

**Czech University of Life Sciences Prague**

**Faculty of Economics and Management**

**Department of Economics**



**Diploma Thesis**

**Analysis of Food Insecurity in Haiti**

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# CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Department of Economics

Faculty of Economics and Management

## DIPLOMA THESIS ASSIGNMENT

Lenka Haubertová

European Agrarian Diplomacy

Thesis title

**Analysis of food insecurity in Haiti**

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### Objectives of thesis

The main objective of the diploma thesis is to analyse the state of food insecurity in Haiti in order to derive recommendations for improvement.

Partial objectives of the diploma thesis are following:

- to analyse selected indicators of food insecurity such as share of undernourished population, food caloric supplies and global hunger index,
- to evaluate whether the country is fulfilling the Millennium Development Goals according to hunger and undernutrition,
- to assess the role of agriculture in the national economy using the indicators such as the percentage in GDP, percentage in employment, share of foreign trade and migration,
- to analyse farming systems in Haiti, their main characteristics of climate, quality of soil, level of mechanization and used input and also the main staple and cash crops,
- to calculate the projections of food demand for the future.

### Methodology

Main method used in the diploma thesis is analysis, which will be based on the selected indicators of food insecurity. Furthermore, statistical methods will be used for calculation of food demand predictions and the thesis will be concluded by a SWOT analysis.

Data used in the analysis will be based on World Bank statistics, United Nations Development Indicators statistics and FAO.

**The proposed extent of the thesis**

60-90 stran

**Keywords**

Haiti, poverty, malnutrition, nutrition, Hunger Index, food demand, analysis

**Recommended information sources**

- Food crisis, food production and poverty [online]. 2010 [cit. 2013-04-10]. Available at: <http://www.agriculturejournals.cz/publicFiles/61881.pdf>. Institute of Tropics and Subtropics, Czech University of Life Sciences, Prague, Czech Republic. Vedoucí práce Šárka Grófová, Karel Smec.
- CHENERY, Hollis Burnley, T SRINIVASAN, Jere R BEHRMAN, Dani RODRIK a Mark R ROSENZWEIG. Handbook of development economics: the economics and politics of agricultural subsidies. 1st pub. New York, N.Y., U.S.A.: Sole distributors for the U.S.A. and Canada, Elsevier Science Pub. Co., 1988-c2010, 5 v. in 6. Handbooks in economics, bk. 9. ISBN 97804445294425.
- KUNA, Zbyněk, Jeffrey R ALWANG a William A MASTERS. Demografický a potravinový problém světa: world food systems and resource use. Vyd. 1. Praha: Wolters Kluwer Česká republika, 2010, 337 s. ISBN 978-807-3575-885.
- LEATHERS, Howard D a Phillips FOSTER. The world food problem: toward ending undernutrition in the Third World. 4th ed. Boulder: Lynne Rienner Publishers, 2009, xiv, 433 p. ISBN 15-882-6638-9.
- NORTON, George W, Jeffrey R ALWANG a William A MASTERS. Economics of agricultural development: world food systems and resource use. 2nd ed. New York, NY: Routledge, 2010, ix, 465 p. ISBN 02-038-5275-3.
- PETERSON, E, Douglas H GRAHAM a Luther G TWEETEN. A billion dollars a day: the economics and politics of agricultural subsidies. 1st pub. Malden, MA: Wiley-Blackwell, 2009, xxi, 292 p. ISBN 978-140-5185-868.
- SOUTHGATE, Douglas DeWitt, Douglas H GRAHAM a Luther G TWEETEN. The world food economy: world food systems and resource use. 1st pub. Malden: Blackwell, 2007, 402 s. ISBN 978-1-4051-0596-5.

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Prague on 31. 03. 2015

## Declaration

I declare that the diploma thesis on topic: “Analysis of Food Insecurity in Haiti“ was written by me, with the help of specific literature and other sources which are included in the review of the used material, and with the help of consultations and advices with my supervisor Ing. Zuzana Smeets Křístková Ph.D.

In Prague 31.3.2015

\_\_\_\_\_ Signature

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# **Analysis of Food Insecurity in Haiti**

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## **Analýza potravinové bezpečnosti na Haiti**

### **ABSTRACT**

The purpose of this thesis is to evaluate the state of food insecurity in a developing country represented by the Republic of Haiti, provide recommendations in terms of food security and reveal to what extent has the rice price crisis of 2008 and the earthquake of 2010 influenced the state of food security in the country. Partial objective of this thesis is to perform projections towards the year 2050 in terms of total population and food demand.

The main terms linked to food security and country profile of Haiti are introduced in the literature overview. For an assessment of food insecurity in the country, an analysis of the four dimensional concept of Food and Agriculture Organization of United Nations (FAO) was carried out in order to derive the current state and recommendations for the country in terms of food security. Partial objective of the thesis provides simulation of four different scenarios of population growth and food demand based on three fertility assumptions by United Nations and one calculated assumption which is based on historical population growth. Above mentioned projections should provide an idea of expected development of total population and food demand and provides the baseline data for potential further research in terms of food supply.

By applying the SWOT analysis at the end of the thesis it was detected that weaknesses significantly outreach strengths in terms of food security in Haiti. Most of the country is facing to stage II- Food Stress, while 13 of its regions are considered as stage III –Food Crisis. Moreover, it was detected that an earthquake in 2010 caused migration of population from affected area to rural areas, which caused a sudden increase in the number of people living in the same household. This population shift resulted in a deficit of basic alimentary goods, price increase for basic foodstuffs and the stock of seeds being used for human consumption. Although the food insecurity nowadays affects approximately 38% of the Haitian population, this proportion fluctuates with regards to repetitive natural disasters, hurricane or drought seasons and due to massive deforestation, also mudslides. Due to such factors, agricultural production fluctuates as well and therefore there currently exists 80% dependency on rice imports. Although Haiti currently does not generate enough domestic

production, many international projects are operating in the country with the aim to introduce new farming techniques that should double Haitian farmers' yields and ensure at least a minimum stability.

**Key words:** Haiti, Malnutrition, Poverty, Poverty, Food Demand, Nutrition, Natural Disasters, Food and Agriculture Organization, World Bank, Power Function, Analysis, Hunger Index

## **SOUHRN**

Cílem této práce je zhodnotit stav potravinové bezpečnosti v rozvojové zemi, zastoupené republikou Haiti, poskytnout doporučení do budoucna a dále pak posoudit do jaké míry ovlivnily potravinovou bezpečnost na Haiti cenová krize na trhu s rýží v roce 2008 a také zemětřesení z roku 2010. Dílčím cílem práce je provedení projekcí do roku 2050 v rámci populačního růstu a poptávce po potravinách.

Hlavní pojmy spojené s potravinovou bezpečností a také celkovým profilem zkoumané země, jsou uvedeny a vysvětleny v části literární rešerše. Pro posouzení nedostatku potravin na Haiti byla použita důkladná analýza čtyř dimenzionálního konceptu Organizace pro Výživu a Zemědělství při Organizaci spojených národů (FAO) která byla provedena tak, aby bylo možné odvodit aktuální stav a doporučení do budoucna z hlediska potravinové bezpečnosti. Dílčím cílem práce je poskytnout simulaci čtyř různých scénářů populačního růstu a poptávky po potravinách, které jsou založeny na třech scénářích plodnosti Organizace pro výživu a zemědělství a také na vlastním scénáři získaným díky výpočtům, které vycházejí z historického vývoje populačního růstu. Projekce do roku 2050 si kladou za cíl poskytnout představu o budoucím vývoji počtu obyvatel a poptávky po potravinách na Haiti a poskytují tak základní data pro případný další výzkum, který by prozkoumal vývoj nabídky potravin.

Díky použití SWOT analýzy v závěru práce bylo zjištěno, že slabé stránky potravinové bezpečnosti na Haiti silně převažují nad silnými. Většina území země nyní čelí stupni II – potravinové napětí, zatímco dalších 13 oblastí jsou považovány za stupeň III – potravinová krize. Kromě toho bylo zjištěno, že zemětřesení v roce 2010 způsobilo migraci obyvatelstva z postižené oblasti do venkovských oblastí, kde došlo k náhlému nárůstu počtu osob, které sdílejí společnou domácnost. Tento jev vyústil v deficit základních potravin, zvýšení cen potravin v oblasti a také jev, kdy se semena ve skladech pro pozdější zemědělskou potřebu použily ke konzumaci. I když nedostatek potravin v současné době postihuje 38% obyvatel Haiti, tento podíl se pohybuje s ohledem na opakující se přírodní katastrofy, období hurikánů

a extrémního sucha a také častým sesuvům půdy díky masivní deforestaci. Těmto jevům se také přizpůsobuje nevyvážená zemědělská produkce a tak je v současné době Haiti z 80% závislé na dovozu rýže. I když v současné době na Haiti panuje nedostatek domácí výroby, v zemi také působí spousta mezinárodních organizací a projektů, které si kladou za cíl zavádět nové zemědělské přístupy, které by měly i zdvojnásobit výnosy Haitiských zemědělců a zajistit tak alespoň minimální stabilitu.

**Klíčová slova:** Haiti, podvýživa, hlad, chudoba, poptávka po potravinách, výživa, přírodní katastrofy, Organizace pro výživu a zemědělství (FAO), Světová banka, mocinná funkce, analýza, Index hladu



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## 1. Introduction

Before Haiti established its independence from France in 1804, it was ranked as one of the most productive and richest world's colony. Due to its natural beauty and an ability to generate innumerable revenue for the French, Haiti was also known as "The Pearl of Antilles". It was able to feed its growing population without any significant obstacles and even able to export some of its agricultural commodities to international markets. Among the most exported items used to belong notably raw/refined sugar, indigo, cotton and also coffee, which by the year 1788 provided half of the world's supplies.

On the other hand, the sugar related industries stood behind the environmental degradation of the country. Moreover, the labor for sugar & coffee plantations was provided by approximately 790,000 African slaves, accounting in 1783–1791 for one third of the entire Atlantic slave trade. This fact leads the country to its current demographic structure. In 1802, the African slaves revolted against the French governance, got their independence and became the first black-led country in the world. However for the most of Haiti's history, the country has experienced political instability and currently is being considered as the poorest country in the Western Hemisphere.

*The country is currently still the poorest one in the Western Hemisphere and the second most densely populated. Significant population growth and periods of economic decline linked primarily to political and social unrest are only some of the factors that have led to dramatic poverty for most of Haiti's inhabitants.* The International Fund for Agricultural Development; IFAD (2014)

Although agriculture is an important sector in Haiti's overall economy, the country currently does not produce enough food crops and livestock to feed its population. *Even though Haiti used to be self-sustainable in terms of rice in 1980's it currently has to import 60 percent of the food it needs, including as much as 80 percent of the rice it consumes.* IFAD (2014)

For these particular reasons, the thesis aims to

- a) *Assess the current development of chosen indicators of 4 dimensional Food Security concept in Haiti (with regards to: availability, access, stability and utilization of food)*
- b) *Calculate projections towards the year 2050 in terms of population growth and food demand*

## 2. Objectives and Methodology

### 2.1. Objectives

Haiti has one of the highest levels of food insecurity in the world and more than half of its population is chronically undernourished. Therefore, the main objective of this thesis is to analyze individual indicators of food security in the country in order to reveal the reasons behind its unstable development, current trends and also to derive recommendations for future.

The initial part of the thesis provides a brief literature overview aimed to Food Security in the literature from a global point of view. Basic issues and terms concerning food security in the world are explained such as for instance Malnutrition, Undernourishment, Food Caloric Supplies, Global Hunger Index and Millennium Development Goals. Based on the explanation of issues and terms mentioned in the literature overview, the thesis will subsequently provide an assessment of Economic, Demographic and Agricultural development in Haiti.

The practical part of the thesis provides answers to two following research questions:

#### **Research questions:**

*Q1: What is the development of food security in Haiti (using time series 1990-2014) and to what extent has influenced the food security in the country*

*a) Global Rice Price Crisis of 2008*

*b) Earthquake that struck Haiti in 2010*

*Q2: What are the projections of population growth and food demand in Haiti towards 2050? Comparison of food demand and population growth with regards to three scenarios of fertility by Food and Agriculture Organization and the author's scenario obtained by statistical calculations*

Concerning the first research question a detailed analysis of four dimensions of food security following FAO concept should reveal the reasons behind each indicator's development over time, assess the current trends, expected future development and propose recommendations. Moreover, the calculations of protein content in three most common Haitian meals are provided and compared to actual daily protein supply of Haitian population in grams per capita.

Regarding the second research question, projections of total population and food demand change towards year 2050 are conducted on a basis of statistical calculations (performing various combinations of functions of power) and compared to United Nation's 3 fertility scenarios. Above mentioned projections should provide an idea of various future development of population and food demand in Haiti, which should provide a baseline data for further future research and projection of food supply, which can be performed as soon as the data regarding consumption in Haiti are available. Due to the current lack of the data or outdated surveys related to food consumption and food supply in Haiti (conducted in 1980s), projections of two above stated variables simply provide estimates of possible ways of future development and it offers a possibility of further analysis by future researchers.

The thesis concludes with a SWOT analysis assessing already discussed areas in terms of food security in Haiti and provides recommendations for improving current state of food security in the country.

## **2.2 Methodology and Analytical Tools**

This thesis is written on a basis of evaluation and further calculation and comparison of statistical data gained mainly from the World Bank's and Food and Agriculture Organization's (FAO) databases in order to evaluate current development of food security in Haiti.

The practical part of the thesis includes three main parts and also three different methods that were used:

### **1) Analysis of 4 dimensions of Food Security following FAO Food Security Concept**

Due to the fact that Haiti is a developing country and also suffers from the unstable role of reporting institutions such as statistical offices, government's reports etc., some of the indicators included in the concept of the FAO cannot be used due to a lack of numerical data in time series. Therefore, only indicators which included significant amount of data were used for this assessment. However the amount of data is sufficient enough in order to assess the state of food security in the country. The source used for this purpose was mainly FAO Food Security Indicators (24<sup>th</sup> October, 2014) and the time series were usually used as 1990-2013. However, in some cases the lack of data in time series occurs, therefore the examined period had to be adjusted to available data. The food security indicators used for an assessment in this thesis are following:

a) Availability dimension

- Average Dietary Energy Supply Adequacy (3 year average data in %, 1990-2014)
- Average Value of Food Production (International dollars per capita, 1990-2012)
- Average Protein Supply (g/per capita/day, 1990-2011) – within this food security indicator, the three most common Haitian meals were taken and the protein content of these meals was compared to average protein supply amongst Haitian population in grams per capita per day. Calculations of recommended daily protein intake (Dietary Reference Intake, DRI), is 0.8 grams of protein per kilogram of body weight (or 0.36 grams per pound). Table 1 below illustrates the baseline data which form the basis of the recommended daily dose of daily protein intake:

**Table 1: Recommended Dietary Allowance for Protein (grams/day)**

<b>Recommended Dietary Allowance for Protein</b>	
	<b>Grams of protein needed each day</b>
<b>Children ages 1 – 3</b>	13
<b>Children ages 4 – 8</b>	19
<b>Children ages 9 – 13</b>	34
<b>Girls ages 14 – 18</b>	46
<b>Boys ages 14 – 18</b>	52
<b>Women ages 19 – 70+</b>	46
<b>Men ages 19 – 70+</b>	56

Source: Centre for Disease Control and Prevention (2012)

b) Access dimension

- Percentage of paved roads over total roads (% , 1990-2000)
- Road Density (per 100km squared of land area, 1990-2000)
- Prevalence of Undernourishment (% , 3 year average, 1990-2013)
- Depth of Food deficit (kcal/per capita/day, 3 year average, 1990-2014)
- Prevalence of Food Inadequacy (% , 3 year average, 1990-2014)
- GDP per capita (Purchasing Power Parity, constant international dollars, 2011; 1998-2013)

c) Stability dimension

- Cereal Import Dependency Ratio (% , 3 year average, 1992-2011)
- Political Stability and Absence of Violence/Terrorism (index, 1996-2012)

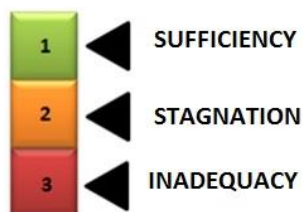
d) Utilization dimension

- Access to Improved Water Sources (% , 1990-2012)
- Access to Improved sanitation facilities (% , 1990, 2000, 2012)

-Percentage of Children under 5 of Age who are Underweight (% , average of 2009-2013)

-Prevalence of Vitamin A Deficiency in the Population (% , 1990-2011)

In order to provide an overall assessment of food security dimensions, an analysis of FAO concept applied on Haiti will conclude with evaluations of each dimension using simple schema, which will help to reveal in which dimensions is Haiti able to achieve positive results and development and where it is falling behind the most as follows:



2) Projections of demographic changes and food demand towards 2050

a) Projections of demographic changes towards 2050

In order to obtain the projected values of Total Population in Haiti in 2050, the software Microsoft Excel and its functions were used. In order to calculate this particular projection, the dataset of the development of population in Haiti had to be gathered and in this case, the data of time series 1998-2013 were used. World Bank (2014)

The larger dataset is used, the more adequate result is obtained. Unfortunately, when assessing the state of demographic changes in developing country, the lack of data available is a common issue. Due to this fact, only the available data was used in order to derive the projections of total population towards 2050. The specific dataset used for this part of the thesis is stated in supplement 6 at the end of this thesis.

For calculating the Total Population, Gross National Income and Food Demand towards 2050, following abbreviations of variables are used:

**Pop2050**.....the desired value of population in 2050

**Pop13**.....the value of the population in 2013

**CAGR**.....Compound Annual Growth Rate (formula explained below)

The compound annual growth rate is calculated by taking the n-th root of the total percentage growth rate, where “n” is the number of years in the period being considered.

In other words, CAGR explains the year-over-year growth rate of an examined variable over a specified period of time.

$$CAGR = \left( \frac{\text{Ending Value}}{\text{Beginning Value}} \right)^{\left( \frac{1}{\# \text{ of years}} \right)} - 1 \quad (2)$$

**GNIq**.....Compound Annual Growth Rate of Gross National Income  
**CAGR(Pop)**.....Compound Annual Growth Rate of total population

b) Projections of Food Demand towards 2050

Calculations in MS Excel and dataset of 1998-2013 (World Bank,2014) were used in order to perform calculations of food demand towards future years: 2020, 2030, 2040 and 2050. The dataset was used for applying various functions of power or following variables:

**FDq**.....Food Demand Growth rate (%)  
**FD50**.....Projection of Food Demand for year 2050  
**GNIq**.....Compound Annual Growth Rate of Gross National Income  
**E**.....Income Elasticity for Food (average of Income elasticities of Demand for 8 commodities for Jamaica; E= 0,70694125)

Due to the fact that United States Agricultural Department (USDA) income elasticity report does not provide elasticity for the most of the developing countries, the value of Income Elasticity for Jamaica (E) – as the closest possible region – was used. For the reason of assessing the state of food demand in a developing country, the individual food elasticity were gathered and an arithmetic mean from all 8 categories of food related income elasticity was performed as follows:

**Table 2: Calculation of Income Elasticity of Demand**

Income Elasticity, Jamaica	Amount
fish	0,8336
dairy	0,79736
oil and fat	0,49218
fruit and veg	0,5926
food other	0,72957
bread and cereal	0,46952
beverage and tobacco	1,00856
meat	0,73214
<b>Arithmetic mean</b>	<b>0,70694</b>

Source: Own processed based on USDA Income Elasticity Report (1996)



Demand for food is a multidimensional variable therefore one single value of elasticity had to be determined in order to calculate food demand in general. For following calculation of food demand, the value of Income Elasticity of demand for Jamaica is equal to: „0.706941“. The values for arithmetic mean. The initial method was to determine the value of elasticity through weighted average according to the share of individual items in consumption, which can be usually obtained from FAOSTAT database, but due to significant lack of data regarding food consumption in Haiti or Jamaica, average mean had to be used in order to obtain one single value of income elasticity of demand instead.

$$\mathbf{Food\ Demand\ growth\ (FDgr)} = \text{population growth} + \text{Elasticity (E)} * \text{income growth} \quad (3)$$

$$\mathbf{Pop2050} = \text{Pop2013} * (1 + \text{FDgr})^{37} \quad (4)$$

$$\mathbf{Demand\ Growth} = \text{Population Growth (Haiti)} + \text{Income Elasticity of Demand (E= Jamaica)} * \text{Gross National Income Growth (Haiti)}$$

$$\mathbf{Food\ Demand} = 100 * (1 + \text{demand growth})^{y^t - y^0} \quad (5)$$

$$(y^t = 2050 \quad y^0 = 2013) \text{ therefore } y^t - y^0 = 37$$

### 3) SWOT analysis of Food Security in Haiti

- based on SWOT analysis the recommendations in terms of food security in Haiti are provided.

## 3. Literature overview – Haiti

### 3.1 Food Security

World Food Summit (1996) defined the Food Security by following explanation: “*Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life*”.

Over the past thirty years, the number of food emergencies has risen from an average of fifteen per year in the 1980s to more than thirty per year since 2000 onwards. The majority of protracted crises are located mostly in Africa, where the average number of crises has tripled over the last twenty years. These crises are fueled mainly by armed conflict, often compounded by drought, floods and the effects of the AIDS pandemic. FAO, SOFI (2010) All above mentioned factors are to be found in the country of study – the Republic of Haiti – as well.

In order to provide a brief introduction into the area of food security, main terms linked to it have to be explained.

#### Food Insecurity

According to FAO (2014), food insecurity is situation that occurs when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution or inadequate use of food at the household level. Food insecurity, poor conditions of health and sanitation and inappropriate care and feeding practices are the major causes of poor nutritional status. Food insecurity may exist in three forms: chronic, seasonal or transitory.

- a) Chronic Food Insecurity is defined as a long-term of persistent inability to meet minimum food consumption requirements. Food insecurity lasting for at least six months of the year can be considered chronic.
- b) Seasonal/Cyclical Food Insecurity occurs when there are habitual seasonal variations of the food security situation. If seasonal food insecurity is present for a total of at least six months a year, it can be considered chronic. If it lasts for a total of less than six months a year, it can be considered transitory.

- c) **Transitory Food Insecurity** is defined as a short-term or temporary inability to meet minimum food consumption requirements, indicating a capacity to recover. Short periods of food insecurity related to rare crises can be considered as transitory insecurity.

In a situation when people cannot meet their dietary needs, several following situation may appear:

- a) **Undernourishment** is a state which lasts at least one year and indicates inability to acquire enough food. It is also defined as a level of food intake insufficient to meet dietary energy requirements. For the purposes of this thesis, “hunger” was defined as being synonymous with chronic undernourishment.
- b) **Undernutrition** is the outcome of undernourishment and(or) poor absorption and(or) poor biological use of nutrients which are consumed as a result of repeated infectious disease. Undernutrition includes being underweight for one’s age, too short for one’s age (stunted), extremely thin for one’s height (wasted) and deficient in vitamins and minerals (micronutrient malnutrition)
- c) **Underweight** is a situation whe one has low weight for age (children) and low BMI (less than 18.5, adults) which is caused by inadequate food intake.
- d) **Malnutrition** is defined as an abnormal physiological condition caused by inadequate, unbalanced or excessive consumption of macronutrients and/or micronutrients. Malnutrition includes undernutrition and overnutrition as well as micronutrient deficiencies (e.g.: Vitamin A deficiency is further discussed in this thesis)

There is no single method of measuring food insecurity, one can usually assess and compare food security indicators e.g.: FAO concept of food security, as it is performed in chapter 4 of this thesis.

### **3.1.1 FAO Food Security concept**

Food and Agriculture Organization (FAO) has defined the objective of food security as assuring to all human beings the physical and economic access to the basic foods they need. This implies four different aspects: availability, stability, access and utilization of food. All 4 dimensions of food security in Haiti and their indicators are further discussed and assessed in 4. In order to provide basic explanations of the four dimensional concept by FAO, brief explanation is provided below:

## 1. Food Availability dimension

The availability dimension is defined as having sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid).

Indicators for assessing food availability in general include:

- 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

## 2. Food Access dimension

Access dimension is defined by access of individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic, and social arrangements of the community in which they live (including traditional rights such as access to common resources).

Access dimension comprises indicators of physical access and infrastructure such as :

- Percentage of paved roads over total roads\*
- Road density\*
- Rail lines density
- Prevalence of undernourishment\*
- Gross domestic product per capita (in purchasing power equivalent)\*
- Domestic food price index
- Share of food expenditure of the poor
- Depth of the food deficit\*
- Prevalence of food inadequacy\*

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\* this food security indicator will be analyzed in chapter 4.1 of this thesis

### 3. Utilization dimension

Utilization dimension is defined as utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security.

Utilization indicators are represented by:

- Access to improved water sources
- Access to improved sanitation facilities
- Percentage of children under 5 years of age affected by wasting
- Percentage of children under 5 years of age who are stunted
- Percentage of children under 5 years of age who are underweight\*
- Percentage of adults who are underweight
- Prevalence of anaemia among pregnant women
- Prevalence of anaemia among children under 5 years of age
- Prevalence of vitamin A deficiency in the population
- Prevalence of iodine deficiency

### 4. Stability dimension

To be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. climatic crisis or economic shocks) or cyclical events (e.g.: seasonal food insecurity). The concept of stability can therefore refer to both the availability and access dimensions of food security.

Stability dimension is represented by following indicators:

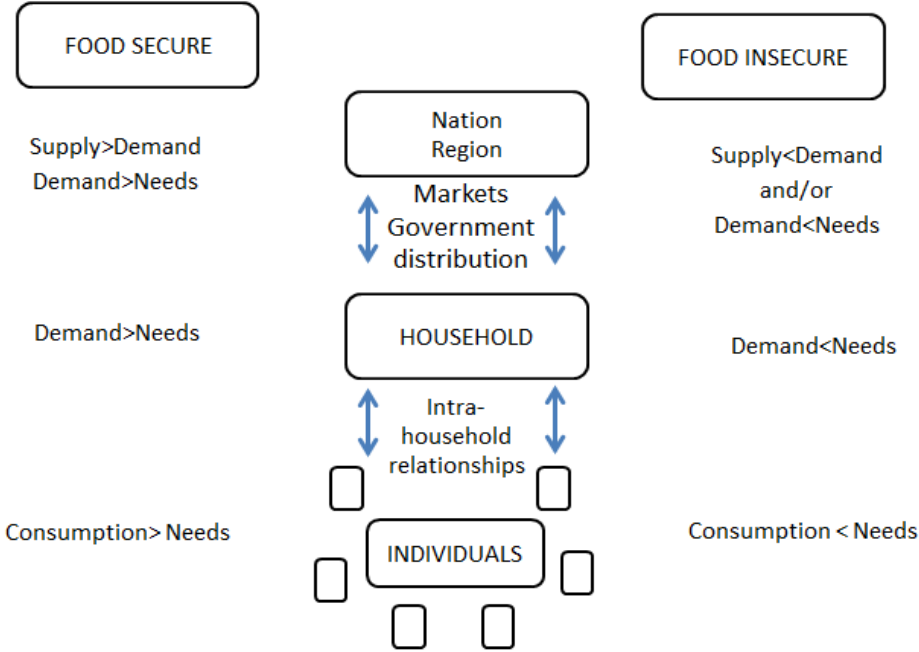
- Cereal import dependency ratio\*
- Percent of arable land equipped for irrigation
- Value of food imports over total merchandise exports
- Political stability and absence of violence/terrorism\*
- Domestic food price volatility
- Per capita food production variability
- Per capita food supply variability

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\* this food security indicator will be analyzed in chapter 4.1 of this thesis

Moreover, FAO also defines 3 most important levels of food security and their interactions. **Picture 1** below shows the individual relationships between national/regional, household and individual levels of food security.

**Picture 1: Different levels of Food Security and major interaction between them**



Source: Own elaboration, FAO, Concepts of Food Security (2005)

- a) National/regional level of food security –within this particular level, changes in food security can be identified by rising prices. These price changes affect the poorest population first, as they need to spend a higher proportion of their income on food. *The absence of an imbalance between food demand and food supply does not mean that all households in the nation are food secure.* FAO, Conceptual Framework of Food Security (2003). It means that if the population suffers from food insecurity it is because they lack entitlement to food (or effective demand in economics) and they simply do not have a possible way of expressing their full need for food in the marketplace.
- b) Household level is the most important one – it is the basic economic unit which determines the level of consumption by the individual. In most analysis there is a presumption that income comes to the household as a whole, resource allocation

decisions are made at the household level and household consumption is divided amongst its members in some relation to the needs of the individuals. At this level, households are identified as food secure if their entitlements (or demand for food), is greater than their needs.

- c) Individual level - within the individual level, the definition of food security is much more straightforward. An individual is food secure if his/her food consumption is always greater than need and the consumption is determined by the claim the individual has on household food resources. The claim may be affected by individual earnings and assets, or by the individual's position in the household.

FAO, Concepts of Food Security (2005)

### **3.1.2 Millennium Development Goals**

Millennium Development Goals are eight international development goals that were established in 2000, following the Millennium Summit of the United Nations, following the adoption of the United Nations Millennium Declaration. All goals aim to improve eight following areas in countries of the world to a certain level by the deadline year 2015:

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV / AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development

United Nations (2015)

Millennium Development goals applied on the country of study – the Republic of Haiti – are to be found in chapter 3.6

## **3.2 Country profile**

In this sub-chapter, a brief introduction into a country of study the Republic of Haiti is provided. Supplement 1 in Appendix provides more detailed information about the country of study.

In the early 19<sup>th</sup> century, Haiti became the world's first republic led by a black nation and the first independent Caribbean state when it gained freedom from French colonial control and slavery in a series of war. Unfortunately, the country, historically called “The Pearl of Antilles” that provided significant revenues for their former French colonizers (exports of raw/refined sugar, indigo, cotton and also coffee). Decades of poverty, environmental degradation (combination of sugar related industries, frequent natural disasters and deforestation) violence, instability and dictatorship have left it as the poorest nation in the Western Hemisphere. **Supplement 3** illustrates the current state (2015) of massive deforestation in Haiti.

To fully understand the general situation in Haiti, picture 2 below illustrates the map of Haiti with individual departments of the country and also the population living in different departments with respect to rural and urban population.

**Picture 2: The Republic of Haiti – departments & geographical specification**



Source: Own modification; <http://mapsof.net/map/haiti>

As **table 3** below shows, departments of Haiti are diversified in terms of total population. The area around the capital Port-au-Prince is populated the most with almost 3 million inhabitants. The most populated areas in Haiti are to be found in larger cities and specifically in those, which are important ports (Port-au-Prince, Gonaïves or Port-de-Paix). On the other hand, the least populated areas are those in the western and northern part of the country (departments 4, 3 or 6), which are mostly rural areas, where population usually feed itself thanks to small



scale farming. The average size of Haitian farm is 1ha and due to the fact that Haiti is located in the middle of hurricane belt, the production is highly influenced by external factors.

**Table 3: Haiti, Administrative Units, Capitals and Population**

Department	Capital	Population
1. Artibonite	Gonaïves	1,168,800
2. Centre	Hinche	564,200
3. Grand'Anse	Jérémie	337,516
4. Nippes	Miragoâne	<b>266,379</b>
5. Nord	Cap-Haïtien	872,200
6. Nord-Est	Fort-Liberté	283,800
7. Nord-Ouest	Port-de-Paix	488,500
8. Ouest	Port-au-Prince	<b>2,943,200</b>
9. Sud	Les Cayes	745,000
10. Sud-Est	Jacmel	518,200

Source: Own processed & <http://GeoHive.com>, Haiti Administrative Units

### 3.3. Economic Development of Haiti

One could assume that mostly mountainous island country with a tropical climate could potentially become a tourist hot spot, but instability and violence, especially since the 1980s, have severely dented that prospect. <http://news.bbc.co.uk> (2012)

It is important to mention that due to the fact that Haiti is located in the Caribbean region, there are also a few specifics that have to be assumed when assessing its economic development:

- The Caribbean islands consist of generally geographical areas which are at risk from frequent natural hazards.
- The economies of island countries are particularly affected by natural disasters.
- Hazard mitigation is essential to Caribbean Islands where disasters may occur with regularity.
- Hazard mitigation and disaster recovery may require a major financial commitment from the national budget. Collymore (2001)

Haiti has recently suffered a sequence of natural disasters, therefore it is not surprising that its economy suffered great losses as well and even nowadays, 5 years after the most significant catastrophe (2010 earthquake), it is still recovering from such an event. On the other hand, other countries and various international institutions are still helping Haiti in its recovery. E.g.: Re-opening of the Haitian airport in Cap-Haitien was financed by Venezuelan

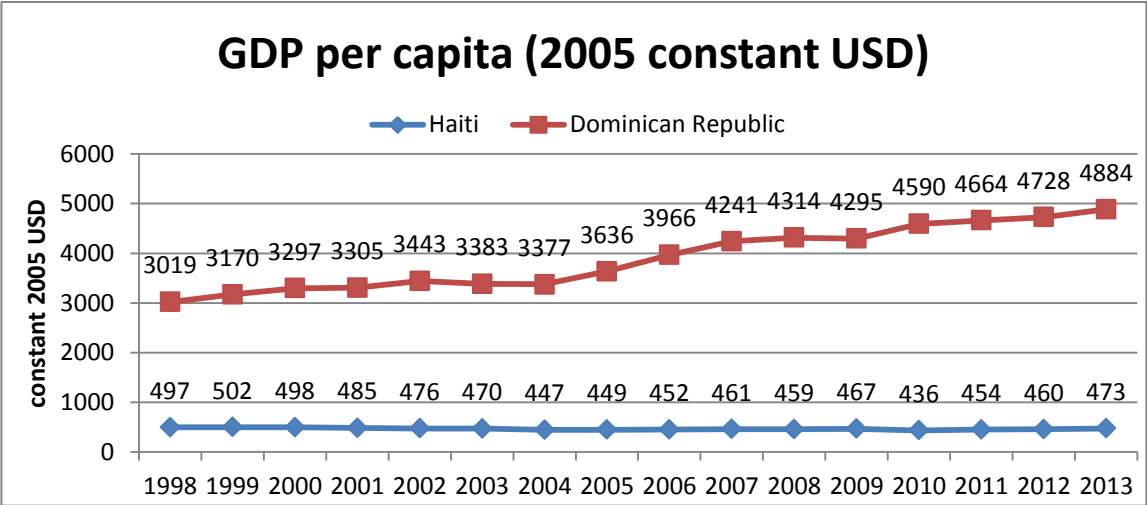
PetroCaribbe Program or the sanitary installations projects in response to the cholera epidemic financed by the World Bank. This international help should ensure the country’s further development and strengthening Haiti’s economic capacities. Unfortunately, it is expected that Haiti will be exposed to unstable meteorological variations in future as well, which will obviously affect difficult business climate and socio-political pressures.

**3.3.1 Gross Domestic Product of Haiti**

Haiti and Dominican Republic share the common island of Hispaniola, the similar amount of population (Haiti: 10.46M and Dominican Republic: 10.6M, 2013) and the climate, although Dominican Republic is considered as the top tourist destination in the Caribbean. Mainly for this particular reason, both countries differ in terms of GDP very significantly as well.

