Forecasting Models of Community Biodegradable Waste Management

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Abstract

This research objection on the data collection of the organic waste amount was produced from 2016 until 2019, through 4 years, the unit is in kilograms. The organic waste is divided into 2 categories, which are fruit peel and food waste, at the center of organic management, generating bio-fermented water to supply the gardens of KU campus and green schools with Vertical Recycled Box (VRB) in Bangkok city. The organic waste data were analyzed using correlation and forecasting statistics, as well as statistical numerical modeling. Pearson's correlation in this research is a technique to measure the correlation between interesting data, but not causation. The forecasting techniques of this research are the moving average, the weight moving average, the simple exponential smoothing, the Holt's exponential smoothing. The amount of organic waste that was produced from 2016 until 2019. There are four forecasting techniques, which are 1) Moving Average k=3, 2) Weight Moving Average k=3, 3) Simple Exponential Smoothing, and 4) Holt's Exponential Smoothing. All the techniques seem to be similar from March until December of 2020 due to the amount of food waste in the year 2018 until early 2019 being stable. But in January and February of 2020, the Moving Average was calculated from the past 3 years of data, and in January of 2016, the amount of food waste was extremely high at almost 1,200 kilograms, which had an effect on the forecasting value in January of 2020. The research result benefits from Pearson's correlation and the forecasting techniques of this research with the moving average, the weight moving average, the simple exponential smoothing, and Holt's exponential smoothing can be used to prepare for what will happen in the future, gain valuable insight, and the result from prediction methods could decrease the cost of environmental management of organic waste.

Keywords: Organic waste; Correlation; Statistic; Forecasting; Numerical modeling

Introduction

The present statistical Analysis from the data collection case to forecasting with statistic numerical modeling. The analysis have Pearson's correlation measure correlation between interested data, but not causation and the forecasting techniques in the present are Moving average, Weight moving average, Simple exponential smoothing, Holt's exponential smoothing. The Pearson's correlation in this research is Technique to measure correlation between interested data, but not causation. The Purpose of the Correlation used to measure how linearly related between two random variables or interested data. The result is in range of -1 to 1, -1 mean the variables have negative relationship and correlation value equal to 1 mean both of variables have position relationship. The value of correlation equal 0 means both of interested data have no relationship between them. Generally, if the values of correlation lay on -0.1 to 0.1, the researchers can assume that there is no relationship and if the values of correlation have values greater than 0.7 or less than -0.7, the researchers can assume that there is strong relationship between those interested data. The benefits of Pearson's correlation are measure the relationship between interested data, the correlation offers a starting position for research, easy to interpret, the related data would have relationship, can be applied to several forecasting method, non-relationship could lead to irrelevant between interested data, ignore these data or manipulate to do the forecasting techniques. The forecasting technique of the Moving average as one of the simplest forecasting techniques have the benefits on the prediction values are stable and The simplest forecasting technique. The forecasting technique of the Weight moving average as more advanced by adding a weight as coefficient in the equation. The set of coefficients that will be assigned a greater weight to newer data point, while past data points are assigned to be less weight, have the benefits on adding the Weight parameter though time, the present data has more value than older data, and may capture present's event that affect the raw data. The forecasting technique of the Simple exponential smoothing as one of the techniques in exponential smoothing forecasting. The simple exponential smoothing technique is weighting between the observed data and the forecasting data, have the benefits on the easiest in exponential smoothing technique, and weight between past forecasting value and actual value could perform better than moving average. The forecasting technique of the Holt's exponential smoothing as the concept is to introduce a term of capturing the trend from the data. This research has done the exponential smoothing by using Python's library called stats model, have the benefits on Holt's exponential smoothing technique can capture trend in raw data, and more accurate than simple exponential smoothing in general.

Research Objectives

The data collection of this research on the organic waste amount were produced in 2016 until 2019 through 4 years. The statistical analysis from the data collection case to forecasting with statistic numerical modelling. Pearson's correlation of this research is technique to measure correlation between interested data, but not causation. The forecasting techniques of this research are the Moving average, the Weight moving average, the Simple exponential smoothing, the Holt's exponential smoothing. All of the result benefits from the prediction methods can be used to prepare for what will happen in the future, gain the valuable in insight, and thee result from prediction methods could decrease cost for the environmental management on the organic waste.

