SOFTWARE DEVELOPMENT FOR WATER PRICING MODEL

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To my beloved family

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ABSTRACT

Water scarcity in terms of quantity and quality leads to increase cost of supplying water to users. The major concerns faced by the water industry are low tariffs that result in insufficient revenue to cover the costs of supplying water and cheap water that discourage water conservation. Underpricing has seriously affected the finances of service providers, and resulted in poor and unreliable water services. Water pricing is an essential component which is instrumental in achieving two important goals: to generate revenue for capital recovery, operation and maintenance, extension and upgrading of the system; and to promote efficiency in use. Hence water pricing model is developed in this study to generate appropriate water tariff that enables water utilities and regulatory bodies to balance the benefits and costs of water usage, and to ensure sufficient revenue for the long term financial sustainability of the water supply business. Visual Basic 6.0 was selected as a tool to develop the water pricing model due to its object-oriented programming. The water pricing model developed provides a user-friendly approach to access to essential knowledge on the water sector in Malaysia, emphasising the economic aspect, and the procedures to calculate the price of water. In the model developed, the price of water was calculated based on capital expenditures (CAPEX) and operating expenditures (OPEX), applying the principle of full cost recovery and partly subsidising the consumers. The water pricing model is limited to calculate water tariffs for domestic residential homes, and industrial and commercial supplies. The model also provides justifications for any adjustment to the current levels of water tariffs. This was obvious that the water pricing model developed in this study acts as an important tool in revising the current water tariffs to ensure the sustainability of water service provision.

ABSTRAK

Masalah kekurangan sumber air dan kemerosotan kualiti air telah mengakibatkan kenaikan harga bekalan air. Masalah utama yang dihadapi oleh industri air ialah harga air sedia ada yang rendah menyebabkan ketidakmampuan untuk menanggung kos pembekalan air dan pembaziran yang disebabkan oleh harga air yang murah. Harga air yang rendah telah menjejaskan kedudukan kewangan syarikat air, dan seterusnya menyebabkan perkhidmatan air turut terjejas. Harga air merupakan komponen penting untuk mencapai dua objektif iaitu: menghasilkan pendapatan bagi pemulihan aset modal, kos operasi dan senggaraan, serta kos menaiktaraf sistem; dan mendorong penggunaan air secara efisien. Lantaran itu, model harga air telah dibentuk untuk menwujudkan harga air yang sesuai bagi membolehkan pembekal air mengimbangi antara pulangan dan kos bagi penggunaan air, serta memastikan pulangan yang mencukupi untuk kestabilan kewangan pembekal air bagi jangkamasa panjang. *Visual Basic 6.0* telah dipilih untuk membentuk model harga air disebabkan oleh kebolehannya menjalankan program berteraskan objek dan sifatnya yang mesra pengguna. Model harga air yang dibentuk membolehkan pengguna mengakses ke maklumat penting berkenaan sektor air di Malaysia, menekankan aspek ekonomi dan prosedur sistematik untuk mengira harga air. Dalam model yang dibentuk, harga air dikira berdasarkan perbelanjaan dalam aset modal (CAPEX) dan perbelanjaan dalam operasi (OPEX), mengaplikasikan prinsip pemulihan kos penuh and subsidi sebahagian daripada harga air. Model harga air yang dibentuk hanya untuk mengira harga air bagi pengguna domestik, komersil dan industri sahaja. Model harga air yang dibentuk juga memberikan justifikasi bagi sebarang perubahan pada harga air semasa. Dengan ini, adalah jelas bahawa model harga air yang dibentuk dalam kajian ini berperanan sebagai perisian penting untuk pembaharuan harga air semasa bagi memastikan kestabilan sektor air berkekalan.