- GDP per capita: Haiti – 473.29 (2005 constant USD,2013)
- GDP per capita: Dominican Republic – 473 (2005 constant USD, 2013)

**Figure 1: Comparison of GDP development of Haiti and Dominican Republic**



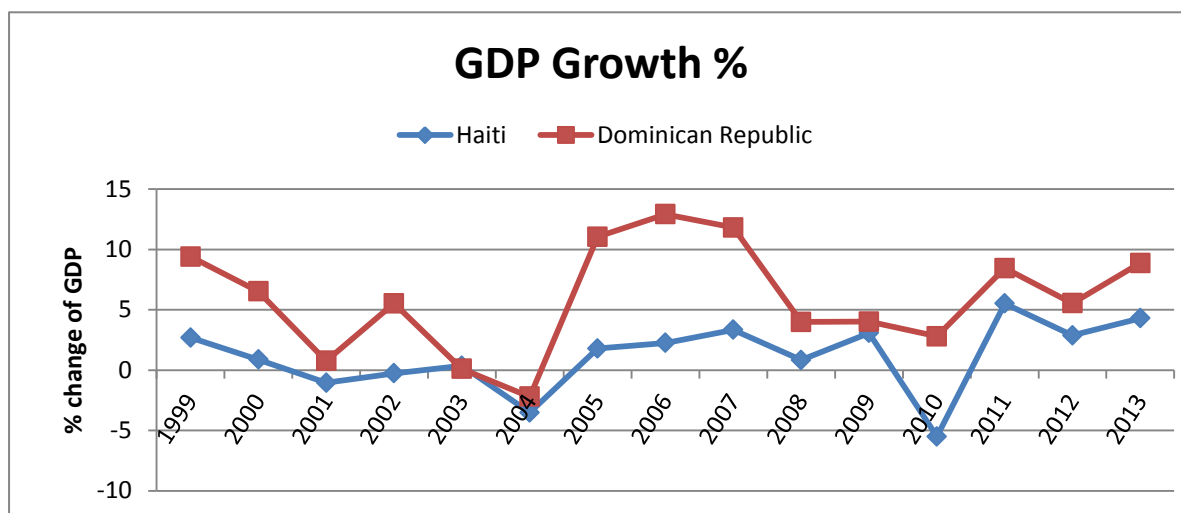
Source: Own processed, World Bank & Google Public Data (2015)

As it can be seen from a development of the curve of GDP per capita in Haiti, although that GDP suffered stagnation or slight decrease during 2008-2010, it even increased significantly after such serious events such as an earthquake in 2010 and hurricane Sandy in 2012. Although the increase is accounted mainly to humanitarian aid which started to flow to the country after 2010’s earthquake. According to World Bank (2015): „A major challenge for Haiti will be to manage the substantial decrease in donor financing. Having declined for the last three years, the trend is expected to continue in the future. This will likely constrain Haiti’s capital investments, which had increased for the last

*three years with limited impact on growth. With limited resources, efficient and effective use domestic and external resources will remain critical.*“

To compare and understand the development of GDP more thoroughly, the curve of GDP growth is illustrated in figure 2 below in a comparison to GDP growth curve of Dominican Republic.

**Figure 2: Comparison of GDP growth development in Haiti & Dominican Republic**



Source: World Bank, Haiti, Dominican Republic (2015)

As it can be seen from the GDP growth curve, it is assumed that due to a fact that agriculture accounts for a significant part of GDP composition (around 25%), the external factors such as natural disasters, droughts, floods etc. will influence not only agricultural production, but also GDP. In the period of 2000-2004, the most serious droughts hit Haiti and therefore, the GDP curve experienced a significant drop in this time period. The similar phenomenon can be observed within year 2010, where an extreme decline due to earthquake of 2010 occurs as well and Haiti experienced a negative change of 5% in comparison to year 2009. Although it is important to mention that except for the epicentre of the earthquake, the agricultural sector was little affected by the earthquake. At the macro-economic level, the success of the 2010 crop year helped cushion the fall of the national GDP as a result of the earthquake. Some regions, however, such as the central highlands and the dryer parts of the Northwest department, experienced some setbacks in agricultural production. However, cholera epidemic that appeared and started to spread quickly in October 2010 and also Hurricane Tomas which hit one of the richest agricultural regions of the country (Grande-Anse) in November 2010 caused that food and cash crops were seriously damaged. Therefore, food

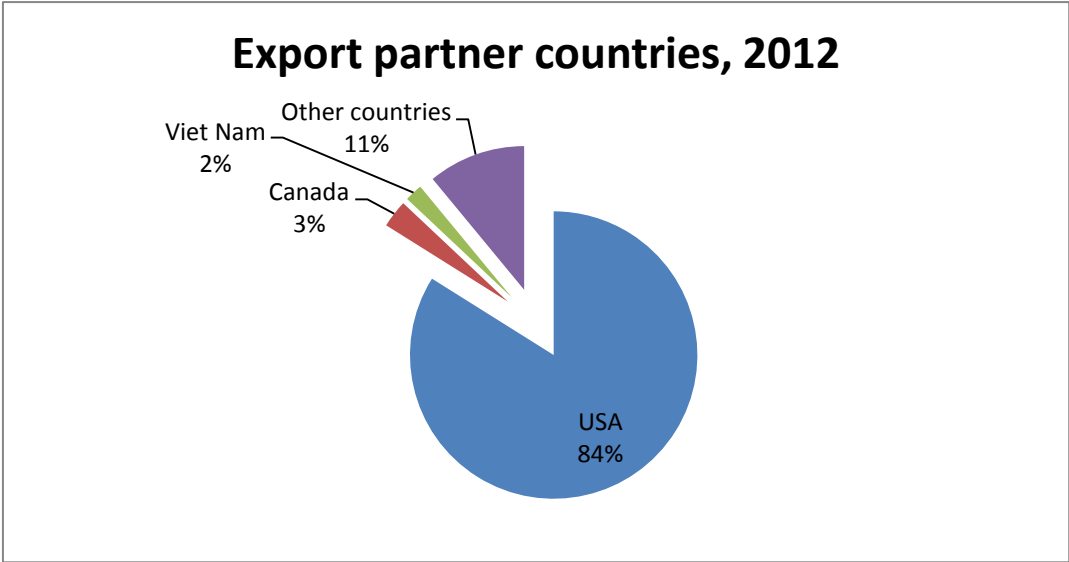
security was affected seriously during the last quarter of 2010 mainly concerning the departments in the South and Artibonite. Nevertheless, an international humanitarian relief, foreign direct investments and building industrial parks out of international help contributes to increasing GDP, thanks to significant apparel exports to the USA. Another minor drop in GDP by 2% can also be seen in 2012, when the sudden decline is assumed to be caused by hurricane Sandy, which destroyed an agricultural productions. Despite the significant humanitarian help, Haiti remains the poorest country in the Americas and one of the poorest in the world with significant needs in basic services.

**3.3.1 Export**

Decades of tariff-free food imports and flooding of food aid sourced from heavily subsidized US farmers has negatively influenced the Haitian agriculture sector, forcing people into urban slums of Port-au-Prince or other large cities, where they compete for jobs in the garment industry, so called “sweatshops”. In the 1950s, agriculture made up 90 per cent of Haiti’s exports, although today, ninety per cent of exports are from the apparel sector, while more than fifty per cent of the country’s food is imported. Global research (2013)

Among the most important countries to which Haiti exports belong:

**Figure 3: Main Haiti’s partner countries for export, 2012**

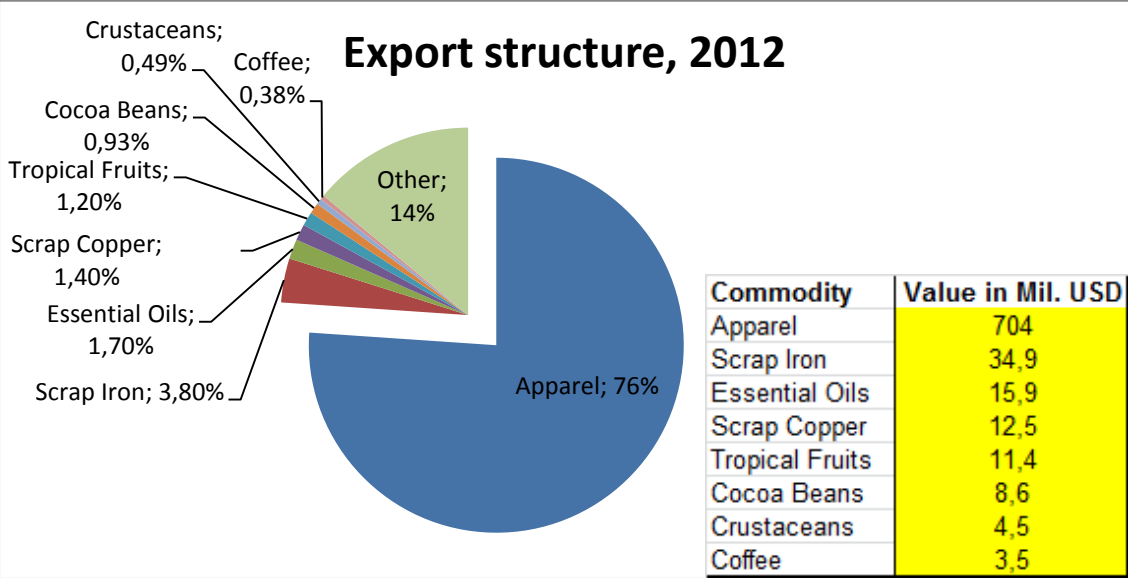


Source: Own processed & Observatory of Economic Complexity (2012)

Figure 3 below shows the detailed composition of exported goods to above illustrated countries. As it can be seen, in terms of exports, Haiti does not concentrate its exports to agricultural commodities to such an extent as in its history, when it belonged to one of the

most significant exporter of coffee. The most recent data (2012) shows that nowadays, Haiti is a major exporter of apparel and it is also expected that this trend will remain stable in future as well, due to opening of new industrial park Caracol, which should offer 65.000 job possibilities by 2020. On one hand, this way Haiti would fight against poverty by providing employment to its population, on the other hand, e.g.: industrial park Caracol is built on an agricultural land and with emerging deforestation, erosion and deterioration of fertile land (15.000 ha lost due to erosion every year), it is expected that even though the population will be employed, it will not have an opportunity to grow their own foodstuff, due to the fact that they do not own land any more. Farmers often sell their land for the purpose of certain profit, but even in case of having certain amount of financial resources, there are poor possibilities to buy foodstuff in rural areas. One has to commute, devote resources for fuel, vehicle to get to the foodstuff vendors and often even this is not possible due to inadequate or damaged roads. Therefore, rural areas of Haiti are usually dependent on their own production.

**Figure 4: Main Haiti’s commodities for export, 2012**



source: Own processed & Observatory of Economic Complexity (2012)

Concerning exports, Haiti is currently the major exporter of apparel (from greater extent it exports to the United States) which constitutes 76% of the total export value. Besides exporting clothes that was in 2012 worth 704 million USD, Haiti also exports scrap iron which constitutes 4% from total exports and essential oils which form 2% of the total exports of Haiti. Concerning agricultural commodities, exports are not as significant as in the history. Former cash crop – coffee – nowadays forms only 0.38% of overall exports with the value of

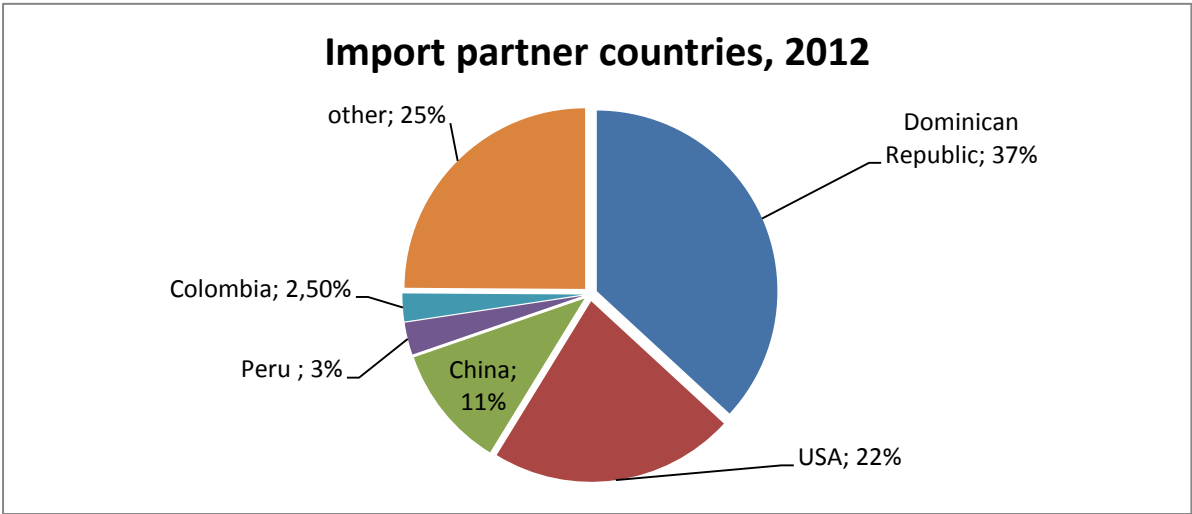
3.5 million of USD. Amongst other agricultural commodities, tropical fruits (1.20% of export), cocoa beans (0.93% of export) or crustaceans (0.49% of export) can be underlined.

Concerning future possibilities, according to latest news of Haiti Libre (2014), Haiti agreed with Dominican Republic to import Haitian beer “Prestige” to Dominican market and also :  
*The two countries, agreed to hold a series of discussions and of planning in order to boost and formalize trade and investment between the two republics.”* Therefore, Haiti could potentially benefit from boosting the cooperation with its neighbor. On the other hand, Haiti should not concentrate on close cooperation with one country only. For instance as it can be seen in recent history (June 2013) Haitian government banned the import of live birds, poultry meat and eggs from Dominican Republic in order to prevent Haiti from entering avian influenza even though that Dominican Republic has not reported any outbreak of such disease for 6 years. In a situation when 2.8% (74.9 million USD) of total Haiti’s import consist of poultry meat, a long-term poultry meat can become a significant threat in terms of food security in Haiti. The similar situation can be observed in terms of bans on imported fruits from Dominican Republic (March 2015) due to danger caused by a fruit fly. On the other hand, even though measures against smuggling banned goods through borders were applied, the Dominican-Haitian border seems to be permeable and it is quite common that poultry from Dominican Republic is to be found in Haitian markets.

**3.3.2 Import**

Foodstuff represents the major proportion of Haiti’s import. Pie charts 5 and 6 below reveal the most significant importing countries and also the share of imported goods.

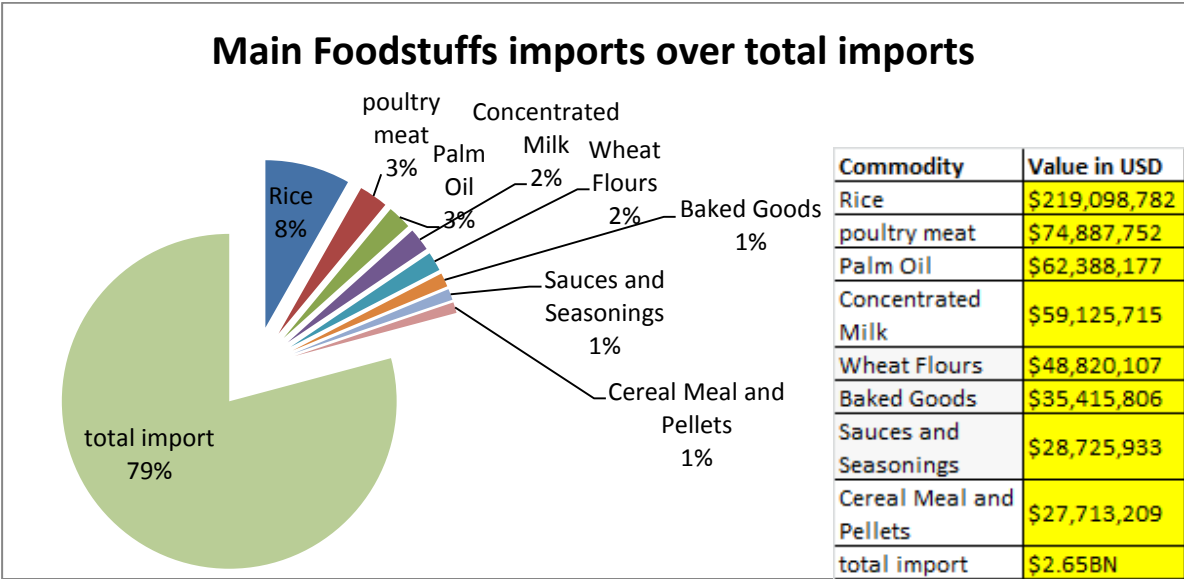
**Figure 5: Main partner countries importing to Haiti**



Source: Own processed & Observatory of Economic Complexity (2012)

As it can be observed in Figure 3.3.5, the most important importer to Haiti is Dominican Republic. Thanks to its proximity to Haitian borders, the Dominican Republic provides 37% of all imported goods (2012). The second most significant importer are the United States of America (22%) but also China (11%). Due to the fact that Haiti is highly dependent on food imports, the figure 3.3.6 below illustrates the detailed value of imported foodstuff in terms of year 2012.

**Figure 6: Share and value of imported foodstuff to Haiti 2012**



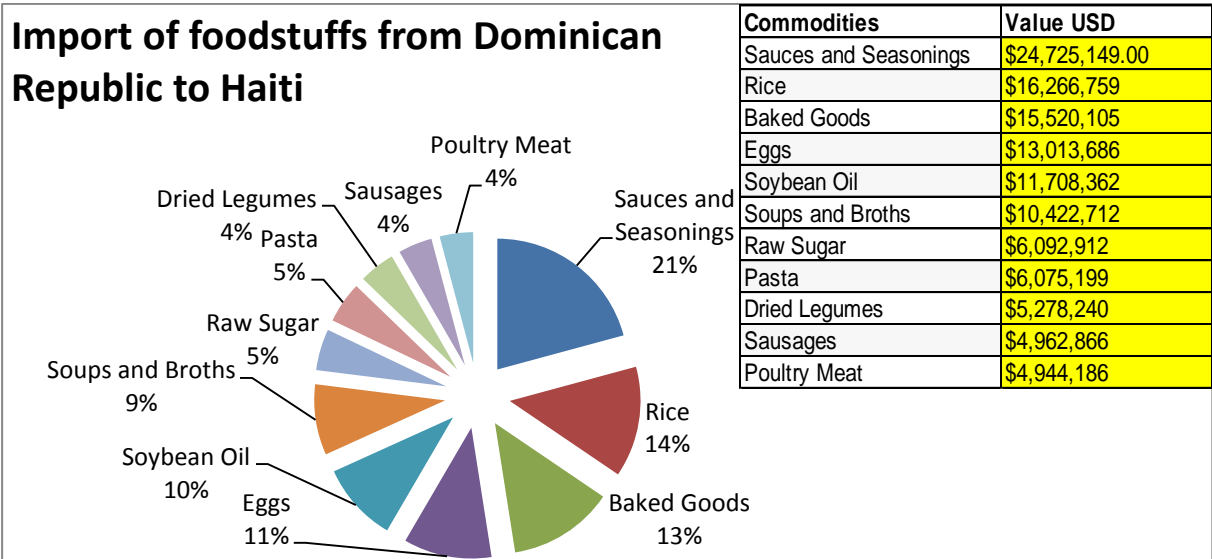
Source: Own processed & Observatory of Economic Complexity (2012)

According to Figure 6 which represents the data for the last available year 2012 it can be observed that amongst main foodstuff that are imported to Haiti, cereals form the most significant value (7% of total foodstuff import), the following most significant imported commodities are rice, which used to be number 1 imported commodity during previous years and now rice forms 4% of total imports, Fixed Vegetable Oils (5% of total import) or Animal Vegetable Oil (6% of total imports).

The event of rice price crisis of 2008 is particularly important for Haiti due to several reasons. Haiti has recently gone through a diet shift. This means that according to Oxfam (2012), after trade liberalization in 1986 and significant reduction of Haiti’s border protection, rice went from being an occasional component of average diet (1-2 meals per week) to the mainstay (7-14 meals per week). The 2010 report of U.S.Government implies the same idea: in 1980s most of the Haitian population lived in rural areas and ate diversified diet consisting of roots,

tubers, maize and sorghum and rice was consumed only occasionally as a luxury item. Today, Haitians are amongst the largest consumers of rice in Caribbean region. Moreover, per capita rice consumption slightly increases (42kg in 2013, 50kg in 2014). Sorghum and maize previously common the most in Haitians meals are nowadays considered as inferior goods. Therefore the rice imports, mainly from the United States (Miami rice), are highest in terms of overall import to Haiti.

**Figure 7: Share and value of imported goods from Dominican Republic to Haiti**



Source: Own processed & Observatory of Economic Complexity (2012)

It is important to emphasize that Figure 7 illustrates the share of foodstuff over total imports from Dominican Republic only, therefore the sum of percentages shown in Figure 7 does not equal to 100%. For providing more explanation over the imports from Dominican Republic to Haiti, table in Figure 7 shows the actual values in of import for chosen commodities for the year 2012 given in US dollars. It is obvious that Haiti is dependent on Dominican Republic rather significantly in terms of sauces and seasonings (21%), rice (14%) or baked goods (13%). Eggs also forms a significant share over the total imports from Dominican Republic to Haiti (11%).

### 3.4 Demographic Development in Haiti

The Republic of Haiti has by far the highest fertility rate in the Western Hemisphere (about five births per woman of child-bearing age) and the Haitian population is expected to grow significantly from 7 million in 1995 to more than 13 million by 2025 (Preeg, Ernest, H. 1996). Moreover, high fertility rates in countries, most recently seen in West Africa (Sierra Leone



and Liberia —with fertility rates of 6.1 and 6.3 children per woman, respectively), can contribute to humanitarian crises like famines, epidemics, or mass criminal violence that require international military intervention. Tanton (2001)

Regarding a potential risk of an outbreak of famines, epidemics and crisis, Haiti is no exception due to its high fertility rates, therefore, it is crucial to first explain the basic terms regarding demographic development in Haiti (*birth rate, fertility rate, population growth, life expectancy*) and analyze current demographic trends (*urban/rural population, outward migration*), when assessing the state of Food Demand and Food Insecurity in the chosen country.

### **3.4.1 Crude Birth rate (CBR)**

The crude birth rate is calculated as the number of live births per 1,000 of the total mid-year population within a given period of time. The crude birth rate is expressed in units per thousand and is a positive component of reproduction.

#### **Calculation of (Crude Birth Rate)**

$$CBR = \frac{b(\text{number of live births})}{p(\text{total midyear population})} \times 1000 \quad (1)$$

Pavlik (1979)

As for the case of the Republic of Haiti, the birth rate for the year of 2014 is equal to 22.83 births per thousand of population. This result shows that Haiti currently ranks the 73<sup>rd</sup> place on the global list of highest birth rates (1<sup>st</sup> is Niger with 46.12 births per 1,000 of population, 2<sup>nd</sup> Mali with 45.53 of births per 1,000 of population and 3<sup>rd</sup> is Uganda with 44.17 births per 1,000 of population). On the contrary, amongst countries with the lowest birth rates there may be included Japan with birth rate of 8.07( 222<sup>nd</sup> place on the world list), Saint Pierre and Miquelon - 7.70 (223<sup>rd</sup> place on the world list) or Monaco with the score of 6.72 (last place on the world list of birth rates – 224<sup>th</sup>). The World Factbook, CIA, 2014).

As mentioned above, birth rates demonstrates the proportion of births to the total population in a place in a given time, usually expressed as a quantity per thousand of population, whereas *fertility rate* shows more precise measure.

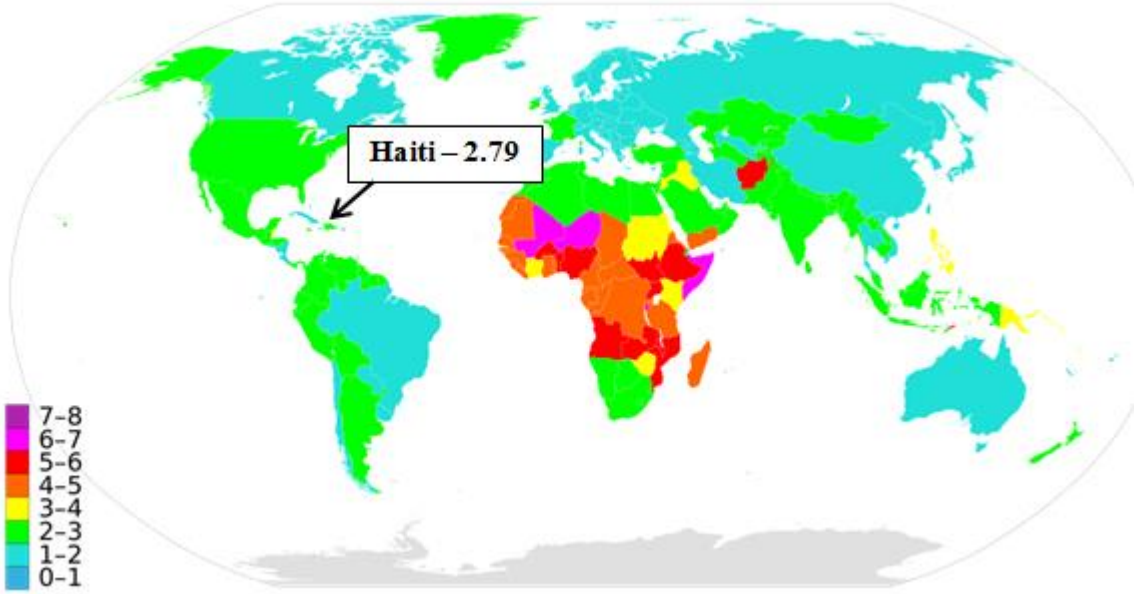
**3.4.2 Total Fertility Rate (TFR)**

According to a definition of CIA, Total Fertility Rate compares figures for the average number of children that would be born per woman if all women lived to the end of their childbearing years and bore children according to a given fertility rate at each age. As mentioned above, TFR is a more direct measure of the level of fertility than the crude birth rate, because of the fact that it refers to births per woman.

As for the last available data from the year of 2014, Haiti is ranked on the 68<sup>th</sup> place of the world list of Total Fertility Rate with the score 2.79. This number particularly means that in average, one Haitian woman is usually able to have 2.79 children. For clarification, the world’s leader in terms of the highest fertility rate is Niger with the score of 6.89 children per woman. On the other hand, the last place occupies Singapore with the score of 0.89 children per woman (224<sup>th</sup> place in the world). The World Factbook, CIA (2014)

**Picture 3** illustratively depicts the global state of fertility rates as well as the current rates of the Republic of Haiti. Even though the total fertility rate (TFR) in the country has been declining steadily from an estimated 4.8 birth per woman in 1995 to 3.212 births per woman in 2012 and even 2.79 in 2014, Haiti still is the country with the highest fertility rates in the Americas. World Bank (2014)

**Picture 3: Total Fertility Rate – Global overview & detail of Haiti**



Source: Own modification & CIA Factbook (2009)

## **TFR Influencers**

According to FAO, access to safe, voluntary family planning is a human right. Family planning is crucial to gender equality and women's empowerment, and it is a key factor for poverty reduction. Yet some 225 million women who want to use safe and effective family planning methods are unable to do so because they lack access to information, services, or the support of their partners or communities. Most of these women with an unmet need for contraceptives live in 69 of the poorest countries on earth.

United Nations Population Fund (2014)

According to Global Finance Magazine (2014) Haiti not only is a developing country, but also currently (2015) accounts amongst the 20 poorest countries of the world. According to studies and literature, this ranking is caused mainly by unfortunate combination of long term unstable political and economic situation as well as by frequent natural disasters. Naturally, when assessing Total Fertility Rate - influencers such as the country's GDP must be considered as well.

A study published by the Hunter College of The City University of New York (2014) reveals that there exist several main factors that affect Total Fertility Rates:

### 1) Importance of children as a part of the labour force

Fertility Rates tend to be higher in developing countries. This trend is common especially in rural areas, where children begin working to help raise crops at an early age. According to the World Bank Database (2015), Haitian children between the age of 7-14 years, who were employed and worked without school attendance was 7.6% (2012) of all children in this age category in a country. This percentage has although decreased significantly, because for the year 2006, the share of children who were not going to school and worked only was 17.7%.

2) Urbanization

Population living in urban areas tend to have fewer children than those living in rural areas where children are needed to perform essential tasks. The population growth rate in Haiti's rural areas has been lower than the growth rate for urban areas, even though fertility rates are higher in rural areas. The main reason behind this phenomenon is disparity is outmigration. The population in rural areas have moved to cities, or they have emigrated to other countries, in most cases to the United States and the Dominican Republic.

3) Cost of raising and educating children

Fertility Rates tend to be lower in developed countries, due to a fact that raising children is much more costly because children don't enter the labour force until their late teens or even early twenties.

4) Educational and employment opportunities for women

Total Fertility Rates tend to be low when women have access to education and paid employment outside their home. In developing countries, women with low or no education generally have two more children than women with a secondary school education.

5) Infant mortality rate

In areas with low infant mortality rates, people tend to have less children because fewer children die at an early age.

6) Average age at marriage ( or the average age at which women have their first child)

Women normally have fewer children when their average age at marriage is 25 or older.

7) Availability of private and public pension systems

Pensions are also important influencers amongst high or low fertility rates because they eliminate parent's need to have many children to help support them in old age.

8) Availability of legal abortions

According to the United Nations and the World Bank, it is estimated that there are currently 26 million legal abortions and 20 million illegal (and frequently unsafe) abortions are performed worldwide each year among the roughly 190 million pregnancies per year. Haitian women often undergo secret abortions because it is impossible to perform it legally. This phenomenon is very dangerous and significantly increases over time.

According to a recent study of Jacqueline Charles (2013) the number of post-abortion deaths in Haiti is unknown, but physicians say post-abortion complications are a leading

cause of maternal death, with the health ministry estimating it could possibly account for as many as 30 percent of them.

9) Availability of reliable birth control methods

One of the most important influencers of total fertility rate is also the access to reliable birth control methods which allows the women to control the number and spacing of children they have. For the case of Haiti, only 34.5% of women ages 15-49 confirm using any kind of contraception. The percentage is low also due to religious reason, when often the religion does not allow using contraceptives. On the other hand president Michel Martelly, who has publicly urged Haitians to consider having smaller families, issued a presidential decree (2013) requiring all public and private health institutions to provide free contraceptives and counseling to any woman who wants them.

10) Religious beliefs, traditions and cultural norms

In some countries, religious beliefs etc. favor large families and strongly oppose abortion as well as birth control. For the case of Haiti, where 80% of population is of Roman Catholic religion, the abortion or modern birth control methods are still taboo.

### **3.4.3 Haiti – Demographic Trends**

After the year 1900, Haiti's population grew dramatically, although life expectancy has been among the lowest in the world – from 54.4 years in 1990 over 57.4 years in 2000 to 62.7 in 2012. The birth rates and infant mortality are still significantly high, compared to other countries in the Caribbean region. Also, roughly two-fifths of the population is under 15 years of age. Britannica (2015)

a) Migration and Exile Communities

According to Britannica (2015), every year over ten thousands of Haitians attempt to improve their living conditions by migrating to other countries, notably Cuba and the Dominican Republic. Moreover, hundreds of thousands of Haitians live in the Dominican Republic, although many of them illegally and under semi clandestine conditions. On the other hand, Dominican government programs allow temporary migrants for agricultural work, primarily bracero (cane-cutting) labor and menial jobs. Many Haitians have also migrated to the United States or Canada. Since the 1970s, large numbers of Haitians have attempted to enter the United States each year in small boats, which is often very dangerous. This phenomenon decreased with the end of the Haitian military regime in 1994 but continued sporadically, particularly during times of political crisis. The U.S.

Coast Guard has ordinarily intercepted such “boat people” and returned them to Haiti nevertheless many others were thought to have drowned en route to Florida, which is more than 560 miles (900 km) northwest of Haiti. In terms of exile communities, many have also been established in The Bahamas, Guadeloupe, and Saint-Martin.

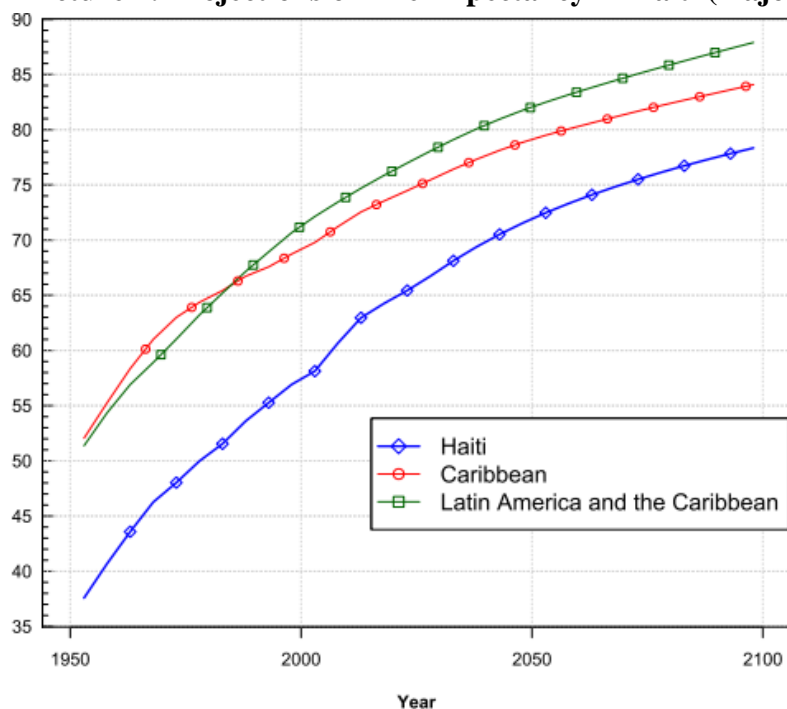
b) Urban/Rural Life

- Urban life in Haiti is very limited and is to be found in a capital Port-au-Prince and 5 other cities only. The substantial majority of Port-au-Prince residents live on very low incomes (62% of the population lives with less than 1.25 international dollars/day) and slums/shantytowns around the city. The largest shantytown in Port-au-Prince is Cité Soleil, situated on swampland near the seafront and vulnerable to flooding, Cité Soleil is home to hundreds of thousands of Haitians. Britannic (2015)
- Rural areas are home to 60% of Haitians from which 88% are poor and 67% are extremely poor. Together with a high fertility rate, Haiti is the second most densely populated country in the Western Hemisphere which is becoming a serious problem in terms of arable land. Agriculture in Haiti provides 50% of jobs at the national level and is very important to country’s GDP – 25%. There are over 1 million small farmers in Haiti who currently struggle with low agricultural productivity and tenure insecurity. Even though that the average farm size in Haiti is quite small – around 1 hectare, increasing population growth and density are becoming a serious threat. All these issues put a pressure on farm size which is exacerbated by urban encroachment on irrigated and arable land. UN, SOFI (2014)

### **3.4.4 Life expectancy**

When assessing the state of population and its projections towards future, it is also important to assess life expectancy and its development over time. Even though it is assumed that total fertility rate will be decreasing in future life expectancy rates are expected to reach higher levels than ever before in a history of Haiti. This would mean that the number of population will still be increasing or at least stagnating, even though the fertility rates tend to be lower. Therefore, Picture 4 below illustrates the current state and UN’s projections of life expectancy.