Literature Review

The accumulation of critical levels of solid organic waste reach in almost all regions of the world. The organic waste must be operated in a sustainable way to avoid depletion of natural resources, minimize risk to human health, reduce environmental burdens and maintain an overall balance in the ecosystem. The different management strategies for organic waste, as well as its environmental impact and regulations that have emerged (Collins, 2017). Industry of Biogas is an important to Polish bioeconomy. Process of anaerobic digestion of sewage sludges enables new added-value bioproducts to be obtained. Eco-innovative fertilizers developed and produced from valorized sludges. Optimized bio-treatment of eutrophic digester liquors is necessary and advantageous. Elaborated novel biotechnologies ensure closing the organic waste management cycles (Kaszycki, Głodniok & Petryszak, 2021). The sustainable products and technologies arises from the enormous negative consequences that anthropogenic activity has on the present and future habitability of Earth. The industrial revolution being a significant contributor to crossing planetary boundaries, it becomes important to re-design and design technology to continue to satisfy needs that humans self-determine and value for their sustenance. The modelling of technical nutrient along the lines of biological nutrient cycles is an example of biological analogy seeking to re-design vicious cycles of industry and the economy along virtuous cycles of nature. Virtuosity of these cycles is qualified by features like closing-the-nutrient-loop, equating waste with food, cascading nutrients within multiple lifecycles etc. Replicating and reaping off such cycles is presumed to preserve the means even when scaled up to meet the requirements of an increasing number of people (Devadula, Gurumoorthy & Chakrabarti, 2015). The organic and plant growth period as variables based on the number of households, and their expected quantity of waste generation within the neighbourhood premises. The land with disposing waste is one of the major effects of urbanization and has adversely affected the urban landscape quality of the cities especially in developing countries. The quality of the wastes which has the potential for reuse in productive landscape purposes is not tapped (Amritha & Kumar, 2019). Organic waste disposal in landfills has created various environmental issues, such as greenhouse gas emissions and leachate. Awareness of this issue has resulted in diverting landfill to compost. Thus, there is a need to develop an analytical tool to select the best composting technology. The assessment steps designed to evaluate specific sustainability criteria of environmental, social, economic, and technical for organic waste management to select the most suitable composting technology (Shukor et al., 2019). Evaluating the management of organic waste policy and to predict the trend of organic waste generation in Albania. The appropriate Box–Jenkins Auto Regressive Integrated Moving Average (ARIMA) determine the quantification of organic waste to be generated. The decision-making process in the planning, change and short-term implementation of organic waste management, and the information provided is very useful in collecting, transporting, storing and managing waste in Albanian cities. Furthermore, the high percentage of the organic waste generation until 2025 constitutes good premises to raising public awareness related to their energy recovery (Oncioiu et al., 2020). Landfilling is one of the easiest methods to be applied in the management of municipal solid waste (MSW). In its development, bioreactor landfill methods that have various advantages over conventional landfill emerge. The use of bioreactor landfills for the management of organic waste in Jatibarang Landfill, Semarang-Indonesia. There are 4 bioreactor landfills operated: 2 anaerobic bioreactors with leachate recirculation and addition of water, and 2 aerobic bioreactors (Oktiawan et al., 2019). Management and recycling of organic waste materials such as agricultural crops and animal manure is becoming an important issue in rapidly growing population. Vermicomposting by earthworms (Eisenia fetida) is useful technique to recover nutrients of plants such as nitrogen, phosphorus, calcium. A vermicomposting system using the earthworm species (Eisenia fetida) and treating it with cattle dung, pig manure and biochar with crop as wheat straw and rapeseed. The waste was established in upland areas of China. It was monitored for two months. Maximum increasing in soil fertility with maximum decrease (39.63%) in C:N ratio. Significant increase of N content in nutrients and reduction in C: N ratios during this process shows conversion of harmful wastes into useful fertilizer (Raza et al., 2019). A comparative analysis of the environmental and economic performances of four integrated waste and wastewater management scenarios in the city of Aarhus in Denmark. The purpose of this analysis is to deliver decision support regarding the installation of food waste disposers in private homes, separate collection and transport of organic waste to biogas plants is a more viable environmental and economic solution. Higher environmental benefits in case of mitigation of human health impacts and climate change, are obtained by transforming the existing waste combustion system into scenario. The waste hierarchy from waste incineration to biogas product at wastewater treatment plants with anaerobic sludge digestion. Considering the uncertainty in the extra damage cost to the sewer system may be associated to the installation of food waste disposers, scenario is the most flexible, robust, and less risky economic solution. An economic, environmental, and resource efficiency point of view, separate collection and transport of biowaste to biogas plants is the most sustainable solution (Thomsen et al., 2018).

