

DIRECT AND INDIRECT ECONOMIC IMPACT OF CLIMATE CHANGE ON THE PROVINCIAL TOURISM, AGRICULTURE AND COMMERCIAL SECTORS OF ZAMBOANGA DEL NORTE

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Abstract

This study is an attempt to look into the direct and indirect economic impact of climate change to three (3) business sectors: tourism, commercial and agricultural, of Zamboanga del Norte by canonical path analysis. Results revealed that temperature and rainfall variations led to a decline in agricultural productivity (-1.90%) but spurred greater economic activities in the commercial (47.0%) and tourism sectors (17.12%). The traditional farming technique generally used in the province accounts for the adverse sensitivity of this sector to climate change. This study proposes that the agricultural sector looks into possibilities of utilizing contemporary farming systems in order to counteract the negative consequences brought about by climate change.

Keywords: *direct and indirect economic impact, climate change, business sectors*

Introduction

The center for Integrative Researches of Maryland in 2008, explained that different sectors and systems are expected to be affected in different ways by the impact of continued climate change in such a way that economic gains from agricultural produce will be altered since growing conditions of agricultural products are lost as temperatures continue to rise. Droughts, water shortages as well as excess precipitations and spread of pests and diseases affecting the agricultural resources create a negative impact on agricultural production.

Similarly, transportation networks, infrastructure, water and electricity (energy) supply systems will be disrupted. The balance between the supply of and demand for energy will be tilted as the demand for energy continues to rise beyond the available supply. For example, in an economy which is primarily dependent on hydropower, such as the island of Mindanao, long episodes of dry season lead to low water pressure that eventually translates to shortages in the supply of electricity. Of course, when power supply is affected, the entire economic system becomes disturbed, generates less and

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results in a drop in productivity. This phenomenon was currently observed throughout the El Nino effect which lasted from October, 2009 to June, 2010 or a period of over eight months with unusually low rainfall throughout the country.

Climate change as manifested by very long dry season or very heavy rainfall also makes people vulnerable to various kinds of health problems, particularly to vector borne diseases. For instance, Chowell et al. (2006) discovered that the incubation period for dengue for persons bitten by mosquitoes (*Aedes aegypti*) is significantly shortened (from 12 days down to 5 days) at temperatures beyond 31⁰C. Not only that, a significant increase in the number of mosquitoes is observed in the rainy season perhaps because of an increase in the number of breeding sites. When these two information are combined, we obtain a grim picture for countries with tropical climates (temperatures ranging from 31⁰C to 34⁰C) and experiencing the La Nina effect. This year alone, the statistics for the number of people detected with one of the dengue serotypes (January to June, 2010) in the Philippines already exceeded the number infected in 2009. A health outburst such as this eventually finds expression in a drastically reduced per capita economic productivity.

The business sector which establishes the economic growth and development of the Province of Zamboanga del Norte will likely experience these negative effects of climate change brought about by the collective effects of frequent water shortages, deteriorating supply of energy, increase in transportation costs and health concerns in the various communities. Though we have limited our analysis to the province of Zamboanga del Norte, we deduce that the same phenomenon can be observed elsewhere in the country.

Climate change, on the other hand, can ironically, also bring about positive impact on the business and industry. A study conducted in 2008 on Climate Change Challenge – Implications for the Tourism Industry, stressed that climate change provides opportunity to generate both tangible and sustainable solutions. An example is on the supply of water. While water supply becomes more and more sparse in roughly every region of the country, it also generates business opportunities for those capitalists who can ultimately do business with purified drinking water, which entails greater productivity for the commercial sector. Opportunities such as this abound and simply reflects man's flexibility to adapt to climate change.

This study, hence, aims to look into the direct and indirect economic impact of climate change on the business sector of the province. In particular, it scrutinizes the direct and indirect effects of rainfall and temperature variations over a 12-month period on three (3) economic sectors: agriculture, tourism and commercial sectors throughout a path analysis. The superseding factors which contribute to the observed productivity of these sectors, namely, energy and health supply, were utilized as intervening nodes in the path analysis acted upon.

