CLIMATE CHANGE EXPLORATION
ASAJAYA SCHEME

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CLIMATE CHANGE EXPLORATION IN ASAJAYA SCHEME

NORPATIMAH BINTI MATDEN

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To my beloved parent, family and friends

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LIST OF ABBREVIATIONS

CTIC	Conservation Technology Information Center
CO_2	Carbon Dioxide
DID	Department of Irrigation and Drainage
ENSO	El-Nino South Oscillation
ET	Evapotranspiration
GCM	General Circulation Model
IDF	Intensity-Duration-Frequency
IPCC	Inter-governmental Panel on Climate Change
Lat	Latitude
Long	Longitude
MHIP	Malaysian International Hydrological Programme
MMS	Malaysia Meteorological Services
SAC	Special Areas of Conservation
SWIM	Soil and Water Integrated Model
WMO	World Meteorological Organisation

LIST OF SYMBOLS

^{o}C	Degree Celsius
^{o}F	Fahrenheit
E	Evaporation
P	Precipitation
R	Runoff

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ABSTRAK

Kebelakangan ini, meningkatnya kesedaran tentang isu persekitaran telah melahirkan idea keberlanjutan, di mana aliran sungai dikawal untuk mengekalkan keseimbangan antara ketersediaan dan penggunaan sumber air tersebut. Perubahan iklim bumi mempunyai kesan langsung pada kitaran hidrologi global dan seterusnya ke atas air. Meningkatnya suhu boleh memburukkan keadaan kekurangan air yang sedia ada, menjejaskan kualiti air atau meningkatkan frekuensi dan intensiti banjir dan kemarau. Oleh kerana itu, kesan-kesan daripada perubahan sumber air cenderung mempengaruhi pembangunan sosial dan ekonomi di sesebuah negara. Sumber air adalah salah satu isu yang diberi keutamaan terhadap kesan perubahan iklim dan adaptasi di Malaysia. Untuk mendapatkan kesinambungan air, para penganalisa harus membayangkan bagaimana iklim berinteraksi dengan pelbagai aspek dari kitaran air. Dalam kajian ini, catatan sejarah purata meteorologi data dalam jangka masa yang panjang dianalisis bagi meninjau kesan yang mungkin timbul di Asajaya Skim ini. Keputusan daripada analisis menunjukkan bahawa Skim ini tidak terkecuali dari kesan buruk dari perubahan iklim. Dengan demikian dapat disimpulkan bahawa Skim Asajaya harus mempertimbangkan kemungkinan kesan perubahan cuaca untuk perancangan yang berterusan dan pengurusan untuk kestabilan sumber dan tanaman dalam Skim untuk masa hadapan.

ABSTRACT

Nowadays, increasing awareness of environmental issue has led to the idea of sustainability, in which a watershed is controlled to maintain a balance between the availability and the use of it resources. Changes to the earth's climate have a direct effect on the global hydrological cycle and hence on water. The rise of temperatures may exacerbate existing water shortages, impair water quality or enhance the frequency and intensity of floods and droughts. Hence, these effects of changes in water resources are likely to affect social and economic development in a country. Water resources are one of the priority issues with respect to climate change impacts and adaptation in Malaysia. To obtain water sustainability, the planners must envisage how climate interacts with various aspects of the water cycle. In this study, the long-term recorded average historic meteorological data are analyzed to explore the possible impact in Asajaya Scheme. The results of the analyses show that this Scheme is not free from the adverse effect of climate change. Thus it can be concluded that the Asajaya Scheme will have to consider the possible impact of climate change for the sustainable planning and management of stable resources and cropping in the Scheme in the near future.

CHAPTER 1

INTRODUCTION

1.1 General

Nowadays, we are on the verge of changing our earth's climate as a result of human activities such as the burning of fossil fuels, destruction of forest, and a wide range of industrial and agriculture activities. Scientifically, the average temperature of the earth's surface is rising through the increased of concentration of carbon dioxide and other green house gases in the atmosphere because of human activities (1PCC 2001). Due to awareness of environmental issues, sustainability is important, in which a watershed is controlled to maintain a balance between the availability and the use of it resources.

Climate change will lead to an intensification of global hydrological cycle and can have major impacts on regional water resources, affecting both ground and surface water supply for domestic and industrial uses, irrigation, hydropower generation, navigation, in-stream ecosystems and water-based recreation. Besides, changes in the total amount of precipitation and its frequency intensity, directly affect the magnitude and timing of runoff and the intensity of floods and drought; however, at present, specific regional affects are uncertain (IPCC 2001).