**Picture 4: Projections of Life Expectancy in Haiti (major area and region)**

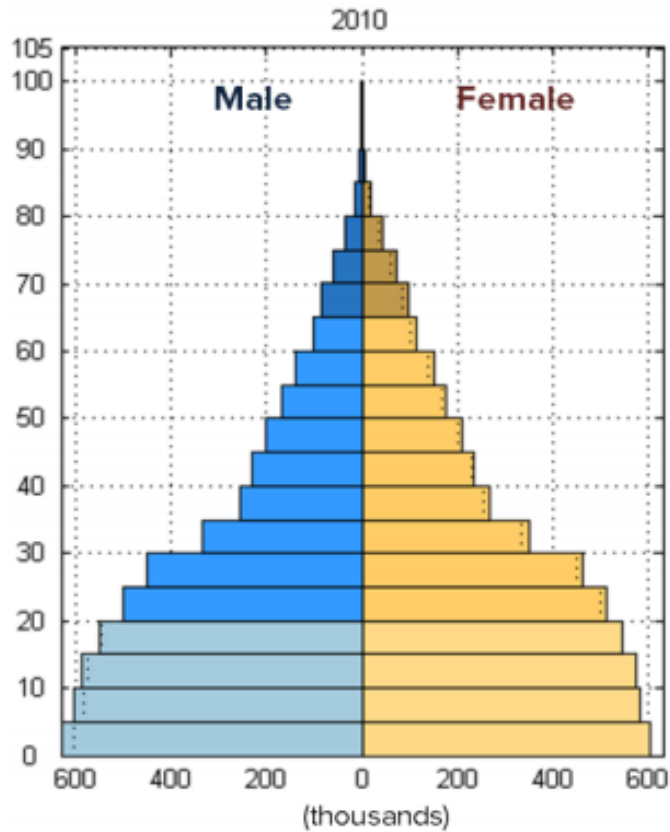


Source: United Nations, World Population Prospects (2011)

**Picture 4** puts an area of life expectancy into a broader context in terms of Region (Latin America and the Caribbean) and a sub-region (Caribbean). It is evident that even in a long term prognosis, the UN projections expect Haitian curve of life expectancy to stay lower than countries in the same region and sub-region.

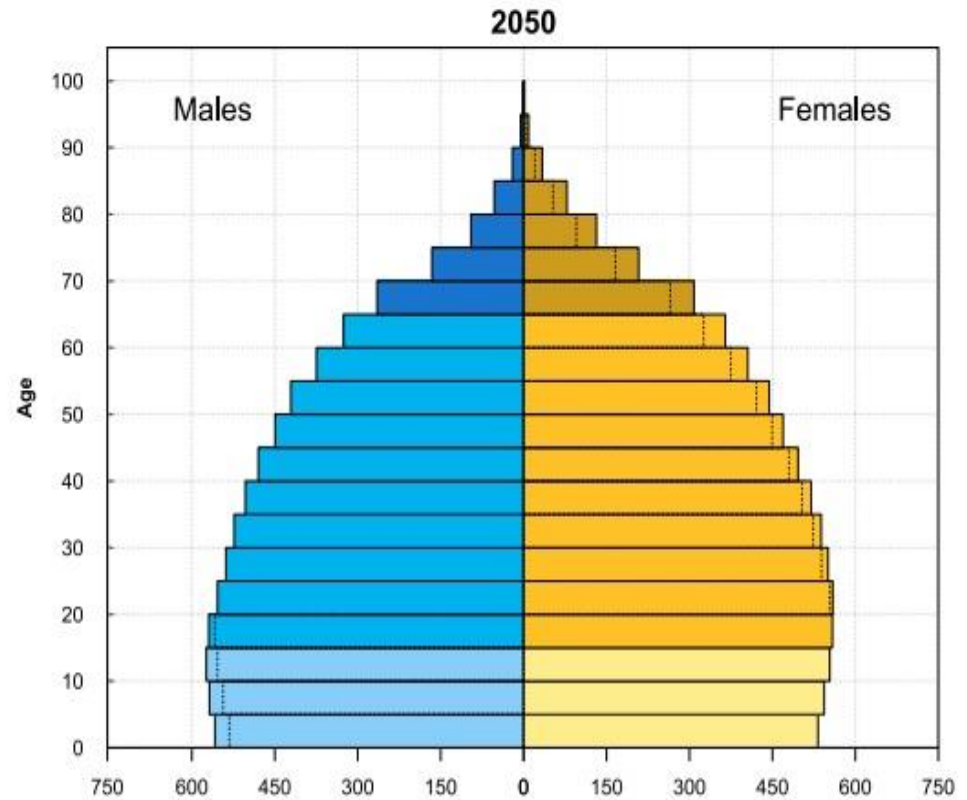
To understand an issue of life expectancy in Haiti, **Pictures 5** and **6** illustrate the demographic composition of the country in a more detailed manner – in a form of demographic pyramid:

**Picture 5: Demographic pyramid of Haiti: 2010**



Source: United Nations, World Population Prospects (2011)

**Picture 6: Demographic pyramid of Haiti 2050**



Source: United Nations, World Population Prospects (2011)

The Picture 5 captures the Haitian population of year 2010 which clearly indicates considerably high amount of young population of the age structure: 0-20 years old. This phenomenon indicates that in terms of population in the productive age (20-40) which could highly influence

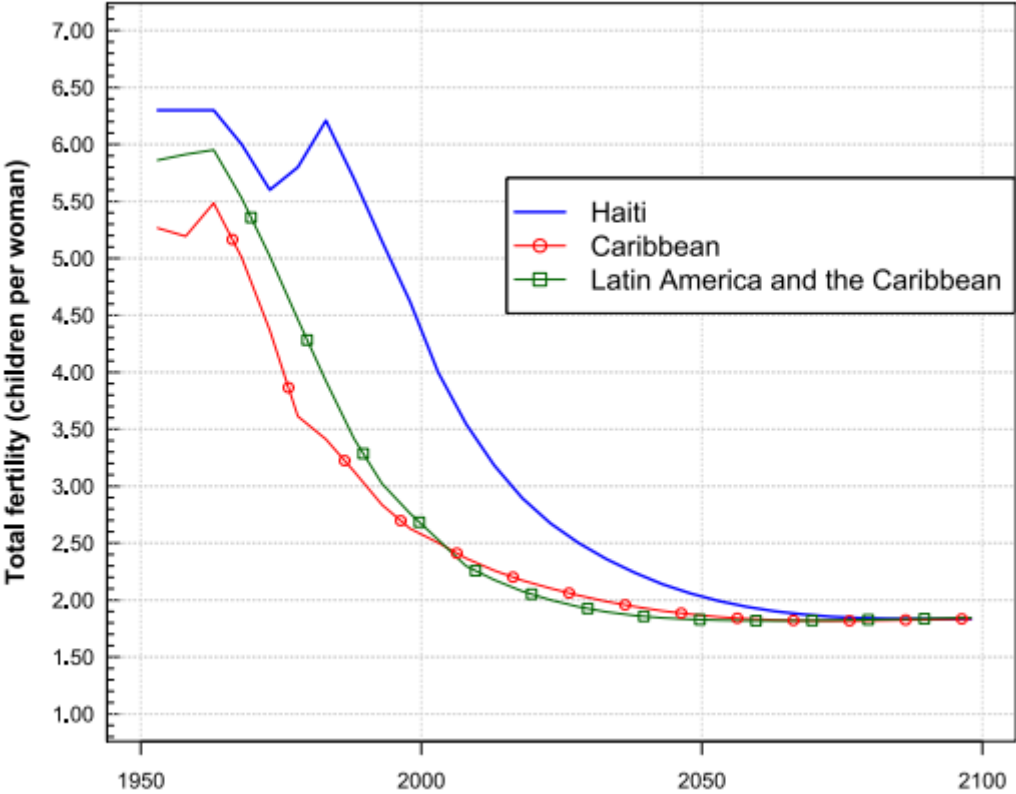


the economic development of the country is considerably missing. Moreover, the current demographic trend expects that after 30 years of age, population considerably either leave the country or is highly affected by natural disasters or diseases that significantly appeared for instance in 2010 e.g.: a massive cholera outbreak which still continues (2015).

The picture 6 captures the population of Haiti towards year 2050, based on United Nations projections of medium fertility scenario. As it can be seen, both figures differ very significantly and the second picture considers that life expectancy in Haiti should significantly increase from 61 for men and 64 for women (2010) to almost 80 years of age for both genders. Therefore, clearly, an improvement of living standard in Haiti is expected to occur. It is clear that according to UN projection, Haiti should experience a phenomenon named “demographic window” which implies that in a period when the share of population of productive age greatly outreach the amount of population out of productive age. Exnerová, Volfová (2008). This stage creates a positive, although temporary period to solve the economic problems of the country. Therefore, the period of demographic window offer a high possibility for improving the economic situation in Haiti from which the population could benefit from.

Therefore it can be assumed that the number of population will probably be increasing (although at a slower pace), even though the projected fertility rate is expected to decline significantly as it can be observed from Picture 7 as follows:

**Picture 7: Projection of Fertility rate in Haiti (major area and region)**



Source: United Nations, World Population Prospects (2012)

### 3.4.5 Elasticity

In order to calculate the projections of food demand in chapter 4.2, income elasticity of demand which will be subsequently used in various functions of power, has to be explained before.

In economics, there exist 3 basic interpretations of Income Elasticity of demand:

- i. A negative income elasticity of demand is associated with inferior goods which means that an increase in income will lead to a fall in the demand and may lead to changes to more luxurious substitutes
- ii. A positive income elasticity of demand is associated with normal goods which means that an increase in income will lead to a rise in demand. If income elasticity of demand of a commodity is less than 1, it is a necessity good. If the elasticity of demand is greater than 1, it is a superior or luxury good.
- iii. A zero income elasticity of demand occurs when an increase in income is not associated with a change in the demand of a good.

Perloff, J. (2008). *Microeconomics Theory & Applications with Calculus*

Table 2 below illustrates the calculation of Income Elasticity of demand for Jamaica, due to lack of data for Haiti. Moreover, arithmetic mean had to be used for calculation one single representative of elasticity. Normally, one could use the weighted average in order to calculate desired elasticity, based on the share of individual items in consumption, which can be obtained for instance from FAOSTAT database. Unfortunately, so far there are no data available regarding commodity consumption for Jamaica, Haiti or neither of developing country in Caribbean region.

**Table 2: Calculation of Income Elasticity of Demand**

Income Elasticity, Jamaica	Amount
fish	0,8336
dairy	0,79736
oil and fat	0,49218
fruit and veg	0,5926
food other	0,72957
bread and cereal	0,46952
beverage and tobacco	1,00856
meat	0,73214
<b>Arithmetic mean</b>	<b>0,70694</b>

Source: Own processed based on USDA Income Elasticity Report (1996)

According to a definition of Income Elasticity of Demand, table 2 above can be interpreted as follows: In case of low income elasticity of demand ( $E < 1$ ) a proportionate increase in income is accompanied by less than increase in quantity demanded. In table 2 the value of coefficient  $E_y$  is less than unity ( $E_y < 1$ ) and moreover, the arithmetic mean of all commodities also indicates value lower than 1, which can be interpreted as a *low income elasticity of demand*. Moreover, if  $E_y < 1$  as illustrated in table 2 various economic literature usually defines this phenomenon as a necessity good. If the elasticity of demand is greater than 1, it is defined as a luxury good or a superior good. In reality, if  $E_y < 1$ , it would mean that there exists e.g.: 5% increase in quantity demanded due to 10% increase in income ( $5/10=0.5$ , which indicates  $E < 1$ ). Table 3 therefore indicates that for an illustrated country of study, increasing portion of consumer's budget will be devoted to purchasing beverage and tobacco, because its elasticity is at its highest levels  $E > 1$  and this category is also defined as luxurious or superior goods. Perloff, J. (2008). *Microeconomics Theory & Applications with Calculus*

### 3.5 Agricultural development of Haiti and role of natural disasters

Agriculture production in Haiti is highly influenced by external factors (hurricane seasons, low rainfall, droughts, cyclones or earthquakes), therefore the role of natural disasters has to be included when assessing the agricultural development in Haiti as well.

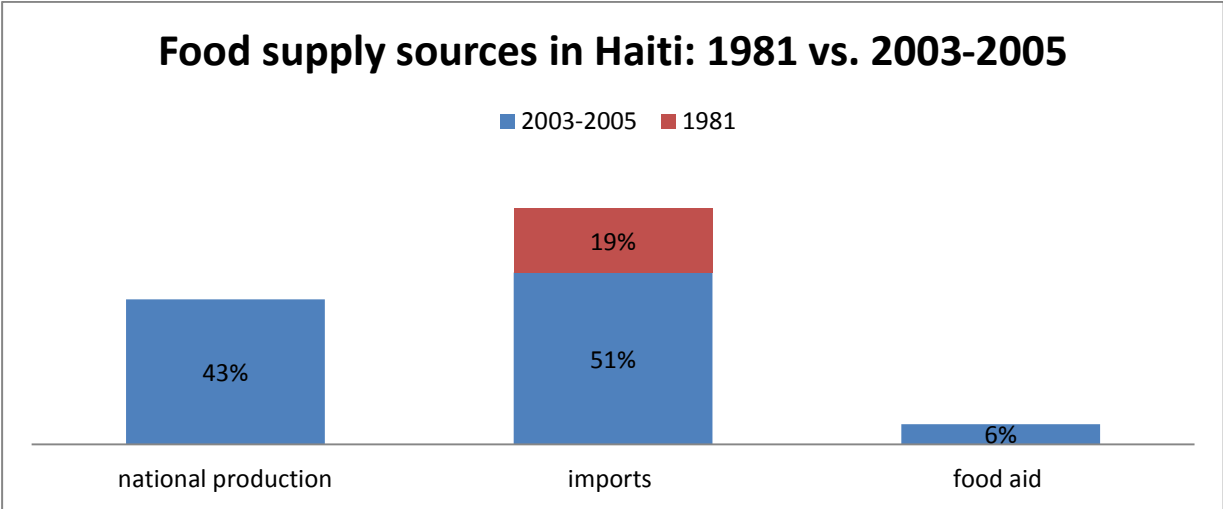
#### 3.5.1 Agricultural development of Haiti

Currently, almost 60% of Haitian population still live in rural areas and are highly dependent on small scale agriculture. Haitian family farms have an area of maximum 1ha and in case that the production is not sufficient due to various external factors families are highly dependent on food imports, which are often unattainable due to low income of the families. Moreover 60% of Haitian population still lives for less than 1.25 international dollars per day. UNICEF (2013)

Haiti’s food supply comes from three main sources: a) national production b) private imports, c) food aid, although imports are the most significant source of food. Haiti, Ministry of Agriculture (2010)

To illustrate the changes and compare the historical development, between years 2003 and 2005, the national production counted for an average of 43% of available foodstuffs goods, while imports of food remained at approximately 51%, and the food aid at around 6%. When compared with year 1981, the situation was considerably different due to food imports which did not even reach 19%. This situation is clearly illustrated in figure 8 below.

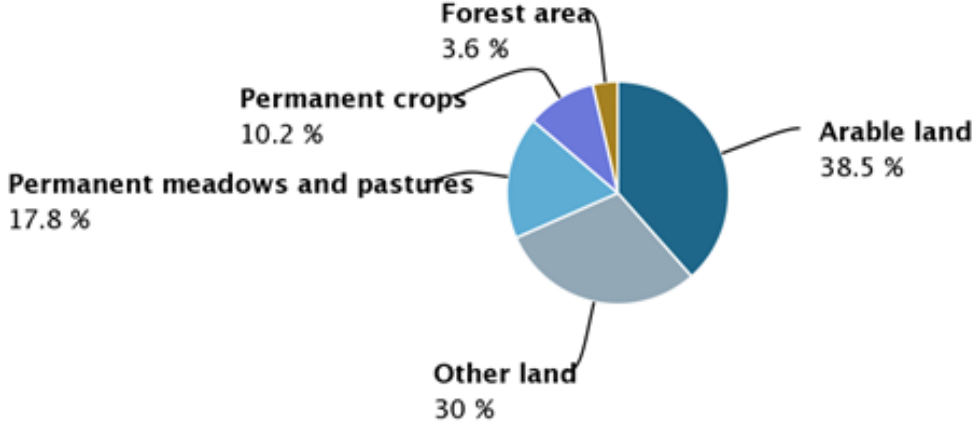
**Figure 8.: Comparison of food supply sources in Haiti: 1981 vs. 2003-2005:**



Source: Haitian Ministry of Agriculture, Natural Resources and Rural Development (2010)

The structure of land use according to the latest available data of 2011 is shown in Figure 8 below.

**Figure 8: Land use in Haiti, 2011**



Source: FAOSTAT, Haiti (2015)

As it can be observed from Figure 8, the second most significant proportion of land is represented by “other land”, which in reality means that 30% of land of Haiti is a non-farmland, mountainous land or damaged land due to high deforestation and subsequent erosion. Therefore there exists a 30% share of land which is not suitable for agricultural purposes. It is also obvious that forest area accounted for only 3.6% in 2011 and according to latest articles the proportion is even lower – at 2% in 2015. Comparing to year 1923, when forests in Haiti represented 60% of total area, it is an extremely worsening of environmental conditions in the country.

Besides deforestation (see supplement 4), Haiti’s environment is very suitable for agriculture. The deforestation process was started by the French to make place for the crops and later by Haitians to produce fuel (charcoal) which resulted in accelerated soil erosion, depleted fertility, reduced water retention and silting of the country's waterways. It is estimated that Haiti loses around 10,000-15,000 hectares of once-fertile land to erosion every year.

On the other hand, combination of factors such as different altitudes, diversity of soil types and climate ensures growing of more crops. Another important positive factor in terms of Haitian agriculture is the quality of the traditional seeds as rice, maize and beans varieties. For instance, traditional varieties of rice are known to be more nutritious than the cheaper, American rice (‘Miami’ rice), which replaced them two or three decades ago as a result of

trade liberalization. Haiti’s traditional rice is therefore better for fighting with malnutrition. *Annals of the University of Petroşani, Economics* (2011)

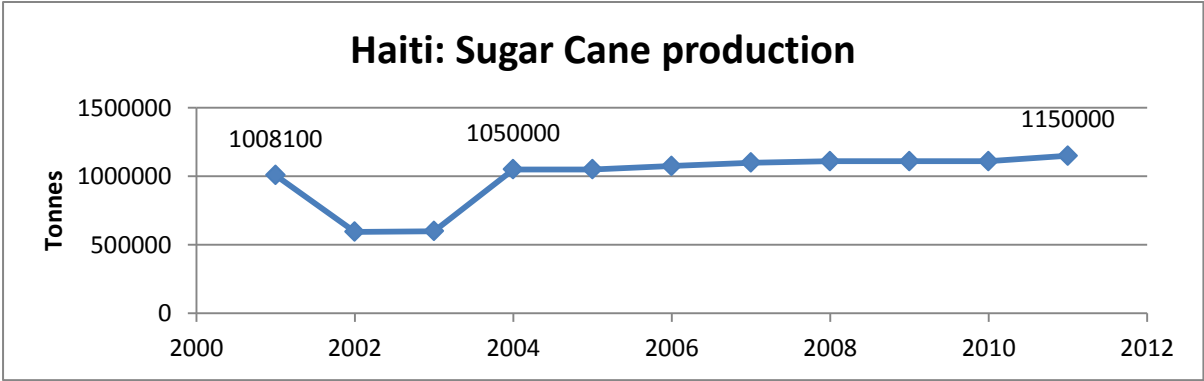
International help besides humanitarian relief flows into Haiti as well. According to Oxfam (2012), the tripartite agreement between Brazil, the United States, and Haiti are committed to a five-year project based on the US Feed the Future initiative, and is designed to improve the stability of watersheds and strengthen agricultural markets. It mainly aims to help vulnerable Haitians escape poverty and hunger and to provide children with nutritious food for their healthy development. The three governments are committed to following goals and improvements:

- Testing new varieties of maize, rice, beans and other crops
- Applying new farming methods that use less water, fertilizers, and seeds
- Improving mango production
- Adopting technologies for storage of grains and vegetables
- Enabling farmers to use their land to produce both food and timber sustainably
- Offering exchange programs and training for farmers and researchers. Oxfam (2012)

**3.5.2 Cash crops**

Once most significant cash crop – coffee used to be very important for export, although in 1988, Haiti had to be excluded from the International Coffee Association (ICA), due to its inability to export ICO quota (300,000 coffee bags of 60kg each). Nowadays, the most significant cash crop is sugar cane and its development of production is listed below in picture 8.

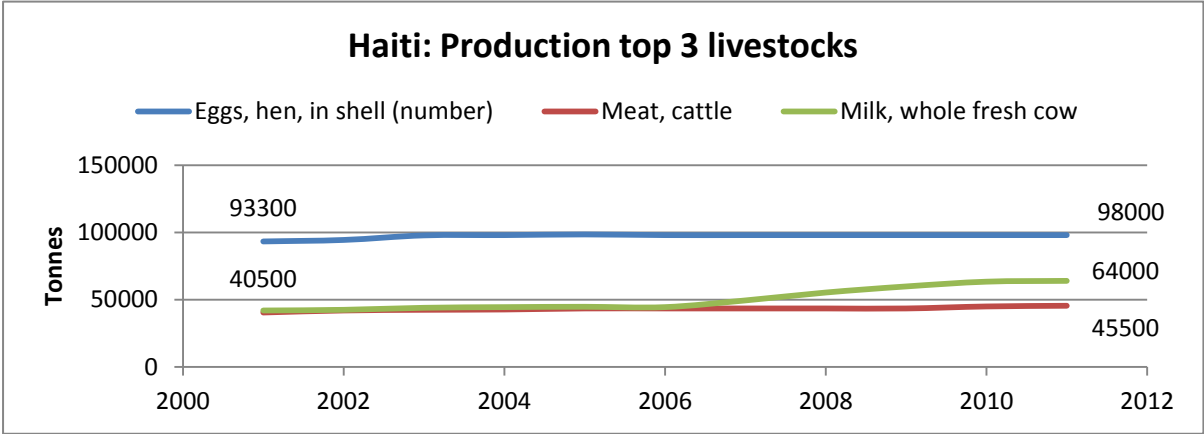
**Picture 8: Development of sugar cane production in Haiti (main cash crop)**



Source: Own processed & FAOSTAT, Haiti (2015)

It can be observed that after a moderate stagnation over the period 2007-2011, Haiti’s sugar cane production indicates an increase by 40.000 tonnes since 2010 onward. In terms of livestock production, figure 8 shows the development of the top 3 livestock production as follows:

**Figure 8: Development of top 3 livestock production in Haiti**



Source: Own processed & FAOSTAT, Haiti (2015)

As figure 8 indicates, it can be seen that over last 11 years period, only the production of whole fresh cow milk increased by 36% (by 23.500 tonnes), otherwise the production of eggs and cattle meat rather stagnates.

As another potential strength of Haitian agriculture, fishing sector can be mentioned. Besides the small border with Dominican Republic, Haiti has a lot of water to use for fishing. Although according to The Economist (2011) the most of the population of Haiti cannot afford to perform fishing for living due to the high price of fuel which is needed for operating the boats and subsequent transportation to customers. Moreover, after the last earthquake in 2010, conditions of roads and overall infrastructure is still very weak in certain areas of Haiti, therefore it would be very difficult to reach customers and make a profit out of it.

According to a study of Univesity of Petroşani: *“Decades of ineffective and exploitative government have contributed to unsustainable farming and land management practices, leading to dramatic soil erosion, declining soil fertility and scarcity of water and seeds. These essential elements of agricultural systems have come under increasing stress in recent years, and the majority of Haitian farmers have not received adequate support to strengthen their knowledge and management of sustainable farming systems”*.



**3.5.3 Haiti’s Agriculture – contribution to GDP**

Although agriculture is an important sector in the overall economy, Haiti does not produce enough food crops and livestock to feed its population. In terms of GDP composition by sector, comparison between Haiti and Dominican Republic is illustrated below in table 4.

**Table 4: Composition of GDP; Haiti and Dominican Republic**

Haiti	Dominican Republic
Agriculture 24.1%	Agriculture 6%
Industry 19.9%	Industry: 29.1%
Services: 56%	Services: 64.9%

Source: CIA, Factbook (2013)

Even though that Haiti is located on the identical island as Dominican Republic the difference in terms of agricultural sector’s contribution to GDP is considerably significant. Even though that Haiti disposes with considerably worse environmental conditions for agriculture, its contribution to GDP in terms of this area is 17.9% higher than its neighbor’s. On the contrary, the most of part of the GDP of Dominican Republic is accounted mainly to tourism, which Haiti cannot offer yet.

**3.5.4 The role of Natural Disasters in terms of Agricultural production**

Natural disasters are quite common events for Haiti as it is located in the middle of the hurricane belt and is subject to severe storms from June to October, occasional flooding and earthquakes and periodic droughts. As Haiti's forests and trees have disappeared due to massive deforestation, landslides have become a major concern, especially during the rainy season, and the destabilizing effects of an earthquake on soil only worsen the problem [Than K., 2010].

After 2010 earthquake, a considerable amount of population who lived in Port-au-Prince and the damaged surroundings, have migrated back to their families to rural areas, which were not hit by the catastrophe that significantly as other areas. According to estimates of Haitian Ministry of Agriculture (2010), the rural areas which are affected by poverty the most, experienced an increase in terms of household members from 5 to 10. Due to a fact that it is rather difficult to bring direct food aid to rural areas without proper infrastructure (paved roads, weak road density etc.), there existed a high risk of rapid exhaustion of alimentary stocks of rural households.

Therefore, the 2010 earthquake provoked following trends in terms of food security:

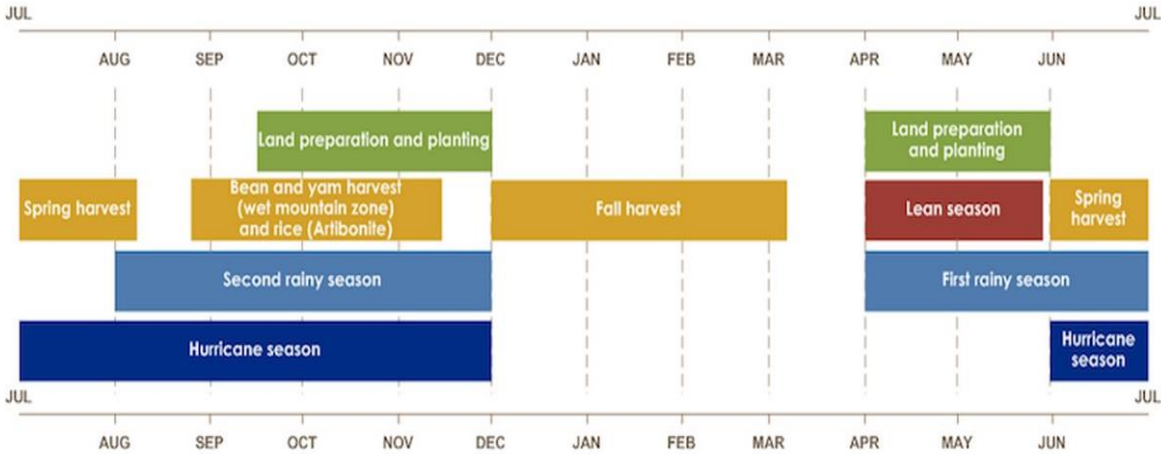
- A sudden and significant increase in the number of people living in the same household in rural areas which resulted in a deficit of basic alimentary goods in rural areas and a greater risk of a significant increase of the food insecurity
- A price increase for basic alimentary goods in rural areas
- The stock of seeds used for human consumption
- A risk for small-scale livestock farmers in terms of slaughtering of producing livestock in order to feed the household
- The impoverishment small-scale farmers, due to the fact that they cannot benefit from price increase (they use their produce for home consumption)
- The incapacity to purchase inputs (seeds, fertilizers, etc.) and tools necessary in the intensification of the agricultural production. Haitian Ministry of Agriculture (2010)

For year 2015 the Haitian government estimates that over 500,000 people could be affected by natural disasters including by storms or other extreme weather events influenced by the El Niño phenomenon. Every year, thousands of families lose their livelihoods during the hurricane season. In all, an estimated 2.5 million Haitians still need assistance to access proper medical care, clean water and sanitation, or to overcome the crippling consequences of poverty, therefore an assessment of Food Security indicators covers also an indicators of an access to clean water and sufficient proteins/per capita/day.

The **picture 8** below shows the detailed time line of agricultural processes and the usual climate conditions in Haiti over time. It is obvious that not only repeating events such as hurricane seasons occur quite frequently, but also, quite a significant amount of ad hoc natural disasters occur as well. As it is obvious from the picture 3, the fall harvest usually takes place from December to March. When looking to historical data of unfortunate events in Haiti, the 2010 earthquake that killed over 200,000 of Haitian population took place in the beginning of January. According to picture 3, in the period when the earthquake struck, such event was not expected by any means.

This simple model of agricultural processes and climate conditions cannot be 100% reliable, but on the other hand, it can help to anticipate at least the hurricane and rainy seasons. Therefore the fall harvest and agricultural production of 2010 was negatively influenced by this event and therefore the crop production was low. As it is visible in Figures in chapter 4 devoted to food imports and cereal dependency ratios, in year 2010, Haiti had to invest to food stuff imports very significantly and had to increase the amount of imported goods in general.

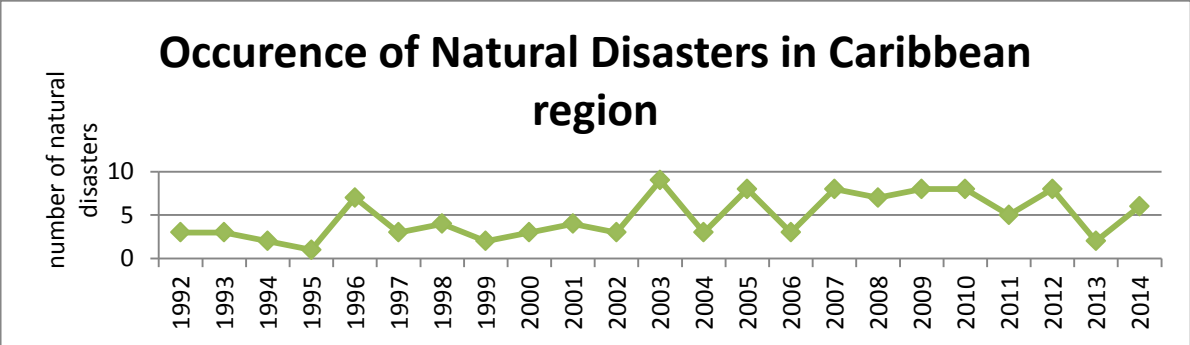
**Picture 8: An illustrative calendar of agricultural processes and climate conditions in Haiti**



Source: Famine Early Warning System Network, (2012)

Moreover, to show the frequency of natural disasters in Haiti, two figures should help to realize the seriousness of the situation. **Figure 9** below illustrates the occurrence of Natural Disasters in *Caribbean region* and **Figure 10** the occurrence of natural disasters in *Haiti*.

**Figure 9: Development of the occurrence of natural disasters in Caribbean region; number of individual natural disasters; 1992-2014**



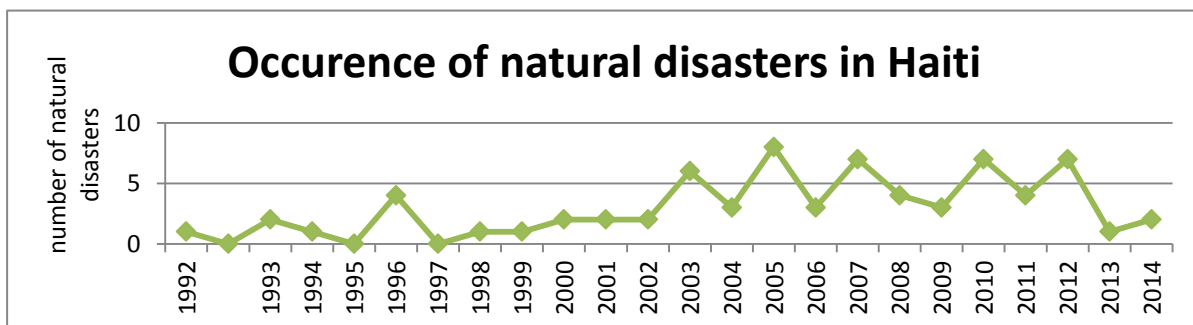
Source: International Disaster Database (2015)

## Discussion

Based on **Figure 9** it is evident that since year 1992 the number of natural disasters in Caribbean region increased, although it is important to mention that these events were of various character, a degree of danger and extent. For instance, the year 2010 may appear as not the one with the highest occurrence of natural disasters, on the other hand, the extent of 2010s earthquake was much more serious in terms of damages and alarming number of victims – over 229 thousands.

In terms of the occurrence of natural disasters in a region, other influencers, such as climate change, also affect agricultural performance. *“Although as yet there is no conclusive evidence that climatic variability and the occurrence of extreme events such as drought, flood and storms, have increased significantly, nevertheless, global models suggest that such changes in climatic variability are likely to occur.”* FAO (2003)

**Figure 10: Evolution of occurrence of natural disasters in Haiti**



Source: Own processed & International Disaster Database (2015)

Amongst the most serious types of disasters in Haiti since 1992 can be included:

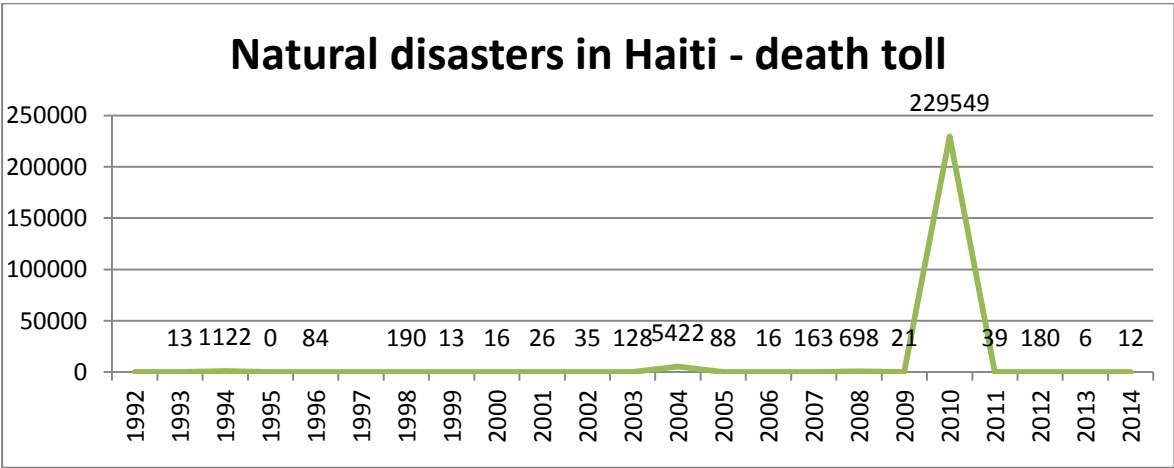
- a) Hurricane Gordon (killed hundreds in 1994)
- b) Hurricane Georges destroys 80% of crops
- c) Floods (killed over 2,500 in 2004)
- d) Tropical storm Jeanne. 1,900 victims in 2004
- e) Tropical storm Noel caused floods and mudslides in 2008)
- f) 3 hurricanes and tropical storm killed 800 in 2008
- g) Earthquake hit Port-au-Prince, 230,000 victims in 2010
- h) Cholera outbreak kills nearly 6,000 in 2010-2011

**Discussion**

The most recent report of World Food Program states that in Haiti, late rains and a dry spell in May and June affected the departments of Centre, Nippes, Ouest, Arisonite and Nord-Est, as well as coastal areas. The dry spell damaged maize, yam and groundnut production. As a result, food stocks will be below average for the poorest households, and a reduction in casual labour opportunities will limit incomes. CNSA/FEWS NET report that in the worst-hit areas food security is expected to reach Phase 3 (Crisis) as early as February 2015. Supplement 4 illustrates the most recent CNSA/FEWS map of food insecurity in Haiti.