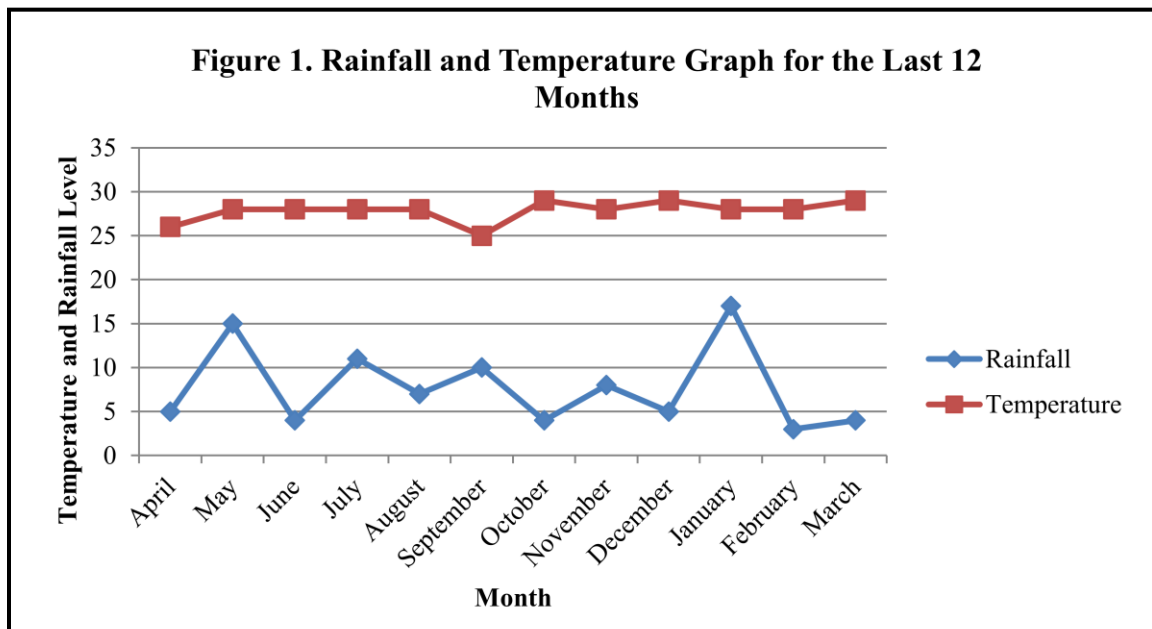
Research Method and Design

The data were taken from different sources which cover a twelve (12) month period commencing April 2009 to March 2010. To establish the regular precipitations and increase in temperature, data were attained from the Philippines Atmospheric survey of the Department of Science and Technology. The data on energy level and public health were taken from sources to incorporate the Zamboanga del Norte Electric Cooperative, DOTC and the hospitals in Zamboanga del Norte. On the other hand, the data on the business sector were from the Department of Trade and Industry, the BIR and the Department of Agriculture. Statistical methods were utilized in order to establish the direct and indirect impact of climate change to the business industries.

The data that came from various sources were statistically treated via simple path canonical correlation technique. The indirect impact were treated individually from the data on climate change to the major impact on the energy sector and public health to the business sector specifically agricultural, commercial establishments and industrial production. The total impact was ascertained by getting the sum of the indirect and direct impact.

