Food Sustainability

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June 24, 2021

Abstract

Abstract: Awareness of Sustainability is increasing and environmental issues are becoming more and more important. However, there is no concise definition or approach of the sustainability. So in this paper, I will discuss the sustainability in terms of Food industry and technology combined by using various researches based on our group project. In the first part, system and environment's terminology and relationships will be discussed. Next, our approach on sustainability in terms of food industry and technologies will be addressed later in 5 steps with examples. In the next session, explanation of importance of regulations of sustainability will be addressed with the differences of regulations in Netherlands and other countries. Finally, advantages and disadvantages of the approach will be discussed with possible further developments and suggestions.

I. System and its environment

The terminology of system is sometimes said to be having common goals and themes in order to sustain itself or stay intact and work together. Ludwig von Bertalanffy (1968) stated that a system is an entity with interrelated and interdependent parts which is defined by its boundaries and it is more than the sum of its parts. Moreover, General system theory, can also be expressed by organism, interaction and system. Ruben & Kim (1975) argued that system is a way of looking at the world which objects are correlated with each other.

System doesn't exist independently. For example, in an intelligent interactive system, systems firstly perceive user, try to understand the environment where the system is, and then act on basis of the information of user in order to achieve a joint goal. Therefore it could be easily shown that systems are influenced by environment. System thinking requires understanding of a system by identifying interaction and correlation of the subsets that builds up the whole system. Inter relationships, perspectives and boundaries together need to be considered and problem cannot be solved by one perspective.

System, according to Bertalanffy, has open system which interacts with its environment. He explained this as growth of fish. When there are less nutrients provided, fish growth is somehow restricted but when the limits of nutrients are eliminated, fish will grow up to its normal size of its species, which is a goal. Then what is environment? In this example, where limits of nutrients existed can be called an environment. Ludwig von Bertalanffy gave the concept of open system, which viability depends on the constant interchange of resources with its environment. According to Burge Hughes Walsh, what happens outside the system is an environment. System and environment can have influence on each other. When modeling a system, it is vital to set the boundary of system and its environment. Environment of the system provide inputs and contains components that interact with interest. Stephanie Draper (2016) stated that sustainable development goals will require strong system approach. It is due to the fact that in order to fulfill sustainable development goals, inter relations, perspectives and boundaries of the goals have to be considered.

II. Approach on sustainability

Sustainability can be explained in various perspectives in market focused, ecologically focused ways. It could be defined broadly as "Constructing a development that meets the needs of the present generation's consumption and demand without hindering future generations from their ability to meet their needs. (WCED 1987)." Our group project approaches Sustainability in terms of foods system with technology combined perspective. While satisfying our generation's sharply increasing population's nutritional needs sufficiently, policy makers and companies have to build up a food provision system or food supply system that meets the consumption or demand .

In doing the group project, each of our team members choose a part of supply chain which they think is most important for sustainability. However, my approach on sustainability was different. My approach on sustainability was that production, distribution, consumption level of sustainability was all equally vital and cannot be neglected. Each steps of level causes a

serious harmful effect on sustainability and needs further development and research.

In the Netherlands, for example, households spent 17% of their budgets in food categories (CBS, 2002). Foods are produced in a complex system which is made up of many processes in supply chain. If we take chocolate as an example, agriculture is needed to get wheat, milk, and eggs. Then after receiving the ingredients, baker will make chocolates. Then these chocolates will be delivered to shops like Albert Heijn or chocolate shops by motorcycles, planes, cars, boats, trains. After these chocolates are selected by consumers, their waste are left out. These processes of food systems as a whole contribute to detrimental environmental effect, which requires the input of scarce natural resources, such as land, energy carriers and water. Other than this, selling beans include process of growing, processing, packaging, transporting and storing (Tilman et al., 2002). According to Willting (1996), in order to make food systems sustainability, it is vital to avoid tradeoffs between chain links.

According to Food and agriculture organization (FAO), food production are the main causes of air pollution, which leads to land erosion. Also, from the UK data of food production, among all the greenhouse gas emissions, only food production causes around 20% of emissions. From the water perspective, our food systems takes over 70% of all the water use. Furthermore, simple things such as people's eating habits has significant impact on the environment. Climate change, deforestation, land erosion, animals or plants extinction, water pollution. It is the reason why we chose particular food sustainability.

