. The most common suggestions included investments in transport and communications as the countries have simple infrastructure and basic road network. Further building pipeline and irrigation systems are important for better food security just for the reason, that rice is basic crop and need irrigated soil to grow. Some countries have not appropriate intake of protein which might be improved by investment in livestock production. Finally to improve food security will also help investment in tourism or opening market for foreign investors, thanks to which will increase the purchasing power. Punching power is very important because nowadays there is ample of food in world only some people are not rich enough to buy what they need.

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Appendix 1. Map of ASEAN

Source: Asia Education Foundation
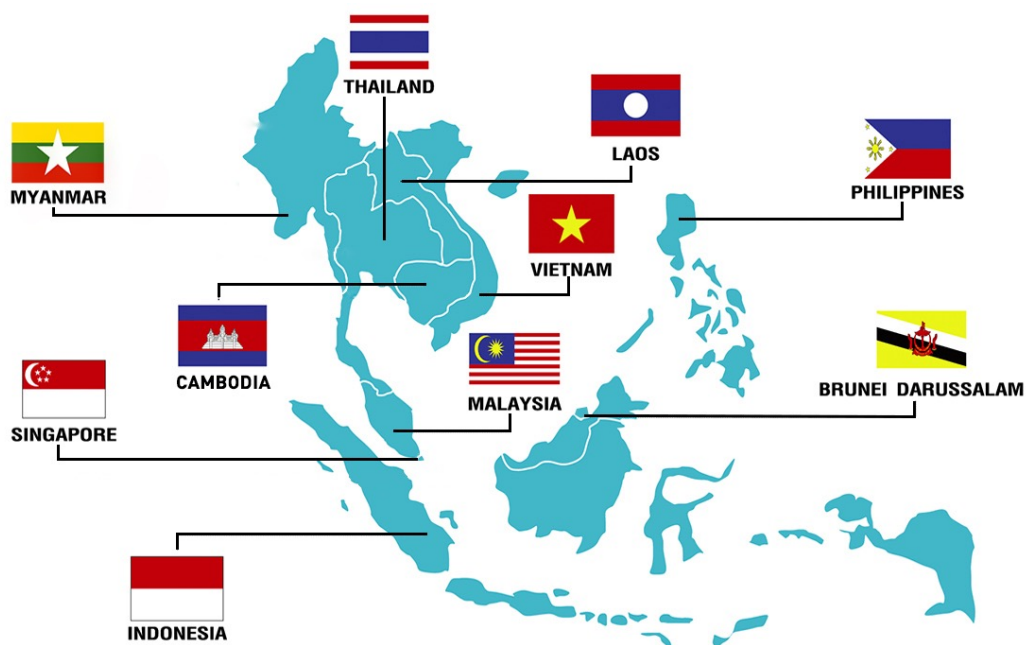
Appendix 2. Basic data for analysis

Source: Food and Agriculture Organization

1. Depth of the food deficit (kcal/capita/day)

location name	code	2006	2007	2008	2009	2010	2011	2012
Brunei	BN	12,00	12,00	14,00	16,00	18,00	20,00	19,00
Cambodia	KH	144,00	135,00	127,00	121,00	119,00	118,00	117,00
Indonesia	ID	136,00	136,00	135,00	129,00	113,00	94,00	76,00
Lao PDR	LA	212,00	191,00	181,00	174,00	171,00	160,00	149,00
Malaysia	MY	25,00	25,00	26,00	26,00	26,00	25,00	24,00
Myanmar	MM	287,00	260,00	229,00	199,00	171,00	149,00	132,00
Philippines	PH	120,00	111,00	102,00	93,00	87,00	87,00	91,00
Thailand	TH	100,00	87,00	77,00	72,00	69,00	68,00	65,00
Viet Nam	VN	144,00	141,00	137,00	129,00	119,00	110,00	103,00

2. Average dietary energy supply adequacy (%)

location name	code	2006	2007	2008	2009	2010	2011	2012
Brunei	BN	128,00	127,00	125,00	123,00	123,00	123,00	124,00
Cambodia	KH	106,00	108,00	108,00	108,00	108,00	108,00	109,00
Indonesia	ID	109,00	110,00	111,00	113,00	115,00	117,00	120,00
Malaysia	MY	122,00	122,00	121,00	121,00	121,00	122,00	122,00
Philippines	PH	114,00	116,00	117,00	118,00	118,00	118,00	117,00
Thailand	TH	112,00	114,00	114,00	113,00	113,00	112,00	113,00
Viet Nam	VN	108,00	109,00	111,00	113,00	115,00	116,00	117,00
Myanmar	MM	94,00	96,00	99,00	102,00	105,00	107,00	109,00
Lao PDR	LA	99,00	100,00	99,00	100,00	100,00	102,00	103,00