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LIST OF ABBREVIATIONS

BOT	-	build, operate and transfer
CAPEX	-	capital expenditures
DBT	-	decreasing block tariff
IBT	-	increasing block tariff
OPEX	-	operating expenditures
PBAPP	-	Perbadanan Bekalan Air Pulau Pinang
SAJH	-	Syarikat Air Johor Holdings
SPAN	-	National Water Services Commission (*Suruhanjaya Perkhidmtan Air Negara)*
SYABAS	-	Syarikat Bekalan Air Selangor
WAMCO	-	Water Asset Management Company
WHO	-	World Health Organisation

LIST OF SYMBOLS

A	-	annuity loan repayment (RM)
B	-	balance financed by utility (RM)
f	-	annual average inflation rate (%)
i	-	annual interest rate without the influence of inflation (%)
i*	-	inflation-adjusted interest rate (%)
n	-	duration of loan repayment (years)
X	-	total loan (RM)

CHAPTER 1

INTRODUCTION

1.1 Preamble

This chapter discusses the overview of the thesis. It gives a brief introduction to the study conducted. The topics covered in this chapter are; background of the problems, statement of the problems, objectives of study, scope of study, and significance of the study.

1.2 Background of the Problems

Water is the basic need of mankind. No life can survive without potable water. Water is one of the essential public utilities. Though large portion of the earth is covered by water, only 0.02 percent of the total are fresh water available from rivers, lakes, and subsurface (Baumann and Boland, 1997). Water resources are connected with worldwide population growth, lack of natural resources, and damage to the environment caused by economic growth and inconsiderate use of water. The sources of water are getting depleted and the quality deteriorates largely due to vast development. Fresh water is no longer pure and abundant, but instead scare and deteriorating. Hence the cost of providing wholesome water escalates continuously. Utilities are facing crisis due to the high costs in providing quality water for consumers and low revenues in return (Padwal, 2003). This has led to

deterioration in the quality of services, such as poor water quality, low water pressure, unreliable supply, slow in settling complaints, as well as inability to fully supply hygienic water to rural areas.

The water bill paid by the majority of households is often very low which is underpriced (Whittington, 2002). At first glance, this appears to be good for households and bad for the utilities, but low utility revenues rebound to adversely affect households in terms of quality of service. Also, due to low water charges, water is used wastefully without realizing the scarcity of water. There is utter lack of appreciation on the part of the public about the tremendous costs and efforts required in making drinking water available right on their taps. The law of demand states that as the price of water increases, the demand should decrease. In short, pricing can be a useful tool in efforts to conserve water (Hanemann, 1997).

The water supply sector in Malaysia has not been performing very well due to poorly organized pricing mechanism where tariff rates are determine without reflecting overall cost recovery. State water supply authorities have problems covering the cost of services and many have deferred maintenance due to capital shortages. The current low water tariffs are not generating sufficient revenues for full cost recovery (costs of operating and routinely maintaining the utilities). If the operating expenditure (OPEX) is to be recouped, the prevalent tariffs must be adjusted. In fact, there are water supply authorities that have not reviewed the water tariff in the last 20 years (Zainal Abidin, 2005). Therefore it is vital to develop a water pricing model to determine appropriate water tariff to ensure full cost recovery and to make the water supply entity financially viable. It is necessary to review and revise the current water tariff scheme (increasing block rate tariff) to reflect the resource optimization and financial availability.

In Malaysia, public water supply at present is largely subsidised by the government (Malaysia Water Industry Guide 2005). Private operations may not find it viable to charge water to prevalent tariffs. To fulfill the aim of relieving itself of financial burden, the government can continue to charge the public at present tariff in which case it has to make up and pay the difference to the private operator. This option is very much hurting the government as the fund allocated for water supply is

limited and there are other sectors that are more in need of fund than the water supply sector. Therefore, the best option without affecting other necessary developments is to raise the water tariffs gradually so that it eventually matches the tariff charged by the private operator to the government. The need to raise water tariff becomes more urgent in light of the increase in fuel prices and power tariff lately. This option not only reduces the government's burden, but also ensures continuous high level of service provided by private water companies.