In short, sustainability in perspective of food has to be considered because food supply chain process as a whole have enormous harmful influence on the environment. Each supply chain steps could not be neglected in my approach. Each steps impose serious effects that includes land erosion, animals and plants extinction, air pollution. And as a cycle, harming environment has negative affect on people such as health problems. Therefore, in my opinion, each steps could not be ignored. Therefore, this paper will discuss production level, distribution level, consumption level and legislation. There can be many solutions for sustainability in the food supply chain, for example, around January 2007 to February 2009, due to salmonella outbreak in crop, there was a weak contamination. However the US government and the Food and Drug Administration (FDA) handled well by making regulation. By implementing and developing a regulation, we can step forward to sustainability.

Extant research suggests that effective for increasing the sustainability could be fulfilled by increasing efficiency in production level, distribution level and consumption level. However, due to space limitation, although the technology of each supply chain will be introduced briefly, the paper will focus on mainly consumption level and how regulations could increase efficiency of consumption level. Other solutions for consumption level such as reducing the meat consumption by substitutes, buying organic will be also discussed.

III. Description of used technologies

✧ Production Level

The main challenge in production stage would be improving efficiency. Agriculture could be common example technology innovations. Increasing efficiency means reducing time or money (inputs) in order to get same output. Albert Einstein said "Everything should be as

simple as possible, but not simpler" which means it is best for companies to first start with easy measures and moves toward complex supply chain. In other words, energy and input is needed in each production level, however if we are able to simplify this, it will increase efficiency. Example could be Dutch online supermarket Picnic using ePvs simplifying delivery steps, transferring steps. More detailed explanation will be continued in consumption section.

Other than simplifying, there are many other indicators of sustainability production. Examples could be fraction of renewable raw materials, total water cost, greenhouse gases intensity, disposal mass fraction, costs of purifying air and etc.

An example for sustainability in production level could be Dutch Farming. Dutch dairy farming is based on NLF 5- layered approach, which is using ethno veterinary practices (herbs) in order to produce quality milk without chemical residues. This way, milk and other livestock products are produced in a sustainable way, which leads to enrichment of soil, farmers getting sufficient income and last, milk is produced without chemical residues.

Other than milk, Duijvestijn Tomatoes are another example of sustainable agriculture. Geothermal energy has been used since 2011 and plans grow in a hydroponic system in order to reduce the water use. To be more specific, tomatoes are grown in bags made by molten basaltic rock into fine fibers. No pesticides are used in this model, and it uses local shell oil refinery which reduces the carbon dioxide being released.

- ✧ Distribution Level

Distribution level is a process of delivering products to consumers. Shops and supply chain distribution partners could be an example. Prior to writing this paper, our group did research on companies in Netherlands such as Picnic and Albert Heijn and Unliever. However, in this paper, only Picnic and Albert Heijn will be discussed. Below, how these companies made progress in sustainability will be discussed.

In the case of "Picnic", which is an online supermarket in Netherlands, dedicates to sustainability in ways of reducing extra packaging and adding solar panels to their warehouses so that it helps to conserve waste and reduce carbon emissions. In order to diminish food waste in distribution level, there are few methods picnic is working on. First of all, by using machine learning models, picnic predicts accurate amount of products and orders from the supplier so it leads to potentially less waste. Second, it uses Picnic app, which is available in Google play which accumulates feedbacks on consumer demands for products and based on this data, it adds or removes products to the assortment. Since this is mainly based on consumer's demand, overstocking of products are prevented. Lastly, by using robotic fulfillment center (warehouse automation), Picnic speeds up delivery and gets closer to its objective, zero food waste.

In reducing Carbon Emissions, Picnic used technology to get efficient distribution delivery. It uses computational logistics using software to optimize order. In delivery progress, Picnic uses ePVs (electric Picnic vehicle), which is electric powered delivery vans generated by the solar panels on the roof of the hub. The progress is efficient in way that ePVs are plugged into smart chargers storing batteries with solar energy in non-peak hours so that at evenings, the energy can be used to maintain food fresh or transmitted to other vans that needs battery.

Albert Hein in 2019, was awarded as the most sustainable supermarket in the Netherlands.