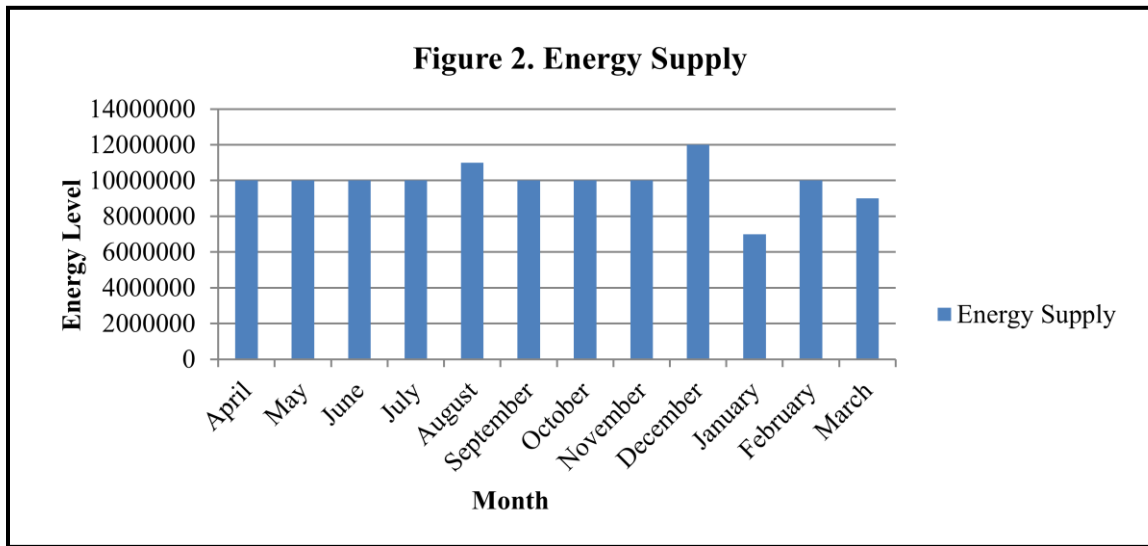
Results

Figure 1 shows the rainfall and temperature data on the twelve – month period.



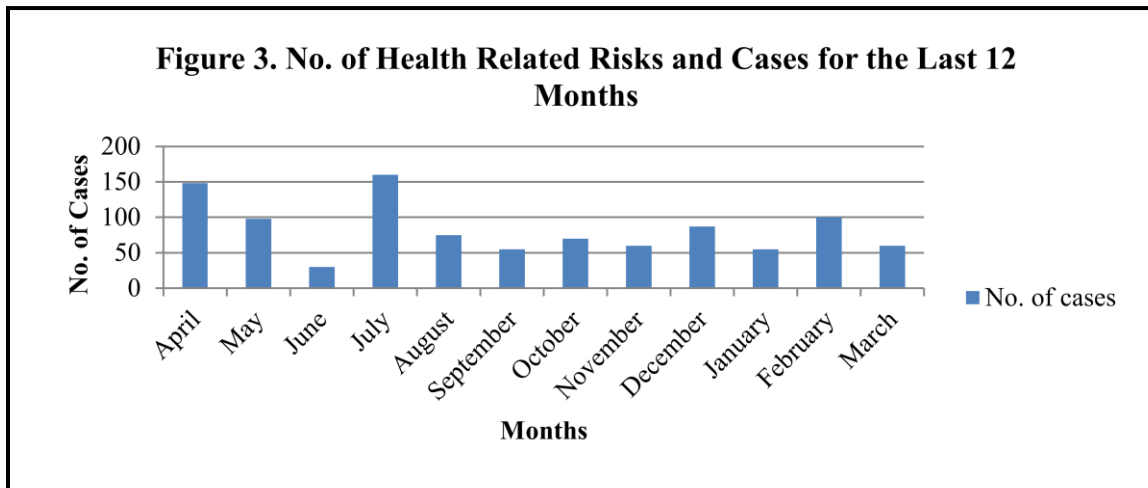
The graph shows that the highest rainfall was in January 2010 which reached up to a level of 17 while the lowest falls on February 2010. On the other hand, the highest temperature was in December 2009 while the lowest was on February 2010.

Figure 2 show the energy supply over the same period.