3. Average protein supply (g/capita/day)

location name	code	2006	2007	2008	2009	2010	2011
Brunei	BN	87,00	85,00	84,00	83,00	83,00	84,00
Cambodia	KH	57,00	60,00	61,00	62,00	62,00	63,00
Indonesia	ID	54,00	55,00	56,00	57,00	58,00	60,00
Lao PDR	LA	61,00	61,00	61,00	61,00	62,00	63,00
Malaysia	MY	79,00	79,00	78,00	78,00	78,00	79,00
Philippines	PH	57,00	58,00	59,00	60,00	60,00	60,00
Thailand	TH	60,00	60,00	59,00	58,00	58,00	59,00
Viet Nam	VN	64,00	66,00	68,00	71,00	74,00	76,00
Myanmar	MM	62,00	65,00	69,00	72,00	76,00	79,00

4. Road density (per 100 square km of land area)

location name	code	2006	2007	2008	2009	2010	2011
Brunei	BN	60,20	51,40	51,50	53,10	52,50	54,20
Cambodia	KH				21,90		
Indonesia	ID	21,30	22,10	22,90	24,90	25,50	26,00
Lao PDR	LA	14,90	15,60	14,80	16,70	20,10	17,30
Malaysia	MY	27,20	35,60	37,10	40,90	43,70	47,00
Myanmar	MM	4,50	4,60	4,60	4,80	5,10	5,60
Thailand	TH	35,10					
Viet Nam	VN	45,80	48,30				

5. Access to improved water sources (%)

location name	code	2006	2007	2008	2009	2010	2011	2012
Cambodia	KH	56,40	58,80	61,30	63,80	66,30	68,80	71,30
Indonesia	ID	81,50	82,10	82,70	83,30	83,80	84,40	84,90
Lao PDR	LA	59,00	61,20	63,30	65,40	67,50	69,50	71,50
Malaysia	MY	99,50	99,60	99,60	99,60	99,60	99,60	99,60
Myanmar	MM	76,40	78,00	79,50	81,10	82,60	84,10	85,70
Philippines	PH	90,10	90,60	91,00	91,40	91,80	91,80	91,80
Thailand	TH	94,80	95,30	95,80	95,80	95,80	95,80	95,80
Viet Nam	VN	86,50	88,00	89,40	90,90	92,30	93,70	95,00

6. Cereal import dependency ratio

location name	code	2006	2007	2008	2009	2010	2011
Brunei	BN	99,00	98,40	98,30	98,20	98,30	98,30
Cambodia	KH	1,60	1,20	-,90	-1,30	-2,20	-1,40
Indonesia	ID	11,70	12,00	11,80	10,30	10,10	12,70
Lao PDR	LA	-,60	-,50	-1,70	-2,50	-4,40	-5,10
Malaysia	MY	80,30	79,00	78,00	76,00	75,40	76,00
Myanmar	MM	-1,40	-1,40	-2,00	-2,60	-2,70	-2,90
Philippines	PH	22,00	21,90	21,30	21,60	22,60	21,90
Thailand	TH	-46,20	-40,30	-48,50	-51,00	-45,20	-41,60
Viet Nam	VN	-13,00	-12,40	-11,10	-10,90	-10,70	-11,00

7. Access to improved sanitation facilities (%)

location name	code	2006	2007	2008	2009	2010	2011	2012
Cambodia	KH	26,40	28,10	29,80	31,60	33,30	35,00	38,40
Indonesia	ID	53,10	54,10	55,10	56,00	57,00	57,90	58,80
Malaysia	MY	95,60	95,60	95,60	95,60	95,70	95,70	95,70
Myanmar	MM	69,20	70,60	71,90	73,30	74,70	76,00	77,40
Philippines	PH	70,80	71,60	72,50	73,40	74,30	74,30	74,30
Thailand	TH	93,60	93,50	93,50	93,50	93,50	93,40	93,40
Viet Nam	VN	64,70	66,40	68,10	69,90	71,60	73,30	75,00
Lao PDR	LA	46,50	49,60	52,60	55,70	58,70	61,70	64,60

8. Percentage of arable land equipped for irrigation (%)

location name	code	2006	2007	2008	2009	2010	2011	2012
Brunei	BN	50,00	42,90	37,50	30,00	27,30	25,00	25,00
Cambodia	KH	9,00	9,40	9,20	9,20	9,00	8,90	8,80
Indonesia	ID	28,90	30,30	30,50	29,50	28,80	28,50	28,60
Malaysia	MY	40,10	40,00	40,70	40,70	40,60	40,10	39,70
Myanmar	MM	21,40	21,40	21,40	21,10	21,20	21,30	21,30
Philippines	PH	27,80	27,70	27,70	27,80	28,30	28,60	29,00
Thailand	TH	40,70	41,50	41,90	41,70	41,20	40,80	40,80
Viet Nam	VN	69,80	72,50	72,90	73,00	72,60	72,10	71,70
Lao PDR	LA	26,60	25,90	24,90	23,90	23,00	22,20	21,70