Figure 11 concludes the chapter devoted to natural disasters in Haiti and represents the death toll of disasters that occurred within the period of 1992-2014. It is obvious that an earthquake in 2010 was the most significant event that occurred during past 22 years, therefore it has to be taken into account as a turning point when it comes to food security, because this event considerably influenced the daily life of Haitians and even after 5 year since the disaster, the country is still recovering from it. The Figure 11 below illustrates the specific death toll caused by natural disasters over past 22 years as follows:

**Figure 11: Development of Natural disasters in Haiti – death toll**



Source: Own processed & International Disaster Database (2015)

**Discussion**

Based on the development of the curve in Figure 11, it is obvious that the earthquake in 2010 played an enormous role in the recent history of Haiti. Another turning point can be observed in 2004, when tropical storm Jeanne and floods killed around 5 thousand of people. It is assumed that in the near future, more natural disasters will occur due to the sensitivity of the

Caribbean region towards natural disasters and among others, to hurricane season, which occurs regularly although with various intensity. According to UN (2015), Haiti is currently better prepared for future disasters. *“National capacities for disaster preparedness and response have been strengthened as a result of the response to the earthquake. The country now has emergency operation centres in each of its 10 departments, as well as the capital Port-au-Prince. Departmental and national emergency plans have been developed. A national plan to reduce seismic risk has been created, and almost two dozen disaster simulation exercises have been carried out across the country, allowing authorities and aid groups to test preparedness and response plans”* United Nations, OCHA(2015)

### **3.6 Assessment of Millennium Development Goals in Haiti towards 2015**

As already explained in chapter 3.1.2, Millennium Development Goals by United Nations were set in 2000 in order to cover 8 main measurable areas and 21 specific targets with the common goal to improve the situation in developing countries all over the world within the areas of health and economic indicators. The latest reports (2014) on the state of the Millennium Development Goals in Haiti are following:

#### **MDG1: Eradicate the extreme poverty and hunger**

The Haitian national poverty rate is 58.6 percent and the extreme poverty rate: 24.7 percent. Currently, the richest one percent of Haitians owns the same wealth as 45 percent of the poorest population.

#### **MDG2: Achieve universal primary education**

The net enrollment rate in primary education has increase from 47 percent in 1993 to 88 percent in 2011.

#### **MDG 3: Promote gender equality and empower women**

Women occupy more than 20 percent of government positions, but only 4.3 percent of seats in parliament.

#### **MDG 4: Reduce Child Mortality**

The number of children vaccinated against measles increased from 25.80 percent in 1987 to 85 percent in 2013. Moreover, following table 5 cover more targets of MDG 4 in terms of reducing child mortality as follows:

**Table 5: Haitian children affected by malnutrition, data of 2009-2013**

Children with low birthweight	23%
Underweight	12%
Stunting	22%
Wasting	5%
Overweight	4%
Vitamin A: full coverage (2013)	13%

Source: UN, SOWC, 2013

Based on a table 5 stated above, it is obvious that the proportion of Haitian children who suffer from various aspects of food insecurity is even nowadays still very serious. An interesting phenomenon can be observed when comparing the proportion of children suffering from wasting (low weight for height, which is also a strong predictor of mortality among children under five) and a proportion of overweight children where the proportions differ by 1%. Therefore it can be assumed, that to some extent, there also exist a food intake excess at the same time as significant amount of underweight children.

Moreover a disturbing proportion of children suffering from *vitamin A* deficiency exist in Haiti as well. Latest report of FAO states that only 13% of Haitian children fulfill vitamin A supplementation within full coverage. Vitamin A deficiency contributes to childhood blindness and increases a young child’s risk of mortality from common illnesses. The main sources of vitamin A are notably food of animal origin or vegetables rich on carotene. Progress on supplementation of vitamin A contributes towards achieving Millennium Development Goal number 4 on child survival. (list of complete Millennium Developments Goals is enclosed in chapter 6 – Glossary of used terms)

**MDG 5: Improve maternal health**

In rural areas, 75% of births are performed without the assistance of qualified person in obstetrics. In urban areas, the majority of women give birth with medical assistance – this is true for almost 60 percent of births.

### **MDG 6: Combat HIV/AIDS, malaria and other diseases**

According to latest report (2014) HIV/AIDS prevalence has stabilized between Haitians aged 15-24 years, from one percent in 2006 to 0.9 percent in 2012. Moreover, 46 % of women has the knowledge that HIV can be transmitted through breastfeeding.

### **MDG 7: Ensure environmental stability**

16,000 hectares of forest have been planted since 1990.

### **MDG 8: Develop a global partnership for development**

From 2012 to 2013, the Department of the West received 34 percent Official Development Assistance, compared to one percent in Nippes and the Northeast. (see chapter 3.2 for country profile and a map of Haiti's departments)

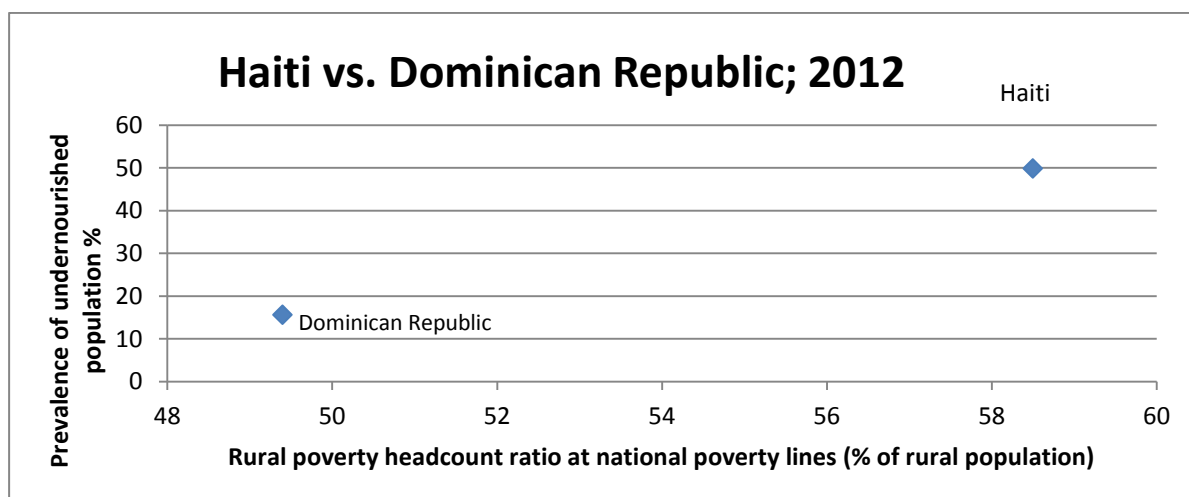
When assessing the state of 8 Millenium Development Goals, one can already see improvements when comparing to year 2000 or even earlier. According to UN's report (Objectifs du Millénaire, 2013) the latest surveys in Haiti indicates that food insecurity highly depend on specific regions of Haiti, most importantly on whether the region was affected by any natural disaster. One cannot say that in urban areas of Haiti, the food insecurity is lower than in rural ones, due to the latest results of food security surveys. According to above mentioned source, in 2012 the prevalence of food insecurity rose up to 43% in rural areas due to cyclon Sandy. On the other hand, one year later, the food insecurity was significantly lower: 27%. An estimated overall proportion of Haitian population suffering from food insecurity for year 2013 is 24%, but it does not mean that this proportion is valid for the entire country. In general, north and north-east departments of Haity are evaluated as the poorest ones and also, most affected by food insecurity. Even for the year 2013, the proportion of insecure population is estimated to be over 40%. On contrary, the region with the lowest share of food insecurity is Centre department, bordering with Dominican Republic with only 17% of population that suffers from food insecurity. This fact is assumed to exist due to easier access to nutritionally richer food in Dominican Republic, that is often obtained illegally from various traffickers.



## 4. Practical part: Analysis of Food Security in Haiti and projections of food demand towards 2050

In order to understand a serious issue of food insecurity in Haiti comprehensive based on the most recent data, Figure 12 below puts the issues of poverty and undernourished population of Haiti into more specific context. Figure 12 explains the relationship between prevalence of undernourishment (%) and rural poverty headcount at national poverty lines (% of rural population) and puts both examined areas into a comparison to Dominican Republic, which shares the island of Hispaniola with Haiti.

**Figure 12: Comparison of Haiti and Dominican Republic undernourished population vs % of rural population below poverty line**



Source: Own processing & FAO, Food Security Indicators (2014)

The Figure 12 reveals that even though Haiti is located on the same island as Dominican Republic, share the common climate and also a high risk of natural disasters and hurricane seasons, the difference between the state of these 2 examined areas is striking. The level of undernourished population in Haiti is equal to almost 50% whereas Dominican Republic indicates the proportion of only 15.6%. Similar phenomenon occurs when comparing the rural population below national poverty lines. In this case, the rural population in Haiti indicates to be under the national poverty lines from 58% of the total rural population whereas for Dominican Republic, the percentage equals to 49.4%. In terms of rural poverty, the countries are rather closer than in terms of prevalence of undernourished population.

However, it has to be emphasized that rural population in Dominican Republic constitutes of only 23% from the total population of the country, whereas rural population in Haiti constitutes up to 45% of the total population. (2012, World Bank, World Development Indicators)

## **4.1 Analysis of 4 Dimensions of Food Security**

Due to the fact that an assessing of the state of hunger and food security in the world is a multi-dimensional issue, the food security must be assessed based on analyzing numerous indicators. For this particular reason, the Food and Agriculture Organization (FAO) of the United Nations (UN) introduced a comprehensive concept of assessing Food Security in the world - “Suite of food security indicators”. The four key dimensions of this concept consist of many sub-indicators and some of them will be subsequently analyzed for the country of study – Haiti.

### **4.1.1. Availability**

In terms of the first food security dimension – *availability* – three indicators with the most significant amount of data was chosen for an analysis of food security in Haiti:

- a) Average dietary energy supply adequacy**
- b) Average value of food production**
- c) Average protein supply**

#### **a) Average dietary energy supply adequacy**

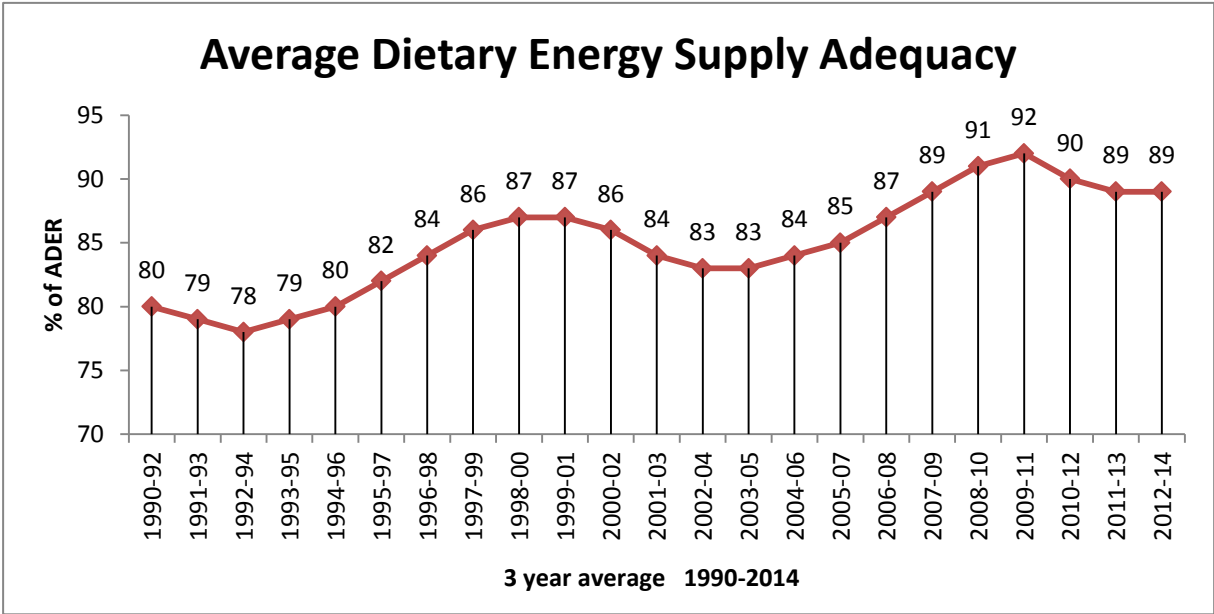
This indicator measures adequacy of the national food supply in terms of calories and expresses the Dietary Energy Supply (DES) as a percentage of the Average Dietary Energy Requirement (ADER) in Haiti. It is calculated as an average over 3 years to reduce the impact of possible errors in estimated DES, due to the difficulties in properly accounting of stock variations in major food. It thus provides an indicator of structural food supply adequacy.

The country's average supply of calories for food consumption is normalized by the average dietary energy requirement estimated for its population, to provide an index of adequacy of the food supply in terms of calories. Analyzed together with the prevalence of undernourishment, it allows discerning whether undernourishment is mainly due to insufficiency of the food supply or to particularly bad distribution. FAO (2014)

In case that the country indicates low average dietary energy supply adequacy it may need to introduce policies for enhancing the means of making more food available to their citizens, including production enhancement, increased trade and effective stock management. The opposite situation may also occur when countries where there are high levels of both - *average dietary energy supply adequacy* but also *high undernourishment* level, more focus on enhancing income and food distribution may be required. This indicator helps to understand whether undernourishment is mainly caused due to insufficient food supply or to bad distribution. would for instance mean to pay more attention to the state and density of paved roads and railroads in the country. Economic and Social Commission for Asia and Pacific (2013)

**Figure 13** below demonstrates the evolution of an *average dietary energy supply adequacy* in Haiti in detail. Moreover, an analysis of this particular indicator applied on Haiti will follow as well.

**Figure 13: Evolution of Average Dietary Energy Supply Adequacy in Haiti, 3 year average; 1990-2014**



Source: Food Security Indicators; FAO (2014), author’s elaboration

The evolution of indicator illustrated in **Figure 13** refers to a percentage of the average dietary energy requirement. The higher the percentage is, the better the country fulfils this examined issue. The Figure 1 illustrates the evolution of this percentage from the year 1990 to 2014. One can observe a significant descent during two periods. First of all, the descent is

obvious in year 1999, when the percentage decreased from the value of 87% to 83% in 2003. It is assumed that this could have been caused by the food price crisis in Haiti in years 2000-2008. Moreover, after the year 2008, when the prime minister Jacques-Édouard Alexis resigned and was replaced by Michèle Pierre-Louis, the overall economic situation had begun to improve. In 2008, Yvonne Tsikata, the World Bank's country director for the Caribbean also planned to provide \$10 million in grant handouts to Haiti for school lunches and work programs and other measures to mitigate food price increases. Unfortunately, after the development agency started to plan helping Haiti to develop a medium-term strategy to improve food security in 2008, another natural disaster hit Haiti in 2010 and it is obvious that the food dietary supply adequacy has decreased to its 2007's level again: 89%.

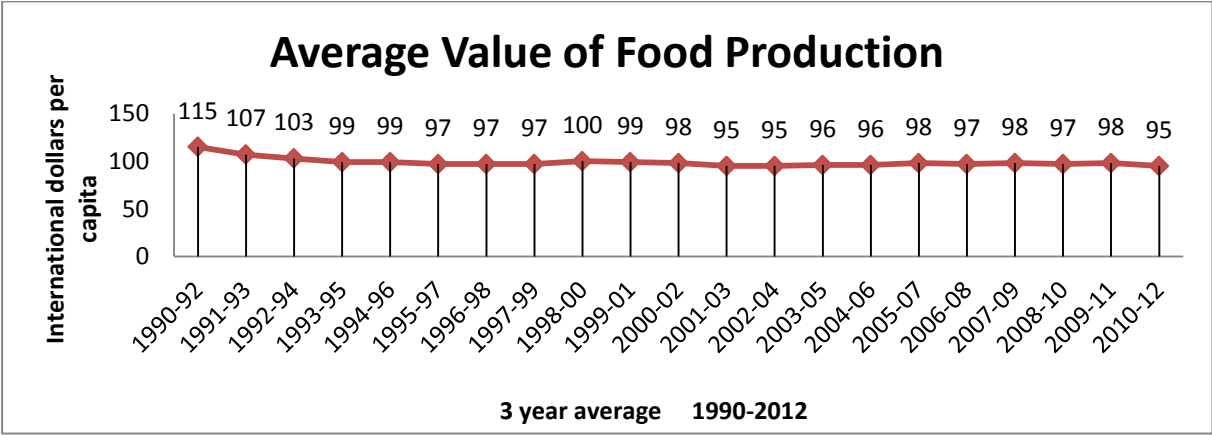
**Status of the indicator:** Stagnates and is expected to stay stable on the level around 89 % in a long term.

**b) Average Value of Food Production in Haiti**

An indicator measures the total value of Annual Food Production (estimated by FAO) expressed in International Dollars per capita. It can be also defined as a cross-country comparable measure of relative economic size of the food production sector in the country.

It provides a cross country comparable measure of the relative economic size of the food production sector in the country. **Figure 14** illustrates the evolution of the average value of food production in Haiti in a period of which the data were available: 1990-2012.

**Figure 14: Annual Average Value of Food Production in Haiti in international dollars**



Source: Food Security Indicators; FAO (2014), author’s elaboration

### **Development of rice production value /import value/import volume in Haiti**

The Figure 14 unfortunately shows only the data average for the years 1990-2012, but it is noticeable that after an earthquake in 2010, the value of food production began to decrease to its 2002 level. It is assumed that due a sequence of natural disasters and droughts, the present value of food production probably has not reach the level of the year 2010 yet, nevertheless, thanks to several international projects and help, farmers are currently learning new techniques of farming with the goal of achieving higher yields on a sustainable basis. According to US AID's (2015) article:“ Project FTF West, introduced new technique of farming in 2010 and contributed to a fact that from 2009 to 2013, corn yields increased by 448%, bean yields increased by 94% and plantain yields by 56%. The FTF West project is expected to last five years and is run under the U.S. Government's flagship food security and global hunger initiative – *Feed the Future*. The new technique that has been introduced in Haiti: System of Rice Intensification (SRI) is a method of rice cultivation that has been adopted in 40 countries already. This technique allows farmers to even double their yields while using fewer seeds and significantly less water and fertilizers. The principles of SRI include good soil preparation, adequate space between plants, using one seed per pocket, intermittent irrigation, weeding between rows, and organic fertilizer. This results in strong roots and vigorous plants that engender high yields. On the other hand, this method has been introduced in a few areas of Haiti only and the import of food is still very significant based on the fact that food import represented 44% of total food availability in 2010, compared with 19% in 1980. SOFI report (2014)

Despite that in the 1980's, Haiti was self-sufficient in terms of rice production the country became a major rice importer over time. The reason for this enormous shift is attributed to changes in trade policies, extreme poverty and vulnerability to extreme weather events. Currently, about 80% of rice and 100% of wheat staples that account for 1/3 of the calorie intake of the population – are sourced from international markets. Moreover, in 2008, Haiti's dependency on international markets had a serious impact on the availability of rice in the country due to 2008 Global Rice Crisis.

### **Great Rice Crisis 2008 - causes**

*The world rice market ran amok in late 2007 and 2008. Prices spiralled as exporters restricted supplies to the market in order to protect their own consumers from shortages. Importers scrambled for supplies to stabilize their own markets. For several months in early*

*2008 it looked as though historic price levels would be reached even when adjusted for inflation. In the end, additional supplies were located (but not used), the panic subsided, and rice prices fell sharply to the trend they had been on since recovery began from the lows in 2002. FAO and Earthscan, The Rice Crisis Markets, Policies and Food Security (2010)*

To elaborate more on Great Rice Crisis and a case of Haiti – between January and May 2008 the price of rice has increased dramatically by more than 300% (from 300 USD per tonne to 1,200 USD per ton) and this fact meant a serious problem for a country that was dependent on rice import from 80%. Moreover, with the change of prime ministers and massive food crisis riots and unrest in 2008, the government started to plan changes in terms of food availability. The president Prèval and private sector leaders introduced a plan to cut the cost of a sack of rice to \$43 from \$51 under following circumstances: three dollars of the price cut would be paid for by businesses and the rest by international donors. During 2008-2010, Haiti spent 50% more on food imports than it received from total merchandise exports and such exposure to international markets make the country vulnerable to the cost of food and price spikes in the global food market as already seen in terms of Rice price crisis. The rice price crisis was caused by overall bad weather conditions in regions that focus on rice exports significantly (China – mainland, India, Indonesia, Viet Nam etc.) and it can be assumed that such events can occur in near future again. For this particular reason, it is crucial to foster local rice production in Haiti in order to avoid such a major dependency on volatile international markets.

Moreover, low levels of rainfall combined with unfavorable socioeconomic conditions have led to reduced crop production in the Southern peninsula, the Central Plateau, the North and the North-East of Haiti. According to a report from December 2014 (USAID) in near future, poor households in the most affected areas could experience a significant deterioration in their food security situation through March 2015. On the other hand, thanks to many international projects that focus on spreading the know-how of new farming techniques, it is assumed that Haiti should be able to double their rice production and avoid the 2013's trend of that the average price of local rice in Croix-de-Bossales (the largest and most important market in the country, located in Port-au-Prince), was 62.91 HTG (=1.32 USD; March 2015) and the average price of imported rice was 39.21 HTG (=0.82 USD; March 2015). This situation led to a lack of motivation to buy and subsequently produce local rice.

According to a 2014's report of the Haitian Ministry of Agriculture, Natural Resources and Rural Development – there are currently 7 international projects, supported by U.S. Government and devoted to commercialization of following areas:

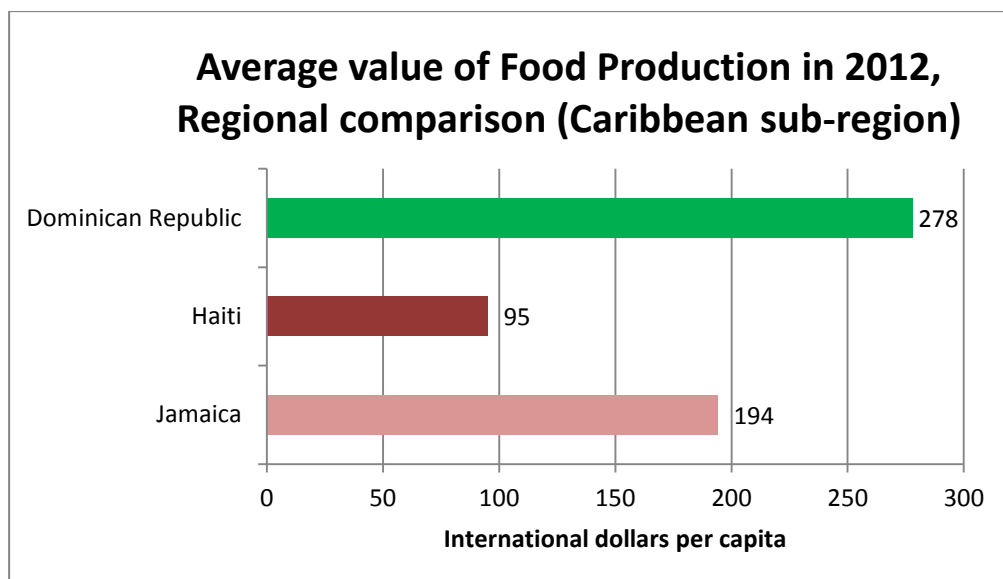
- a) rice, beans, corn
- b) bananas
- c) bananas, vegetables and tomatoes
- d) development of coffee regions

Thanks to international project, it is assumed that *the average value of food production* should increase in coming years. On the other hand, there are many factors that can slow or even stop the current trend and they are mainly: unstable weather conditions or natural disasters. International projects operate in different regions of Haiti and their details, including the amount of investments in million of USD, are listed in Supplement 2.

### **Discussion**

The development trend of Average value of Food production over the period 1990-2012 did not show any significant progress in terms of food production and indicates that Haiti does not produce enough food to feed its population sufficiently. Therefore, the role of imported foodstuff is considerably large. Compared to Dominican Republic which is located within the same island – Hispaniola - the gap between these two countries is still of a significant extent even when examining historical data of both countries. When taking into account the data from 1990-2012, Dominican Republic still shows up to \$100 more in terms of annual food production value than Haiti. The latest possible comparison of countries in the Caribbean sub-region was taken into account and is shown in Figure 15 below:

**Figure 15: The state of average food production in 2012, country comparison, international dollars per capita**



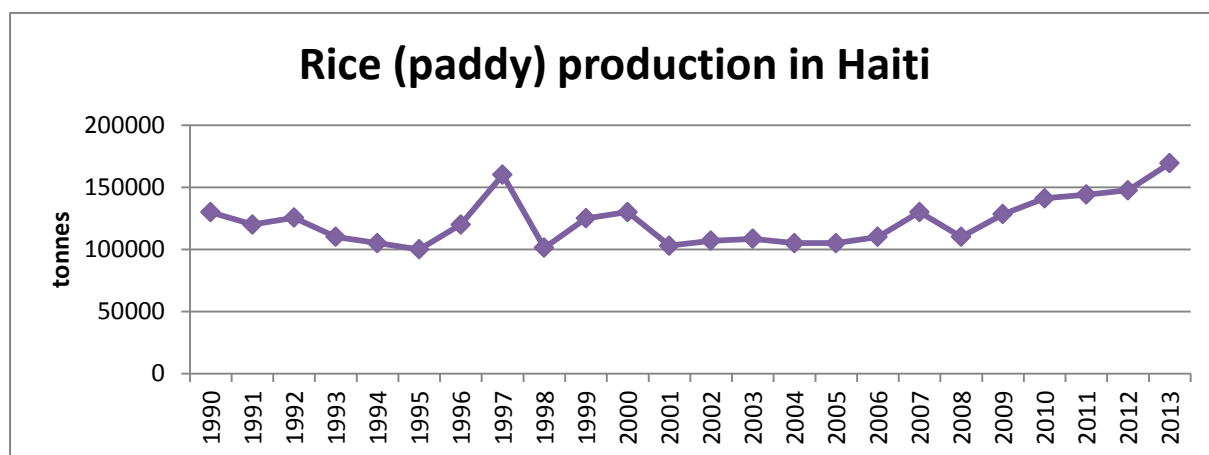
Source: Food Security Indicators; FAO (2014), author’s elaboration

**Prospects of the indicator:** slight decline and stagnation with expected future increase thanks to introduction of new farming techniques (e.g. rice intensification). However, there is also a high risk of future decline due to frequent natural disasters, therefore it is expected that the curve of food production in Haiti will fluctuate and will not remain stable in a long term.

**Development of rice (paddy) production value/import value/import volume**

In order to demonstrate to what extent the Great Rice Crisis played a role in Haiti’s production and import of rice, three figures below will be compared:

**Figure 16: Development of rice (paddy) production in Haiti (tonnes);1990-2013**



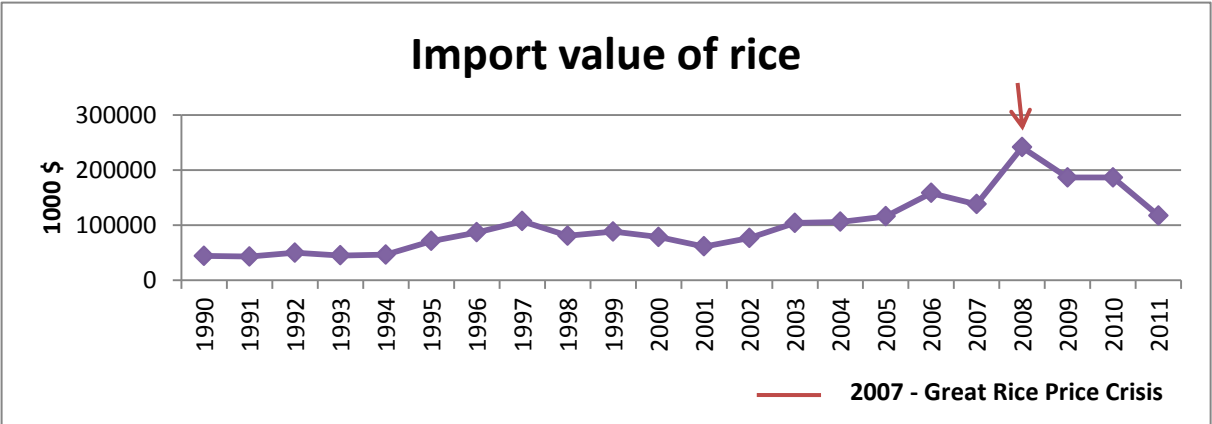
Source: Own processing & FAOSTAT database (2014)



Based on the Figure 16 curve development it can be observed that there were a few more important milestones in an examined period (1990-2013). It is important to emphasize that due to frequent inability to obtain accurate data for analysis of food production in Haiti, even FAO uses its own estimates in order to provide comprehensive analysis. In case of Figure 16, FAO's estimates concern the data of following years: 1993-1995, 1997,1999. For this particular reason, it is more difficult to define the reasons behind the sudden increase in terms of domestic rice production. It can be assumed, that in 1998 a project under the The International Fund for Agricultural Development (IFAD), aimed to Food Crops Intensification (US\$18.5 million) was being executed in Haiti during the period 1983-1999. Based on this fact, it can be derived that as the project was coming to the end of its execution, it also significantly helped in terms of fostering rice production in Haiti (from 100,000 tonnes in 1995 to 150,000 tonnes in 1997).

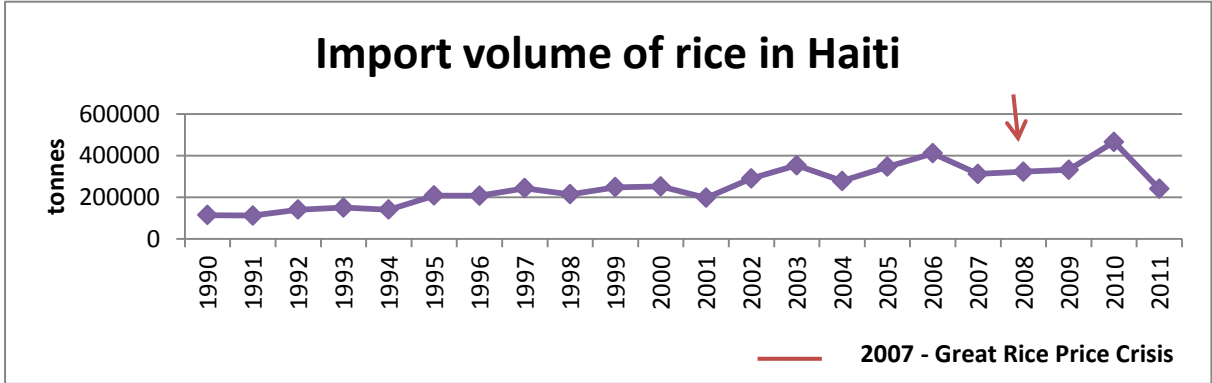
The second milestone can be seen in 2007, when the Great Rice Crisis appeared and it is assumed that due to a fact that the price of imported rice jumped up by 300%, the local production increased from 110,000 tonnes in 2006 to 130,000 in 2007. After the earthquake in 2010 and a period of food price crisis (from 2008 to 2011, when food prices reached their highest levels, FAO), it was obvious that Haiti as a developing country simply cannot depend on volatile international markets in terms of food imports that significantly and with the help of internationally financed projects (USAID, Supplement 2) aimed on food crops intensification, it can be observed that the curve of production is significantly increasing and even exceeded to its 1997 level, which is considerably promising development.

**Figure 17: Development of import value of rice (total, milled equivalent) with regards to food price crisis in 2007**



Source: Own processing & FAOSTAT database (2014)

**Figure 18: Development of import volume of rice (milled equivalent) in Haiti; tonnes;**



Source: Own processing & FAOSTAT database (2014)

When comparing Figures 17 & 18, an interesting phenomenon can be observed. However the development from 1990-2007 is more or less similar both for import value (in dollars) and import volume (tonnes), the year 2008 is very different. Due to 300% increase of price of imported rice, the situation had changed considerably. Even though the volume of imported rice remained more or less similar (311,502 tonnes in 2007 and 322,578 in 2008), the curve of import value shows that the value of goods that Haiti imports had increased, even though that the amount (import volume) remained almost the same as the previous year. On the other hand, when the rice price crisis calmed down at the end of 2008, it can be observed that both curves are decreasing as well. The curve of import value due to the fact that the prices on international markets had decreased to almost its 2007 level and also due to a fact that starting year 2011, Haiti increased its production and loses its major dependency on rice imports. It is assumed that the reason behind the rice production increase is mainly recovering from post-earthquake period by considerable international humanitarian help and international supporting projects that are focusing on introducing new techniques and processes in agriculture production e.g.: rice intensification that allows farmers to even double their yields. (See Supplement 2 for detailed list of supportive international projects). Supplement 8 illustrates the rice price development in various markets in Haiti and US imported rice price after year 2008.

When comparing the value of rice production that Haiti is able to offer to local market to value and volume of imported rice, it is obvious that imported rice prevails over the local one. The volume of rice production in 2010 equaled to *141 thousands of tons* whereas the volume of imported rice in the same year was equal to *465 thousands of tons* which is over 3 times more than Haiti was able to produce in 2010.

Unfortunately, the data of imported rice after the year 2011 are missing in the FAO database. The latest data would be important for further analysis of imported vs. produced rice in Haiti, therefore here opens up a future possibility of more detailed research on this issue as soon as the new data are available. It would be interesting to examine the development after the year 2011 due to the fact that rice production has improved since 2013 (147.5 tonnes in 2012 to 169.2 tonnes in 2013).

c) **Average protein supply**

An indicator of protein supply is given in a time series of 3 year average in order to reduce the impact of errors in recording of annual stock variations. The indicator is set as a weighted average (weights total population of Haiti) of an average protein supply that is expressed in grams per capita per day.

Proteins are a primary constituent of living things and also nutrient sources for organisms that do not produce their own energy from sunlight. Regarding human nutritional needs, proteins exist in two forms: *a) complete proteins* – which contain all nine of the amino acids that humans cannot make themselves *b) incomplete protein* – which lack or contain only a very small proportion of one amino acid or more. Moreover, the daily intake of proteins should be balanced from two reasons otherwise two abnormalities may occur:

- a) Protein deficiency can cause symptoms such as insulin resistance, hair loss, fatigue, loss of muscle mass, low body temperature or hormonal irregularities. Moreover, severe protein deficiency is fatal.
- b) Excess protein can lead to problems as well, for instance the immune system to overreact, liver dysfunction from increased toxic residues or possibly bone loss due to increased acidity in the blood. Matějčková, Sovják (2004)

Daily intake of proteins is very important as an underweight prevention. Protein contributes to calorie intake, therefore, if one eats more protein than he/she needs, the overall calorie intake could be greater than one's calorie needs and it also contributes to weight gain. Moreover, proteins are also important for growth and development in children, teens, and pregnant women. National Institute of Health (2015)

### **Example 1**

The recommended protein intake (Dietary Reference Intake; DRI) is 0.8 grams of protein per kilogram of body weight (or 0.36 grams per pound). **Table 6** below illustrates the recommended values of daily protein intake for various age groups as well as for gender groups.

