

DESIGN OF WATER PUMPING AND PURIFICATION SYSTEM
UTILIZING RENEWABLE ENERGY FOR SARAWAK RURAL AREA

CHRISTOPER NARANG

A dissertation submitted to
Faculty of Engineering, University Malaysia Sarawak
in partial fulfillment of the requirement for the
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Dedicate to my loving parents, Mr. Narang Nawun & Mdm. Ajan Banta,
and all my siblings, who has supported and encouraged me through good
time and hard time

Thank you for your support and encouragement

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ABSTRACT

Water pumping and purification system with the storage tank is the complete combination of water supply system and it is the necessity for modern living. This system is normally installed in urban area together with sophisticated water treatment plant. It is impossible to install water treatment plant in rural area as the populations are small and scattered. Thus in order to achieve the minimum requirement water quality in the rural area, the system normally employed simple pumping and purification system. Therefore, this study attempted to design and affordable water pumping and purification system for Sarawak rural area. The design will be essentially to be low cost, unsophisticated and the technologies should be available locally. This study is focused on integrated utilization of renewable energy and the water treatment system constructed will be affordable to the villages. Proposed designs completed with Simulation Software will be made specifically for two case study locations.

ABSTRAK

Sistem pam dan penapisan dilengkapi dengan tangki penyimpanan adalah satu kombinasi yang lengkap bagi system pengagihan air dalam keperluan era moden masa kini. Sistem ini biasanya dibina di kawasan bandar dan dilengkapi dengan logi rawatan air yang canggih. Ini adalah mustahil untuk membina logi rawatan air di kawasan pendalaman kerana kawasan ini mempunyai populasi penduduk yang rendah dan pola penduduk yang bertaburan. Maka, bagi mencapai tahap minima kualiti air di kawasan luar bandar, satu sistem pam dan rawatan air yang ringkas diperlukan bagi mencapai tahap tersebut. Oleh itu, kajian ini dijalankan bertujuan mencipta satu sistem pam dan rawatan air bagi kawasan pendalaman Sarawak. Sistem ini seharusnya berkos rendah, ringkas dan mudah didapati. Fokus kajian ini adalah mengaplikasikan penggunaan tenaga boleh diperbaharui dan sistem rawatan air dibina bagi kesesuaian dan keselesaan penduduk kampung. Rekabentuk cadangan dan program simulasi akan dibina secara spesifik bagi setiap lokasi kes kajian.

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CHAPTER 1

INTRODUCTION

1.1 Introduction to Malaysia

Malaysia is located in South-East Asia between latitudes 1° and 7° N and longitudes 110° and 119° E. It consists of Peninsular Malaysia and the States of Sabah and Sarawak, which are situated on the north-western coast of Borneo (Central Intelligence Agency, 1998). The total land area of Malaysia is $329,758 \text{ km}^2$ where $1,200 \text{ km}^2$ from that area covered by water. Malaysia is divided administratively into 13 states and 2 Federal territories. It is home to a population of some 24 million people, and nearly 40% of which live in rural areas.

Malaysia climate is equatorial with high humidity, and is characterized by the annual southwest (April to October) and northeast (October to February) monsoons. It has an annual rainfall volume of 320 billion m^3 (bcm) for Peninsular Malaysia; 194 billion m^3 for Sabah, and 476 billion m^3 for Sarawak (UNICEF / WHO, 2001).

1.2 Introduction to Sarawak

Sarawak is currently divided into eleven administrative divisions namely Kuching, Samarahan, Sri Aman, Betong, Sarikei, Sibü, Mukah, Kapit, Bintulu, Miri and Limbang as shown by **Figure 1.1**. The total area covered is 124,449.5 Km² and the population is about 2,214,300 with the population density of 16.6 per Km² (Pillay, Tan *et al.*, 2001).