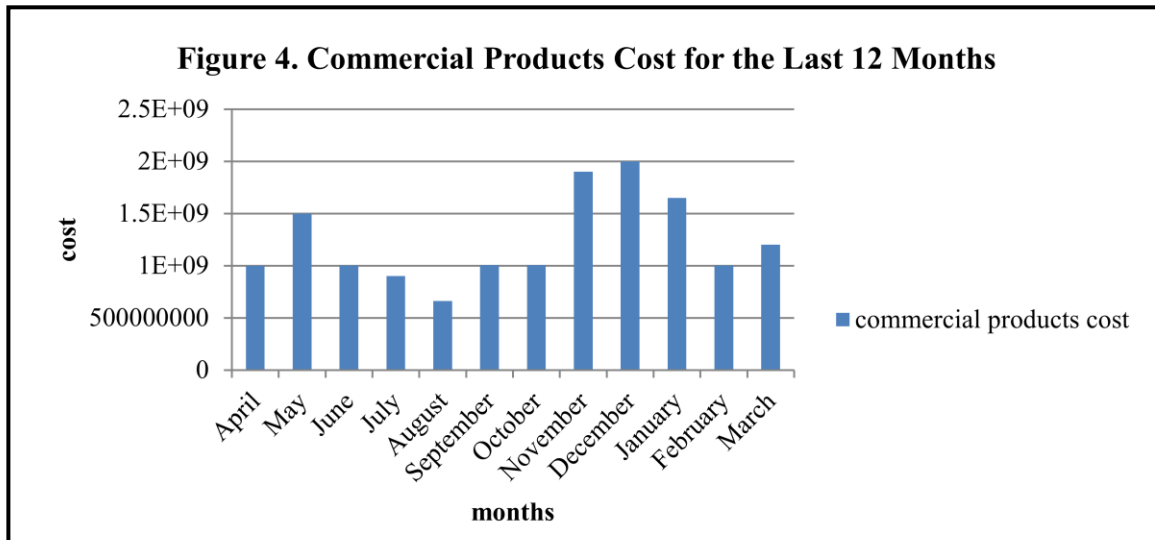
The graph shows that the highest supply of energy was on December 2009 with 12 million kilowatts and the lowest was in February where there is only about 8 million kilowatt supply of energy.

Shown in figure 3 are the data on respiratory cases recorded in the Province on Zamboanga del Norte.



It could be seen that the highest number of cases occurred in July of 2009 while the lowest was in June in the same year. However, the number of cases on health related issues were fluctuating from month to month. This could be due to the fact that climate change may have brought about different cases at different levels depending on the vulnerability of people who are prone to climate change related illnesses.

Figure 4 shows the commercial product cost during the last 12 months.



The highest cost of commercial products was seen in December and November in the year 2009. It could be noticed that the commercial products cost were fluctuating depending on the period since commercial products are typically seasonal. Commercial products are generally seasonal. In most cases, large amount of sales could only be achieved during Christmas seasons, valentines, class openings and class closing times. Thus, it could also be seen on the data that commercial products are seen to be its peak during these times.

Figure 5 shows the agricultural products cost as recorded in the Department of Agriculture bases on Quarterly reports published the Bureau of Agricultural Statistics (BAS).

