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Climate Change Impact on Water Level in Peninsular Malaysia

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Abstract Part of climate change impact can be seen in the changing of river flow and water level. The objective of this research is to determine the change in water level for north and south region of peninsular Malaysia. One set of data for each region; north region (Kedah), south region (Johor) were collected from the Department of Irrigation and Drainage Malaysia. The result indicates that the mean water level of the rivers during 30 years for both north and south regions have decreased. In the recent years decreasing trend of water level were obtained. This could lead to soil erosion problem.

Keywords Climate change, Water level, River

1. Introduction

1.1. Climate Change Effect on Malaysia

There are some studies related to climate change impacts on Malaysia. Shaaban *et al*., (2006) stated that the whole Peninsular Malaysia will be warmer by about 2 degrees Celsius in the next 50 years if the simulated future climate in the Canadian CGCM1 study becomes true. According to Shaaban (2013) there are 3 main climatic parameters observed in Malaysia which are temperature, rainfall and sea level. Malaysian Meteorology Department (2013) stated that, generally, the overall correlation analysis of annual mean temperatures over the low land areas has the largest trend over Southern and Central Peninsula Malaysia while the lowest trend is in Sarawak. The rates of increase are about 1.5˚C to 2.7˚C per 100 years. In respond to water crisis in Malaysia, expert said Malaysia will face a water crisis by 2050 if conservation measures are not taken (NST, 2014).

1-hour rain intensity in year 2000 to 2007 has significantly increase by 17% compared to 1970s values. For example in 2007, massive floods occurred in Batu Pahat, Johor Baru, Kluang, Kota Tinggi, Mersing, Muar, Segamat all are in Johor southern state of peninsular Malaysia. The massive floods bring losses about RM1.5 billion to Malaysia. Satellite alimentary data recorded rise in sea level about 4.3cm to 11.9cm from year 1993 to 2010 (Shaaban, 2013). Figure 1 shows an example of flooding happened in Malaysia that effected the water supply, the Flooding of Bukit. Pinang Treatment Plant, Kedah in 2010.

Figure 1. Flooding of Bt.Pinang Treatment Plant (Source: N. A. Z. Abidin, 2012)

1.2. Climate Change on Water Level

Studies related to trends in river flows during the 20th century have been studied frequently since the Third Assessment Report and some of these studies have detected significant trends in some indicators of river flow, and some have demonstrated statistically significant links with trends in temperature or precipitation; but no globally homogeneous trend has been reported (IPCC, 2007). Bates *et al.,* (2008) stated that, generally, climatic warming is expected to start a drying trend in wetland ecosystems.

This is the part of climate change effect, leading to the water level alterations, would be the main agent in wetland ecosystem change. Monsoonal areas are more likely to be affected by more intense rain events over shorter rainy seasons, worsen by flooding and erosion in catchments and the wetlands themselves. According to Doll and Zhang (2010) climate change is impacting freshwater ecosystems not only by changing temperature but also flow variability which can be described by characteristic like long term

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annual and monthly means, statistical low and high flow, daily to interanually variability and the timing of the flows.

Two selected river sites in Kedah and Johor were chosen to represent north and south region in Peninsular Malaysia. The study was carried to observe the climate change effect on water level in these past 30 years. The aims of the study are to determine and compare the water level trends for both north and south regions.

2. Methodology

Water level data was obtained from two inventory water level station recorded by Department of Irrigation and Drainage Malaysia. The first station is 1737451 at Sg. Ketil at Kuala Pegang, Kedah in the North region while the second station is 5604818 at Sg. Johor at Rantau Panjang, Johor in the South region.

Figure 2. Stick gauge at river station (Source: Department of Irrigation and Drainage Malaysia, 2014)

Department of Irrigation and Drainage Malaysia (1982) is using standard stick gauge for observing water level in a river stations. Generally if the river sstation equiped with stick gauge only, paid observer will read the water level at 6.00 a.m and 6.00 p.m daily. Where the river stations are equiped with automatic water level recorder complete with stick gauges, the water level are normally observed at regular intervals, such as weekly or monthly, to check the records registered on the recorder charts. To ensure the uniformity of stick gauge installation, a standard 2-metre length has adopted for generall aplication.

For the observation, the observer must have access as close to the stick gauge as possible and cleared the debris on the stick gauge to avoid error in reading the water level. The observer should not read the stick gauge from a steep bank at the river stations to avoid parallex error. It is necessary to get the mean water level if there is surge around the stick gauge.

The bottom of the stick gauge corresponding to the zero reduce level of any metre in all stages should be checked and adjusted to an accuracy of ± 1mm by levelling from the temporary bench mark or permenant bench mark estabalish at the river station. All stick gauge must be checked and maintain in a vertivcal position at all times. Figure 2 shows the Stick gauge at river station.

Figure 3 shows the location of Kedah and Johor that represent the north and south region while Figure 4(a) and (b) show the location of the stations.