Research Methodology

The data collection of the organic waste amount were produced in 2016 until 2019 through 4 years, the unit is in kilogram. The organic waste divided into 2 categories which are fruit peel and food waste on center of organic management generating the bio fermented water to supply for garden of KU campus and green schools with Vertical Recycle Box (VRB) on Bangkok city. The organic waste data analyzed on statistics of correlation and forecasting with statistic numerical modelling follow as;

1. Pearson's correlation: Technique to measure correlation between interested data, but not causation (Kirch, 2008).

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

Parameter:

r_{xy} correlation between x and y

x_t value of x at time t

$\bar{x}$ average of x

y_t value of y at time t

$\bar{y}$ average of y

2. Moving average: This technique is one of the simplest forecasting techniques. The formula is as follow:

$$\hat{y}_{t+1} = MA(k)_t$$

Parameter:

$\hat{y}_{t+1}$ forecasting value at t+1 period

k number of time periods

3. Weight moving average: This technique is more advanced by adding a weight as coefficient in the equation. The set of coefficients that will be assigned a greater weight to newer data point, while past data points are assigned to be less weight. The formula is as follow:

$$\hat{y}_{t+1} = WMA(k)_t$$

Parameter:

W coefficient value as weight

4. Simple exponential smoothing: This is one of the techniques in exponential smoothing forecasting. The simple exponential smoothing technique is weighting between the observed data and the forecasting data (Brown, 1963; Billah et al., 1985).

$$\hat{y}_{t+1} = \alpha y_t + (1-\alpha)\hat{y}_t$$

Parameter:

$\hat{y}_t$ forecasting value at t period

y_t actual data at t period

α the smoothing factor, $0 \leq \alpha \leq 1$

5. Holt’s exponential smoothing: The concept is to introduce a term of capturing the trend from the data (Holt,1957). This research has done the exponential smoothing by using Python’s library called statsmodel (Seabold & Perktold, 2010).

$$L_t = \alpha y_t + (1-\alpha)(L_{t-1} + T_{t-1})$$

$$T_t = \beta(L_t - L_{t-1}) + (1-\beta)T_{t-1}$$

$$\hat{y}_{t+p} = L_t + pT_t$$

Parameter:

α the smoothing factor for level, $0 \leq \alpha \leq 1$

β the smoothing factor for trend, $0 \leq \beta \leq 1$

Research Results

The amount of organic waste that produced in 2016 until 2019, the unit is in kilogram. We can divide organic waste into 2 categories which are fruit peel and food waste. In the first year, the amount of organic waste is moving around 1,200 – 1,900 kilograms. Then in the year of 2017, the trend seems to be negative which mean the organic waste is reducing among time and stay below 1,000 kilograms in January and February of 2018. After March of 2018, the organic waste start to increase up to around 1,300 kilograms and stay around 1,100 – 1,300 kilograms until December of 2018 then the graph is dropping to below 1,000 kilograms and reach the smallest amount of organic waste in June of 2019 then increasing and stay to around 2,200 – 2,800 in the last 4 months of 2019 (Table 1 and Figure 1).

Table 1 The amount of organic waste in range of 6 months.

Date	Organic waste (kilograms)
Jan 2016 to Jun 2016	9,840
Jul 2016 to Dec 2016	9,803
Jan 2017 to Jun 2017	9,257
Jul 2017 to Dec 2017	6,563
Jan 2018 to Jun 2018	6,914
Jul 2018 to Dec 2018	7,563
Jan 2019 to Jun 2019	4,521
Jul 2019 to Dec 2019	11,930

Fig. 1 The amount of organic waste from the beginning of 2016 until the end of year 2019.

Since organic waste here is fruit peel and food waste, The line graph of amount of fruit peel and amount of food waste in 2016 until 2019. The fruit peel line is moving around 500 – 1,600 kilograms from the January of 2016 until June of 2019 then the waste in fruit peel appears to be large after July of 2019. In January of 2016, there are amount of food waste occurring to be large number then the food waste is dropped in February of 2016 and then line is slightly reduced almost reach to 0 kilogram at around January of 2018 and remain almost zero-food waste until the line slightly increasing again in November of 2018 and remain at low amount of food waste until around September of 2019 then the amount of food waste occurring to be large (Table 2 and Figure 2).

Table 2 The amount of fruit peel and food waste in range of 6 months.