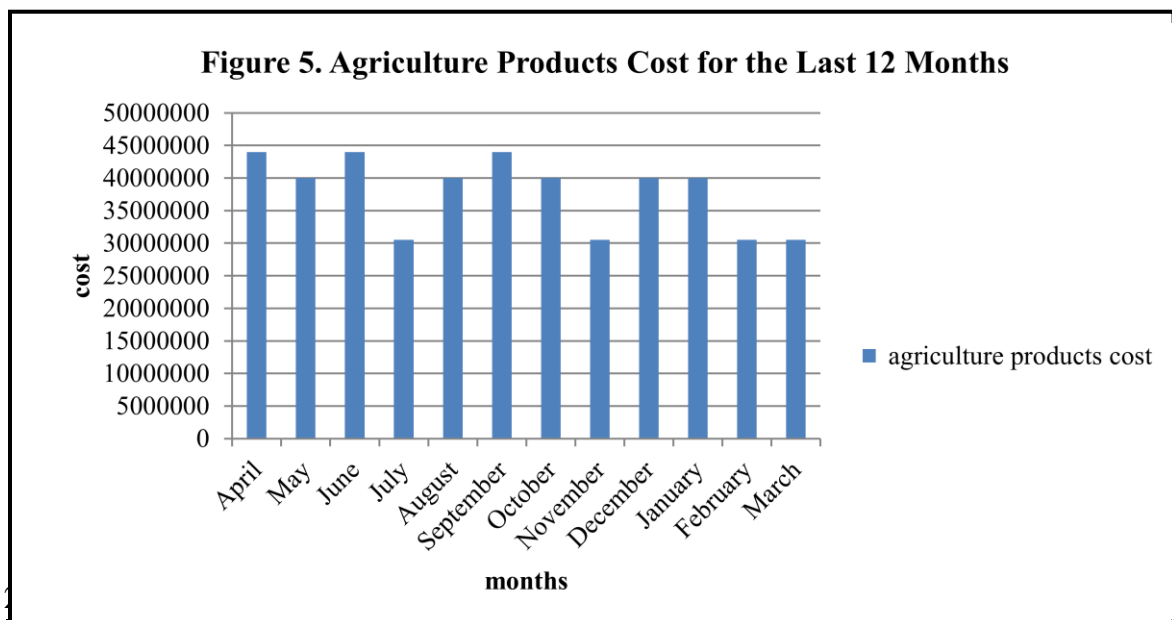
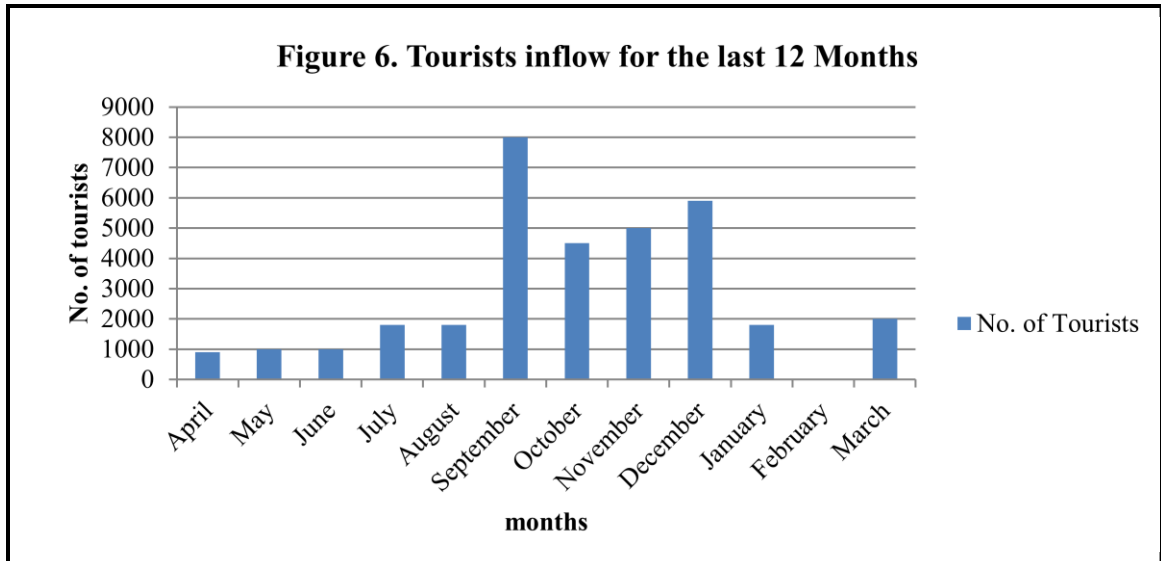