Descriptive statistics to measure mean, median, minimum, maximum values and to measure spread such as standard deviation, range and variance were carried out. To obtained the trend, water level from year 1978, 1979 and 1980 were compared to water level from year 2011, 2012 and 2013. The monthly mean of water table were used for all the analysis.

Figure 3. Map of Peninsular Malaysia showing the location of Kedah and Johor (Source: Department of Irrigation and Drainage Malaysia, 2014)

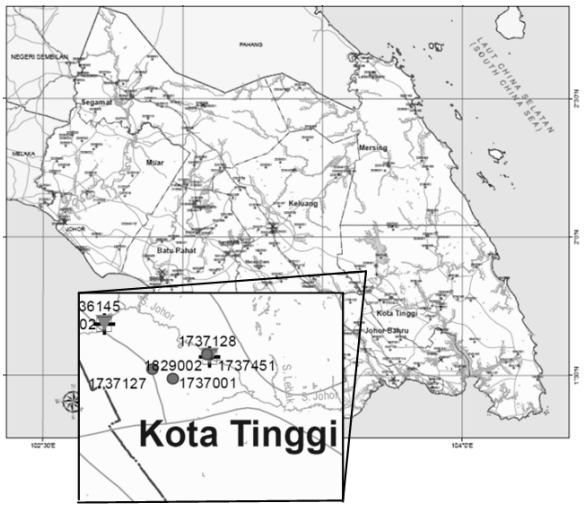

Figure 4(a). Map of Johor showing the station location (Source: Department of Irrigation and Drainage Malaysia, 2014)

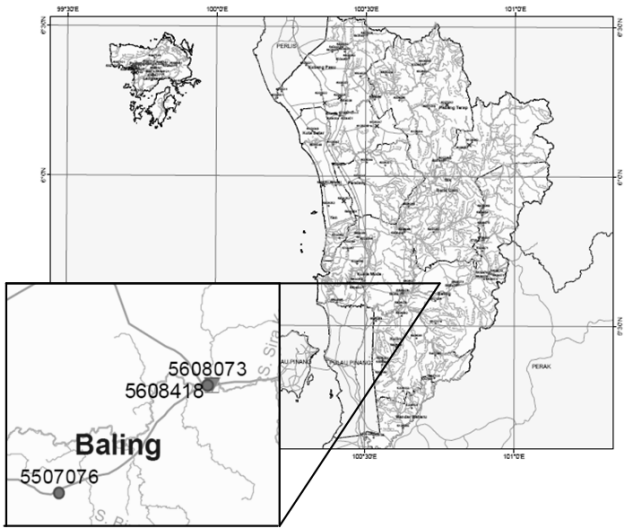

Figure 4(b). Map of Kedah showing the station location (Source: Department of Irrigation and Drainage Malaysia, 2014)

3. Results and Discussions

The descriptive statistic was used for analyses to obtain the typical value. The summary of the discriptive statistics for north and south regions are shown in the Table1 below.

As can be seen in Table 1, the mean for both regions are lower in the recent years. For instance, the mean of water levels in north region for 2011 to 2013 are lower compared to 1978 to 1980 by 2.04%. On the other hand, the mean of water levels in south region are lower by 14.05%. The maximum water table for north region has decreased from 31.02m to 30.37m. In addition, South region recorded a decrease in maximum water level from 6.41m to 4.66m.

The weather in Malaysia is characterized by two monsoon regimes, namely, the Southwest Monsoon from late May to September, and the Northeast Monsoon from November to March (MOSTI, 2013). The Northeast Monsoon brings heavy rainfall while Southwest Monsoon signifies drier weather.

Table 1. Summary of descriptive statistic for water level in each Region

Region	North		South	
	1978-1980	**2011-2013**	**1978-1980**	**2011-2013**
Number of month, N	36	36	36	36
Mean (m)	29.8742	29.2553	4.1672	3.3719
Std. Error of Mean (m)	0.05740	0.05585	0.11197	0.08980
Std. Deviation (m)	0.34440	0.33510	0.67184	0.53878
Variance (m^2)	0.119	0.112	0.451	0.290
Range	1.58	1.51	3.00	2.05
Minimum (m)	29.44	28.86	3.41	2.61
Maximum (m)	31.02	30.37	6.41	4.66

Figure 5 and Figure 6 illustrate the relationship between water level and time (month) for three years. From figure 2, the north region clearly shows that 1978-1980 have an increasing trend of water level. However, for 2011-2013 decreasing trend was illustrated. 1978-1980 shows higher water level compared to 2011-2013. North region is affected by Northeast Monsoon that brings heavy rainfall annually and it can be seen in the water level trend. The maximum water levels for every year occurred from November to March for both 1978-1980 and 2011 and 2013.

Figure 6 represent water level variations for South region. 1978-1980 shows higher water level compared to 2011-2013. Increasing trend is illustrated for 1978-1980 while 2011-2013 shows flat trend. South region is affected by Southwest Monsoon which signifies drier weather. As can be seen in Figure 3, from May to September both 1978-1980 and 2011-2013 recorded a lower water level compared to the rest of the year.