Date	Fruit peel (kilograms)	Food waste (kilograms)
Jan 2016 to Jun 2016	7,434	2,404
Jul 2016 to Dec 2016	8,083	1,720
Jan 2017 to Jun 2017	7,540	1,717
Jul 2017 to Dec 2017	5,629	934
Jan 2018 to Jun 2018	6,794	120
Jul 2018 to Dec 2018	7,332	231
Jan 2019 to Jun 2019	4,141	380
Jul 2019 to Dec 2019	9,910	2,020

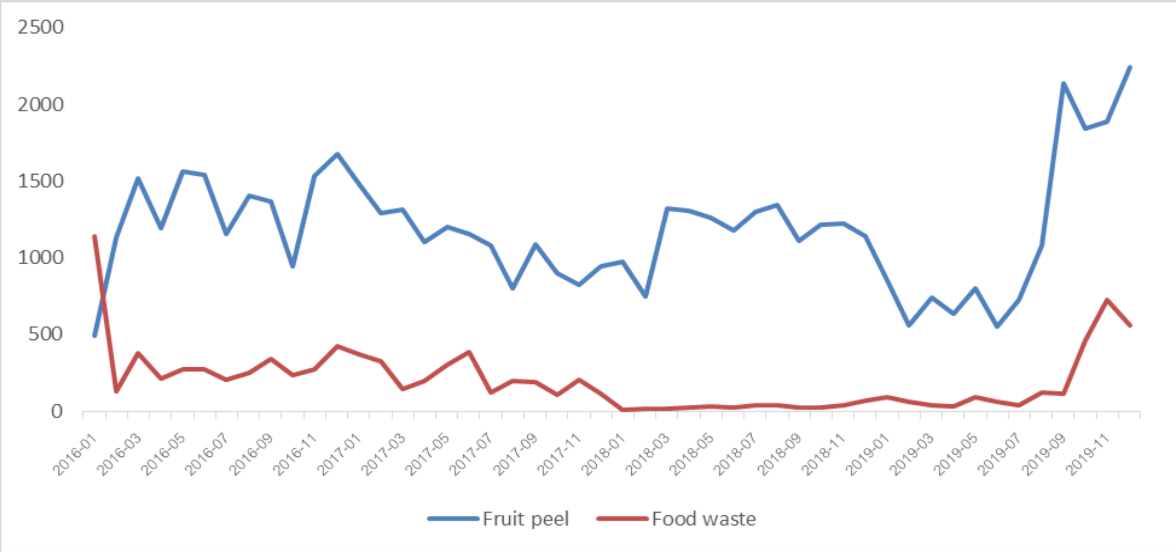

Fig. 2 Amount of fruit peel and food waste that were using for fermentation from the beginning of 2016 until the end of year 2019.

The bio fermented water was produced from organic waste by transforming. One of benefit of bio fermented water is for planting plants. The amount of bio fermented water that were produced, the amount of bio fermented water that were produced moving around 150 – 800 liters. Only in July of 2569 that was produced more than 1,300 liters (Table 3 and Figure 3)

Table 3 The amount of bio fermented waste in range of 6 months.

Date	Bio fermented waste (kilograms)
Jan 2016 to Jun 2016	2,140
Jul 2016 to Dec 2016	4,300
Jan 2017 to Jun 2017	2,700
Jul 2017 to Dec 2017	2,600
Jan 2018 to Jun 2018	2,700
Jul 2018 to Dec 2018	2,600
Jan 2019 to Jun 2019	1,300
Jul 2019 to Dec 2019	1,990