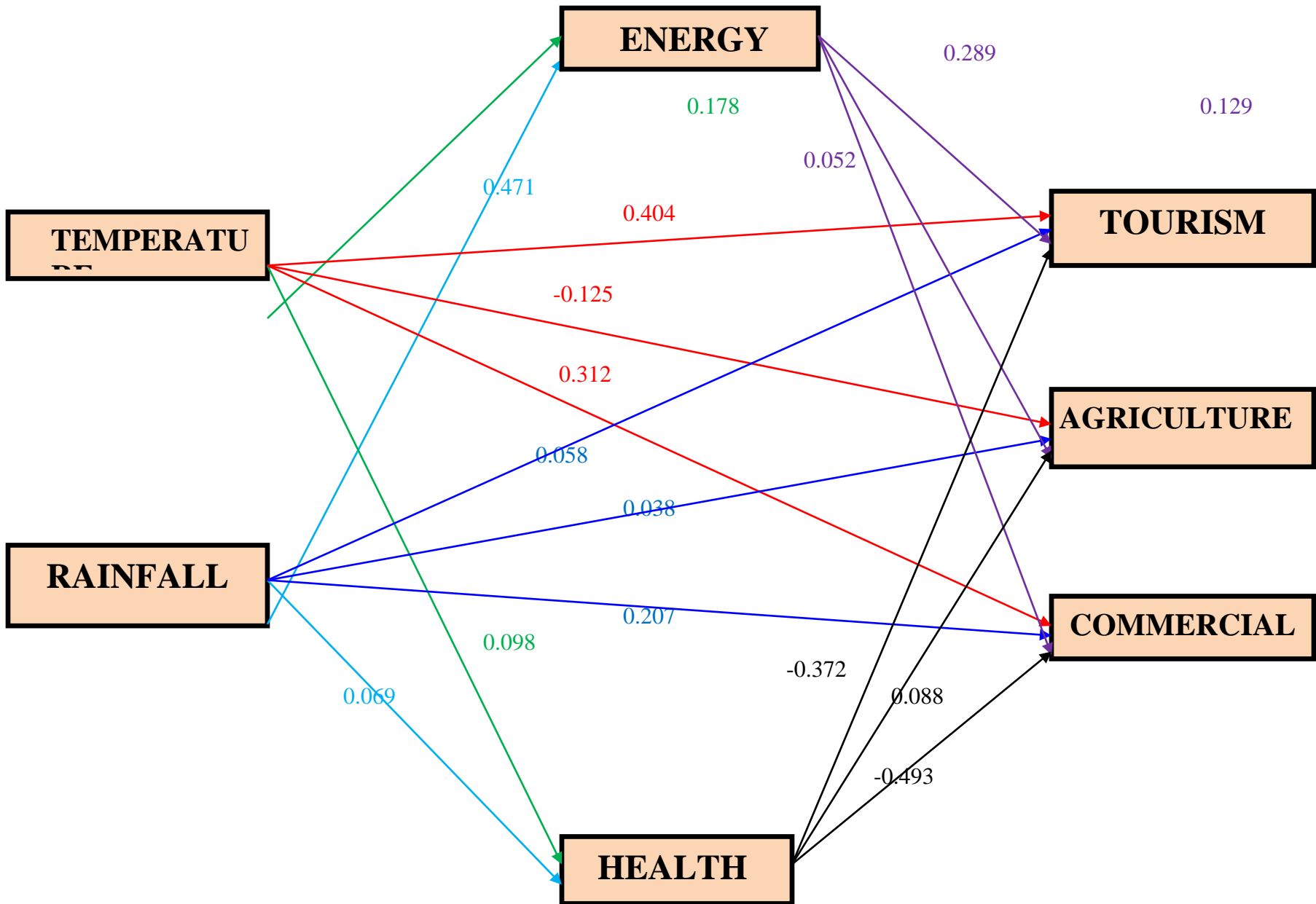