**Table 6: Recommended Dietary Allowance for Protein (grams/day)**

<b>Recommended Dietary Allowance for Protein</b>	
	<b>Grams of protein needed each day</b>
<b>Children ages 1 – 3</b>	13
<b>Children ages 4 – 8</b>	19
<b>Children ages 9 – 13</b>	34
<b>Girls ages 14 – 18</b>	46
<b>Boys ages 14 – 18</b>	52
<b>Women ages 19 – 70+</b>	46
<b>Men ages 19 – 70+</b>	56

Source: Centre for Disease Control and Prevention (2012)

As mentioned above, the value of protein intake is derived from a simple calculation: 1kg of body weight multiplied by 0.8g of protein. Therefore, the Table 1 demonstrates that in average, an adult woman weights 57.6kg needs 46g/proteins/daily and an average adult man 70kg. To apply this calculation on a country of study – Haiti – 3 examples were calculated based on the structure of Haitian meals, that are common the most: 1) Riz National (Rice with red beans) 2) Poul ak nwa (chicken with cashew nuts) 3) Bacalao (salted Pacific Codfish)

- 1) **Riz National** – as for this particular national meal, the contents of proteins in red beand covering the daily supply is calculated as follows:

**Table 7: Calculation of daily dose of proteins contained in red beans**

<b>Recommended intake of proteins/g/day</b>	<b>Amount of red beans to cover the daily dose of proteins (100g of red beans=23.5g of proteins)</b>
Women: 46g	195g
Men: 56g	238g

Source: Own processing & calculations, Food database and calorie counter (USDA,<http://www.ars.usda.gov>)

**Results:** Daily dose of proteins in red beans equals to **195g of red beans** (women) and **238g of red beans** (men), therefore combined with proteins contained in rice (4-8g of proteins in 100g of rice, depends on a type and country of origin), this national meal is very suitable for covering daily need of protein according to norms given by Centre for Disease Control and Prevention. (2012)

2) **Poul ak nwa** – as for the second national meal which consists of fried chicken and cashew nuts, the recommended daily dose of proteins was calculated as follows:

**Table 8: Calculation of daily dose of proteins contained in fried chicken breast**

Recommended intake of proteins/g/day	Amount of fried chicken to cover the daily dose of proteins (100g of fried chicken=20.57g of proteins)
Women: 46g	223.6g of fried chicken
Men: 56g	272.2g of fried chicken

Source: own processing & calculations, Food database and calorie counter (USDA,<http://www.ars.usda.gov>)

**Results:** Daily dose of proteins in fried chicken was calculated as **223.6g** (women) and **272.2g** (men). With the combination of cashew nuts which contain from 5-8 grams of proteins per 100g, this meal is also able to cover daily dose of protein needs.

3) **Bacalao (salted cod fish)** – as for the third example of meals that are common in Haiti, the fish must be included as well (the importance of fishing is further explained in chapter 3.2.4). Atlantic Codfish is often included in many Haitian traditional meals therefore calculation of daily dose of proteins contained in Atlantic cod fish is illustrated in table 9 below:

**Table 9: therefore calculation of daily dose of proteins contained in Pacific Codfish**

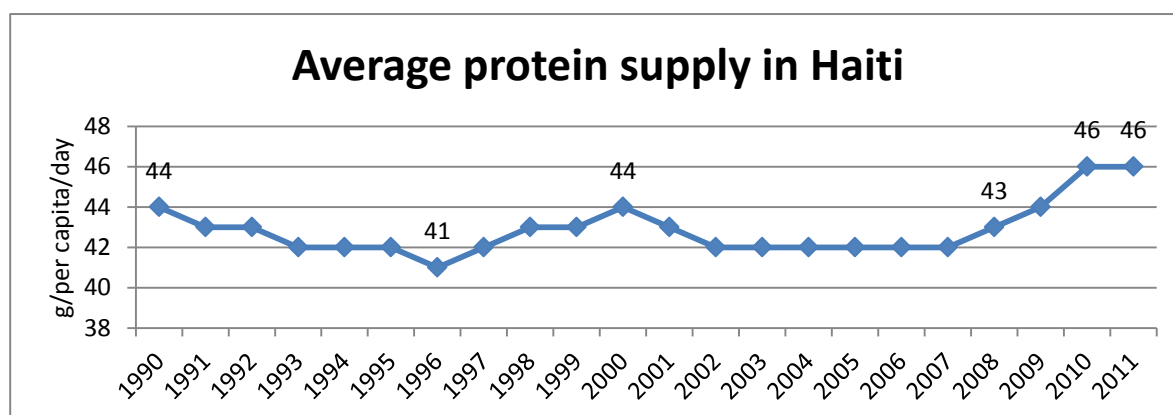
Recommended intake of proteins/g/day	Amount of codfish to cover the daily dose of proteins (100g of Atlantic Codfish=17.7g of proteins)
Women: 46g	259.8g Atlantic Codfish
Men: 56g	316.3g Atlantic Codfish

Source: own processing & calculations, Food database and calorie counter

(USDA, <http://www.ars.usda.gov>)

**Results:** According to nutrition tables, the average raw Atlantic cod fish (that is the most common species in Caribbean sub-region) contains 17.7g of proteins per 100g of fish. To cover the recommended daily protein dosage, it is enough if a woman eats 259.8g of cod fish (or herring, which has the same protein content as cod fish) and a man 316.3g of Atlantic cod fish. This meal is usually served as a *Haitian patty*, which means that fish meat is usually baked in puff pastry and is eaten as a very favorite appetizer. 100g of puff pastry contains at least 8g of proteins, therefore this meal (if above stated dosages comply) is also suitable for covering daily protein requirements.

**Figure 19: Development of average protein supply in Haiti; 3 year average; g/per capita/day**

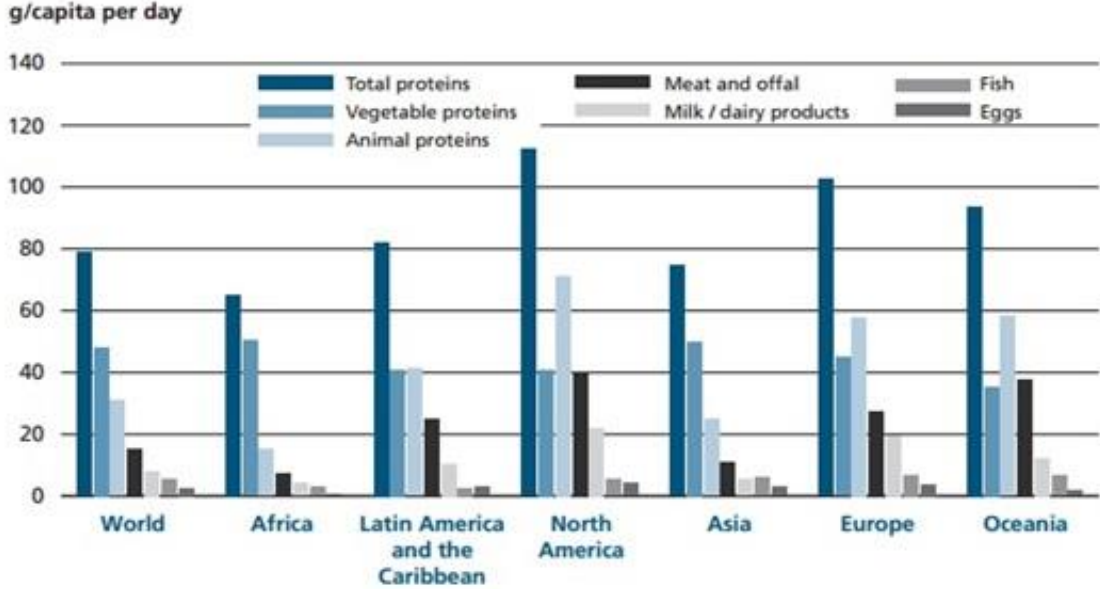


Source: Food Security Indicators; FAO (2014), author's elaboration

According to FAOSTAT, the average protein supply of animal origin refers to only 9g of proteins in 2010 and 10g of proteins in 2011. This low amount leads to an assumption that food intake in Haiti is does not cover meals of animal origin sufficiently. For instance, 100g of Pacific Codfish contains 17.7g of proteins, which is almost twice more than Haitian population gets in average per day.

Although the Figure 19 may seem to indicate a recent significant increase of *average protein supply* in Haiti, the numbers have to be put in context from a global point of view. For this particular reason, **Picture 9** helps to put the examined issue into a broader context.

**Picture 9: Development of total world’s protein supply**



Source: FAO, The State of World Fisheries and Aquaculture (2014)

In **picture 9** it is assumed that among protein supply components account following agricultural commodities/products: a) vegetable proteins b) animal proteins c) meat and offal d) milk/dairy products e) fish f) eggs

When comparing the protein supply on a continental level, it can be assumed that in North America, there exists an excess of protein supply and an increasing trend of prevalence of adult obesity which reached 70% in 2008. When comparing to the world’s average protein supply which accounts approximately to 80g/per capita/day from which the proteins are gained mainly thanks to consumption of vegetable proteins, the level of protein supply in region of the country of study – Latin America and the Caribbean – is even slightly higher than the world’s average. On the other hand, it is assumed that the Caribbean region is more vulnerable to hostile climate conditions (droughts, floods, regular hurricane seasons, easier spreading epidemics – cholera, 2010-2013, over 8,000 victims- etc.), therefore it is expected that as for this percentage (protein supply of cca 82%), the Latin America rises the percentage of protein supply percentage significantly. Finally, the Haitian long term statistics of protein supply is much lower than the world’s average.

There are no data available when it comes to individual components of protein supply, therefore the **Figure 19** shows that the average protein supply in Haiti varies between *41g/per capita/day* to *46g/per capita/day* over the past 21 years long time series. Unsurprisingly, during 2000-2008 the protein supply remained at its lowest values due to long-term unfavorable weather conditions and natural disasters and also the food price crisis which culminated in 2008. It is assumed that population living close to sea side can supply their protein dosages by fishing, although nowadays, due to less nutrients by the shore, the fish are often beyond the reach of the fishermen's modest boats, therefore even the population by the sea side is vulnerable to food insecurity.

**Prospects of the indicator:** Stagnant trend with the possibility of future increase thanks to introduction of new farming techniques as it is already seen in Figure 8 on an example of rice production, when it grew from 2012 to 2013 by 14.7%.

#### **4.1.2 Access**

In terms of the second food security dimension – *access* – four indicators with the most significant amount of data were chosen for an analysis of food security in Haiti:

- a) **Percentage of paved roads over total roads (% , 1990-2000)**
- b) **Road Density (per 100km squared of land area, 1990-2000)**
- c) **Prevalence of undernourishment (percentage)**
- d) **Depth of food deficit (kcal/per capita/day)**
- e) **Prevalence of food inadequacy (percentage)**
- f) **GDP per capita PPP (international dollars, constant 2011)**

Due to lack of recent data available, the first two indicators **a+b** are assessed only briefly. It was found out that in Haiti, there existed only 24% of paved road over total roads and the road density formed only 15% per 100 square kilometers of land area in the latest available year - 2000, which is highly inadequate. These factors also play an important role in terms of access to food, because as it can be observed, the population has only limited possibility to transport themselves in order to reach the vendors of foodstuff or to address the potential customers.

#### **c) Prevalence of undernourishment**

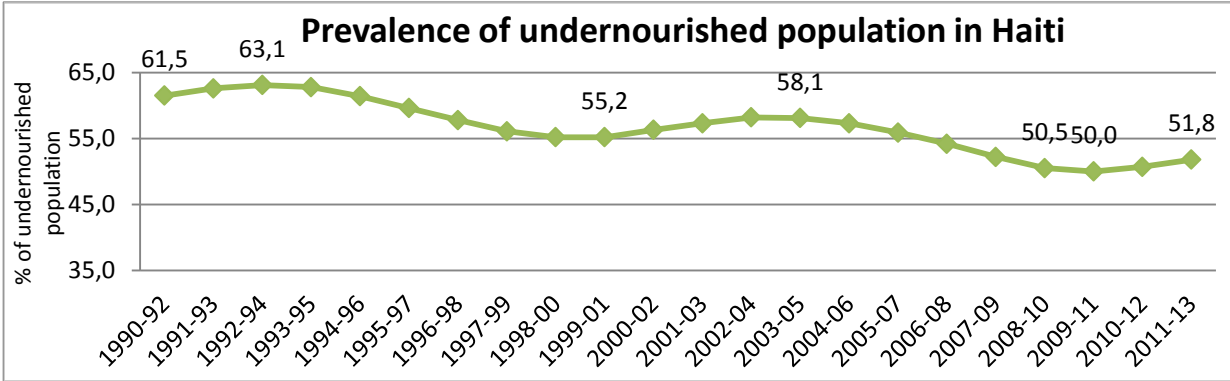
The first indicator of - *Access* - is *prevalence of undernourishment* which represents the probability that a randomly selected individual from the population consumes an amount of calories that is insufficient to cover her/his energy requirement for an active and healthy life.



Other definition by FAO explains this issue as a *proportion of population estimated to be at risk of caloric inadequacy*.

The indicator is computed by comparing a probability distribution of habitual daily Dietary Energy Consumption (DEC) with a threshold level called the Minimum Dietary Energy Requirement. Both are based on the notion of an average individual in the reference population. FAO, Food Security Indicators (2014)

**Figure 20: Evolution of undernourished population in Haiti (3 year average)**



Source: Food Security Indicators; FAO (2014), author’s elaboration

World Food Program’s Hunger Map (2014), states that Haiti is the only country in the Western Hemisphere, with the share of undernourished population higher than 35%.

This number is a threshold for a state, marked as an *extremely high level*. There are only a few countries in a world with a similar state of undernourished population – five countries in Africa (Namibia, Central African Republic, Malawi, Ethiopia and Zambia) and also Democratic People’s Republic of Korea. Nowhere else in the world is currently such a serious situation in terms of high levels of undernourished population.

According to FAO, there was over 49% of Haitians undernourished in 2012. Based on the evolution of a curve in Figure 20, one can observe a gradual decrease of undernourishment in the country from the percentage of 58.2% observed in the period of 2002-2004 to 50.0% in the period 2009-2011. Moreover, it is obvious that an earthquake in 2010 was a significant factor that contributed to spreading of malnutrition in the country again due to increasing percentages of undernourished population in coming years – for the period of 2011-2013 the share of undernourished population increased to 51.8%. Although that the share of undernourished population is not that alarming as for instance in the period of 1992-1994 –

when 63.1% of total population who suffered from malnutrition, the current number (51.8%) is still very serious and amongst highest in the world. Therefore, this indicator is extremely important when assessing the state of food security in Haiti. It can be assumed that besides natural disasters and unstable weather, the rural and urban indigent populations of Haiti suffer malnutrition because of the country's economic policies. When taking into consideration the share of undernourished population in *Dominican Republic*, which shares the same island of *Hispaniola* as Haiti and shares similar weather conditions, the percentage of undernourished population is radically lower – 14.6%. Therefore the long term negative economic situation and economic policies, politically unstable environment, public riots due to high food prices must all be very significant influences to such high share of undernourished population.

Over the past 23 years, the number of undernourished population in Haiti has decreased from 61.5% in 1990 to 55.2% in 1999. The influence of food price crisis in the coming period contributed to the increasing trend of undernourished population, but also decreasing up until the year 2010. The turning point seems to be the earthquake in 2010, which is assumed to cause overall bad economic, political and also health conditions and risks, due to momentarily inability to get fresh water and basic human needs or adequate hygiene or health care. The spreading epidemic of cholera also contributed to overall poor nutrition intake and damaged infrastructure made it very difficult to ensure an adequate access to food in areas that were cut off by infrastructural damages in Haiti.

**Prospects of the indicator:** increasing trend (in a negative sense) with the possibility of gradual mitigation (5 years after the earthquake = significant humanitarian help, internationally financed projects introducing new techniques and processes in agricultural production and food crops intensification, Haiti's government's supportive programs aiming the year 2025 - Ministry of Agriculture, Natural Resources, and Rural Development; (2010)

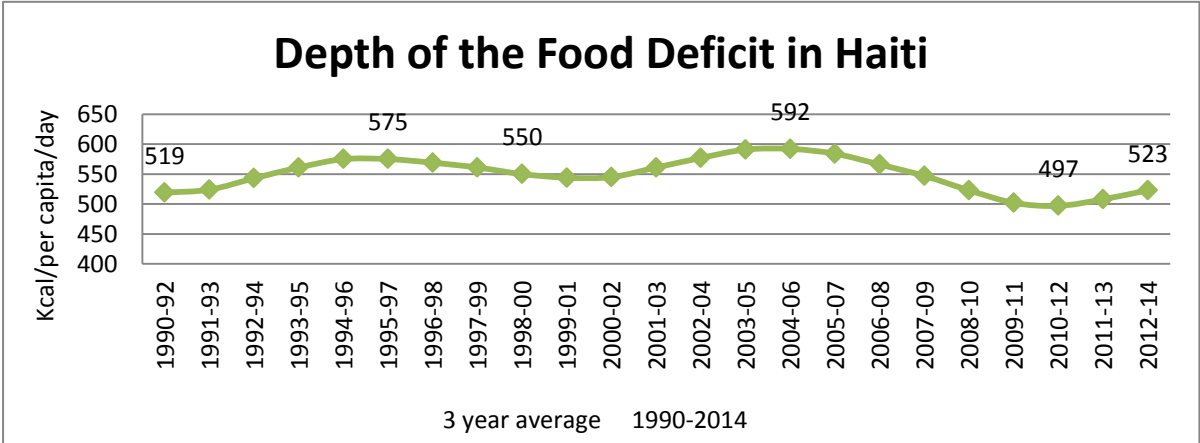
**a) Depth of the food deficit**

The second chosen indicator of - *Access* - is represented by the Depth of food deficit that is according to FAO defined as an *average food consumption of the undernourished*, multiplied by *the number of undernourished*, and divided by the *total population*.

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 indicator is calculated

as a weighted average over 3 years and is expressed by the amount of Kcal per capita and per day. The Figure 21 below explains the evolution of food deficit in detail.

**Figure 21: Evolution of the depth of the food deficit in Haiti; 1990-2014**



Source: Food Security Indicators; FAO (2014), author’s elaboration

According to FAO, the value for Depth of the food deficit (kilocalories per person per day) in Haiti was 523.00 as of the *period 2012-2014*. This value basically means that in average, there was 523.00 Kcal missing daily for undernourished population to be lift from their status. As the graph above shows, over the past 22 years this indicator reached a maximum value of 592.00 as of the period 2004-2006, which was expected due to a food price crisis in Haiti that culminated in 2008 by the public unrest and changing of prime ministers. On the other hand, a minimum value of 497.00 Kcal/per capita/day is monitored for the time period of 2010-2012. Unfortunately, the year 2010 is again crucial point of starting ascension due to same reason as for the share of undernourished population illustrated in this chapter.

Over the past decade decreasing trend, although after the *earthquake in 2010*, the depth of food deficit started to increase again to its present value 523 Kcal – which the population lack every day per capita, in order to get out of their current status of undernourished.

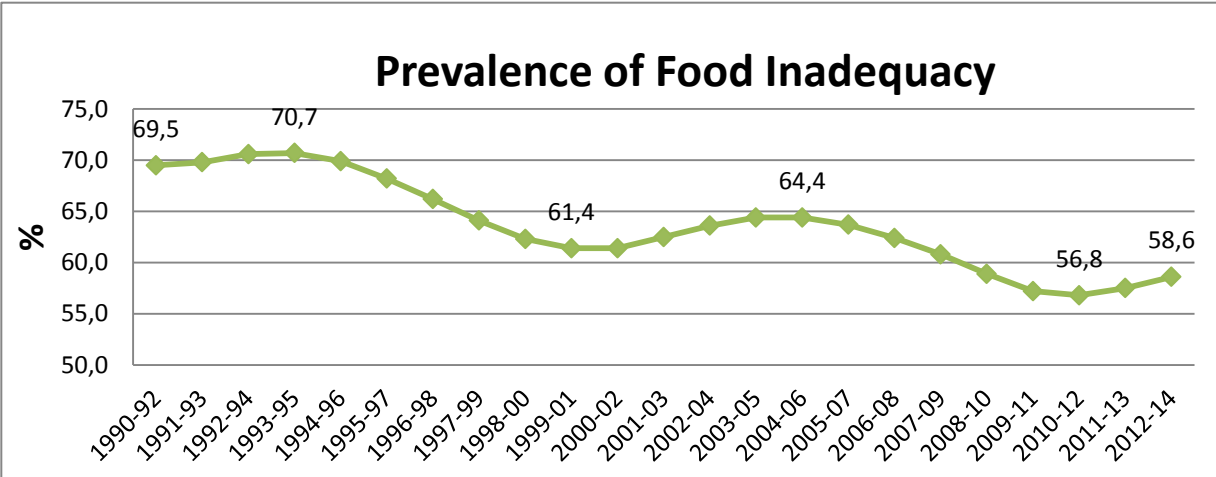
**Prospects of the food security indicator:** increasing trend (in a negative sense)

**b) Prevalence of food inadequacy**

The third chosen indicator in terms of a dimension - *Access* - is prevalence of food inadequacy which represents the proportion of population at risk of not covering the food requirements associated with normal physical activity.

Moreover, the prevalence of food inadequacy includes also people who, even though cannot be considered chronically undernourished, are likely being conditioned in their economic activity by insufficient access to food. This indicator is expressed as a percentage of population, who are not necessarily undernourished, but have limited access to food. FAO; Food Security Indicators (2014) Time serie - 3 year's average; 1990-2014

**Figure 22: Development of prevalence of food inadequacy in Haiti**



Source: Food Security Indicators; FAO (2014), author’s elaboration

The development of food inadequacy in Haiti is illustrated for 24 years period with respect to a fact that *Figure 22* x-axis values are weighted averages of three years period of time. It can be observed that the food inadequacy reached its maximum of 70.7% in a period of 1993-1995. The main reason behind this very high percentage of food inadequacy in Haiti is assumed to be caused by significant environmental deterioration, declining agricultural production, droughts (continuing from 1986, very severe from 1991 to 1993, but relieved in 1994 by the best rains in 30 years), cyclones, and floods. These events have helped to sustain periodic epidemics and high rates of chronic malnutrition. After this period, the percentage of food inadequacy begun to slowly decrease and started to increase also after another major weather related event in 2010 – an earthquake.

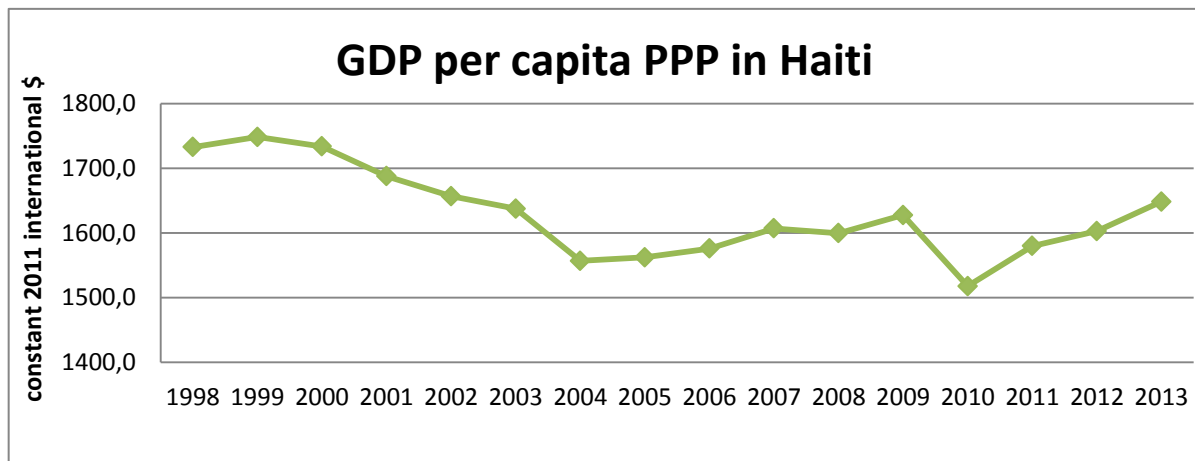
With coming international help, projects and foreign investments, the local production is expected to be growing again in coming years and therefore seven small farmers (1 ha of farm land per a Haitian farmer in average), should have the knowledge needed for e.g.: rice intensification technique as already described.

**Prospects of the indicator:** Currently increasing trend with an expectation of future decline.

**c) GDP per capita PPP (constant 2011 international dollars)**

The fourth indicator of –Access- is gross domestic product (Purchasing Power Parity) converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2011 international dollars. FAO, Food Security Indicators (2014). Figure 23 below illustrates the development of GDP per capita (PPP) in Haiti.

**Figure 23: Evolution of GDP per capita (Purchasing Power**



Source: Food Security Indicators; FAO (2014), author's elaboration

In Figure 23, one can observe very significant changes over a time period of 15 years for which the data were available. For the case of GDP per capita PPP in Haiti, there were no data of FAO available, therefore the data of the World Bank were used instead. One can observe that the period of 2004-2008 shows a significant decline of the GDP curve. It is assumed that due to a fact that agriculture is quite significant component of the total GDP (24%), two main the factors could have caused such a decline. Firstly, the exceptional period of droughts, which caused unusual drop in agricultural production and therefore, Haiti was not able to export its agricultural commodities to such an extent as before. Secondly, further reasons causing this decline are assumed to be the changes in trade policies that forced Haitian population not to produce and buy their local grown commodities, but rather to buy cheaply imported ones from the United States. At this point, a particular example of rice can be mentioned - the trade liberalization policies have involved the lowering Haiti's lowest tariffs

on rice imports. American University of Washington, DC's study (2004) explains that currently the rice import tariff accounts for 3%, which is much lower than rice import tariffs of all other nations in the Caribbean Community. The Haitian market is now flooded with US rice imports ("*Miami rice*") and some have accused the US from dumping its rice to Haiti. The impact of the decline of rice production in Haiti has been devastating to its rural population which is already desperately poor.

In order to explain the role of agriculture in the Haitian GDP, it is important to underline that according to CIA Factbook (2014), the share of agriculture in the Haitian GDP accounts for 24.1% which is almost 4 times more than in neighboring *Dominican Republic* (6% only) Therefore, concentrating on rebuilding the former exporting commodities could be a solutions (exports of coffee and tropical fruits). This is already happening to some extent thanks to 218,000 euros in subsidies to the agribusiness sector provided by European Union. Subsidies provided by EU are part of the binational cooperation program between Haiti and the Dominican Republic, funded by the European Union, which aims to enhance the competitiveness of enterprises with an export potential. Moreover, these subsidies will allow the beneficiaries to acquire inputs to increase their production capacity, develop marketing and export strategies, participate in international trade fairs, obtain certificates of quality and support the economic integration between the two nations on the island. HaitiLibre(2015). Another plan for the period of 2015-2025 is devoted to rebuilding competitiveness in terms of coffee production.

**Status of the indicator:** After a dramatic drop in 2010, GDP curve shows increasing tendency and even outperformed its 2009 level. It is expected that in case there are no significant natural disasters in coming years, government of Haiti will be successful with its plan to foster agricultural production and even tourism. For the second mentioned – most of the governments of the world including US issued a travel warning noting that foreign tourist had been victims of violent crime, including kidnapping or even murder, therefore due to a fact of high criminality and even recent earthquake, it is assumed that Haiti will probably not reach the amount of tourist comparable to neighboring Dominican Republic any time soon. Nevertheless, the Best Western Premier hotel or Marriott hotel were opened in Haiti in 2012, therefore there is possible revenue increase coming from tourism, but definitely not that significant as in Dominican Republic yet. To make the tourism a major contributor to the country's GDP, significant improvements has to be implemented (principally infrastructure,

hotels, restaurants and most importantly, the criminality has to be decreased in order to attract tourists from developed countries).

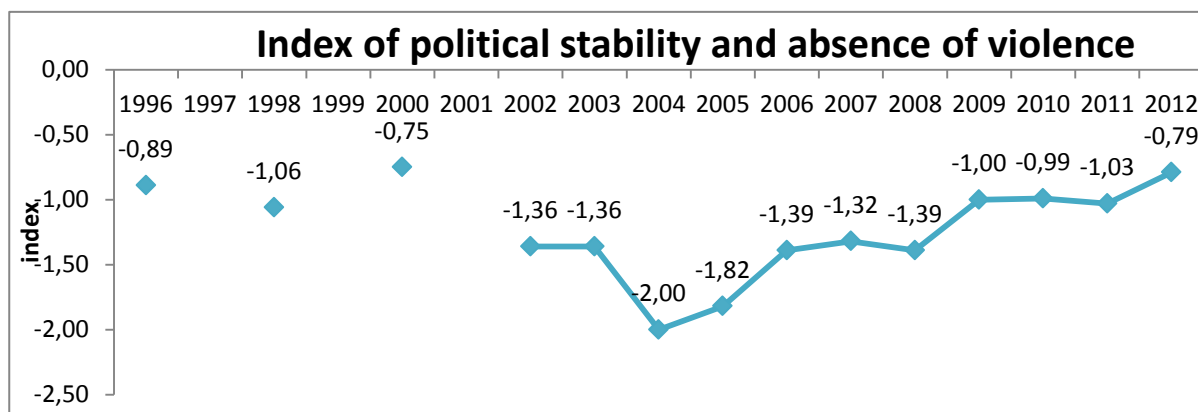
### 4.1.3 Stability

The dimension of stability is especially important when it comes to developing countries. Political instability, violence, unrest and protests may occur quite frequently, especially when the population feels insecure for various reasons. The changes in trade policies in Haiti in 2004, unfortunate sequence of extreme droughts and subsequent floods, earthquakes, low agriculture production, increasing percentage of population suffering from malnutrition etc., all these reasons might have contributed to overall dissatisfaction and violence and instability in Haiti, that will be analyzed by following indicators of stability.

#### a) Political stability and absence of violence index

The first indicator of the – *Stability* - dimension of food security measures perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. FAO, Food Security Indicators (2014)

**Figure 24: Evolution of political stability and absence of violence index**



Source: Author & FAO, Food Security Indicators (2014)

Due to facts that during frequent unrests, protests and political instability the quality of data cannot be always ensured the analyzed index of political stability and absence of violence provides rather incomplete data in the time series. However, at least majority of the data for the past 16 years can be analyzed in 13 cases and can also be put into a context of events in the country easily. The stability index of political stability and absence of violence expresses values, that vary from approximately -2.5 (weak stability) to 2.5 (strong stability) in the analyzed country.

When observing the Figure 24, one can notice that during the period of 16 years (1996-2012), no value of index with a positive sign appears. The most positive value appears in the year 2000 as “-0.75”. Otherwise the evolution of this index after the year of 2000 expresses rather alarming negative values. The deepest instability in Haiti is so far measure in year 2004 with the value of “-2”, which represents very weak stability in the country. The period of 2004-2008 is also evaluated as the one with the highest number of public riots and increasing level of undernourished population due to changes in trade policies, high prices of local grown agricultural commodities. Another factor that is assumed to contribute to the general dissatisfaction and raising criminality in the country were extreme weather conditions (droughts and subsequent floods in Haiti). It is then not surprising that the period of 2004-2008 is assessed to be the one with the most negative political stability and violence index. However according to Figure 24, the curve of the violence index in the country is has been increasing ever since, therefore it is expected that there was no significant worsening of the situation since the last measuring in 2012 when the indicator had a value of -0.79, the second highest (best) value within the examined period of 1996-2012.

Within the examined period of 1996-2012 the index of political stability and the absence of violence remained in negative values, which means very weak stability in the country. Natural disasters, poverty and subsequent high level of criminality especially in the area of Port-au-Prince is assumed to be the main reasons behind overall insecurity in the country. **Prospects of the indicator:** Increasing trend (positive sense). The index already almost reached its 2000’s level and is expected to grow in near future, thanks to new government’s plans in terms of overall security in the country.

**b) Cereal dependency ratio**

As the second indicator food security dimension - *Stability* – was chosen as a Cereal Dependency Ratio (CDR) which represents a sum of the various components of the indicator: imports, exports and production by regions/sub-regions and then application of the formula cereal imports divided by (cereal production + cereal import - cereal export), given in percentage of dependency.

$$CDR = \frac{I(cereal)}{\{P(cereal) + I(cereal) - E(cereal)\}} \tag{5}$$

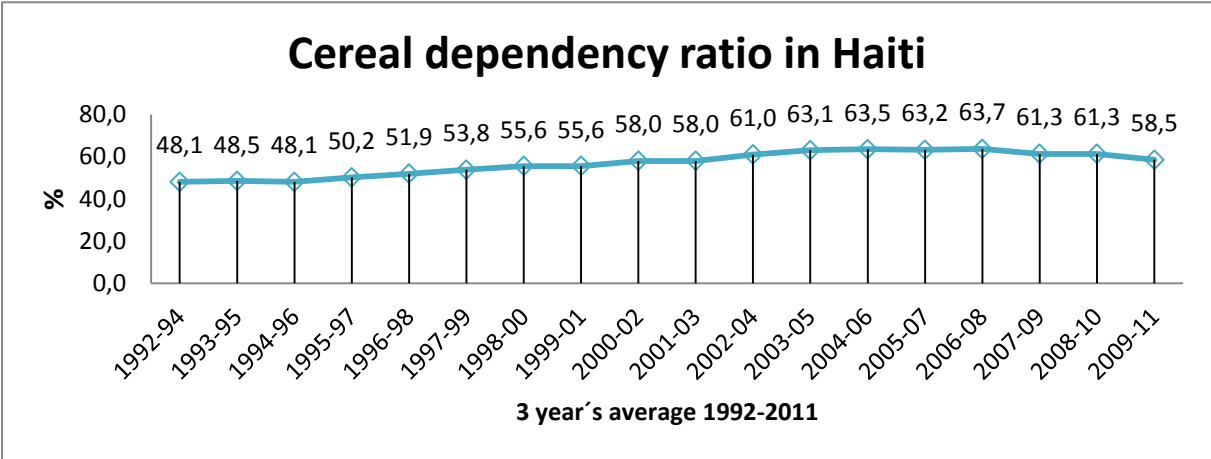
**P** -production, **I** – cereal import, **E**- cereal export



Another definition of cereal dependency ratio by FAO is that this indicator is a proxy to measure the cereal self-sufficiency of a country and the potential impact of shocks in the international trade market. FAO (2013)

The Figure 25 below illustrates the development of cereal dependency ratio in Haiti:

**Figure 25: Development of cereal dependency ratio in Haiti**



Source: Author & FAO – Food Security Indicators (2014)

The cereal dependency ratio evolution over 19 year period is illustrated in *Figure 25*. For this figure 3 years data average was used. When observing the dependency ratio, it is obvious that since the period 1992-1994, when the share of cereal dependency was 48%, the ratio was increasing since then and according to latest available data of 2009-2011 - it still is remaining to its level close to 60%. To give more precise numbers, in 2010, Haiti imported 832,603 tonnes of cereals and 544,718 tonnes of cereal in 2011, which is the latest possible data. (FAO, Cereals, Import Quantity in Haiti). Based on these values, it can be assumed that there is a decreasing tendency and that Haiti has recently not imported that significant amount of cereals as in its history, although the year 2010 remains the one with the highest value of imported cereals from the entire examined timeline (1992-2011).

