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 **Food Waste Recycling**

**Research Project**

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**Abstract:**

Source-separated collection system of household food waste has been implemented national wide in South Korea. Food waste recycling rate that means conversion rate to recycle is over 90 % in present. However, over the value of 90 %, we need to enhance the efficiency of food waste recycling process. We analyzed material flow of 24 food waste recycling facilities and calculated solid recovery rate to key-process. We found that 3–13 % of the solids from food waste outflows with foreign materials and 27–33 % of the solids outflow with wastewater. As a result, solid recovery rates are 65.3, 60.9, and 56.3 % in wet feed facility, dry feed facility, and composting facility, respectively. Alternative ways to recovery solid from wastewater or collection tools to exclude plastic bags, salt, and moisture content are required to make food waste recycling more efficient.

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# **Introduction:**

 According to the WFP (2022), more than eight hundred million individuals all over the world do not get enough food. Amongst them, the international organization estimates that forty-five million people are “at risk of sliding into famine (ibid). On the other hand, eighty percent of energy production all over the world comes from fossil origins (IEA, 2018). In another context, FAO stated that less than eleven percent of the land all over the world is arable and the percentage decreases regularly (Zhang H, Matusto T , 2010). Hence, the global warming threat becomes greater every day. Meanwhile, the amount of lost or waste calories (produced food) is approximately twenty-four percent (Kee-Young Yoo and Sora Yi, 2015). However, food waste recycling appears as an essential factor to reduce the harmful issues and increases the beneficial aspects of this process (Kee-Young Yoo and Sora Yi, 2015).

 It is important to understand how food waste recycling is essential to get use of waste materials that may turn into threat on people in terms of health, environment and economy. First, food waste may mean loss in money as people pay for a product and they do not benefit from. Next, they (individuals, restaurants, or other businesses) are obliged to pay the expenses of discarding about 1.3 billion tons annually (increasable) Themelis NJ, Kim YH, 2002).Third, they pay directly or indirectly for fertilizers that are used domestically or in farms to get rich soil and better crops. As well as, people pay for energy to get electricity, and heating. On the other hand, recycling food waste introduces solutions for all the above cases in terms of economy.That digested food waste is much better than chemical fertilizers since “the nutrients are preserved in effluent”. Moreover, they state that producing chemical fertilizers threatens the environment as it causes more nitrogen emission while the gas has already exceeded the safe zone in the atmosphere. They introduce the process of recycling food waste as a source of environment friendly energy. They suggest to use the emitted gases from artificially digested food waste to generate electricity and use them for heating as a clean resource. Additionally, Chanakya (2007) argue that under controlled conditions (without oxygen) the process of anaerobic food waste digestion has the potential to convert the organic wastes into useful products such as biofuels (e.g. biogas) and nutrient enriched digestates which can be used as soil conditioners or fertilizers. In this context, Chiew and others (2015) agree with Chanakya and others (2007) that converting food waste into energy and fertilizers is an attractive practice both economically and environmentally. Eventually, it is obvious that a wise use of food waste might be a great fortune by recycling it, whereas discarding it may cause environmental and economic losses; while millions of people worldwide suffer from or under threat of famine (El-Fadel M, Findikakis AN, Leckie JO, 1997).

# **The sources of food waste:**

## ****1 – The mass-market system****

Farmer – factory – transports – storage – retailing in supermarket: all these steps of the chain of our actual system induce waste, in order to offer us what we, final customers, are used to find and expect: affordability – choice – uniformity – food safety. First, affordability often means lower quality. Then, choice and uniformity mean lots and lots of unsold and wrong shaped products. Last but not least, food safety, though necessary, reached so extreme and absurd levels that extremely fresh products are daily wasted days before they would actually perish(Troschinetz AM, Mihelcic JR , 2009).

## ****2– Households****

We, consumers, produce approximately 30% of the global amount of the world food waste. To make it simple, we tend to eat too much, cook too much, buy too much. Making a list of items to buy and follow it, taking a daily check of what we store in our fridge, reusing our leftovers, buying a little everyday rather than a lot once a week, are simple actions that can have big results for the planet…and your wallet (Bartone CR, Bernstein JD, 1993).

## ****3 – Recycling****

The ways of recycling we choose are a source of waste, when they are not the most efficient. Thus, the best is to not produce the waste. But when the waste exists, the best renderings are: 1/feeding animals, 2/producing methane, 3/producing compost. Then, producing compost is better than nothing, but is not as energy-efficient as feeding a pig in order to get pork (Bartone CR, Bernstein JD, 1993).

