

Determining Effects of Tropical Cyclones to Rice and Corn Production in Eastern Samar Philippines an Association Rule Mining Application

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Abstract: *The primary aim of the study is to employ a data mining technique, specifically association rule mining in determining the effects of tropical cyclones to the rice and corn production in Eastern Samar, Philippines. The researcher utilized the exploratory research design, which started with the pre-processing of data, application of association rule mining and ultimately the development of a theory. It was determined that the number of tropical cyclones affects the rice and corn production in Eastern Samar. The analysis shows that although Eastern Samar receives many cyclones annually there is still an increase in rice and corn production. The results can be used as inputs in the development of new strategies for the province to improve its rice and corn production.*

Index Terms: *Data mining, Association rule mining, itemset, tropical cyclone, knowledge discovery*

I. INTRODUCTION

The Philippines is considered as one of the world's climate hotspots, vulnerable to natural disasters, floods, droughts and other worst manifestations of climate change [1]. The World Risk Report released in 2014 ranked the Philippines second as most at risk worldwide and third among countries most exposed worldwide [2]. These natural calamities have detrimental economic and environmental impacts on the affected areas and its community [3]. On average, 20 tropical typhoons hit the country every year leaving thousands dead and billions of properties damaged affecting 0.5 percent of its gross domestic product annually [4]. On November 8, 2018, Typhoon Haiyan, the world's strongest recorded typhoon with wind speeds reaching up to 300 kilometers per hour and storm surges of over 4 meters, made its landfall at Eastern Samar, Philippines [5]. Haiyan created heavy devastations to the eastern region of the Philippines, killing more than 6, 300 people and affecting no less than 14 million people [6]. Haiyan also resulted in severe negative economic effects. It was estimated to have caused 12.4 billion in infrastructure damage. The agriculture and fishing sector, which are primary economic drivers of the eastern part of the Philippines, suffered from to a 2.85 million metric tons of lost crops and 24,000 metric tons of lost fisheries stocks [5]. Eastern Samar, being largely dependent on its agriculture and natural resources sector, has to determine strategies to address the negative effects of natural calamities. This study primarily aimed to explore the association of the rice and corn

production in Eastern Samar to the tropical cyclones received by the Philippines annually using data mining techniques. Datasets gathered from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and the Philippine Statistics Authority (PSA) were pre-processed and analyzed using association rule mining and a theory was developed based on the data analysis.

II. RESEARCH FRAMEWORK

As shown in figure 1, the research is initiated through the collection of datasets from the World Wide Web. The datasets were then pre-processed to suit the need of the researcher. After the thorough data pre-processing, data mining techniques specifically (association rule) was employed. The results of the data mining became the basis of a theory.

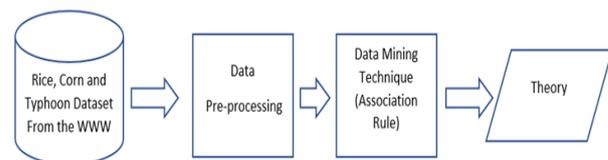


Figure 1. Research Framework

III. RESEARCH METHOD

The research commenced with the collection of datasets containing information on the number of tropical cyclones the Philippines receive annually through the PAGASA portal and a dataset containing Eastern Samar rice and corn production per metric ton for the past 11 years through the PSA dataset portal [10,11].

Association rule mining was employed to determine the association of the rice and corn production to the number of cyclones being received by the Philippines annually. The same technique was used to determine the effects of typhoons in ICT products in the Philippines [8].

The following are the parameters to determine association rules. Itemset – Tropical Cyclone, Rice and Corn Dataset Support – fraction of transactions that contain an itemset. Minimum support – 4 (One more than half the cases) Using the apriori, we can reduce the number of itemsets we need to examine. Apriori principle states that if an itemset is infrequent, then all its **supersets** must also be infrequent [8].

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IV. RESULTS

After the data pre-processing and association rule mining was made, the following results were collated.

Table 1. Number of Tropical Cyclones, Rice and Corn Production from 2008-2018

Year	No. Tropical Cyclones (A)	Irrigated Palay (B)	Rainfed Palay (C)	Palay (D)	White Corn (E)	Yellow Corn (F)	Corn (G)
2008	21	12403.00	34750.00	47153.00	219.00	214.00	433.00
2009	22	11389.00	34902.00	46291.00	249.00	246.00	495.00
2010	14	12092.00	39703.00	51795.00	281.00	278.00	559.00
2011	15	15735.00	37897.00	53632.00	261.00	273.00	534.00
2012	19	17895.00	41518.00	59413.00	294.00	299.00	593.00
2013	25	19807.00	43418.00	63225.00	303.00	268.00	571.00
2014	17	19985.00	43620.00	63605.00	307.00	302.00	609.00
2015	19	19248.00	43140.00	62388.00	325.00	315.00	640.00
2016	11	19409.00	42493.00	61902.00	258.00	198.00	456.00
2017	22	18848.00	40906.00	59754.00	330.00	265.00	595.00
2018	21	18054.00	41534.00	59588.00	341.00	274.00	615.00
Sum	206	184865	443881	628746	3168	2932	6100
Mean	19	16805.91	40362.82	57158.73	288.00	266.55	654.55

Table 1 shows the instances in the datasets that were collected from the PSA and PAGASA portals [11, 12].

* Rice and Corn data is expressed in metric tons

Table 2. Tropical Cyclones, Rice and Corn Production expressed using Association Rules

	A	B	C	D	E	F	G
1	1	0	0	0	0	0	0
2	1	0	0	0	0	0	0
3	0	0	0	0	0	1	1
4	0	0	0	1	0	1	0
5	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1
7	0	1	1	1	1	1	1
8	1	1	1	1	1	1	1
9	0	1	1	1	0	0	0
10	1	1	1	1	1	0	1
11	1	1	1	1	1	1	1

Table 2 shows how the number of typhoons (A) and Rice and Corn production data (B-G) is expressed using Association rule mining by transforming the data to 1 if the value is greater than or equal its mean and 0 if it is less than the mean [8].

Table 3. Trimmed Table containing the value 1 on column A

	A	B	C	D	E	F	G
1	1	0	0	0	0	0	0
2	1	0	0	0	0	0	0
5	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1
10	1	1	1	1	1	0	1
11	1	1	1	1	1	1	1

Table 3 is a trimmed version of table 2, showing only data with a value of 1 in column A. Such process was made to determine only significant items that are directly affected by the number of tropical cyclones (A).

Table 4. Items with a value of 1

	Items
1	-
2	-
5	BCDEFG
6	BCDEFG
8	BCDEFG
10	BCDEG
11	BCDEFG

Table 4 shows the different items that have a value of one.

Table 5. Items and Its Corresponding Support

	Support
B	5
C	5
D	5
E	5
F	4
G	5

Table 5 shows the total number of support per column. It was determined that columns B-G are accepted as per association mining rule because the values were able to meet the minsup 4. This would entail that column B-G (Rice and Corn Data) are all directly affected by Column A (tropical typhoon data) for years 2008, 2009, 2012, 2013, 2015, 2017, 2018.

V. CONCLUSION/THEORY

It has been determined through a data mining technique that tropical cyclones indeed affect the rice and corn production in Eastern Samar. It can be noted that data in 2013 (the year when Haiyan hit the Philippines) was included in the items directly affected by typhoons. It is then theorized that the number of tropical cyclones received by the Philippines is associated with the increase of rice and corn production.

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