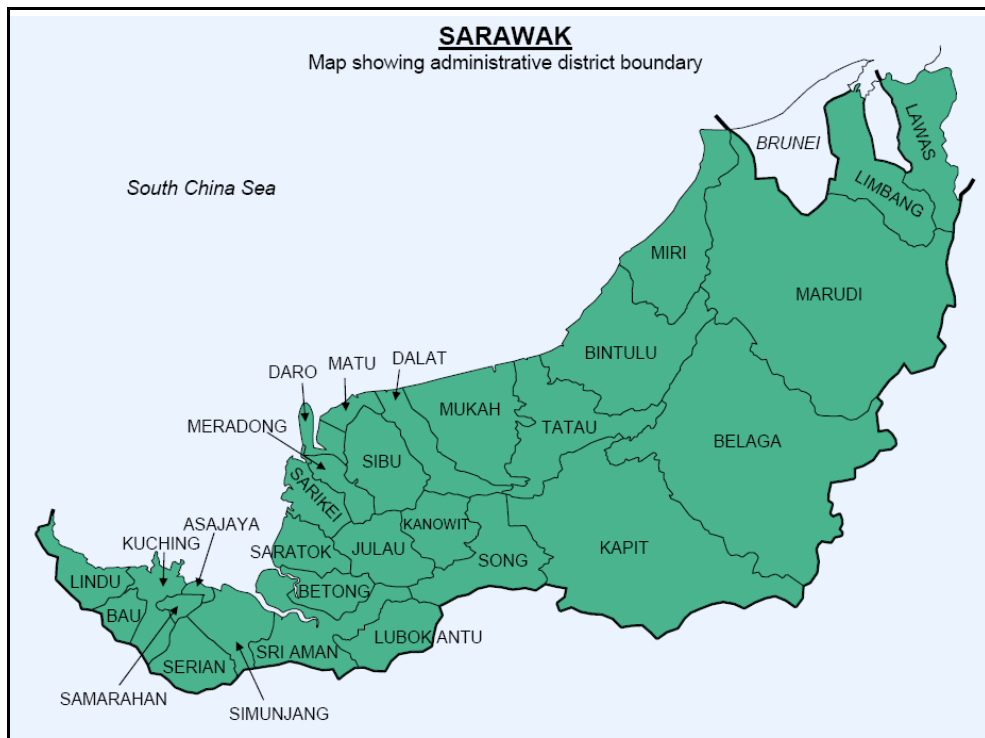


Figure 1.1: Map of Sarawak (UNICEF / WHO, 2001)

As shown in **Figure 1.2**, Sarawak's population are multiracial and as shown in **Figure 1.3**, about 54.9% of Sarawak population live in rural area and the rest in the urban area (Leete, 2005).

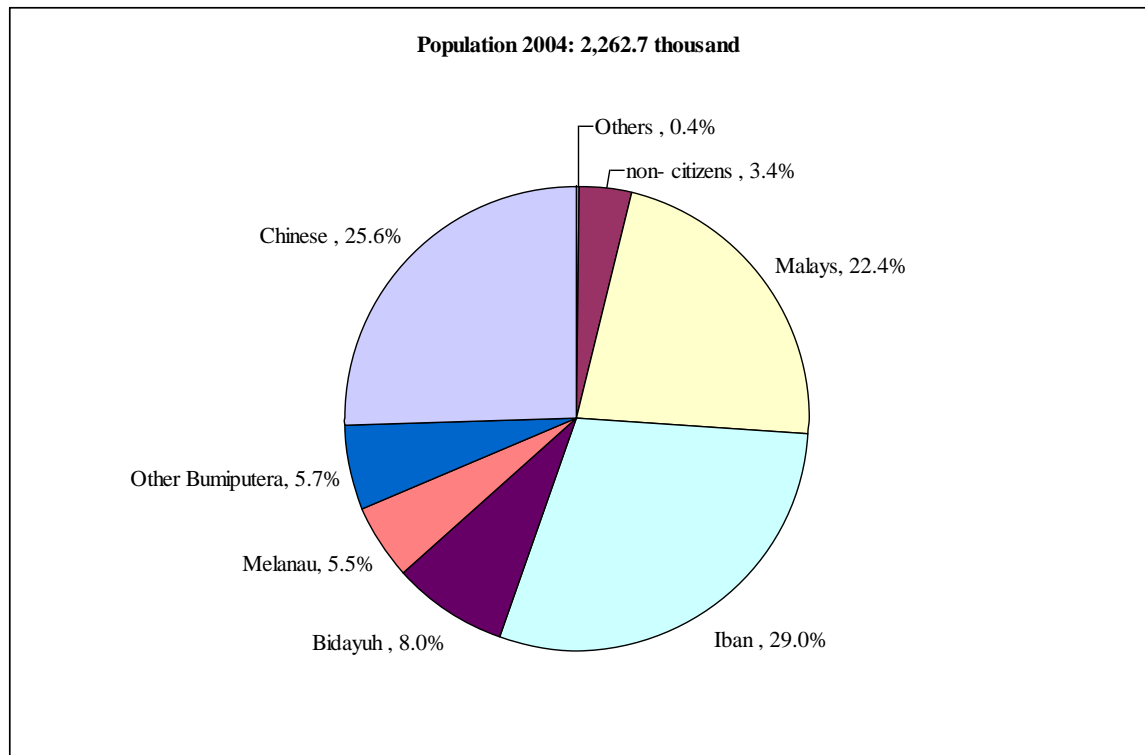


Figure 1.2: Sarawak's population size and composition year 2004 (Vital Statistics, 2003)

1.3. Problems in Sarawak Rural Areas.

In Sarawak, there are three common issues faced by the people in the rural area, namely transportation, electricity and water supply.