It can be assumed that as for the past decade especially, Haiti is rather dependent on imported cereals from abroad due to several reasons. Extreme droughts, earthquake, subsequent floods, hurricane Tomas, spreading cholera (2010-2013) and low rainfall (which is the main factor of low cereal yields in Haiti), all contributed to very low cereal production and therefore, the cereal import had to be increased.

**Prospects of the indicator:** Decreasing trend is likely to remain due to increasing productivity of local agricultural production, although the prediction cannot be positive with any certainty due to changing weather conditions. The latest data shows that: “*Cereal imports in the 2014/15 marketing year (July/June) are forecast at 705 000 tonnes, 7 percent above last year’s near-average level. The increase mainly reflects higher imports of rice and maize which are expected to increase by 8 and 18 percent, respectively, from last year as a result of the sharp drop in this year’s production.*” FAO (December, 2014) The drop in 2014’s production was mainly caused by very low rainfall, which is one of the most serious causes of low agricultural yields.

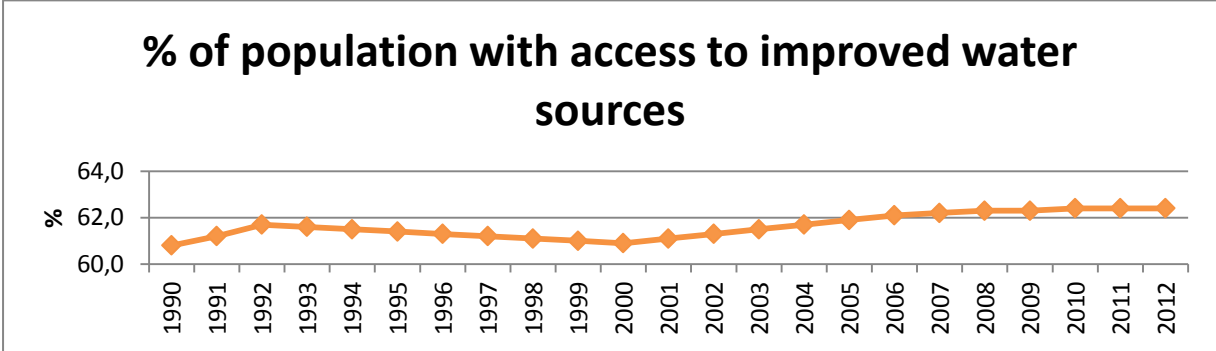
#### **4.1.4 Utilization**

The fourth dimension of food security has to be analyzed as well in order to assess the overall state of food insecurity in Haiti. Food utilization is influenced by the way in which the food is handled, prepared and also stored. Good state of health is a prerequisite for the human body to absorb nutrients effectively, and hygienic food helps maintain a healthy body. Access to clean water is crucial to preparation of clean, healthy food and maintaining a healthy body, therefore an indicator of the percentage of population with access to improved water source is examined. As a second indicator of the dimension of utilization the share of population within children under 5 years of age and prevalence of anemia was chosen.

- a) **The percentage of population with access to improved water sources**
- b) **Prevalence of anemia amongst children under 5 years of age**
- c) **Access to Improved sanitation facilities**
- d) **Percentage of Children under 5 of Age who are Underweight**
  - a) **The percentage of population with access to improved water sources**

The first indicator of Utilization of food is given in percentages and represents the share of population that has an access to improved water sources such as household connection, public standpipe, borehole, protected well or spring, and rainwater collection. Unimproved sources include vendors, tanker trucks, and unprotected wells and springs. Reasonable access is defined as the availability of at least 20 liters a person a day from a source within one kilometer of the dwelling. FAO, Food Security Indicators (2014) Figure 26 shows the percentage of above described population.

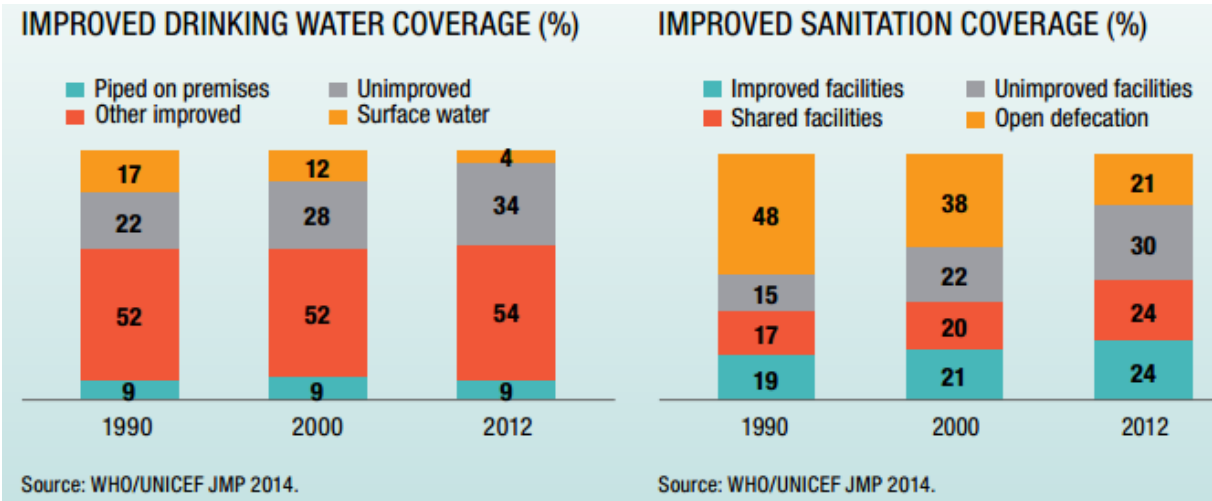
**Figure 26: Development of the share of population with access to improved water sources**



Source: Author & FAO Indicators (2014)

Another source (WHO/UNICEF JMP 2014) presents a more detailed picture of the development of drinking water coverage and improved sanitation coverage as follows:

**Picture 9: Development of the drinking water and improved sanitation coverage in Haiti**



Source: WHO/UNICEF JMP (2014)

The above illustrated curve in Figure 26 represents the development of the share of population with a reasonable access to improved water sources. The curve captures the examined period of 1990-2012 and demonstrates that over 22 years, the percentage of population with an access to reasonable water sources has changed more or less by 2% only. The population with and access to improved water sources currently accounts for 62.4%. The consequences for the remaining share which does not have such an access to it can be very dangerous when it comes to spreading of various epidemics (Cholera 2010-?) and other diseases. Here comes the part when e.g.: one can have an access to food that contains sufficient nutrients, proteins, but in case that one will use the water from a not improved water source for further processing, the consequences may be very serious. Together with very slowly increasing level of

sanitation coverage, sufficient level of hygiene is very hard to reach for the most of the Haiti's population, especially the part located in Port-au-Prince and its slums, where the sanitary conditions are still very weak. According to picture 5, the unimproved facilities and open defecation is present in Haiti from 51%, which is a striking proportion when considering the fact that this percentage is the latest one, from year 2012. All these reasons surely contribute to incessant struggle with cholera epidemics.

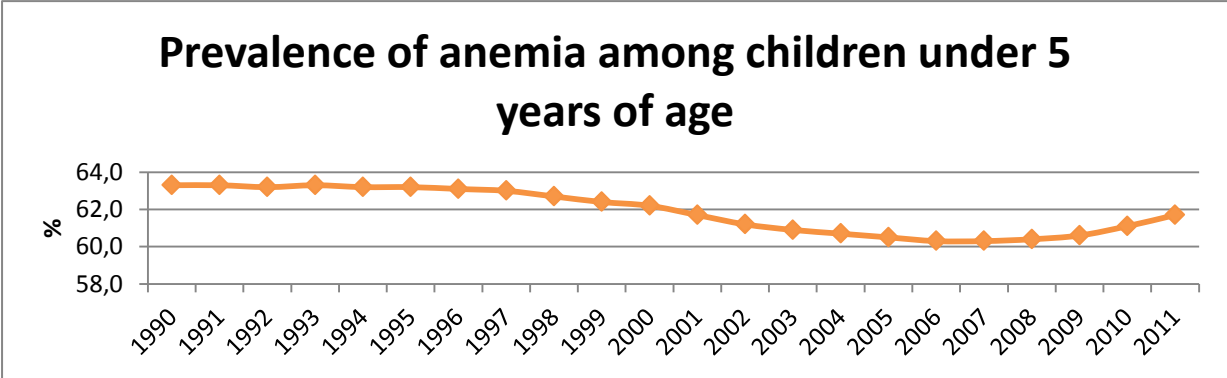
**Prospects indicator:** slightly increasing trend (2000-2008) with a stagnation tendency (2008?)

**b) Prevalence of anemia amongst children under 5 years of age**

Another indicator of Food Utilization represents the share of children unde 5 years of age and a prevalence of anaemia among them. An indicator measures nutritional imbalance and malnutrition resulting in undernutrition assessed by prevalence of anaemia.

Anaemia is a condition in which the number of red blood cells (and consequently their oxygen-carrying capacity) is insufficient to meet the body's physiologic needs. The cut-off values for public health significance is 40%. A prevalence of Anaemia equal or higher than this level signals a severe public health problem.

**Figure 27: Evolution of prevalence of anemia among children under 5 years of age in Haiti**



Source: Author & FAO Food Security Indicators (2014)

The above illustrated Figure 27 represents the development of prevalence of anemia among children under 5 years of age. It can be observed that during the examined period 1990-2011, the situation has been improving only slightly and the overall percentage of children with anemia was decreasing from 63.3% in 1990 to 60% in 2006. The percentage change could have been more significant when considering the length of examined period. Therefore, it is

not expected that the situation in terms of prevalence of anemia can be improved significantly any time soon due to a fact, that only minor goals have been achieved over past 21 years. After year 2006, it is obvious that Haiti still is struggling with quite an alarming percentage of children suffering from anemia in a long run.

**Prospects of the indicator:** Since 2010’s earthquake increasing trend (negative sign)

**c) Percentage of Children under 5 of Age who are Underweight**

Chapter 3.2.1 already explains an issue of underweight children under 5 years of age. The table below represents the average of period 2009-2013 and indicates that stunting and low birthweight are the most significant threats.

**Table 10: State of World Children report, Haiti, 2009-2013 average**

Children with low birthweight	23%
Underweight	12%
Stunting	22%
Wasting	5%
Overweight	4%

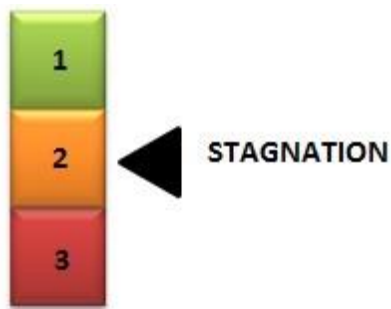
**Prospects of the indicator:** Compared to year 2006 when all above stated values were doubled, there exists a declining trend within all sub-indicators of underweight children.

**4.1.5 Evaluation of the results of food security**

*“What is the development of food security in Haiti (using time series 1990-2014) and to what extent has the Rice Price Crisis of 2008 and the earthquake that struck Haiti in 2010 influenced the food security in the country?”*

Four dimensions of food security in Haiti were assessed following the FAO food security indicators concept. Not all indicators were used for analysis, only those with the most reliable or complete data for the purpose of assessing the food security in the country. Following 4 categories of FAO’s concept, answers to Q1 are provided for each dimension below:

**1) Availability dimension** is evaluated as a food security dimension within which the majority of food security indicators stagnate (e.g.: even for a period of 20 years as within the area of average value of production). Nevertheless, recent measures were established in order to improve the current stagnation towards positive results.



Within this category of food security, 3 food security indicators were assessed: a) Average dietary energy supply adequacy b) Average value of Food Production and c) Average protein supply

This dimension addresses the -supply side- of food security and is determined by the level of food production, stock levels and net trade.

In all cases, the year 2008 and 2010 played a considerable role in terms of worsening the Food Availability in the country. Rice price crisis of 2008 increased the price of imported rice on which Haiti was dependent from 80%. Figures 9-10 of chapter 3.2.5 compare the value and volume of imported rice in detail. (1990-2011). On the other hand, it is also visible that Haiti tries to foster their local production of rice, because according to FAO data for year 2013, the local rice (paddy) production has risen by 14.7% since 2012, therefore it is expected that Haiti will probably mitigate the extent of imported rice and by doing so, it would also mitigate its exposure to volatile prices in international markets.

In terms of c) Average protein supply, dosages of daily protein needs were calculated for 3 most common Haitian meals (Riz Nationa, Poul ak nwa and Bacalao) and it was calculated that for sufficient daily protein coverage (56g of proteins daily – men-”M” and 46g of proteins daily – women-“W”), the population of Haiti should consume:

- i) men: 238g; women: 195g of red beans
- ii) men: 272g; women: 223g of fried chicken
- iii) men: 316g; women: 259g of Atlantic Codfish

It was detected that current average protein supply in Haiti is increasing and in 2011 corresponded to 46g/per capita/day which is a sufficient amount of protein dosage for a woman, that weights 57.6kg, although for an average men, who weights 70kg, the protein supply is still inadequate and should rise up to 56g/per capita/daily.

2) **Access dimension** was assessed as the one with indicators of food security that showed negative results on a long-term basis.



Detailed discussion towards an “inadequate” level of food security within this dimension follows below:

- d) Percentage of paved roads over total roads (% , 1990-2000)
- e) Road Density (per 100km squared of land area, 1990-2000)

Due to lack of recent data, it was only found out that in Haiti, there existed only 24% of paved road over total roads and the road density formed only 15% per 100 square kilometers of land area, which is highly inadequate.

f) Prevalence of undernourished population

Even quite recently, during the period 2002-2006 the share of undernourished population reached 58%. This proportion is assumed to be caused by unusual droughts and low agricultural production. Moreover, the percentage of undernourished population has increased again after 2010 earthquake, when it rose by 2% and the current trend, even though it has minor declining tendencies, is still very serious and undernourished population form 52% of the total population. Therefore Haiti is falling behind the rest of the countries in Western Hemisphere and no significant improvement can be seen based on its historical development.

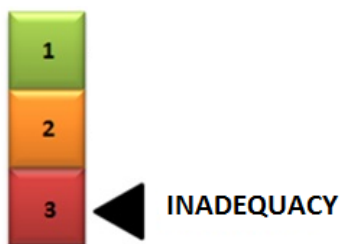
World Food Program defines the threshold for extremely high level of undernourished population as 35%. Haiti exceeds this threshold by 17%, it can still be considered as the one with extreme high level of undernourished population in the world, therefore this indicator has to be evaluated as inadequate level of food security.

- g) Depth of food deficit has increasing tendencies in a long term. In 2012-2014 period, there existed 523 Kcal/per capita/day gap in terms of lifting the undernourished population from their status. Even though that over the period of extreme droughts and rice price crisis (2000-2008), the values of food deficit were even higher

(592Kcal/per capita/day), the current trend of the indicator is still increasing therefore the food deficit is deepening since 2010 earthquake.

- h) Prevalence of food inadequacy is currently (2012-2014) represented by 58% of total population who are at risk of not covering the food requirements associated with normal physical activity. In the period of 2000-2008 as mentioned above, the share of population at risk was even higher – around 64%. Even though that nowadays the share is lower, it although has increasing tendencies after 2010 earthquake. Nevertheless, with the coming international help, projects and foreign investments the local production is expected to be growing again (if there are no events such as the 2010 earthquake occurring again) thanks to e.g.: rice intensification technique, EU subsidies (218,000 euros in subsidies to the agribusiness sector, HaitiLibre, March 23<sup>rd</sup> 2015 ) or development plans in terms of boosting coffee production and its export (Coffee sector development plan for 2015-2025, HaitiLibre, March 16<sup>th</sup>, 2015).
- i) GDP per capita PPP (2011, constant international dollars) shows increasing trend after a dramatic drop after 2010 earthquake. Nevertheless, GDP per capita PPP has nowadays already outperformed the 2009 level. It is expected that Haitian government will be successful with its plan to foster local agriculture production and even tourism. (2010, HAITI NATIONAL AGRICUTURAL INVESTMENT PLAN) In terms of fostering the tourism in the country, there is still long way to go (principally building new infrastructure, roads, hotels, restaurants and criminality decrease has to be ensured).

**3) Stability dimension** is assessed as a dimension with long-term negative development, therefore is evaluated as a dimension with high risk of worsening or stagnation of current negative state.

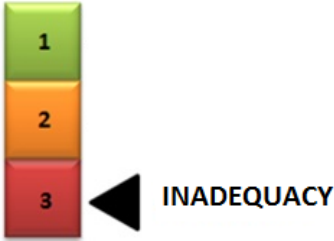




In case of Haiti, the unfortunate sequence of extreme droughts, floods, earthquakes, low agriculture production and increasing share of undernourished population can all be the reasons for increasing the instability, violence and overall dissatisfaction in Haiti.

- a) Index of political stability and absence of violence has currently increasing trend with possible positive values in near future. Otherwise within the examined period 1996-2012 – the index fluctuated between -0.86(1996), -2 (2004) and -0.79 (2012) with respect to lowest values in the period of 2004-2008 (period of significant droughts, floods and rice price crisis). Surprisingly, the indicator scored positive values after 2010 earthquake on the other hand, there is no onward data since 2012, in order to prove this positive development. The coming presidential elections in Haiti (2015) may change its current positive development and cause instability again.
- b) Cereal dependency ratio is provided in 3 year average percentage values and indicates highest values in the period of 2003-2008 (even in times of rice price crisis). The current trend is slightly decreasing however the dependency is still relatively high and Haiti is still dependent from 58.5% in terms of cereal imports. It is expected that the dependency ratio will have decreasing tendencies in near future as well thanks to implementing new farming techniques in most of the regions of Haiti.

**4) Utilization dimension** scores with following results:



Four main food security indicators were assessed:

- a) The percentage of population with access to improved water sources represents the share of population that is not exposed to polluted water and subsequent diseases associated with polluted water (cholera outbreak after 2010 earthquake). The current trend rather stagnates and the share of population with access to clean, drinkable water is 62%, although the share still fluctuates between 60-62% over the period 1990-2012 which is still considerably low amount. Moreover, the state of sanitation is still very weak,

unimproved facilities and open defecation is present in Haiti from 51% which contributes to spreading various diseases and overall health instability.

- b) Prevalence of anemia amongst children under 5 years of age measures the share of above specified population's nutritional imbalance and malnutrition resulting in undernutrition assessed by prevalence of anaemia. General definition states that a prevalence of anaemia equal or higher than 40% of population signals a severe public health problem. The share of anaemia amongst children under 5 years of age in Haiti fluctuates from 64% in 1990 to 60% in 2006, although since 2010 earthquake there exist an increasing trend and the share of population suffering from anaemia is almost 62% which signals severe public health problem.

As it can be seen from all analyzed indicators of food security, events such as Rice price crisis in 2008 and unfortunate sequence of droughts and floods during 2000-2006 and 2010 earthquake played very important role in terms of food security in the country. For most of the indicators, the values were improving towards year 2009, although year 2010 was a turning point which has worsened the share of undernourished population and agricultural production. In terms of serious diseases, cholera outbreak in 2010 has also highly influence the overall situation in the country. Katz (2014) states that cholera outbreak caused doubled death toll than Ebola outbreak in the world. Therefore only in Haiti, there are about 9,000 victims of cholera as for 2014 data.

It is expected that thanks to recovering programs and international help, Haiti has already surpassed the worst post-earthquake period (2010-?) and with coming foreign investments a period of economic growth should start as well. An example of post-earthquake international help is explained in a paragraph below.

For instance, new Caracol industrial park devoted to apparel production for exports in the northern department of the country was built recently and promised to ensure 65,000 job possibilities by 2020. The dark side of this project, sponsored by Bill and Hillary Clinton's is that an industrial park Caracol (and not only this particular one) were built on a fertile, arable land that was taken from small scaled farmers. According to Al Jazeera English interviews with Haitian farmers (2012) imply that there exist an assumption that farmers were forced to give up their arable land with a promise that they will be compensated in a way that they will not have to work again in their life. As one of the farmers said, she obtained 1,200 dollars only and now she is landless. On the other hand, the farmers were offered to work in the

industrial park (factories for textile processing, for further exports to U.S.A), but according to the Caracol's policy, it is not possible to work there if one is more than 40 years old and the job opportunities are very limited. Most of the farmers who are now landless are elderly and therefore, they do not fulfill the conditions to work in the "sweatshop". Moreover workers in Caracol earn maximally 5\$ daily and the working conditions are very bad. (No food provided by the company, only one cup of water that according to workers is not even clean, which causes significant concerns in a times of cholera epidemic etc.) Moreover, there is no transportation service provided to get to the industrial park, so workers have to spend more money for getting to work every day and food. Therefore there exists an open question if the new industrial park will help Haiti to get back on its feet, or turn out to be just another sweatshop with poor work conditions. Therefore, fostering the agricultural sector with foreign investments as it was suggested in 2011, would have been wiser solution. AlJazeera (2012) provides an interview where it was noted that in 2011, the initial plan was to invest into agriculture in Haiti and with proper investors, it would even be possible to create 700,000 jobs in agriculture. Instead, the foreign investments went to building a Caracole industrial park, which was for more investors seen as more interesting investment.

On the other hand, at least some international project exist in the country and are helping to introduce new techniques of farming (possibility to double farmers' yields while using fewer seeds and significantly less water and fertilizers) in order to help Haiti to increase food security in the country by ensuring family farmers to obtain higher production, double their yields and decrease the country's level of dependency on imports. The negative aspects of such a high dependency on overseas rice (80%, 2008) has influenced the country very significantly and such event made the government to act against increasing level of food insecurity (National Agricultural Investment Plan, 2010). It is also obvious that besides chronic food insecurity amongst 24% of population (2013), transitory food insecurity is also present in Haiti – 43% of population in rural areas (2012). Although such high proportion was caused by cyclone Sandy that struck Haiti in 2012 and the proportion was lowered significantly towards 2013. It is expected that local food supply in Haiti will have an increasing tendency again, if the farmers will implement new techniques (Rice intensification etc.) and in case that there are no significant variations in terms of natural disasters.

## **Discussion**

After assessing almost all available food security indicators, it was detected that Haiti's weaknesses reveal positives in terms of food security areas. From all figures stated in this chapter it is also possible to detect that earthquake of 2010 meant very significant change in all dimensions of food security and in many cases caused striking drop (GDP, Prevalence of undernourished population, access to clean drinkable water). On the other hand, year 2010 meant one of the good agricultural productions, thanks to the fact that the earthquake did not affect rural areas and did not influence the agricultural production. Only at the end of 2010, Haiti experienced great losses in agriculture due to hurricane Tomas, which affected the second Haitian harvest at the end of the year. The second part of the research question regarding rice price crisis is discussed above. Haitian population experienced a shift in terms of diets and got used to have rice as a main meal even several times daily therefore when volatile international markets were forced to rise the price of the rice, Haitian population was not prepared for it and therefore, one of the worst political indices in Haitian history is recorded in 2008, when the rice price crises culminated. After such an experience, the recommendation would be to distribute Haitian diet amongst variety of agricultural commodities as for instance roots and tubers, which formed a major part of Haitian menu two decades ago.

Over the examined time period 1990-2014, following the food security areas experienced dynamic development:

### **Positive development**

- Reduced dependency on international markets within rice imports and increased production of local rice has by 15%. Therefore it is expected that in terms of self-sufficiency in terms of rice, Haiti is on the right track. On the other hand, it has to be underlined that climatic conditions and frequent shifts of drought and floods will always be a significant factor in terms of Haiti's production, therefore it should definitely not give up imports of foodstuff.
- Increased level of protein intake from 42g/per capita/day in 1990 to 46g per capita/day, which is sufficient intake for a woman who weights 57kg. Although the average protein intake in Caribbean and Latin America is 80g/per capita/day which is still unattainable for Haiti.
- Decreased proportion of undernourished population by 10%. (61% in 1990 to 51%)
- Decreased prevalence of food inadequacy by 10% (1990 – 69%, 2012 – 58%)

## **Negative development**

- Increased cereal dependency ratio by 12% (60% in 2009-2012, 48% 1990-1993)
- Highly insufficient density and of roads in Haiti
- Even though there used to be 2 railway lines until 1932, no functioning railways and no rail connections are to be found in Haiti since then. Also, there are no rail connection with the neighboring Dominican Republic – therefore the dimension of access to food is much more limited.
- Political instability index indicates negatives values ever since it is being measured in Haiti. The security in the country is not ensured it also is one of the main reasons why Haiti's GDP is not benefiting from tourism, comparing to Dominican Republic where the situation is opposite.
- The area of poor health conditions and significant phenomenon of spreading diseases is connected with natural disasters. Striking number of 51% indicates the proportion of unimproved sanitation facilities combined with open defecation. This seems to be a striking share when considering the year of the assessment – 2012.
- Proportion of unimproved water sources has increased over last 20 years, forming 34% in 2012.

## 4.2 Projections of demand towards 2050

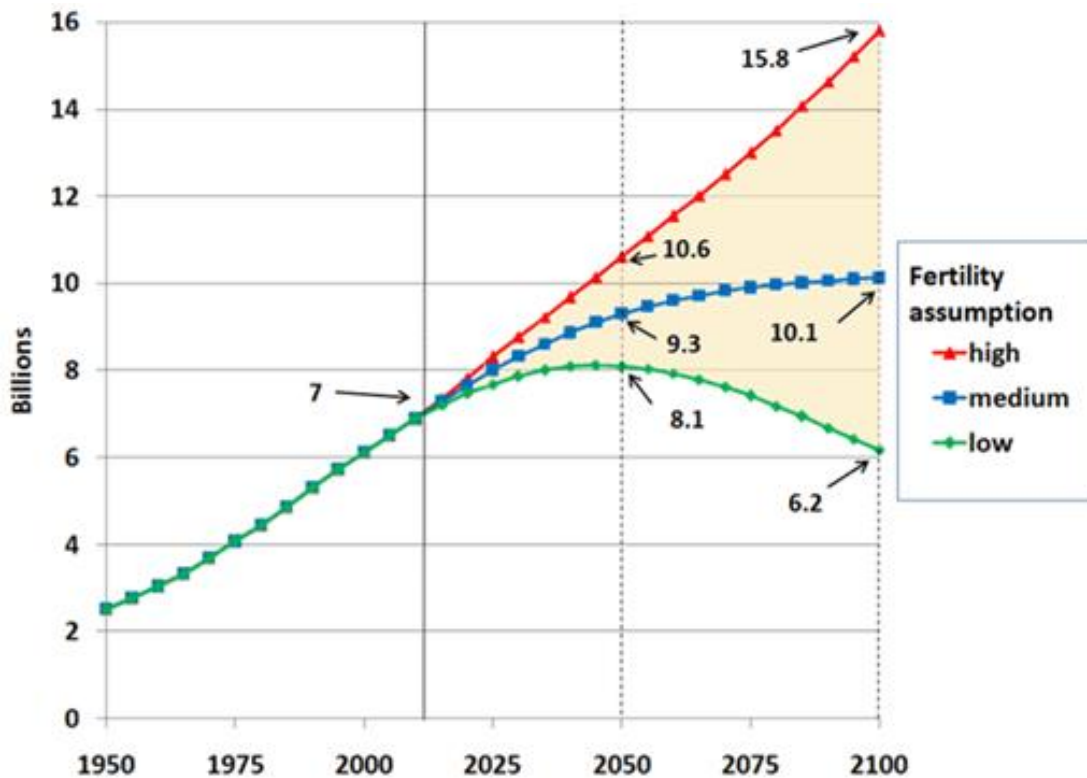
For a partial objective of this thesis, practical part 4.2 aims to provide projections in terms of demographic changes and food demand in Haiti towards 2050.

### 4.2.1 Projections of demographic changes in Haiti towards 2050

#### Population Growth & Life expectancy – UN projections and own calculations

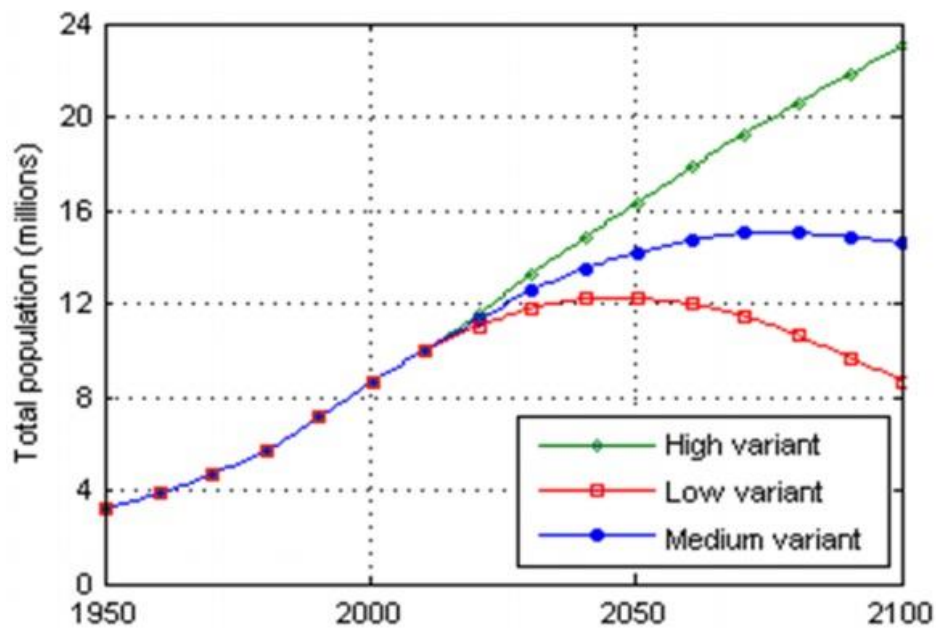
**Picture 12** provides United Nations' detailed illustration of 3 different fertility scenarios from a global point of view. To compare and comment on this issue, **Picture 13** will follow with UN's projections of Haitian population under the same conditions.

**Picture 12: UN projections of World Population under 3 Fertility Assumptions**



Source: United Nations, World Population Prospects (2011)

**Picture 13: UN projections of Haitian Population under 3 Fertility Assumptions**



Source: United Nations, World Population Prospects (2011)

According to UN projections, there are 3 various scenarios that are expected to occur within examined period 2010 (when the UN projections were published) to year 2100:

- a) High Fertility Assumption - under this assumption, fertility is projected to remain 0.5 children above the fertility in the medium variant over most of the projection period. This means that countries reaching a total fertility of 2.1 children per woman in the medium variant have a total fertility of 2.6 children per woman in the high variant.

UN projects the World's population to increase up to 10.6 billion in 2050 and 15.8 billion by the year 2100.

As for Haiti, the high fertility assumption implies that the total population is expected to increase to 16,316 000 in 2050 and to 23 050 000 in 2100, which would mean a significant problem within the population density of the island Hispaniola, on which Haiti is located. Current population of Haiti (2015) accounts for 10,604 000 people with the density of 382 people per squared area.

**Discussion:** This scenario would mean that by the year 2100 Haiti would experience the 117% growth of population compared to the state of population of year 2015 and the 53% growth by 2050 compared to the number population in 2015.

**Table 11: High fertility assumption projections:**

Year	Population	
2015	10 604 000	
Year	Population	% change
2050	16, 316, 000	+53%
Year	Population	% change
2100	23, 050, 000	+117%

Source: Own processing & calculations, United Nations – World Population Prospects (2011)

- b) Medium Fertility Assumption implies that the World’s population will increase to 10.1 billion people in 2100 and 9.3 billion by 2050 (2.1 children per woman). For the case of Haiti, the medium variant suggests that as for the year 2050, the population should increase to 14,178 000 people and 14,566 000 people by 2100. This projection curve even implies future stagnation and decline.

**Discussion:** Under the conditions of the medium fertility assumption, the population of Haiti should experience 33% population growth by 2050 and subsequently 37% population growth by 2100.

**Table 12: Medium Fertility Assumption projections:**

Year	Population	
2015	10 604 000	
Year	Population	% change
2050	14,178 000	+33%
Year	Population	% change
2100	14,566 000	+37%

Source: Own processing & calculations, United Nations – World Population Prospects (2011)



- c) Low Fertility Assumption implies that countries reaching a total fertility of 2.1 children per woman in the medium variant have a total fertility of 1.6 children per woman in the low variant – that is 0.5 child less than suggested for medium fertility assumption.

Under the low fertility assumption, the world population should even decline under the current level (2010, 7 billion people) and should reach the value of 8.1 in 2050 and 6.2 in 2100. As for the case of Haiti, the low fertility variant suggests the future number of Haitian population to become *12 200 000 in 2050* and *8 219 000 by 2100*.

**Discussion:** The scenario of Low Fertility suggests that the population of Haiti should experience 15% population growth by 2050 and subsequently a decline towards 2100 for which the population should decline by 2 098 460 which accounts to -22%.

**Table 13: Low Fertility Assumption projections:**

Year	Population	
2015	10 604 000	
Year	Population	% change
2050	12 200 000	+15%
Year	Population	% change
2100	8 219 000	-22%

Source: Own processing & calculations, United Nations – World Population Prospects (2011)

To conclude on the issue of fertility rates, one cannot estimate the future changes of population structure very precisely. Due to a fact that Haiti is a developing country with a high risk of natural disasters (periodic hurricane seasons, earthquake-January 2010) outbreaks of epidemics (cholera 2010-?) etc., it is highly probable that Haiti will undergo unexpected population behavior/trends which are difficult to predict precisely. As an example of such trends, an article by Jamaican Gleaner from October 2010 (6 months after an extreme earthquake) should demonstrate a recent specific case, when a completely new issue in terms of fertility rates appeared. According to United Nations Population Fund (UNFPA), Haiti’s birth rate has tripled since the January 2010 earthquake. Igor Bosc, UNFPA representative to Haiti further explained that:” *The situation in Haiti has worsened since the earthquake. Family and community structures are breaking down and young people are very sexually active at an early age. We now*

*have to intensify our campaign against HIV/AIDS and do more work in the area of family planning," he said, through an interpreter.*“ Population that was affected by the earthquake is living in tent cities and it is very difficult for parents to control their teenage children. The volunteer doctor also explains that: *“Many of them are teenagers and others in their early 20s. We don't know what it was like before, but what we are seeing is that a lot of women who are coming to us are pregnant.”* Moreover Mr. Bosc explains further that: *“..there has been an increase in violence against women and that sexual behavior among Haitians now create the opportunity for increasing sexually transmitted infections. Only 12 per cent of the population use condoms and the prevalence of HIV is likely to increase.”*

First of all, the values for year 2015 in this chapter are estimated by United Nations.