According to the parent company, Ahold Delhaize website, this supermarket focuses on providing healthier choices to consumers, product transparency as well as eliminating waste. In detail, Albert Hein provides transparency to consumers through on pack product labeling so that it is easy to read , and consumers could identify whether product has genetic modification or not. According to the CEO, healthy food leads to healthy communities by decreasing the risk of disease. So this supermarkets helps customers be aware of what they eat. Other than providing transparency to customers, Albert Heijn eliminates waste by creating a program so that computer system takes location, weather, sales performance and stock into account and calculates optimal price in order to decrease products that are not sold and reduce waste. Albert Heijn predicts to reduce food waste by 50% in 2030. In 2021, Albert Heijn grocery stores will be getting rid of plastic bags and as a start, it will first replace small plastic bags with given reusable nylon bags according to De Standaard.

✧ Consumption Level

After the Distribution progress, consumption level is followed. As introduced before, food consumption alone is responsible for 20% of GHG. The most common effective way to reduce detrimental environmental effect on consumption level could be cutting the consumption of meat or dairy products and substitute it with organic fruits or vegetables, pills. According to Pelletier N and Tyedmers (2010), per capita meat consumption in 2050 should be only around 20% of current meat consumption. Not only in consumer's health perspective, but in terms of effect of meat or dairy products consumption on environment, they have different and various impacts that contribute to changes in climate, roughly pollution and resource depletion. There are researches indicates that meat products or dairy products have substantial detrimental impact greenhouse gas emissions (GHG) on environment. It was calculated that livestock production consists of around 15% of global greenhouse gas emissions.

More specifically, according to the environmental sustainability of the Dutch diet released by National Institute of public health and the environment, we can distribute meat into three kinds (beef, pork and chicken). A research was conducted to get the average environmental impacts of these three meat types through full cycle. Environment was divided into six types (Land use, Water use, Greenhouse Gas emissions, Acidification, Fresh water eutrophication, Marine eutrophication). Beef had the highest impact of all six environment impacts. On the other hand, fruits and vegetables had low levels of GHG emissions.

Therefore, reducing the amount of meat and substituting it with fruits and vegetables is a vital matter. In the Netherlands, a survey was conducted, and around 70% of people are interested in reducing meat and 50% of them agreed on imposing tax on meat or dairy products. There are already many practices of reducing meat. ProVeg and Smart Protein Project joint study found that, the European plant-based market has grown 49% over the past two years and the Netherlands is one of the fastest growing markets.

Not only on one environmental perspective, but on health perspective, according to Coff and Milestone (2008), 1.5 billion people are overweight due to extensive amount of consumption in sugar, animal protein and Trans fats. IASO said that obesity is responsible for high blood pressure with leads to premature death and disabilities such as cancers, musculoskeletal disorders, stroke and hypertension. Therefore, consumption habits needed to be changed. Cohen (2005) said that bonus on sustainable consumption could be effective. Currently, the

Netherlands government is investing in the development of alternative protein sources such as insects, micro-algae, seaweed, pulses, mushrooms and nuts.

IV. Regulations

From now on, the regulations will be discussed. The Netherlands has made considerable progress in developing environmental targets and issues since the early 1990s. Compared with other countries, the Netherlands implemented environment concerning policy quite early.

Examples of good practices in 2021 could be uses of green tax instruments to tackle climate and environmental problems by removing several subsidies and exemptions for petroleum and natural gas. Other measures such as imposing tax on meat is discussed actively, which is already held in other countries such as Germany. By implementing tax on meat, it is expected to slow climate change and use the revenue to clean up polluted areas resulted by animal agriculture.

In 1980s Netherlands faced problems such as lack of landfill capacity and there was urge for the policies. Examples of law sets used in the Netherlands could be waste hierarchy, reducing waste generation per capita in absolute terms, limiting energy recovery to non-recyclable materials.

The Netherlands has high score in waste management. From the statistics, the amount of landfilled waste decreased from 35% in 1985 to 2.3% in 2010 while the percentage of recovery (including Waste-to-energy) has risen from 50% to 88%. The government aims to reduce the amount of residual waste incinerated/landfilled from 10 million tons in 2012 to 5 million tons in 2022.