So as we can see, food waste is the result of many different linked and unlinked causes. Fighting against food waste doesn’t mean one fight and one solution, but many different fights and solutions, as various as the ones that each of our imaginations will be able to bring (Bartone CR, Bernstein JD, 1993).

# **Methods of food waste recycling**

There are two major methods to recycle food waste:

## In vessel composting

This method involves mixing garden waste with food waste. The organic waste is shredded and composted in a vessel or enclosed container for about 2-4 weeks at temps unto 70 degrees C, to ensure that all microbes are killed off and to speed up the composting process. In this food waste recycling technology, the resulting material from the earlier process is kept outside for about 1-3 months, and turned regularly to ensure the quality before being used as a soil conditioner (McKay G, 2002).

## AD or Anaerobic Digestion

The Anaerobic Digestion or AD method of food waste recycling uses microorganisms in order to break down the food waste, animal manure, energy crops slurries. The process takes place in a chamber which is free of oxygen. When the matter breaks down, it gives off the gas methane which is then collected. The collected methane gas is used to produce biogas. The biogas can be used for electricity generation, or as fuel for heating systems and transportation. The whole process creates a digestate which is rich in nutrients which is used as fertilizer in agriculture, and also in the process of land regeneration(Floret N, Mauny F, Challier B, Arveux P, Cahn JY, Viel JF, 2003).

# **Three Types of Recycling:**

Here are the three main types of recycling: mechanical, energy and chemical.

## Mechanical Recycling:

Globally speaking, mechanical recycling is the most used method to give residues new usages, whatever they are. Through this method, plastics – whether obtained from industrial scrap or domestic or commercial disposal – are mechanically transformed without changing their chemical structure, so they can be used to produce new materials. Today, mechanically recycled plastics are used to make new packages, garbage bags, floors, hoses and car parts, among others. This is the most widely used technology for Polyolefins (Kee-Young Yoo and Sora Yi, 2015).

## Energy Recycling:

Energy recycling consists of converting plastic into both thermal and electric energy by leveraging, through incineration, the heat power released by these materials in the form of fuel.  Energy recycling is important due to its ability for diversifying the energetic matrix and optimizing the space available in heavily populated cities with little room for landfills. This solution is widely used in Europe and Japan, but requires heavy investments and the engagement of public authorities, since it isn’t financially sustainable (Themelis NJ, Kim YH, 2002).

On the other hand, energy recycling has settled itself as an environment-friendly solution. As with cars, waste incineration plants for energy recycling use catalysers to withhold emissions. “Energy recycling used to be negatively seen because of the emissions it produced, but that was then, back in the 70’s and 80’s. Today, clearer rules have been set for incineration equipment to work properly and ensure emissions are more environment-friendly,” says Miguel Bahiense, Plastivida’s CEO, the Social and Environmental Institute for Plastics.

1. **Chemical Recycling:**

Of these three, chemical recycling is the most complex process. With this method, plastics are reprocessed and their chemical structure modified so they can be used as raw material for different industries or as a basic input for manufacturing new plastic products. However, chemical recycling is more expensive and requires large amounts of plastic to be economically feasible (Bartone CR, Bernstein JD, 1993).

According to Miguel Bahiense, Plastivida’s CEO, it’s too early to talk about the potential of chemical recycling because it is still under development.  “Chemical recycling is probably out there in order to propose alternative solutions for something not easily retrieved by energy or mechanical means, instead of replacing those methods,” says Bahiense. “Chemical recycling is still in its childhood. It exists in a lab, but nothing we could refer to as a real-world thing. Chemical recycling is more complex and requires greater technology developments” (Bartone CR, Bernstein JD, 1993).

# **Conclusions:**

Proper disposal of food waste has posed a stern pecuniary and environmental concern. It appears that conversion of food waste into energy via anaerobic processes in terms of methane is economically viable. However, difficulties accompanying the collection as well as transportation of food waste should also be considered. Nevertheless, the stumpy or no cost of food waste along with the environmental aids considering the waste discarding would balance the initial high investment costs of the biorefineries. Moreover, the efficacy and cost base of the generation could be upgraded by intensifying research and optimization studies on assimilating different value-added product manufacturing processes.

**The aim of project:**

This work aims to introduce and illuminate the people in Kurdistan and wherever it is read about the benefits of food waste recycling and support the efforts for this purpose.

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