Second of all in all other author’s calculations in this thesis, only the official data of World Bank’s database are used for currently the most recent year available – 2013. According to United Nations estimates, stated in the World Population Prospects (2013), the population of Haiti should experience following phenomena towards the year 2050:

- a. Decrease of Total Fertility Rate - United Nations estimates assume that there is a decreasing trend in terms of Total Fertility Rate (TFR) towards 2050. The specific values of UN’s estimates are shown below in Table 14:

**Table 14 Development and future projections of fertility rate in Haiti: \***

2005-2010	2010-2015*	2015-2020	2025-2030	2045-2050
3.54	3.18	2.90	2.50	2.06

Source: Own processing & United Nations, World Population Prospects (2013)

Projection of fertility rate in Haiti has, according to UN, rather descending tendencies. Current estimates state that the fertility rate in Haiti for years: 2010-2015 is 3.18 children per woman (blue colour in Table 14). However, the trend is changing in a descending manner towards years 2045-2050, when the fertility rate is estimated to become 2.06 children per woman. When considering the lowest estimated TFR, it should also be taken into account that the result of 2.06 children per women is still highly exceeding the EU (28 countries) average of 1.58 children per woman (Eurostat, 2012) or 2.2 for Caribbean Region (Trading Economics, 2012).

\* Red colour – future (2050) estimate

Blue colour – current (2015) trend/values

\* 2015 represents the UN’s estimated population

This descending trend is in contradiction with *Research question 2 (Q2)*, which assumes an increasing trend in terms of the total population. However, the state of population does not only depend on fertility rate but also on life expectancy, which can highly influence the total population even in case of fertility rate in 2045-2050 being lower than in 2010-2015.

- b. Increase in the level life expectancy – United Nations estimates assume an increasing trend in terms of life expectancy in Haiti. The development of the values is shown in Table 4.2 below:

**Table 15: Development of the level life expectancy in Haiti**

2005-2010	2010-2015*	2015-2020	2025-2030	2045-2050
61	62.5	63.9	65.3	71.6

Source: Own processing & United Nations, World Population Prospects (2013)

As it can be seen from table 15, United Nations estimates that the life expectancy in Haiti will probably be increasing in coming 4 decades. The current (2010-2015) trend in terms of life expectancy (men & women average) is 62.5 years and should reach even 71.6 towards year 2050. This trend indicates possible total population increase, even though that the total fertility rate is and is expected to slightly decrease.

- c. Increase in total population

According to United Nations, there exist 3 different scenarios of population projections to the future. Among these belong: *Medium variant* – which assumes medium fertility rate of 2.1 children per woman; *High variant* – which assumes high fertility rate (more than 2.5 children per woman) and *Low variant* which assumes low fertility rate (less than 1.6 children per woman).

**Table 16: Calculated percentage changes of total population based on officially published data for the latest available year 2013:**

<b>Time Series</b>	<b>Historical development</b>	<b>% change of population</b>
2013*/1998	2013/1998	<b>+24.5%</b>
	<b>United Nations Estimates 2050</b>	
2050/2013	Low Fertility Variant	<b>+18%</b>
2050/2013	Medium Fertility Variant	<b>+37.5%</b>
2050/2013	High Fertility Variant	<b>+58.2%</b>

Source: Own processing and calculations & United Nations, World Population Prospects (2013)

Due to a fact that red/blue highlighted values are the estimates of *United Nations World Population Prospects published in 2013*, the real values may differ. Therefore the fourth scenario is provided thanks to own calculations which are shown below. It is assumed that the values will differ e.g.: due to a fact that real values of the Total Population, Gross Domestic Product were used for the year 2013. (Years 2014; 2015 were not published at the time of writing this thesis yet, therefore they could not be used).

The main purpose of calculations below is to determine the value of total population in 2050, population growth in Haiti observed within time series 1998-2013, comparison of percentage change of population using 3 fertility scenarios (low, medium, high) and its comparison to the state of population in 2013.

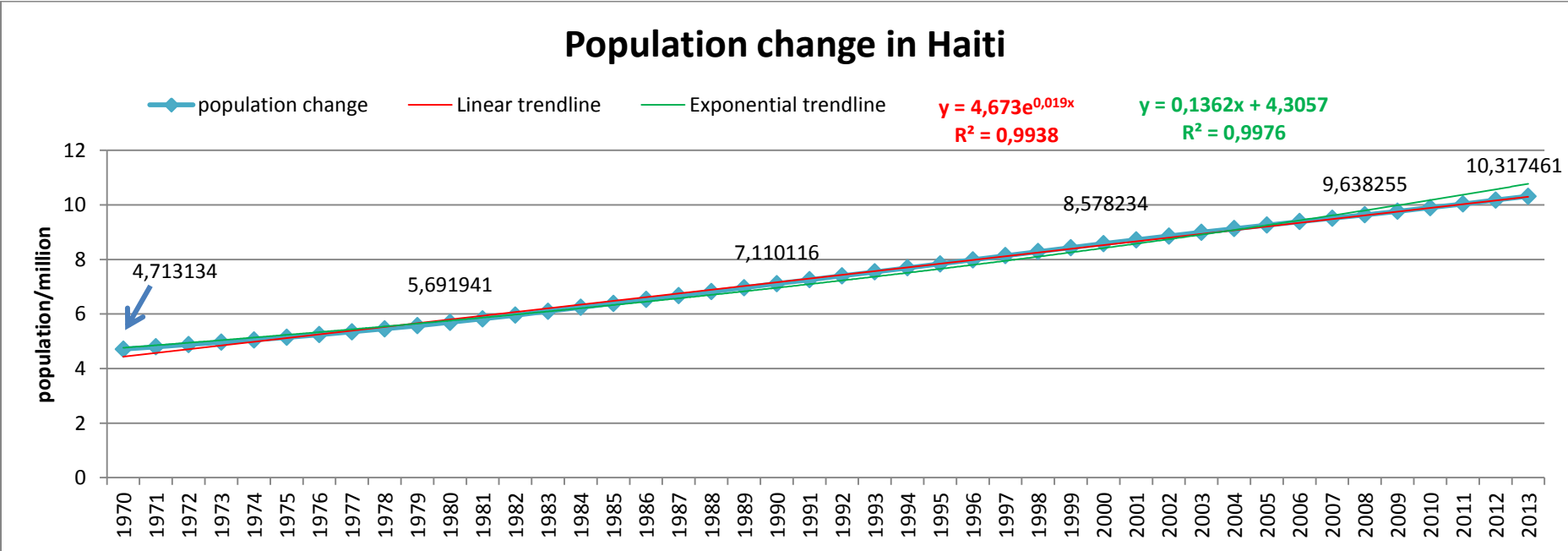
Using the datasets of United Nations and World Bank a projection of *Food Demand* in Haiti towards 2050 is calculated as well. However, due to the lack of data, only a dataset of years 1998-2013 was available to use.

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\* 2013 – official amount of population in Haiti (World Bank, World Development Indicators)

In order to provide a comprehensive snapshot of Haiti’s population changes and its development, the Figure 28 below provides a synoptical overview of the population growth in a time series of: 1970-2013. Moreover, besides the real population change, exponential and linear trend-line and their equations are provided as well. Figure 28 also provides descriptions of the values in terms of each decade. As it can be seen, Haiti’s population has increased by **119%** in terms of time series 1970-2013 as shown below in figure 28:

**Figure 28: Population change in Haiti 1970-2013**



Source: Own processing & World Development Indicators, World Bank (2014)

**Own Calculation of Total Population in Haiti towards 2050 based on historical growth rates**

In order to obtain the fourth projection towards 2050 in terms of population growth in Haiti, various functions of power were used as explained in methodology.

It was calculated that the compound growth based on historical data of the time series: 1998-2013 and total population in million is 1.47% and finally that the population in 2050 will reach 17.71 million. The calculated value is however significantly high and even exceeds the high fertility scenario by UN, therefore it is rather not probabilistic that the population would grow in a same pace as during 1998-2013. In order to obtain more probabilistic projection, more factors connected with demographic transition should be included in calculations such as high birth rates and death rates or low birth rates to death rates. Therefore, calculated +72.8% population growth is rather too optimistic and should be taken only as a variant with low probability.

**Table 17: Own calculated projection of Total Population towards 2050 and percentage population increase**

Compound Annual Population Growth Rate (1998-2013)	<b>1.47%</b>	<b>% population increase 2013-2050</b>
Population in 2050 (million)	<b>17.71</b>	<b>+72.8%</b>

Source: Own calculations based on World Bank’s own modified dataset (Supplement 6)

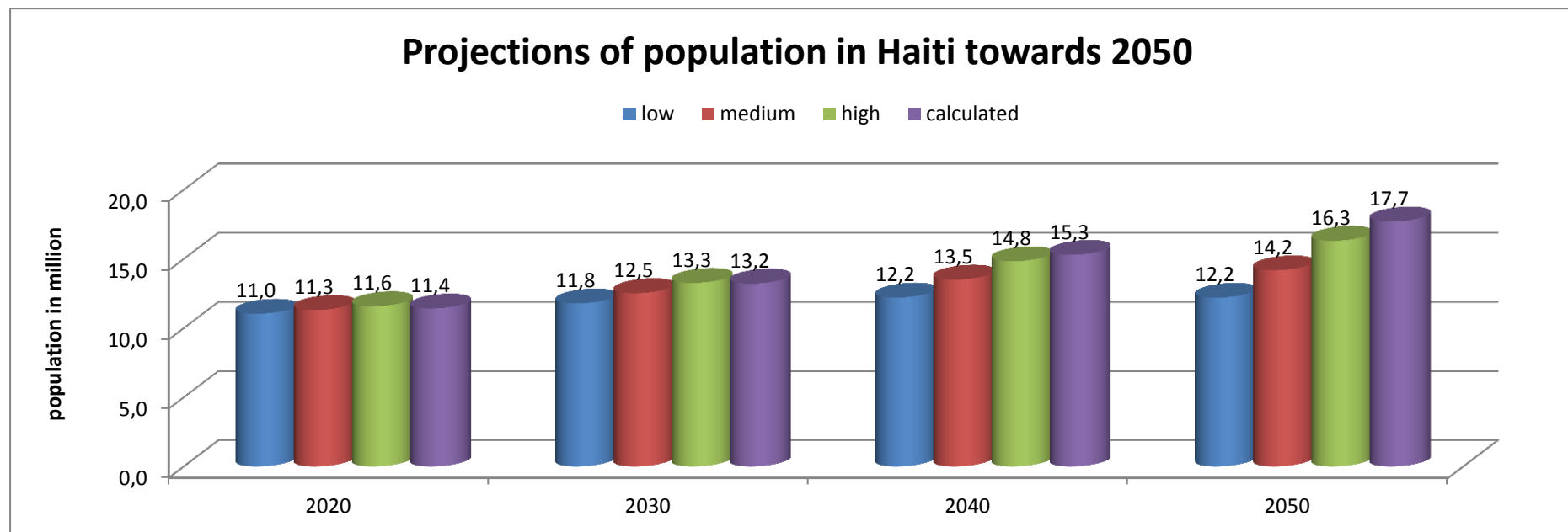
When comparing the calculated value of total population in 2050, it is obvious that the calculated number is very high and even exceeds the estimation of United Nations “high variant”, which estimates the Haiti’s population to reach 16.36 million by 2050. The calculated value implies that by 2050, Haiti should experience 72% increase in terms of total population. This fact is caused mainly by the methodology that was used for the calculation, which follows the linear development of the population and used compound annual Growth Rate of 1.47% per annum, which follows historical growth rate in terms of time period

As it can be seen from Figure 28, different values were obtained. High, medium and low fertility scenario provided by United Nations (2013), were explained in previous chapters. The calculated value of population projection for year 2050 exceeds the value of high fertility scenario by UN by 8%. It is assumed that the estimate of United Nations also includes the role

of external factors that influence the population growth (natural disasters, higher mortality rate, diseases outbreak etc).

More precise illustration in terms of development of total population in Haiti for future periods of 2015-2050 within own calculated scenario and also 3 different UN fertility scenarios is shown in Figure 29 below.

**Figure 29: Projection of Total Population in Haiti towards 2050 based on own calculations**



Sources: Own processing, calculations & World Bank, World Development Indicators (Supplement 6)

The violet column in Figure 29 is increasing with the annual growth rate of 1.47%. In reality, it is very unlikely that such scenario would occur due to many external factors that influence population growth and life expectancy, especially in a developing country such as Haiti and also due



to using the population growth which is based on historical population growth within period 1998-2013. Therefore, own calculated scenario (violet) represents Haiti in a situation when no external factors influence the population growth, which grow in the same pace as from 1998-2013.

### 4.2 Projections of Food Demand in Haiti towards 2050

For the calculations of food demands towards future years: 2020, 2030, 2040 and most importantly 2050, Microsoft Excel was used in order to run the dataset through power functions as follows:

**Demand Growth** = Population Growth (Haiti) + Income Elasticity of Demand (E; Jamaica)\*Gross National Income Growth (Haiti)

**Food Demand**= 100\*(1 + demand growth)<sup>y<sup>t</sup>-y<sup>0</sup></sup>

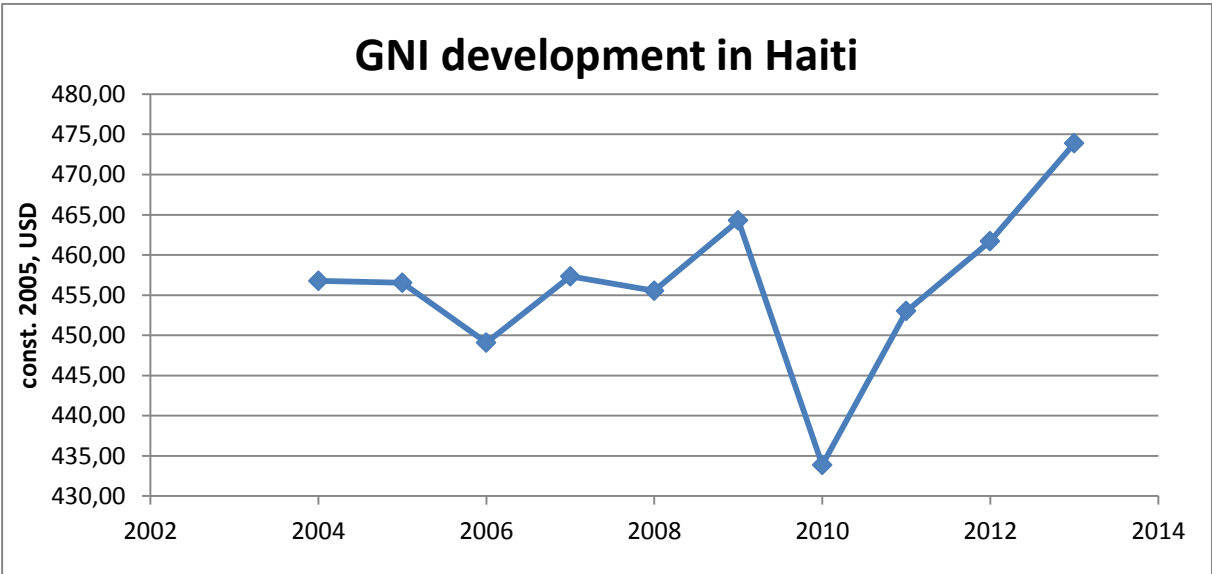
(y<sup>t</sup> = 2050 y<sup>0</sup> = 2013) therefore y<sup>t</sup> - y<sup>0</sup> = 37

In order to perform projection of food demand, gross national income projection and its growth has to be detected firstly.

#### 4.2.2 GNI in Haiti – development and future outlook

Due to a lack of data in terms of Gross National Income in Haiti (time series 2004-2013), the variable of population growth needed for further calculation of demand growth had to be modified into the time series of 2004-2013 instead of 1998-2013 as stated above (Calculation of Total Population in Haiti towards 2050). Therefore, following the formula stated in methodology above, the new compound population growth rate for time series of 2004-2013 is: **1.37%**

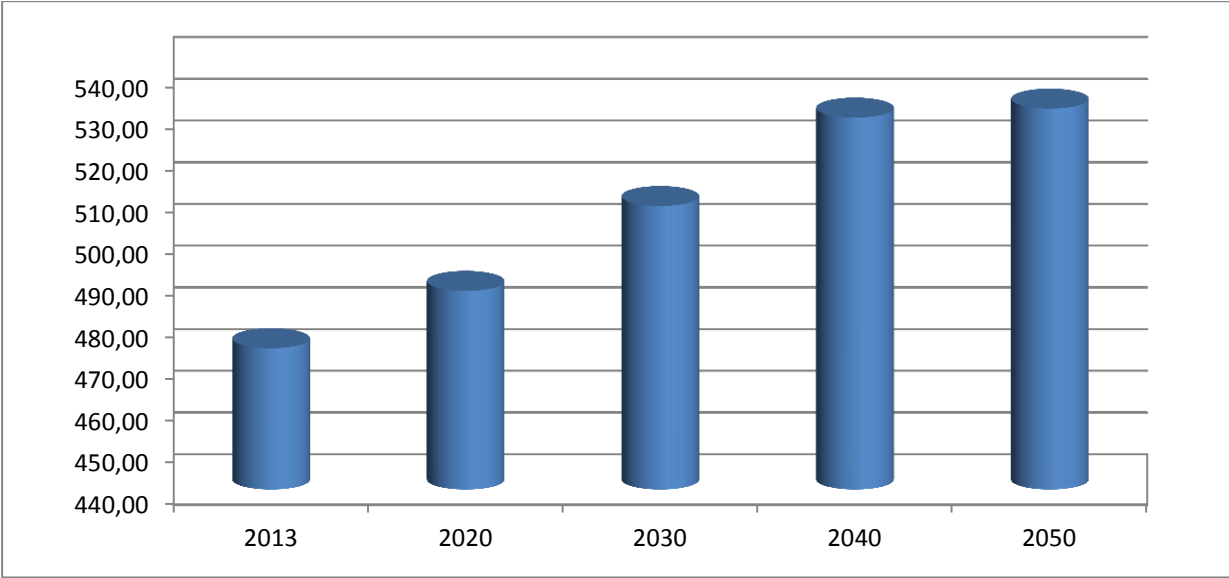
**Figure 30: Historical development of GNI in Haiti; 2004-2013**



Source: Own calculations based on World Bank, Haiti dataset (2014)

Projections of GNI towards 2050 based on historical development of GNI growth are shown below.

**Figure 31: Projections of GNI towards 2050 based on historical population growth(2004-2013)**



Source: Own calculations based on World Bank, Haiti dataset (2014)

Using the compound growth of Gross National Income (GNI) of Haiti given in constant 2005, USD – it was calculated that:

**Table 18: Partial calculated values for obtaining food demand of 2050**

Weighted Average of Income Elasticity of demand for Food (Jamaica)	<b>0.7069413</b>
Food Demand (2013)	<b>100</b>
Population CAGR(2004-2013)	<b>1.37%</b>
Gross National Income CAGR(2004-2013)	<b>0.41%</b>
Compound Annual Food Demand Growth Rate (2004-2013)	<b>1.78%</b>
Food Demand	<b>222.6</b>
Food Demand 2050 (percentage) Food Demand (2050) – Food Demand (2013)	<b>122.6%</b>

Source: Own processed & calculated, World Bank Dataset

- a) the compound growth of GNI using the only available time series of: 2004-2013 is equal to +0.41%
- b) the Food Demand growth using the power function stated in the equation above is equal to: +1.78%
- c) the value of food demand towards 2050 obtained through power function is equal to: +122.6%

Using the power functions above and dataset of World Bank for the time series of 2004-2013, it was detected that food demand in Haiti should increase by 122.6% compared to year baseline year 2013 (Food Demand (2013) = 100). Nevertheless, all results are counting with the fact that the population growth is equal to as calculated above: 1.37% annually, reaching the total population of 17.71 million by 2050, which means +72.8% increase since 2013. This result is also discussed below in chapter 4.2.3.

These results may be perceived as disturbingly high although as mentioned before, the methodology used to obtain these results does not involve the external factors, notably the role of natural disasters and climate conditions etc., which can play crucial role in the country's economic and agricultural performance as well as population growth and life expectancy.

Therefore calculations regarding the fourth projections scenario obtained in chapter 4 should be perceived as only an estimate, not as a certain and precise prognosis of future development. This thesis therefore proposes the idea of possible further research, using another methodology as for instance econometric modelling of food demand in the country, including the coefficient of climate change, which would represent the role of external factor that influences food supply, subsequently food security in the country. However, due to a fact that Haiti is a developing country, the crucial data for further research are missing in the databases of FAO or World Bank., therefore another country of study would be a logic decision to make in case that one would like to explore food security issues further.

#### **4.2.3 Evaluation of the results of food demand projections**

Food demand projections were also compared with 3 fertility scenarios (low, medium, high,) published by United Nations and food demand was calculated for each scenario as well. The data –set used for these calculations representing average annual population change was used as follows:

**Table 4.10 Average annual rate of population change within 3 fertility scenarios (high, medium, low) by United Nations**

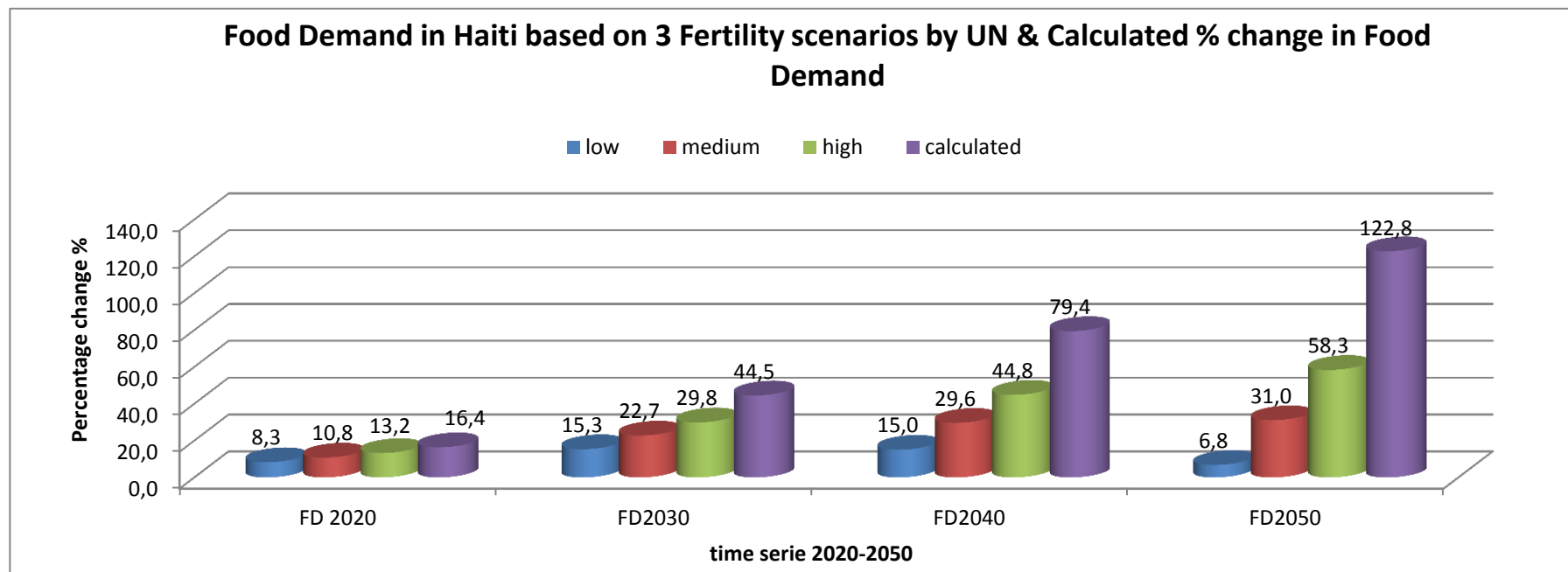
Haiti	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050
High fertility	1,566	1,538	1,458	1,314	1,204	1,125	1,059	0,991
Low fertility	1,194	0,954	0,746	0,622	0,484	0,321	0,140	-0,041
Constant fertility	1,639	1,703	1,694	1,652	1,627	1,630	1,654	1,678

Source: Own processed & World Population prospects (2012)

Data set and computational procedure in terms of determining the projections of food demand towards 2020, 2030, 2040 and 2050 is enclosed in supplement 7 at the end of this thesis.

A comprehensive comparison of changes in terms of Food Demand is illustrated in figure 4.3 below. It includes results of calculations of food demand within 3 fertility scenarios provided by United Nations and also a comparison to fourth, own calculated scenario of development of food demand in Haiti.

**Figure 4.3 Comparison of development of Food Demand changes in Haiti towards 2050; 3 Fertility Scenarios by United Nations (High, Medium, Low) and own calculated percentage changes**



Source: Own processed, calculations & UN, World Population Prospects, File POP/2: Average annual rate of population change by major area, region and country, 1950-2100 (percentage); 2012

As for the development of food demand in Haiti it can be observed that for the near future, year 2020, the food demand in terms of all 4 estimates fluctuates between 8-16.4% of increase since year 2013, which is taken as a baseline year with Food Demand equal to 100. In terms of next 3 decades, the difference between all 4 scenarios differ more than in terms of comparison of projection of population towards 2050 stated in chapter 4.1 Although one of the reasons may also be caused by including Income Elasticity of Demand of Jamaica. Due to the lack of data for other Caribbean countries, including Haiti, the violet projection should be taken as one of the extreme

estimates because it is also taking into consideration historical population growth based on time series of 1998-2013 and naturally, the population simply cannot grow within the same pace for 37 next years (2013-2050), therefore estimates of UN (low, medium and high fertility) are to be more precise due to taking into consideration many external factors which influence population growth. Concerning 3 fertility scenarios by UN and their development of food demand, the values should be more realistic because the food demand was calculated by using individual population growths (table 4.10) and only the value of income elasticity of demand which had to be chosen from Jamaica, could cause possible inaccuracies in 3 future food demand estimates.

When taking into consideration following 3 scenarios (medium, high and author's projections) it is assumed that such level of food demand would cause increasing imports from abroad. This exposure to international markets would be very risky for Haiti when importing e.g.: rice, due to already experience rice price crisis in 2008. Regarding medium and high fertility scenarios – food demand would increase by 31% and 58% which would most probably mean that Haiti's domestic production would not be sufficient for feeding its population by any means and the country would have to be exposed to volatile international markets very significantly. This could mean serious economic issues, and even social, when considering serious riots in times of rice price crisis of year 2008, when huge number of dissatisfied and hungry population protested against it all over the country. In a situation of 1) low fertility scenario – food demand in 2050 would increase by 6.8% since 2013, this situation is assumed to be feasible for Haiti thanks to the fact that the food demand has not increase from its current value that significantly (2013)

### 4.3 SWOT Analysis focused on food security in Haiti

SWOT Analysis applied on a country of study – Haiti – should assess all strengths, weaknesses, opportunities and threats that were discussed in both parts of this thesis and should help to derive conclusions and recommendations in order to provide possible solutions to improve food security and reduce poverty in the country.

In case of this thesis, SWOT analysis helps to summarize already discussed areas in terms of food security and poverty as well as the potential opportunities and threats that may influence the country's future development as follows:

#### SWOT analysis

##### INTERNAL ANALYSIS

##### STRENGTHS

- History of strong competitive advantage in terms of commodity exports (coffee, mangoes)
- After long time period of exporting mainly apparel, Haitian beer is currently (2014) being successfully exported to Dominican Republic
- High nutritional quality of traditional Haitian seeds (although limited amount only)
- Possibility of two harvests in a calendar year

##### WEAKNESSES

- The poorest country in the Western Hemisphere (55 percent of the population living below the poverty line of \$1.25 per day)
- Location in the middle of hurricane belt
- Recurring flooding, earthquakes and periodic droughts
- Inadequate supplies of clean, drinkable water
- Spreading of diseases associated with polluted water (cholera outbreak 2010-?)
- Underdeveloped industrial sector and services (70 percent of population depends on small-scale subsistence farming)
- High share of undernourished population (49.8% in 2012)
- High dependence on food imports (Number 1. imported commodity is foodstuff)
- Underdeveloped transport infrastructure (20% paved roads over total roads)
- Current negative GDP growth (4.3% 2012, 3.8% 2013)



- Low level of development and extreme poverty (ranked 168th out of 187 on the Human Development Index)
- High price of local agricultural commodities and cheaper imported agricultural goods (rice, cereals) due to almost no tariffs
- Demand for cheaper imported goods, although it has lower nutritional value (“Miami rice”)

#### EXTERNAL ANALYSIS

#### OPPORTUNITIES

- High potential for development of agriculture (international projects, crop intensification, EU subsidies etc.)
- Greater cooperation with Dominican Republic, as the closest importer, in terms of foodstuffs import

#### THREATS

- Increased occurrence of natural disasters
- Increased occurrence of floods and droughts
- Deforestation, extreme soil erosion resulting in the loss of arable land
- More landless farmers due to Foreign Direct Investments which aim to support building of large industrial parks (Caracol) which are built on fertile arable land that belongs to family farmers
- Poor sanitation (especially in Port-au-Prince, potential increase of spreading diseases)
- Poor access to improve water sources (potential spreading of water related diseases)
- High risk of public riots and overall political instability with coming elections at the end of 2015

### Results

When commenting on the SWOT analysis of Haiti, it is obvious that its weaknesses highly outreach its strengths. Food security cannot be ensured easily when the political situation is unstable, the role of natural disasters highly influence agricultural production and current foreign investments are causing the farmers to become landless due to building new industrial parks on a fertile arable land. Together with massive deforestation and continuing erosion, Haiti loses around 10,000-15,000 hectares of once-fertile land every year which is an extremely serious issue. If the continuing trend of building new industrial parks rather than

supporting local agriculture by any means lasts in a long term, there exists a high risk of future food imports dependencies at even higher levels than in history of Haiti, due to lack of fertile, arable land.

In terms of food security, there exists a following vicious circle – farmers sell their land to foreign investors in order to improve their financial situation, get in some cases an inadequate amount of money for their land and are landless. They subsequently can work in “sweatshops”, but in case that they are elderly, the factory will not accept them to work there. Due to an inadequate road infrastructure and high price of fuel, it is difficult to get to markets in the cities or other farmers to buy food, so it is expected that if there are no significant improvements in the agriculture area, the level of undernourished population will even increase and exceeds its current 58% level. Due to a fact that Haiti is an island country, there is no other possible solution of getting any more of the arable land anywhere else, therefore with the current trend of selling the fertile land to building factories continues, there is no possible way out.

Most of the population have moved to larger cities and capital Port-au-Prince, where a possibility to get an access to food is higher – thanks to direct access to imported goods through foreign ships – or live close to borders with Dominican Republic, which does not have any significant problems with food insecurity. In 2000, only three percent of Dominican exports went to Haiti. Nine years later, that number had grown to 15 percent, according to 2012 World Bank report *Haiti, República Dominicana*. If the current trends of low local production in Haiti remains stable, it is expected that Haiti’s dependence on its closest neighbor Dominican Republic will significantly increase, due to unsustainable environmental degradation of Haiti.

#### **4.4 Recommendations to improve Food Security in Haiti**

There are several possible opportunities that Haiti can use in order to improve food security in the country through increasing local agricultural production.

The first suggestion is to create peasant cooperatives in order to mitigate the small scale farming which often generates an agricultural production to feed one family, otherwise there is not much left for trading and potential profit making. The larger scale farming and possible implementation of crop intensification techniques would offer a possible solution in order to

increase food security not only in rural areas. By doing so, peasant cooperatives would increase their production and also their power on the market as sellers.

Another suggestion is to introduce income generation programs complemented with nutrition programs in order to prevent Haitian households from using seed capital and micro credits for food consumption. FAO currently (2014) implements such a program in order to decrease food insecurity in urban areas of Haiti, where food insecurity is also quite significant such as in a few departments' capital cities such as Jacmel in the south, Cap-Haitien in the north or Fort-Liberté in the north east of Haiti, where the food security is marked as phase II – state of food stress. The activities of FAO (2014) concentrate on supporting of urban gardening, recycling and composting activities in urban areas together with training in nutrition, food preservation and marketing. The idea of urban gardening is mainly to provide families with fresh produce which is rich in vitamins and minerals but it also can be a source of income. Urban gardens can be set up in small spaces e.g.: in small containers, wooden tables or even used tires and are ideal for placing in places such as on rooftops or in small courtyards.

In terms of reforestation programs which are currently being developed and implemented, it would only be a positive solution if peasant would find an alternative way of making charcoal (from coffee bushes for example), otherwise Haiti would be facing another wave of deforestation, which is currently not quite possible due to estimated 2% forests in a country.

One of the last solutions would be reintroducing trade tariffs for imported products. By doing so, Haitian government would have a possibility to accumulate finances and Haitian products would be able to compete with imported cheaper food products. (As it was already experienced with imported US rice which was historically cheaper than local one)

## **6 Conclusion**

For greater food security in the world's population it is crucial that there exists a faster growth of food production prior to population growth. Generally it applies that in the world (even developing regions except of Africa) there exist a natural growth of food production per capita. However, an indicator of growth of food production per capita does not take into consideration the distribution of food among individual countries or groups. Therefore it can be assumed that even in 21<sup>st</sup> century, the world suffers from uneven food security with respect to greater vulnerability of developing countries (significant dependence on foodstuff imports from abroad, sensitivity to price volatility in foreign markets, sensitivity to natural disasters in

case of Caribbean region etc.) . While in poor economies, there exist a general shortage of food for the masses of the population manifested by malnutrition, starvation and related diseases, developed countries, by contrast, are characterized by an excess of food and higher level of obesity.

Based on the findings in the practical part of this thesis (chapters 4.1 and 4.2) there exist various scenarios of population and food demand growth towards 2050. Three scenarios (Low, Medium and High fertility) of United Nations were compared to an own calculated scenario and it was found out that considering projections of population in Haiti towards 2050, all four scenarios provides logical explanations of population growth based on various fertility rates although it cannot be easily stated which scenario will probably come true.

Based on calculations in chapter 4, the population in Haiti is expected to increase to 12.2 million (low fertility scenario), 14.2 million (medium fertility scenario), 16.3 (high fertility scenario) or even very low probabilistic scenario of 17.7 million (author's calculations) by 2050.

When it comes to projections of food demand towards 2050, above specified four scenarios differ more significantly due to several reasons. Food demand for 2050 is expected to increase by 6.8% (Low fertility), 31% (Medium fertility), 58% (High fertility) and even 122% according to author's calculations. The reason for the last projection of being so high is that because of author's consideration of stable population growth of 1.36% annually which is higher than the third fertility scenario (high fertility) provided by United Nations (1.025% calculated as an average of 1.059% and 0.991% for time periods of 2040-2045 and 2045-2050). The annual population change by United Nations estimates provides different numbers every 5 years from 2010-2050, therefore the author's projection has to be higher, due to using the stable percentage of annual population change.

When considering possible scenarios for 2050 it is assumed that in case of low fertility scenario and so far increasing level of rice production, Haiti would be able to feed itself without any significant need of imports. When taking into consideration following 3 scenarios (medium, high and author's projections) it is assumed that such level of food demand would cause increasing imports from abroad. This exposure to international markets would be very risky for Haiti when importing e.g.: rice, due to already experience rice price crisis in 2008.