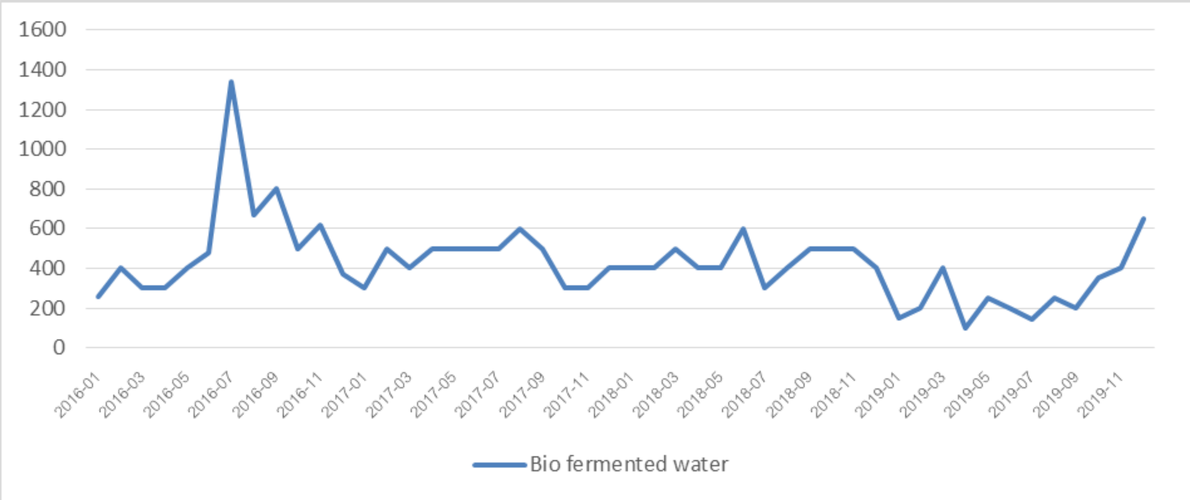

Fig. 3 Show the amount of bio fermented water that were produced from year 2016 until year 2019.

Since we know that fruit peel and food waste were used to produce bio fermented water, then the amount of both fruit peel and food waste were used should have relevant with the amount of bio fermented water was produced and we can have the relevant value by calculating Pearson's Correlation Coefficient., the correlation between fruit peel and food waste is 0.2853 which has weak correlation between those two ingredients for producing bio fermented water. And the correlations between bio fermented water and both fruit peel and food waste are 0.2518 and 0.0877 respectively, which mean bio fermented water and fruit peel have a weak correlation, but bio fermented water and food waste have no correlation (Figure 4 and Table 4).

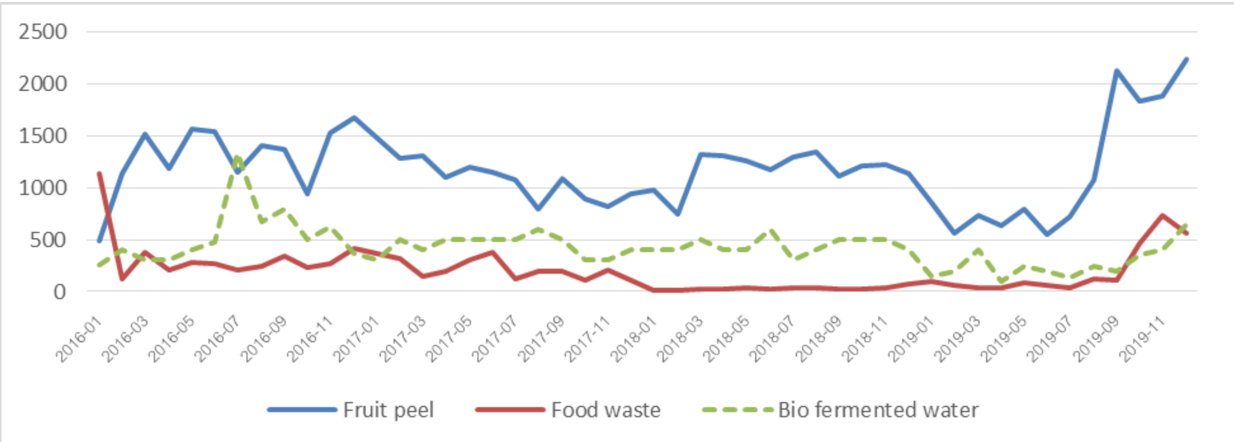

Fig. 4 Comparison between fruit peel, food waste, and bio fermented water since 2016 until 2019.

Table 4 Correlation between fruit peel, food waste, and bio fermented water

Correlation	Fruit peel	Food waste	Bio fermented water
Fruit peel	1		
Food waste	0.2853	1	
Bio fermented water	0.2518	0.0877	1

There are 4 forecasting techniques which are 1) Moving Average k=3, 2) Weight Moving Average k=3, 3) Simple Exponential Smoothing, and 4) Holt's Exponential Smoothing. The Simple Exponential Smoothing and Holt's Exponential Smoothing are calculated in by stats models. Since predicting the 12 months forward by using normal time-series data format could have large error, then we use Year-on-Year data format (YoY), The Year-on-Year data format using the previous data from same time in the past year to do forecasting. For example, in Moving Average k=3 mean using 3 past data to calculate the forward data, if we want to forecast the amount of fruit peel will be used in 2020 then the 3 past data will be January of 2017, January of 2018, and January of 2019. Those 3 techniques, Moving Average, Weight Moving Average, and Simple Exponential Smoothing, have remarkably similar value, but Holt's Exponential Smoothing has a slightly difference (Table 5 and Figure 5).

Table 5 The prediction values in 4 forecasting techniques in fruit peel in year 2020.