1.3 Statement of the Problems

Water is a fundamental necessity for all forms of life, of course, as well as to all the activities of human society. Unlike the past, present water supply is a drastically different, challenging, and complex task. The new challenges faced today and in the future include, sources of water are depleting, increase frequency of droughts, and the contamination of the natural water sources which has further limited the supplies. In view of the problems faced nowadays, the costs of supplying potable water to the public also rise. The water supply industry is a capital intensive industry, and involves high operational and maintenance costs. The infrastructure alone – from dams to treatment plants and distribution systems entails high investments. Operational costs such as energy and labour cost, and cost of maintaining the dams, treatment plants, distribution network, and pumps are no less costly. As the financial requirement to provide adequate services is ever increasing, the revenue generated from water charges paid by consumers is now inadequate to make the water supply industry financially sustainable for the long term. Most utilities have a zero-profit constraint. Hence, appropriate tariff that will generate sufficient revenue to enable well-managed water service providers to finance the delivery of the services according to the standard required must be designed. In designing appropriate water tariff, full cost recovery principles should be adopted, though not entirely recovered from the consumers. For the case in Malaysia, capital works are funded by the government to keep the tariff at affordable level. This is important to ensure fairness or equity among water users. In addition, the current low water prices also discourage water conservation and use of water inefficiently.

By raising the price of water to recover all reasonable operating expenses and to yield a fair rate of return, consumers tend to value and use water sparingly. Another weakness in the existing water pricing scheme in Malaysia is the cross-subsidization. The most obvious involves a cross-subsidy from industrial to residential water users where residential water users' demand is financed by revenues derived from industrial users. Therefore, the effort to develop a water pricing model to determine the most appropriate water tariff that not only guarantees full cost recovery and encourages water conservation, but also reduces cross-subsidisation, has been chosen as the study goal. The water pricing reform aims at enhancing and sustaining the economic of the water industry.

1.4 Objectives of Study

This study aims to develop a financial model for full cost recovery for the water supply services in Malaysia. The model developed is expected to achieve the following objectives:

i) To ease policy makers and water supply utilities to look into various scenarios.

ii) To recommend an approach to select a range of affordable prices of water and at the same time, generate adequate revenues to ensure that utilities can recover their costs.

iii) To develop scenarios where the existing water tariffs could be adjusted to signal scarcity, thus encouraging the more efficient use of water.

iv) To develop a software to allow adjustment and justification of water tariff.

1.5 Scope of Study

This study focuses on the water supply industry in Malaysia. Data from Syarikat Air Johor Holdings (SAJH), a privatised water company in the State of Johor will be obtained to be applied to the proposed model. The scope of this study includes designing a software to determine water tariffs for domestic residential homes, commercial, and industrial supply. Many studies have compared the components of different water pricing schemes (Liu *et al*., 2003; Monteiro, 2005), and approached the implementation of water pricing reforms (Whittington, 2002; Azevedo and Baltar, 2005) but not the development of sustainable water pricing model holistically. So in this study, a water pricing model was developed to calculate a reasonable rate of water pricing in Malaysia. The model developed is targeted for private water companies and state water supply authorities.

1.6 Significance of the Study

The significance of the study is as follows:

(a) Water is indeed the basic human need, and to supply clean water to the public is a costly act. The price of water in most developing countries is underpriced. Without adequate pricing mechanisms, water service providers are unable to recover the costs to adequately fund their operation and thus, systems will deteriorate and the quality of service will suffer (Azevedo and Baltar, 2005).

(b) The major problems faced by the water industry in Malaysia include, depleting water resources, pollution of water sources, as well as inadequate tariff structure to fund utility operations and maintenance (Shahabudin, 2004b).

(c) One of the key features of Malaysia's proposed water services reform is the necessity to determine an appropriate water tariff in the endeavor to establish a sustainable water services industry (Lim, 2004).

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