Figure 6 is the graph showing the tourism inflow in the last 12 months. The data were taken from the Department of Tourism Region IX.



As shown on the table, the maximum number of tourists in the province was in September 2009 which reaches up to more than 8000 in one month. This is owed to the regional and national conversations which are held within the province that brought about inflow in local and international tourists visiting the province. While it is true that tourist inflow could be seasonal, but organizations may establish activities that would bring about tourists within the province on cities within the province of Zamboanga del Norte.

Figure 7 on the next page shows the results of the path canonical analysis performed on these variables.



Path Analysis

Table 1 shows both the direct and indirect impacts of climatological variables on the Tourism Industry in the province over the period.

Table 1. Impact of Climatological Variables to Tourism

Variables	Direct Impact	Indirect Impact Via Energy	+	Indirect Impact Via Health	=	Indirect Impact To Tourism
Temperature	0.404	0.034	+	-0.036	=	-0.002
Rainfall	0.0508	0.136	+	-0.026	=	0.110
Total:	0.0912					0.080
Grand Impact = 0.912 + 0.080 = 17.12 %						

Table 2 shows the direct and indirect impacts of climatological variables on the Agriculture Industry

Table 2. Impact of Climatological Variables to Agriculture Industry

Variables	Direct Impact	Indirect Impact Via Energy	+	Indirect Impact Via Health	=	Indirect Impact To Agriculture
Temperature	-0.125	0.023	+	-0.010	=	-0.013
Rainfall	0.038	0.061	+	-0.006	=	0.055
Total:	-0.087					0.068
Grand Impact = -0.087 + 0.068 = -1.9 %						

Table 3 shows the direct and indirect impacts of climatological variables on the Commercial Sector.

Table 3. Impact of Climatological Variables to Commercial Sector

Variables	Direct Impact	Indirect Impact Via Energy	+	Indirect Impact Via Health	=	Indirect Impact To Commerce
Temperature	0.312	0.009	+	-0.048	=	-0.039
Rainfall	0.207	0.024	+	-0.034	=	0.010
Total:	0.519					-0.049
Grand Impact = 0.519 + -.049= -1.9 %						



Discussions

Monthly average records of both temperature and rainfall over the twelve – month period were not very erratic except for isolated cases in the months of February and March, 2010. In January 2010, a high rainfall volume was noted followed by sudden drops in the months of February and March, 2010. Of the two (temperature or rainfall), the rainfall data appears to be a better gauge for climatological changes for short period of time because of the relatively higher variances noted.

Similarly, energy supply data appeared to be constant until the months of March, 2010 and April, 2010 (not shown) where abrupt drops in energy supply were noted. Unfortunately, it was erratic and these months were not covered by the present study.

Meanwhile, the data acquired for health showed variable movement with the months of August and September, 2010 demonstrating high incidence of diseases. Such a data characteristic (relatively high variance) is ideal for determining the compatibility (or incompatibility) of diseases noted with the climatological indicators (rainfall and temperature)

Extremes in temperature and rainfall adversely affected the agricultural sector which registered a negative direct impact index of (-8.70%). In particular, just two months of high temperatures (March, 2010 and April, 2010) already made a pronounced drop in the farmers' yield and harvest of agricultural crops. Taking into account the indirect impact of climatological situations (through the energy supply and health status), nonetheless, temperature and rainfall were noted to have insignificant positive impact of 6.8%. Over all, extremes in temperature and rainfall translates into a drop in farm productivity by about -1.905%.

On the other hand, changes in both temperature and rainfall had positive direct impact (51.9%) on the commercial sector although these jointly had negative negligible indirect impact (energy + health) on the sector (-4.9%). In general, these two climatological parameters precipitated a universal increase in commercial productivity by a little less than 50% (47%). The net positive impact of rainfall patterns and variable temperature on the commercial zone can be elucidated by the corresponding higher demand for consumer products that are required during rainy season or during long stretches of drought e.g. bottled water, beverages, soft drinks, and others. Thus, while the agricultural sector suffers a set – back (negative impact index) on its productivity due to aberrant weather patterns, the same phenomenon surprisingly spurs more economic activity in the commercial sector.

Ultimately, the tourism industry, as a general rule, is also certainly impacted by the observed climatological constraints (rainfall and temperature). A net positive tourism growth of 17.12% was calculated. However, high temperatures tended to damper the tourism industry (-0.20%) but such negative impact is easily absorbed by the overall robustness of the industry to climate change.

Conclusions

The most easily affected economic sector by changes in climatic pattern is the agricultural sector which is easily and adversely affected by either long stretches of drought or heavy rainfall in the province. The farming method adopted by most farmers in the province is traditional and is so much dependent on nature.

Nonetheless, mild to moderate fluctuations in both temperature and rainfall patterns tended to benefit the commercial sector most pursued by the tourism sector. The massive demand for consumer commercial products during long summer episodes or long rainy seasons boosts this particular economic sector in the province of Zamboanga del Norte. Similarly, the tourism industry in the province is found to be comparatively robust with respect to fluctuations in temperature and rainfall. In particular, tourists appear to prefer the tourism destinations in the province e.g. beach resorts and waterfalls during a long summer period. Tourists also account for stimulating the growth of the commercial sector in the province.

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