Date	Moving Average k=3	Weight Moving Average k=3	Simple Exponential Smoothing	Holt's Exponential Smoothing
Jan 2020	982	507	320	1,063
Feb 2020	1,057	154	433	993
Mar 2020	1,384	181	400	1,351
Apr 2020	1,200	143	400	1,219
May 2020	1,341	202	433	1,291
Jun 2020	1,292	227	527	1,232
Jul 2020	1,179	121	713	1,203
Aug 2020	1,183	162	557	1,172
Sep 2020	1,189	186	600	1,146
Oct 2020	1,019	121	433	1,065
Nov 2020	1,192	172	473	1,141
Dec 2020	1,253	200	390	1,163

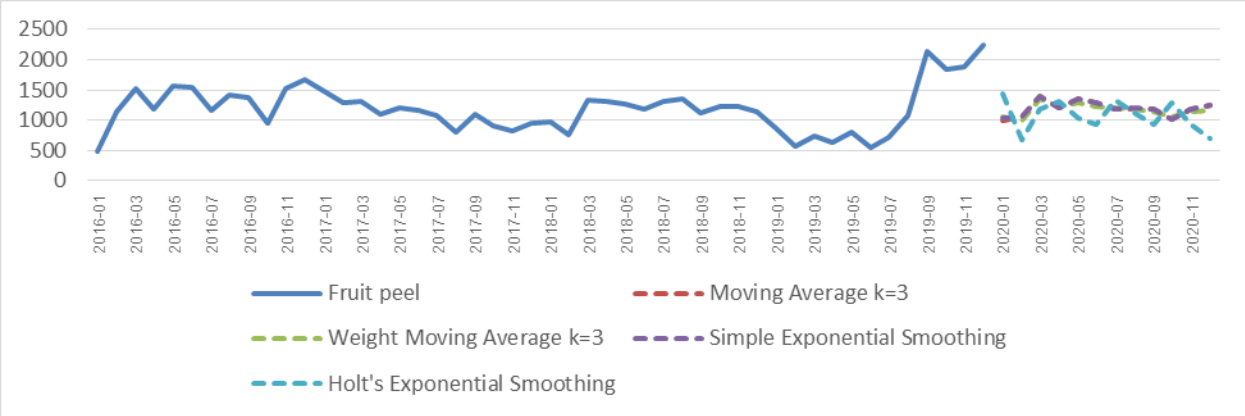

Fig.5 Forecasting techniques in fruit peel in year 2020.

All of techniques seem to be similar in March until December of 2020 due to the amount of food waste in year 2018 until early of 2019 is stable. But in January and February of 2020, Moving Average was calculated from past 3 years data and in January of 2016 the amount of food waste was extremely high at almost 1,200 kilograms which make an effect to the forecasting value in January of 2020. Weight Moving Average also has the effect of value from January of 2016, but less than Moving Average due to weight parameters. The Simple Exponential Smoothing moving around 20 – 200 kilograms in the first 6 months and stable around 20 – 60 kilograms in the last 6 months. And Holt's Exponential Smoothing predict around 10 – 100 kilograms in 2020 (Table 6 and Figure 6).

Table 6 The prediction values in 4 forecasting techniques in food waste in year 2020.

Date	Moving Average k=3	Weight Moving Average k=3	Simple Exponential Smoothing	Holt's Exponential Smoothing
Jan 2020	507	320	1,063	319
Feb 2020	154	433	993	135
Mar 2020	181	400	1,351	121
Apr 2020	143	400	1,219	112
May 2020	202	433	1,291	161
Jun 2020	227	527	1,232	186
Jul 2020	121	713	1,203	94
Aug 2020	162	557	1,172	126
Sep 2020	186	600	1,146	133
Oct 2020	121	433	1,065	85

Date	Moving Average k=3	Weight Moving Average k=3	Simple Exponential Smoothing	Holt's Exponential Smoothing
Nov 2020	172	473	1,141	133
Dec 2020	200	390	1,163	141