River is the most common type of transportation in Sarawak rural area and also as source of water supply. According to Sarawak Rivers Board (SRB) and United Nations Development Programmed (UNDP) it is important to improve the usage of 55 rivers in Sarawak as a viable and integral form of transport in rural areas (UNDP MALAYSIA, 2007).

In the 9th Malaysia Plan, Sarawak's government ensure a more inclusive growth with improved equity, and that those people living in rural areas enjoy the benefits of Malaysia's development by community water transport to improve mobility and access to economic and social services.

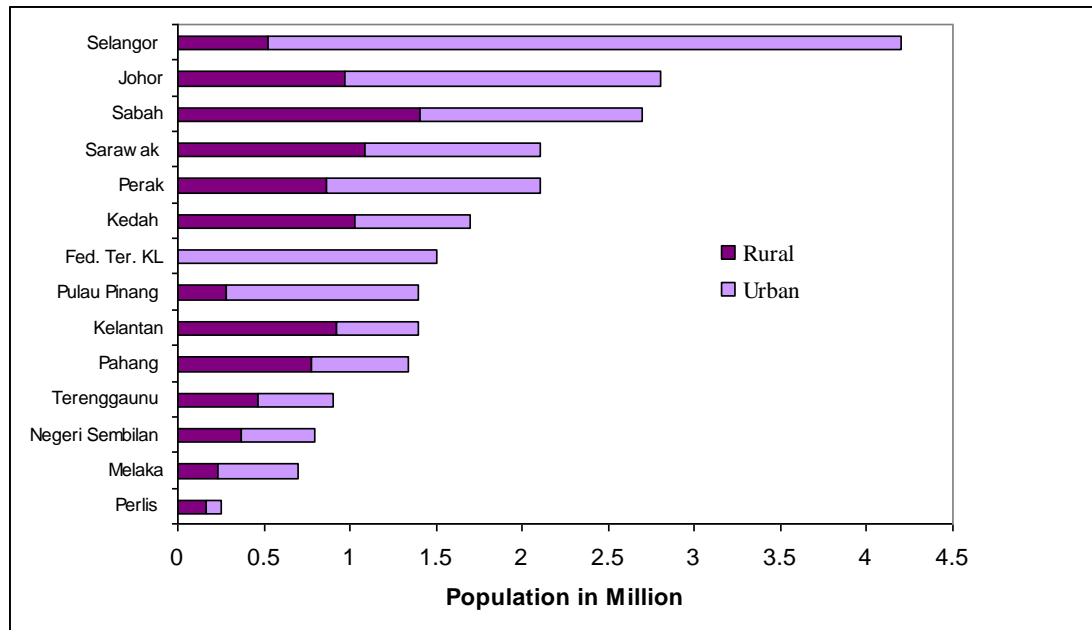


Figure 1.3: Population in urban and rural area, Malaysia, 2000 (Census, 2000)

As shown in **Figure 1.4**, in year 2000, about 20% of Sarawak rural areas are not supplied with electricity (Ministry of Energy, 2000). Sarawak Electricity Supply Corporation, SESCO operates a 132/275 Kv transmission line, which interconnected the major towns of Kuching, Sri Aman, Sarikei, Sibul, Bintulu and Miri. According to Deputy Chief Minister Tan Sri Dr George Chan about 280 out of a total of 1,000 schools scattered throughout Sarawak do not have electricity supply at present, because they are deep in the interior (State News, 2006).

Region	1990	1995	2000
Peninsular	91	99	100
Sabah	48	65	75
Sarawak	50	67	80
Malaysia	80	92	93

Figure 1.4: Rural Electrification Coverage by Region. 1990 – 2000 (Ministry of Energy, 2000)

Even though almost 86% of the population in Sarawak is covered with safe water supply (Raja Zainal Abidin, 2004), but there are still issues arising with water problems in rural area especially from pollution that derived by human activity such as logging activity, ineffective and unsystematic agriculture system and etc. In rural areas that are not connected to a treated water supply, drinking water is obtained from rivers, ground and rain water. The water from these sources is supplied to the villages establishment via gravity feed systems, wells with or without house connections, and by the collection of rainwater.

If the water source elevation is located lower than the village, a pumping system is required to transmit the water to their establishment. Logically, in the rural area, it is difficult to install the sophisticated pumping system. Therefore, there are three factors that must be considered in selecting the pumping system which are;

i. Reliability of service

To make sure that the pumping system able to deliver treated water to the consumer at desired pressure.

ii. Initial cost