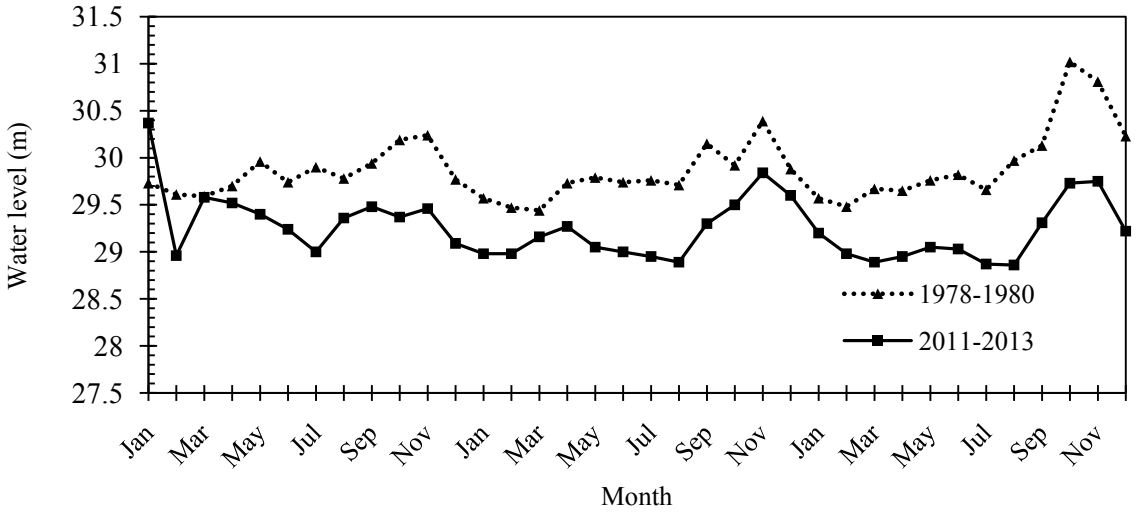

Figure 5. Water level in North Region

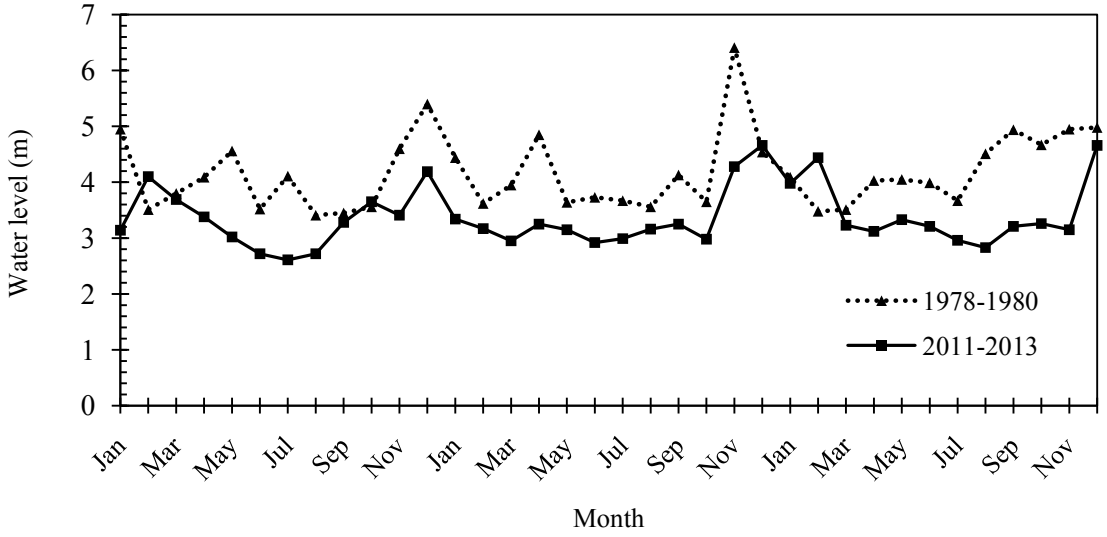

Figure 6. Water level in South Region

The climate change Impact will be greater over the years. We have to change our lifestyle, not to stress the environment, be more protective and not to pollute it in order to cope with the change in climate and its impact. We need to understand the long term effect of climate change on our ecosystem.

4. Conclusions

Climate change has proven to effect the water level in the previous study [IPCC, 2007: Bates *et al*., 2008: Doll and Zhang 2010: Shaaban et al., 2006]. This study is to determine and compare the water level trend in the north and south region of Peninsula Malaysia based on data from 1978 to 1980 and 2011 to 2013.

Descriptive statistics from the two stations show the mean water level for recent years were lower compared to the previous 30 years. The mean of water levels in north and south region are lower by 2.04% and 14.05% respectively.The maximum water table for north region was decrease from 31.02m to 30.37m while in the south region a decrease in maximum water level from 6.41m to 4.66m was recorded.

Both water level trends for south and north region were affected by Monsoon regimes. The graphs for both regions showing a decreasing trend. Malaysian autorities should be aware on this trend to prevent future water crisis.

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