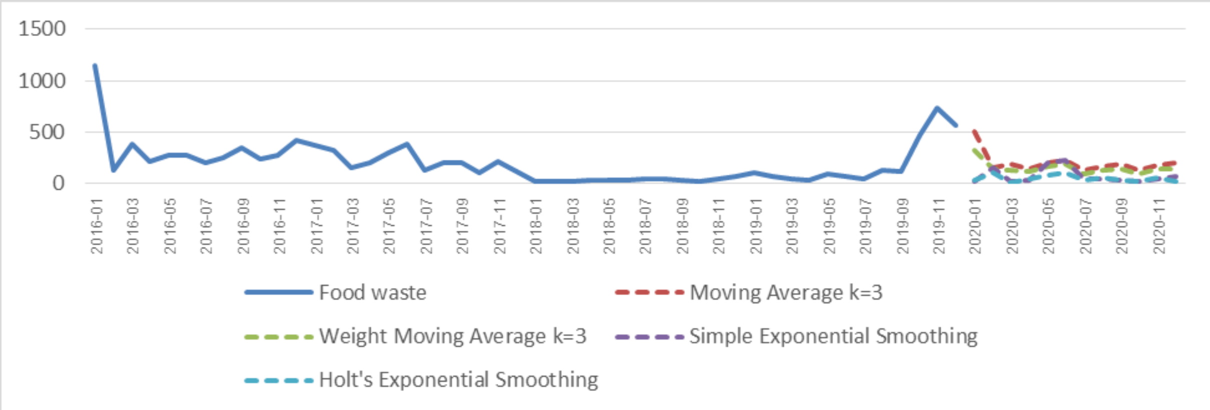

Fig.6 Forecasting techniques in food waste in year 2020.

Moving Average has a bit high value in July of 2020 because of previous years. Weight Moving Average perform similar to Moving Average but not vary as Moving Average, this technique forecast around 300 – 600 kilograms. Simple Exponential Smoothing and Holt's Exponential Smoothing have similar value, but Holt's Exponential Smoothing technique forecasted the value slightly lower than Simple Exponential Smoothing (Table 7 and Figure 7).

Table 7 The prediction values in 4 forecasting techniques in bio fermented waste in year 2020.

Date	Moving Average k=3	Weight Moving Average k=3	Simple Exponential Smoothing	Holt's Exponential Smoothing
Jan 2020	320	1,063	319	343
Feb 2020	433	993	135	433
Mar 2020	400	1,351	121	433
Apr 2020	400	1,219	112	417
May 2020	433	1,291	161	433
Jun 2020	527	1,232	186	547
Jul 2020	713	1,203	94	540
Aug 2020	557	1,172	126	512
Sep 2020	600	1,146	133	550
Oct 2020	433	1,065	85	433

Date	Moving Average k=3	Weight Moving Average k=3	Simple Exponential Smoothing	Holt's Exponential Smoothing
Nov 2020	473	1,141	133	453
Dec 2020	390	1,163	141	395

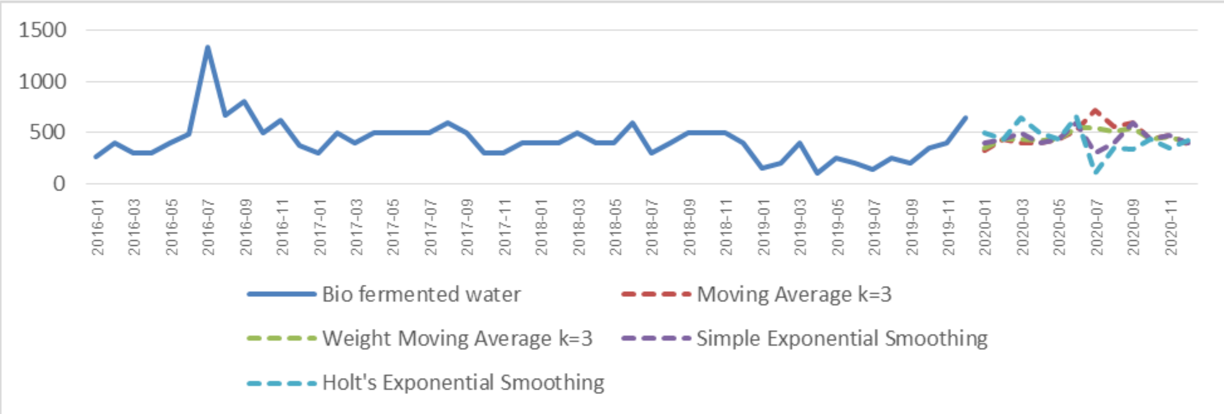

Fig.7 Forecasting techniques in bio fermented water in year 2020.

Discussions

1. The data collection of the organic waste amount were produced in 2016 until 2019 through 4 years, the unit is in kilogram. The organic waste divided into 2 categories which are fruit peel and food waste on center of organic management generating the bio fermented water to supply for garden of KU campus and green schools with Vertical Recycle Box (VRB) on Bangkok city. The organic waste data analyzed on statistics of correlation and forecasting with statistic numerical modelling. Pearson's correlation of this research is technique to measure correlation between interested data, but not causation. The forecasting techniques of this research are the Moving average, the Weight moving average, the Simple exponential smoothing, the Holt's exponential smoothing.