Concerning assessing of food security dimensions by FAO, the results and recommendations were derived from applying of the SWOT analysis and it was detected that weaknesses significantly outreach strengths in terms of food security in Haiti. Most of the country is currently facing to stage II- Food Stress, while 13 of its regions are considered as stage III – Food Crisis. Moreover, it was detected that an earthquake in 2010 caused migration of population from affected area to rural areas, which caused a sudden increase in the number of people living in the same household. This population shift resulted in a deficit of basic alimentary goods, price increase for basic foodstuffs and the stock of seeds being used for human consumption. Although the food insecurity nowadays affects approximately 38% of the Haitian population, this proportion fluctuates with regards to repetitive natural disasters, hurricane or drought seasons and due to massive deforestation, also mudslides. Due to such factors, agricultural production fluctuates as well and therefore there currently exists 80% dependency on rice imports. Although Haiti currently does not generate enough domestic production, many international projects are operating in the country with the aim to introduce new farming techniques that should double Haitian farmers' yields and ensure at least a minimum stability. On the other hand, after assessing 15 food security indicators applied on Haiti, positive development was detected in terms of decreasing the proportion of undernourished population and food inadequacy by 10% since 1990, increasing the protein supply to a normal value that is sufficient for a woman (46g/per capita/daily) and most importantly, decreasing the proportion of rice import dependency at the detriment of increased domestic production of rice. To conclude, it is expected that Haiti will be exposed to natural disasters, hurricane seasons etc., on the other hand, with coming international help and projects, it is also expected that the in the course of time, Haiti will ensure itself at least a minimum stability in terms of food self-sufficiency.

## 7. References

- [1] "Central Intelligence Agency (2014), Country Comparison: Birth Rate. [Internet], Available from: <<https://www.cia.gov/library/publications/the-world-factbook/rankorder/2054rank.html>> [Accessed 30 January 2015]
- [2] *Canadian Journal of Public Health / Revue Canadienne De Sante'e Publique* 96.3 (2005), Veugelers, Paul J. (2011), Dietary Intake and Risk Factors for Poor Diet Quality Among Children in Nova Scotia. [Internet], Available from: <[http://www.nal.usda.gov/fnic/DRI/DRI\\_Tables/estimated\\_average\\_requirements.pdf](http://www.nal.usda.gov/fnic/DRI/DRI_Tables/estimated_average_requirements.pdf)>.[Accessed 29 February 2015]
- [3] Central Intelligence Agency, (2014), Country Comparison : Total Fertility Rate. [Internet], Available from: < <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2127rank.html>> [Accessed 30 January 2015].
- [4] CHARLES, JACQUELINE. (2014) Women in Haiti Embracing Birth Control despite Taboos." *Miamiherald*. [Internet], Available from: <<http://www.miamiherald.com/news/nation-world/world/americas/haiti/article1957834.html>>.[Accessed 28 March 2015]
- [5] Collymore, J. *DISASTER IMPACT ON THE CARIBBEAN* (n.d.): n. pag. 2001. Web. 8 Mar. 2015. <http://cdemavl.org/bitstream/123456789/34/1/DISASTER%20IMPACT%20ON%20THE%20CARIBBEAN%20Collymore%20revised%20in%202001.pdf> .> [Accessed 22 February 2015]
- [6] Eurostat (2015), Tables, Graphs and Maps Interface (TGM) Table. [Internet], Available from:<http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdde220&plugin=1>> [Accessed 03 February 2015]
- [7] FAO (2003), *TRADE REFORMS AND FOOD SECURITY; Conceptualizing the Linkages*. [Internet], Available from: <<http://www.fao.org/docrep/005/y4671e/y4671e06.htm>>.[Accessed 28 March 2015]
- [8] FAO (2014), Implications of Economic Policy for Food Security : A Training Manual. [Internet], Available from: <http://www.fao.org/docrep/004/x3936e/x3936e03.htm>.> [Accessed 25 February 2015]
- [9] FAO (2014), Measuring Different Dimensions Of Food Security. "Measuring Different Dimensions of Food Security, *THE STATE OF FOOD INSECURITY IN THE WORLD 2013*. [Internet], Available

- from: <<http://www.fao.org/docrep/018/i3434e/i3434e02.pdf>>. [Accessed 28 January 2015]
- [10] FAO in Emergencies. (2014), Haiti. [Internet], Available from: <http://www.fao.org/emergencies/countries/detail/en/c/161491>.> [Accessed 19 February 2015]
- [11] FEWS NET. Famine Early Warning System Network (2015), HAITI Price Bulletin <[http://reliefweb.int/sites/reliefweb.int/files/resources/Haiti\\_2015\\_01\\_PB\\_EN.pdf](http://reliefweb.int/sites/reliefweb.int/files/resources/Haiti_2015_01_PB_EN.pdf)>.
- [12] Food Security Portal. (2014), Haiti. [Internet], Available from: <<http://www.foodsecurityportal.org/haiti>>. [Accessed 10 February 2015]
- [13] GeoHive (2015), Haiti Administrative Units. [Internet], Available from: <http://www.geohive.com/cntry/haiti.aspx>.> [Accessed 03 February 2015]
- [14] Georges, Josiane. "I. General Information." *Trade and the Disappearance of Haitian Rice*. Ted Case Studies Number 725, June 2004, n.d. Web. 02 Mar. 2015. <<http://www1.american.edu/ted/haitirice.htm>>
- [15] Global Finance Magazine (2014), The Poorest Countries in the World. *Recent GFM Updates RSS*. [Internet], Available from: <https://www.gfmag.com/global-data/economic-data/the-poorest-countries-in-the-world>.>[Accessed 03 February 2015]
- [16] Hunter College, What Factors Affect Birth Rates and Fertility Rates. . [Internet], Available from: <<http://www.geography.hunter.cuny.edu/~tbw/ncc/Notes/Chapter6.pop/chapter.6.what.factors.affect.birth.fertility.rates.outline.html>>.[Accessed 28 February 2015]
- [17] James, CLR (1963). *The Black Jacobins*. New York: Vintage Books. p. 45.
- [18] Matějčková, Radka, and Richard Sovjak. *Human Nutrition and Prevention of Food-borne Diseases*. Prague: Czech U of Agriculture, 2004. Print. p. 31-32.
- [19] McLellan, James E. (2010). *Colonialism and Science: Saint Domingue and the Old Regime* (reprint ed.). University of Chicago Press. p. 63. ISBN 978-0-226-51467-3. Retrieved 2010-11-22. [...] French Saint Domingue at its height in the 1780s had become the single richest and most productive colony in the world.
- [20] MECOMeter. Macro Economy Meter (2014). Total Fertility Rate - by Country. [Internet], Available from: <<http://mecometer.com/topic/total-fertility-rate/>>.[Accessed 28 February 2015]
- [21] MINISTRY OF AGRICULTURE, NATURAL RESOURCES, AND RURAL DEVELOPMENT (2010), Haiti National Agriculture Investment Plan. [Internet], Available from:

- [https://www.gafspfund.org/sites/gafspfund.org/files/Documents/Haiti\\_NationalAgricultureInvestmentPlan.pdf](https://www.gafspfund.org/sites/gafspfund.org/files/Documents/Haiti_NationalAgricultureInvestmentPlan.pdf).> [Accessed 08 February 2015]
- [22] Pavlík, Z.: Demografický přehled světa, in. Ročenka Lidé a země 1980, Academia, Praha, 1979, str. 125-135
- [23] Perloff, J. (2008). Microeconomics Theory & Applications with Calculus. Pearson. ISBN 978-0-321-27794-7.
- [24] PhDr. Věra Exnerová PhD., and Andrea Volfová, B.A., MSc. (2008), Demografický Vývoj Ve Světě | [Internet], Available from: <<http://www.rozvojovka.cz/demograficky-vyvoj-ve-svete>>. [Accessed 28 January 2015]
- [25] Preeg, Ernest H. (1996), The Haitian Dilemma: A Case Study in Demographics, Development and U.S. Foreign Policy Centre for Strategic and International Studies, 1996. [Internet], Available from:< <http://haitipolicy.org/Dilemma.pdf>>.[Accessed 28 January 2015]
- [26] Rural Poverty Portal." *Rural Poverty Portal*. (2014) Available from: <<http://www.ruralpovertyportal.org/country/home/tags/haiti>>.[Accessed 28 January 2015]
- [27] Searchamelia (2012), Haiti Needs an Economic Identity to Survive. [Internet], Available from: <<http%3A%2F%2Fwww.searchamelia.com%2Fhaiti-needs-an-economic-identity-to-survive>>.[Accessed 28 March 2015]
- [28] Tanton, John H. (2001), Long-Term Global Demographic Trends: Reshaping the Geopolitical Landscape. [Internet], Available from:<[https://www.cia.gov/library/reports/general-reports-1/Demo\\_Trends\\_For\\_Web.pdf](https://www.cia.gov/library/reports/general-reports-1/Demo_Trends_For_Web.pdf)>. [Accessed 28 January 2015]
- [29] Than, K., National Geographic News (2010) Haiti Earthquake, Deforestation Heighten Landslide Risk. [Internet], Available from: <http://news.nationalgeographic.com/news/2010/01/100114-haiti-earthquake-landslides>.> [Accessed 29 February 2015]
- [30] The Observatory of Economic Complexity (2014), *OECD: Haiti (HTI) Profile of Exports, Imports and Trade Partners*. Available from: <<http://atlas.media.mit.edu/profile/country/hti/>>.[Accessed 26 February 2015]
- [31] The World Factbook (2009), *Choice Reviews Online*. Available from: <[https://www.cia.gov/library/publications/the-world-factbook/geos/print/country/countrypdf\\_ha.pdf](https://www.cia.gov/library/publications/the-world-factbook/geos/print/country/countrypdf_ha.pdf)>. [Accessed 28 February 2015]
- [32] Trading Economics, (2015), Fertility Rate - Total (births per Woman) in Latin America and Caribbean, [Internet], Available from:<



<http://www.tradingeconomics.com/latin-america-and-caribbean/fertility-rate-total-births-per-woman-wb-data.html>.> [Accessed 03 February 2015]

- [33] UNESCAP (2013), Food Security - Statistical Yearbook for Asia and the Pacific 2013 Economic and Social Commission for Asia and Pacific, 2013. [Internet], Available from: <<http://www.unescap.org/stat/data/syb2013/D.3-Food-security.asp>>. [Accessed 28 March 2015]
- [34] UNFPA - United Nations Population Fund (2014), Family Planning. [Internet], Available from :<<http://www.unfpa.org/family-planning>>. [Accessed 29 February 2015]
- [35] United Nations Development Program, Analyzing a Country Situation - Analytical Tools. Available from: <[http://web.undp.org/psd-toolkit/1c\\_tools10a.html](http://web.undp.org/psd-toolkit/1c_tools10a.html)>. [Accessed 28 March 2015]
- [36] United Nations Development Programme (2013), Rapport Objectifs du Millénaire pour le développement. [Internet], Available from: [http://www.latinamerica.undp.org/content/dam/haiti/docs/mdg/UNDP-HT-HaitiRapportOMD2013\\_20140611.pdf](http://www.latinamerica.undp.org/content/dam/haiti/docs/mdg/UNDP-HT-HaitiRapportOMD2013_20140611.pdf).> [Accessed 19 February 2015]
- [37] United Nations New York (2013), World Population Prospects, The 2012 Revision, Highlights and Advance Tables. [Internet], Available from: [http://esa.un.org/wpp/Documentation/pdf/WPP2012\\_HIGHLIGHTS.pdf](http://esa.un.org/wpp/Documentation/pdf/WPP2012_HIGHLIGHTS.pdf) .> [Accessed 26 February 2015]
- [38] United Nations Office for the Coordination of Humanitarian Affairs (2013), La Tortue, *HAITI: Food Security Priority Areas*. [Internet], Available from :<[http://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/IPC\\_Classification\\_Food%20Security23102013%20ENGLISH.pdf](http://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/IPC_Classification_Food%20Security23102013%20ENGLISH.pdf)>. [Accessed 29 February 2015]
- [39] World Bank (2014), Country, Haiti, [Internet], Available from: <http://data.worldbank.org/country/haiti>.> [Accessed 19 February 2015]
- [40] KUNA, Zbyněk, Jeffrey R ALWANG, William A MASTERS. Demografický a potravinový problém světa: World food systems and resource use. Vyd. 1. Praha: Wolters Kluwer Česká republika, 2010, 337 s. ISBN 978-807-3575-885
- [41] Bordley, Robert F; McDonald, James B. (Apr 1993): 209 Estimating aggregate automotive income elasticities from the population income-share elasticity Journal of Business & Economic Statistics 11.2
- [42] United States Department of of Foods Agriculture (October 2002), Nutritive Value Of Food. Available from:

<[http://www.ars.usda.gov/SP2UserFiles/Place/80400525/Data/hg72/hg72\\_2002.pdf](http://www.ars.usda.gov/SP2UserFiles/Place/80400525/Data/hg72/hg72_2002.pdf)>.

[Accessed 26 February 2015]

- [43] Nourishing the Planet (29 January 2010), Looking to Agriculture to Help Rebuild in Haiti. [Internet], Available from: <<http://blogs.worldwatch.org/nourishingtheplanet/looking-to-agriculture-to-help-rebuild-in-haiti-new-york-times-haiti-united-nations-food-and-agriculture-organization-fao-un-world-food-programme-heifer-international-oxfam-africa-agriculture-food-sec/>>.

[Accessed 28 March 2015]

- [44] Al Jazeera English (October 2012), Will Foreign Investment Aid or Exploit Haiti? [Internet], Available from: <<http://www.aljazeera.com/programmes/insidestoryamericas/2012/10/2012102683415308385.html>>.[Accessed 28 March 2015]

- [45] Disasters report (26 Feb 2013), Natural Disasters In Haiti 2013. [Internet], Available from: <<http://www.disaster-report.com/2013/02/natural-disasters-in-haiti-2013.html>>.[Accessed 28 January 2015]

- [46] Thomson Reuters Foundation, Moloney, Anastasia (June 2013), Drought, Poor Harvest to Worsen Haiti Food Crisis – WFP. [Internet], Available from: <<http://www.trust.org/item/20130618050112-zpqnd>>. [Accessed 28 January 2015]

- [47] Global Research (10 July 2013), Made in Haiti, Dumped in Haiti: Slave Labor and the Garment Industry. [Internet], Available from: <<http://www.globalresearch.ca/made-in-haiti-dumped-in-haiti-slave-labor-and-the-garment-industry/5342396>>. [Accessed 26 February 2015]

- [48] USAID (December 2014), Food Assistance Fact Sheet - Haiti. [Internet], Available from: <<http://www.usaid.gov/haiti/food-assistance>>.[Accessed 28 March 2015]

- [49] Oxfam. (12 Jan 2015), Haiti Progress Report 2014. [Internet], Available from: <<http%3A%2F%2Fpolicy-practice.oxfam.org.uk%2Fpublications%2Fhaiti-progress-report-2014-337992>>. [Accessed 28 January 2015]

- [50] MacLeod, Murdo J. Settlement Patterns. (27 January 2015), *Encyclopedia Britannica Online*. [Internet], Available from: <<http://www.britannica.com/EBchecked/topic/251961/Haiti/286810/Settlement-patterns>>.[Accessed 28 January 2015]

- [51] Haiti Libre (16<sup>th</sup> March, 2015), Haiti - Agriculture : Coffee sector development plan (2015-2025) [Internet], Available from:< <http://www.haitilibre.com/en/news-13397-haiti-agriculture-coffee-sector-development-plan-2015-2025.html>>. [Accessed 30 March 2015]

- [52] Haiti Libre (March 23rd, 2015), Haiti - Agriculture : 218,000 euros in subsidies to the agribusiness sector. [Internet], Available from: <<http://www.haitilibre.com/en/news-13443-haiti-agriculture-218-000-euros-in-subsidies-to-the-agribusiness-sector.html>> [Accessed 30 March 2015]
- [53] Haiti. *Enabling the Rural Poor to Overcome Poverty in Haiti* 12.137 (2014): n. pag. IFAD, [Internet], Available from: <[http://www.ifad.org/operations/projects/regions/pl/factsheet/haiti\\_e.pdf](http://www.ifad.org/operations/projects/regions/pl/factsheet/haiti_e.pdf)>. [Accessed 28 March 2015]

## 8. Appendix

### Supplement 1: Haiti – country profile

Country profile of Haiti	
<b>Full name:</b>	Republic of Haiti/ <u>République d'Haïti</u>
<b>Population:</b>	10.604 (UN, 2015)
<b>Capital</b>	Port-au-Prince (2.2M inhabitants, 2011)
<b>Area:</b>	27,750 square km (10,714 square miles)
<b>Arable land:</b>	38.5% (2011), 10,000-15,000 more hectares lost due to erosion annually
<b>Major languages:</b>	Creole, French
<b>Religion:</b>	80% Roman Catholic, 16% Protestant (10% Baptist, 4% Pentecostal, 1% Adventist, 1% other Christian). <u>Vodou</u> is also practiced by half the population, in combination with Roman Catholicism.
<b>Life expectancy:</b>	61 years (men), 64 years (women) (UN,2012)
<b>Monetary unit:</b>	1 gourde = 100 centimes
<b>Main imports:</b>	Foodstuff (rice, wheat from USA), manufactured goods, fuel
<b>Main exports:</b>	Light manufactures, coffee, oils, mangoes
<b>GNI per capita, Atlas method (current US\$):</b>	Estimated to be low income: \$810 (World Bank, 2013)

Source: World Bank Database, Haiti (2015), United Nations (2012, 2015)

## Supplement 2: Recommended Daily Caloric Intakes

### RECOMMENDED DAILY CALORIC INTAKES

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Young Children	Kcal/day		
<1	820		
1-2	1150		
2-3	1350		
3-5	1550		
Older children	Boys	Girls	
5-7	1850	1750	
7-10	2100	1800	
10-12	2200	1950	
12-14	2400	2100	
14-16	2650	2150	
16-18	2850	2150	
Men	light activity	moderate activity	heavy activity
18-30	2600	3000	3550
30-60	2500	2900	3400
>60	2100	2450	2850
Women	light activity	moderate activity	heavy activity
18-30	2000	2100	2350
30-60	2050	2150	2400
>60	1850	1950	2150

Source: Canadian Journal of Public Health / Revue Canadienne De Sante'e Publique 96.3 (2011)

### Supplement 3: Suite of Food Security Indicators 2014; 4 Dimensions of Food Security

FOOD SECURITY INDICATORS	DIMENSION
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	AVAILABILITY
Percentage of paved roads over total roads Road density Rail lines density	PHYSICAL ACCESS
Domestic food price index	ECONOMIC ACCESS
Access to improved water sources Access to improved sanitation facilities	UTILIZATION
Cereal import dependency ratio Percentage of arable land equipped for irrigation Value of food imports over total merchandise exports	VULNERABILITY
Political stability and absence of violence/terrorism Domestic food price volatility Per capita food production variability Per capita food supply variability	SHOCKS
Prevalence of undernourishment Share of food expenditure of the poor Depth of the food deficit Prevalence of food inadequacy	ACCESS
Percentage of children under 5 years of age affected by wasting Percentage of children under 5 years of age who are stunted Percentage of children under 5 years of age who are underweight Percentage of adults who are underweight Prevalence of anaemia among pregnant women Prevalence of anaemia among children under 5 years of age Prevalence of vitamin A deficiency (forthcoming) Prevalence of iodine deficiency (forthcoming)	UTILIZATION

Source: *Measuring different dimensions of foodsecurity, FAO (2014)*

## Supplement 4: Summary of the reinforcement of the commercial farming in Haiti; Ministry of Agriculture, Natural Resources and Rural Development

<b>HAÏTI</b> <b>BILAN 2013</b>   <b>AGRICULTURE, ÉLEVAGE, PÊCHE ET PAYSANNERIE</b>			
<b>LE RENFORCEMENT DE L'AGRICULTURE COMMERCIALE</b> <b>30 millions \$US en cours d'investissement</b> <b>(plus de 500 emplois permanents créés et 20 000 emplois temporaires)</b>			
ENTREPRISES	PRODUITS	INVESTISSEMENTS (M\$ US)	ZONES
Compagnie haïtienne de production agricole CHPA S.A.	Commercialisation du riz, maïs et haricots	4	L'Artibonite, le Grand Sud et le Centre
Agri-Succes / Haïti Originale / Dole	Commercialisation de la banane	10	Région Goâvienne
AGRITRANS	Commercialisation de la banane	5,8	Nord-Est et Nord-Ouest
ANAPAH	Commercialisation de céréales	1,5	National
PISA (REBO)	Développement de 3 régions caféières	3,5	Rendel, Thiotte et Baptiste
GEO Wiener	Développement de 3 régions caféières	2,5	Grand'Anse
SISALCI	Sisal	2,5	Nord-Est

Source: The government's Major Undertakings in 2013. Ministry of Agriculture, Natural

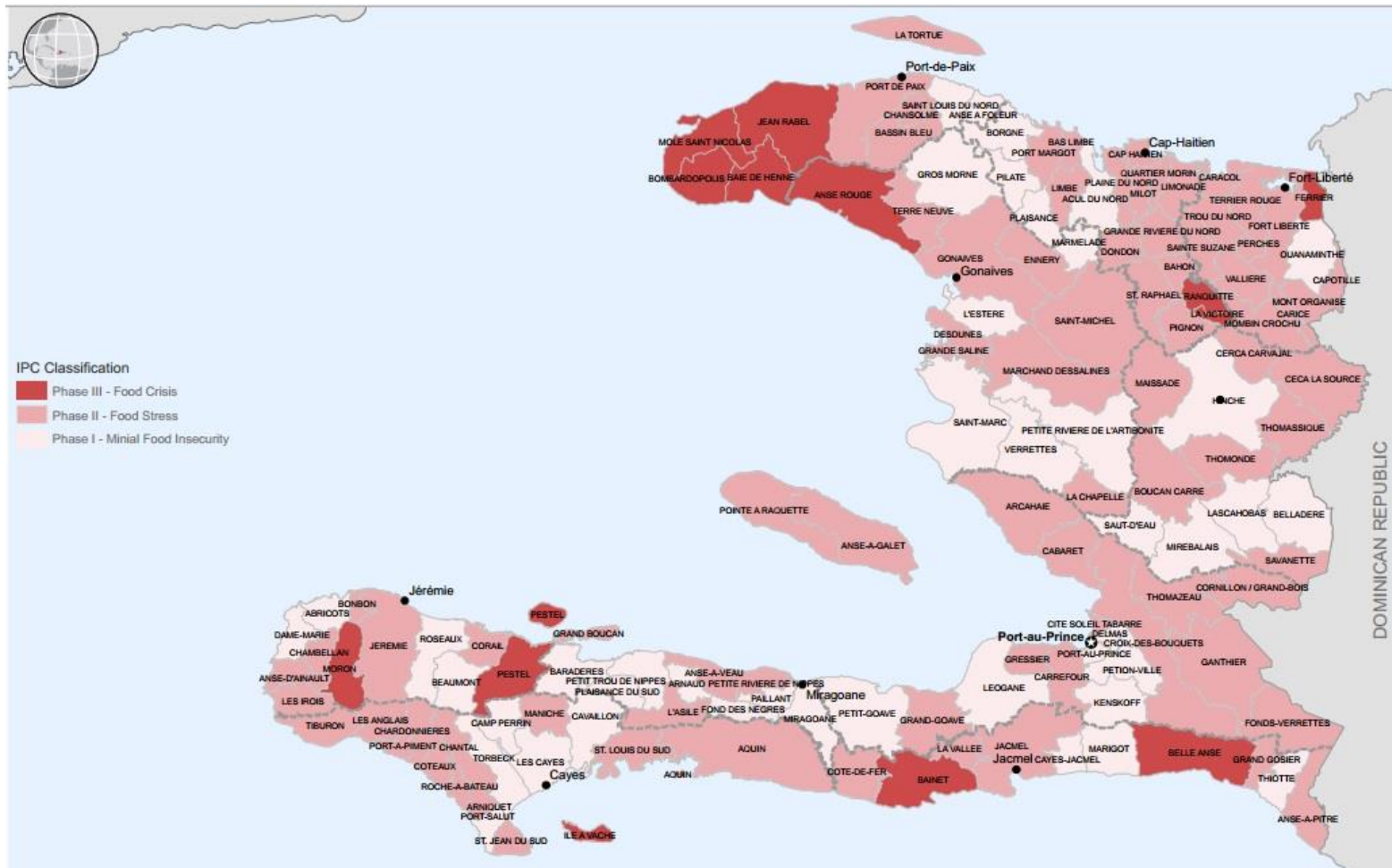
**Supplement 5 – Illustration of current deforestation in Haiti (2015)**



Source:<http://searchamelia.com> (2015)



**Supplement 6 – The map of Food Insecurity in Haiti (2013) showing the Haitian regions in the state of food crisis (dark red), food stress (light red) and minimal food insecurity (white)**



Source: United Nations, OCHA (October, 2013)

**Supplement 7: Dataset of main variables used for projections of population, Gross National Income and Food Demand in Haiti towards 2050**

Year	Population	Population growth	GDP per capita(const. 2005 USD)	GDP Growth	GNI	GNI growth
1998	8,28	1,818555	497,4590265	0		
1999	8,43	1,7662849	501,9288715	0,898535309		
2000	8,57	1,7035286	497,7696663	-0,82864434		
2001	8,72	1,6419498	484,5575659	-2,65425986		
2002	8,85	1,5858004	475,6868824	-1,8306769		
2003	8,99	1,5299922	470,1621615	-1,16141966		
2004	9,12	1,4752867	447,0096431	-4,92436872	456,76	0
2005	9,26	1,4240612	448,5848301	0,352383222	456,53	1,3831014
2006	9,38	1,3701692	452,4494235	0,861507837	449,09	-0,2741302
2007	9,51	1,3233676	461,4290834	1,984677044	457,32	3,1907039
2008	9,63	1,3005739	459,3105992	-0,45911371	455,54	0,9139411
2009	9,76	1,3080157	467,3195182	1,743682607	464,29	3,2617082
2010	9,89	1,3350822	435,7703587	-6,75108962	433,87	-5,2962407
2011	10,00	1,369505	453,5865492	4,088435596	453,01	5,8522739
2012	10,17	1,3947226	460,2093429	1,460094833	461,71	3,3524237
2013	10,31	1,4024372	473,2978726	2,844038222	473,87	4,0830707
Average:	9,30	1,4843333	467,9082122	-0,29174788	456,2	1,8296502
compound growth rate	0,014725455	-0,0171729	-0,00331371	0,085782599	0,0041	0,1278127
compound growth rate %	1,47%	-1,70%	-0,33%	8,50%	0,41%	12,70%
2008	Rice Price crisis					
2010	Earthquake					

Source: Own processing & United Nations, World Population Prospects (2013) and World Bank, World Development Indicators (2014)

**Supplement 8: Dataset for calculation of Food Demand towards 2050, 3 fertility scenarios by United Nations (Low, Medium, High):**

Haiti	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050	2050-2055	Av. Gr
Low	0,0095	0,0075	0,0062	0,0048	0,0032	0,0014	-0,0004	-0,0018	0,004
Medium	0,0125	0,0111	0,0098	0,0086	0,0074	0,0061	0,0049	0,0040	0,008
High	0,0154	0,0146	0,0131	0,0120	0,0113	0,0106	0,0099	0,0093	0,012

Adj.GR	2020	2030	2040	2050	E(Jamaica)	0,70694
low	0,009	0,006	0,002	-0,001	FD2013	100
medium	0,012	0,009	0,007	0,004	GNI Gr	0,00409
high	0,015	0,013	0,011	0,010		

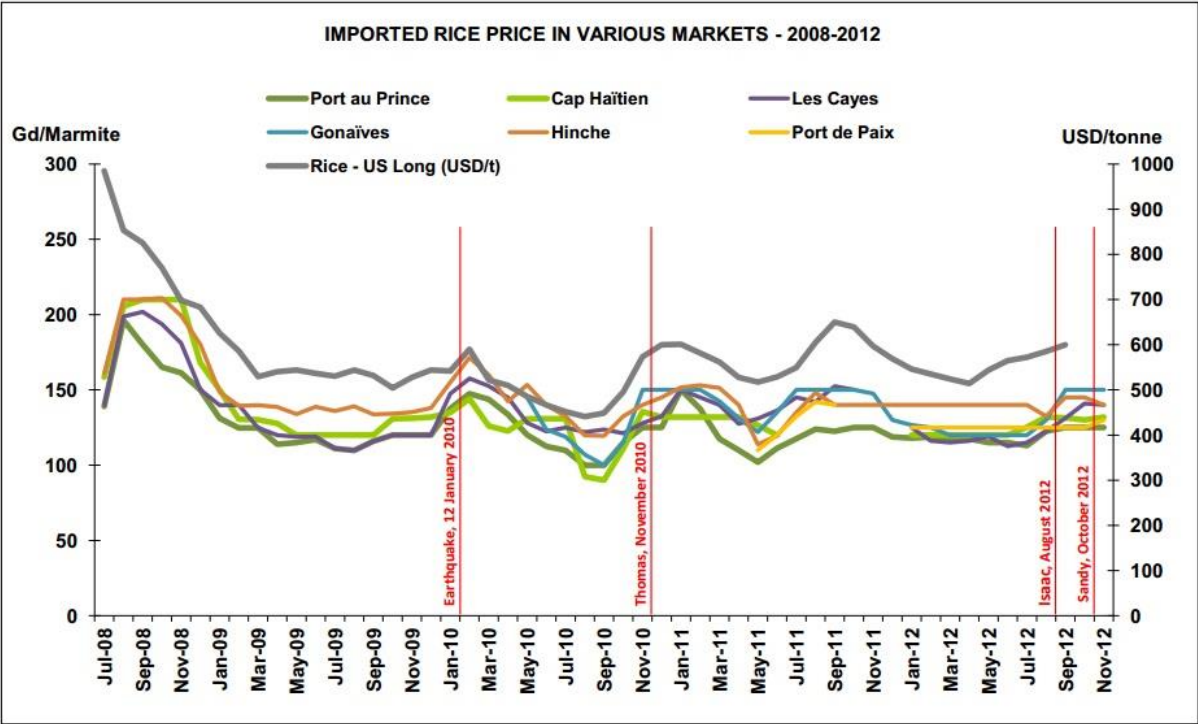
Adjusted population growth rate - arithmetic mean of 2015-2025 in order to obtain value for year 2020.

food demand	FD 2020	FD2030	FD2040	FD2050	demand 2013	FD %	FD 2020	FD2030	FD2040	FD2050
low	108,254	115,328	115,028	106,758	100	low	8,3	15,3	15,0	6,8
medium	110,769	122,726	129,633	131,044	100	medium	10,8	22,7	29,6	31,0
high	113,203	129,85	144,835	158,343	100	high	13,2	29,8	44,8	58,3

demand grwt	Dem.Gr. 2020	Dem.Gr2 030	Dem.Gr 2040	Dem.Gr2 050
low	0,01139	0,00842	0,0052	0,00177
medium	0,01472	0,01212	0,00966	0,00733
high	0,01787	0,01548	0,01381	0,0125

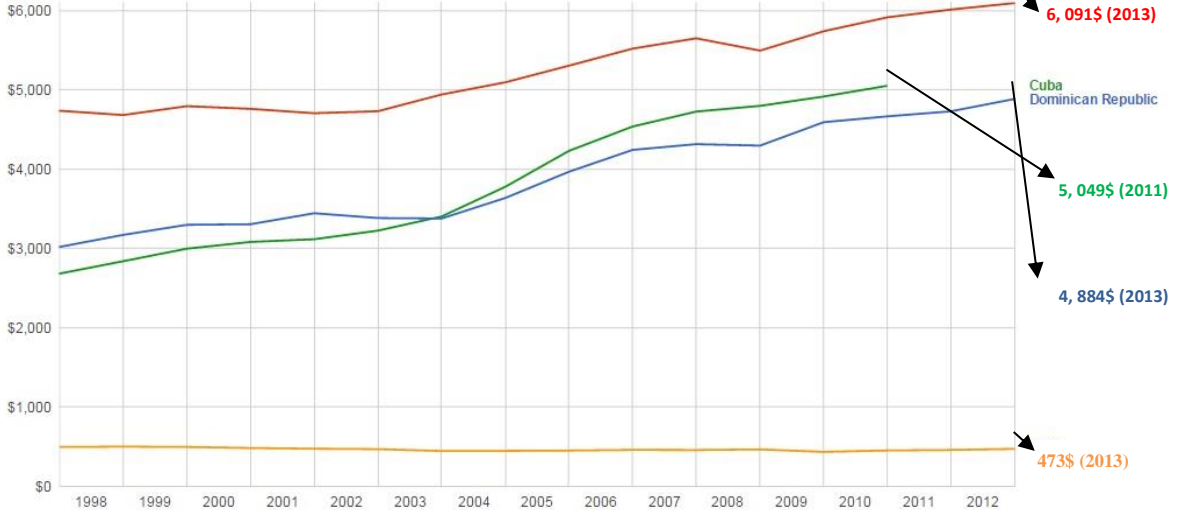
Source: Own processed (MS Excel outcome) & calculations used for obtaining percentage values of food demand projections towards years 2020, 2030, 2040 and 2050 (Green table)

### Supplement 9: Development of rice price in various markets over the period 2008-2012



Source: <http://wfp.org> (2013)

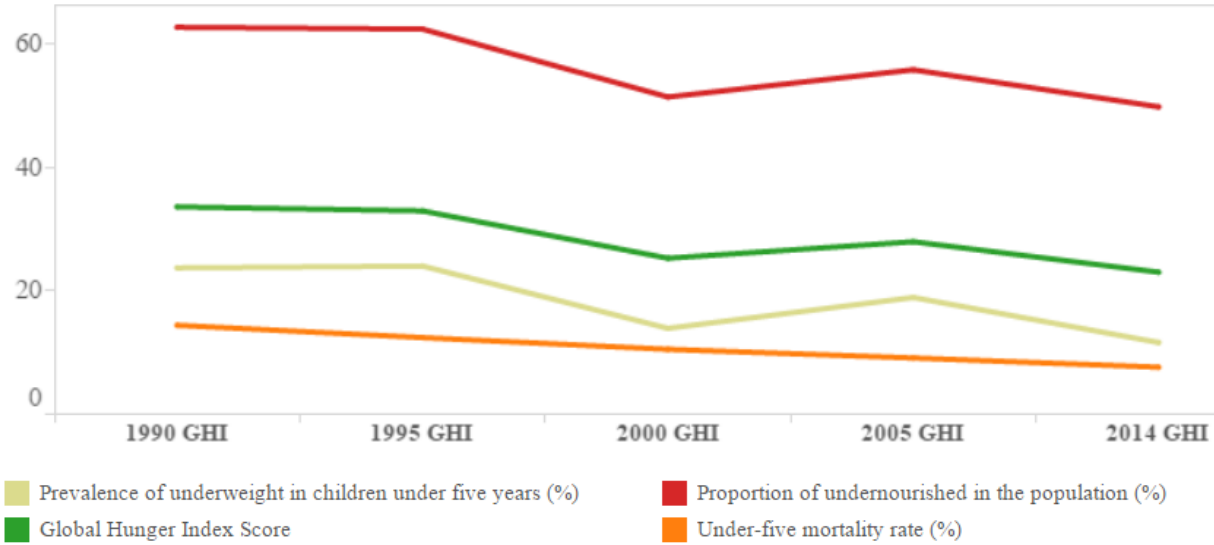
### Supplement 10 Development of GDP per capita, constant USD 2000



Source: Own modified Figure based on Google Public Data Explorer, GDP per capita (constant 2000 US\$)

# Supplement 11 Global Hunger Index development of Haiti

Haiti (2014 GHI Rank: 67 out of 76)



Source: <http://foodsecurityportal.org/haiti> (2015)