As mentioned previously, the Netherlands have started to implement policies and increased attention for sustainability in 1990s. However in Asia, the progress of making policies were quite slow, and public attention for green, or sustainability was not popular since their main objective was economic development. However starting from the 2000s attention increased.

Specifically in China, during the past decades due to rapid pace of economic growths, the carbon dioxide (CO_2) emissions approximately tripled at 2007 compared with 1990 data.

However, from 2010, starting from the 11^{th} Five-Year Plan, Chinese policymakers started t o recognize importance of environmental protection. Based on the Chinese Data, the vegetation cover and carbon sequestration have increased in some regions and soil erosion has decreased. Under Ministry of Ecology and Environment (MEE), China was able to reduce the speed of pollution such as solid waste permitting, soil pollution, water pollution and air emissions. Chinese government used methods such as direct enforcement which bans certain companies to omit more than particular amount of waste or by increasing incentives, increasing inspections, shutting down polluted facilities, moving polluted facilities in regular basis.

Although, there is a remarkable development in food sustainability, according to Aschemann et al (2007), food sustainability have experience a huge increase in most industrialized countries.

V.Discussion of the pros and cons of the approach

Problems with this approach (consumption) exists because food consumption habits depend on cultural background, needs, food experience, preferences, exposure, accessibility and price. So it is hard to control or find single solution that applies to all people. For example, decreasing meat and dairy products consumption would not apply to developing countries that are extremely poor, where their main meal is oat, corn, potatoes. Wealthy countries has technologies available and nutritious food so they are able to cut foods or products that consumes lots of resources or results in GHG (green house emissions).

However, it is still considerably meaningful that this consumption approach, takes into account of people's health, not only environmental effects. According to Shetty P (2002), our agricultural system has gained access to foods such as high sugar processed foods, vegetable oils, GHG-intensive meat and dairy products. This lead to obesity in not only the wealthy countries but also in poor countries. Foresight (2007) stated that this obesity is due to highly energy contained diets as well as changes in lifestyles. Food and Agriculture Organization statistic in 2011 indicates that about 850 million of people have unbalanced nutrition. Around 3.5 million of children dies from lacking sufficient energy. The approach takes into account of people's health such as nutritional status into account. Innovations in technologies enabled us to increase efficiency, however, by this development, millions of people's health are negatively affected. Other than this, innovations caused detrimental effect on humans in ways such as pesticides or disease such as malaria, which resulted from agricultural water use.

VI. Future steps

It is truly meaningful that "Grow first, clean up later" attitude has changed as increased awareness of sustainability in most of countries. We have to find solutions to challenges where our generations could satisfy, while diminishing deterioration of global environment.

According to Tilman D and Balzar C (2011), one of the challenges could be the percentage of people working in farming sector decreasing while the world population is dramatically increasing, which leads to the fact that supply doesn't meet demand. Conforti P (2011) stated that in order to solve this challenge, food production needs to be increased to 50% till 2050. So this leads to that fact technological innovations are necessary. However, as addressed in the previous section, some technologies development resulted in harmful effects on humans such as malaria or uses of pesticides. Food sustainability problems results in inequalities, which should be solved through increasing the efficiency of the technologies, but the consequences it will occur should not be neglected. Although the consequences is unclear, we have to consider how can we develop technologies to reduce the steps of food supply chain, while delivering equal or more healthy, nutritious diet to people.

Despite of the differences and difficulty of making policy or solutions that will apply to all countries or consumers, by clustering consumers into different groups depending on their food preferences, cultural background, decreasing consumption of meat and dairy products could be possible, while increasing the organic food consumption level. Vandevijvere (2009) said that 35% of Belgian consumes 25% of daily energy intake outside. Polices and solutions need to be developed, considering changes in lifestyles.

A Report by World Resources Report Creating a Sustainable Food Future, says that in order for food sustainability in 2050, food gap, land gap and the GHG mitigation gap should be met. Food demand should be met, gap between agricultural area and the area required should decrease. Till 2050, 15 gig tons of carbon dioxide are expected to be released which will result in 2 degrees global warming. In order to solve these issues, governments, companies, food producers, consumers have to take actions in sustainability. Policies for sustainability have to be developed and implemented, and countries have to work together.

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