2. All of techniques seem to be similar in March until December of 2020 due to the amount of food waste in year 2018 until early of 2019 is stable. But in January and February of 2020, Moving Average was calculated from past 3 years data and in January of 2016 the amount of food waste was extremely high at almost 1,200 kilograms which make an effect to the forecasting value in January of 2020. Weight Moving Average also has the effect of value from January of 2016, but less than Moving Average due to weight parameters. The Simple Exponential Smoothing moving around 20 – 200 kilograms in the first 6 months and stable around

20 – 60 kilograms in the last 6 months. And Holt's Exponential Smoothing predict around 10 – 100 kilograms in 2020.

3. Moving Average has a bit high value in July of 2020 because of previous years. Weight Moving Average perform similar to Moving Average but not vary as Moving Average, this technique forecast around 300 – 600 kilograms. Simple Exponential Smoothing and Holt's Exponential Smoothing have similar value, but Holt's Exponential Smoothing technique forecasted the value slightly lower than Simple Exponential Smoothing.

4. The research result benefits from Pearson's correlation and the forecasting techniques of this research with the Moving average, the Weight moving average, the Simple exponential smoothing, the Holt's exponential smoothing can be used to prepare for what will happen in the future, gain the valuable in insight, and thee result from prediction methods could decrease cost for the environmental management on the green community on the organic waste.

Conclusion

1. The amount of organic waste that produced in 2016 until 2019. We can divide organic waste into 2 categories which are fruit peel and food waste. In the first year, the amount of organic waste is moving around 1,200 – 1,900 kilograms. Then in the year of 2017, the trend seems to be negative which mean the organic waste is reducing among time and stay below 1,000 kilograms in January and February of 2018. After March of 2018, the organic waste start to increase up to around 1,300 kilograms and stay around 1,100 – 1,300 kilograms until December of 2018 then the graph is dropping to below 1,000 kilograms and reach the smallest amount of organic waste in June of 2019 then increasing and stay to around 2,200 – 2,800 in the last 4 months of 2019.

2. The organic waste here is fruit peel and food waste, the line graph of amount of fruit peel and amount of food waste in 2016 until 2019. The fruit peel line is moving around 500 – 1,600 kilograms from the January of 2016 until June of 2019 then the waste in fruit peel appears to be large after July of 2019. In January of 2016, there are amount of food waste occurring to be large number then the food waste is dropped in February of 2016 and then line is slightly reduced almost reach to 0 kilogram at around January of 2018 and remain almost zero-food waste until the line slightly increasing again in November of 2018 and remain at low amount of food waste until around September of 2019 then the amount of food waste occurring to be large.

3. The bio fermented water was produced from organic waste by transforming. One of benefit of bio fermented water is for planting plants. The amount of bio fermented water that were produced, the amount of bio fermented water that were produced moving around 150 – 800 liters. Only in July of 2569 that was produced more than 1,300 liters.

4. The fruit peel and food waste were used to produce bio fermented water, then the amount of both fruit peel and food waste were used should have relevant with the amount of bio fermented water was produced and we can have the relevant value by calculating Pearson's Correlation Coefficient., the correlation between fruit peel and food waste is 0.2853 which has weak correlation between those two ingredients for producing bio fermented water. And the correlations between bio fermented water and both fruit peel and food waste are 0.2518 and 0.0877 respectively, which mean bio fermented water and fruit peel have a weak correlation, but bio fermented water and food waste have no correlation.

5. There are 4 forecasting techniques which are 1) Moving Average k=3, 2) Weight Moving Average k=3, 3) Simple Exponential Smoothing, and 4) Holt's Exponential Smoothing. The Simple Exponential Smoothing and Holt's Exponential Smoothing are calculated in by stats models. Since predicting the 12 months forward by using normal time-series data format could have large error, then we use Year-on-Year data format (YoY), The Year-on-Year data format using the previous data from same time in the past year to do forecasting. For example, in Moving Average k=3 mean using 3 past data to calculate the forward data, if we want to forecast the amount of fruit peel will be used in 2020 then the 3 past data will be January of 2017, January of 2018, and January of 2019. Those 3 techniques, Moving Average, Weight Moving Average, and Simple Exponential Smoothing, have remarkably similar value, but Holt's Exponential Smoothing has a slightly difference.

Suggestions

Data collection of types the different biodegradable wastes on other locations across country in experiment period with the statistical assessment to forecasting with numerical modelling of the Moving average, the Weight moving average, the Simple exponential smoothing and the Holt's exponential smoothing.

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