Climatic change has a direct effect on hydrology through its link with evapotranspiration. The scenarios of changes in atmospheric variables, effect surface and subsurface hydrology, such as temperature, precipitation, and evapotranspiration are component to assess the potential effects of predicted climatic change on water resources. They are various hydrologic models have been used to explore the possible impact of climate change scenarios. This study will explore the possible climate change in the scheme through analyzing the long-term recorded monthly average historic meteorological data. Moreover, it also discusses the investigation of water sustainability and how climate interacts with variables aspects of water cycle.

1.2 Problem Statement

Climate change is one of the greatest global challenges today. Increasing evidence of present such as greenhouse gasses, global surface temperature, and extreme weather give significant impacts of climate change on health, agriculture, and water resources.

According to Rotary Club of Kuching Central report 2004, due to the occurrence of unrelenting heavy rain, which coincided with high tide, more areas in Sarawak especially in the state's central region, comprising Sibu, Bintulu, Kuching, Samarahan and Sri Aman divisions recently encountered one of the worst flooding in years. This is because the excessive waters caused rivers and waterways to swell and overflow. As a consequence, there was widespread flooding in the low-lying areas. The flooding resulted in sufferings and difficulties to many people in the towns as well as in the rural areas. At the height of the flooding, more than 10 thousand people, especially those in rural areas were evacuated to higher grounds and sheltered in relief centers. The flood situation left behind a trail of destruction across vast areas in Kuching and surrounding areas. There was widespread electricity blackout and many villages were under several meters of water, a few major roads were cut off while others were choked with massive traffic jams, farmlands were destroyed, 121 schools were closed, many houses and bridges were damaged or destroyed due to landslides or being swept away by swift currents. A number of fatalities were

reported due to landslide or drowning. Outside of Kuching, the worse affected areas were the Samarahan Division and Bau District. In the Asajaya District in Samarahan, floodwater inundated thousand of homes with water level reaching in excess of 6 feet in certain areas. Six families lost their homes due to landslide and swift water current.

How climate change will affect water resources is the most importance issue for the region. Therefore, interpreting how a water resources system might perform given the hydrologic conditions that would accompany and climate change scenario will virtually always require modeling of water resources system. This study provides understanding of climate change and its implication for various aspects of the water cycle. Climate change will alter water availability, water demand and water quality. In this study long term recorded monthly average historic meteorological data such as temperature, rainfall, precipitation, humidity etc. are analyzed to explore potential impact of climate change in the Scheme.

1.2.1 Study Area

The Asajaya Drainage Scheme (Figure 1.1), located between South China Sea in the north, Batang Samarahan in the east in Samarahan Division, Sarawak. Total areas for Asajaya Drainage Scheme are 17087 Hectares where the land utilization is about 81% which the overall area of planted is 13853ha.

The climate here is classified as tropical rain forest type characterized by its high temperature and high rainfall. Abundant rainfall of about 3,830 mm is recorded annually. The annual average runoff is about 2460 mm or 306 billion cubic meters. Nevertheless, it is divided within a year into two seasons, namely, wet and dry seasons due to the influence of two monsoon winds, North-East monsoon from November to March and Southwest monsoon from May to September. Although mean yearly rainfall is abundant in this region, it is not evenly distributed in terms of time and area.

Nowadays, Asajaya is the one of under the development area in Sarawak. For that, development is not possible without water. Because of the strong water and development linkage, monitoring the sustainability of resources can effectively provide an indication of sustainable development in a country. One of the major water issues affecting sustainable development in Malaysia is climate changes. Water resource availability is depending on the process of evapotranspiration within the water cycle.

The scheme project begins in 1969 and completed in 1988. Now, the operation and maintenance of the scheme are under Drainage and Irrigation, Asajaya.The objectives of the project are, to prevent sea-water inundation, to reduce flooding, to prepare the land for agricultural production and improve yields and to uplift socio-economic conditions. The seven main rivers in the

scheme are Batang Samarahan, Sungai Moyan, Sungai Asajaya, Sungai Sampun, Sungai Semera, Sungai Jemukan, and Batang Sadong. The main physical facilities constructed are 22 tidal control gates, 6 tidal control flap gates and river-bank protection structures.

Figure 1.1: Location of study area, Asajaya Scheme.