

**UNIVERSITI TEKNOLOGI MARA**

**MICROBIAL WATER QUALITY  
ANALYSIS AND HUMAN HEALTH  
RISK ASSESSMENT OF ROYAL  
BELUM STATE PARK**

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## ABSTRACT

Temenggor Lake located in Royal Belum State Park is an important water resource for indigenous people, an ecosystem for aqua organisms and a place for water recreational activities for visitors. Hence, we need to know the status of water quality to ensure the water is not a hazard or tend to give risk of illness to the users. There have been activity of sewage disposal from houseboat directly into the lake and pollutant inputs came from indigenous people household waste as well as from domestic and wild animals were contributed to the deterioration of water quality as result of hazard to their health. An analysis of microbial water quality and human health risk assessment in Temenggor Lake, Royal Belum State Park has been conducted at two types of sampling locations, namely visitor water recreational areas and indigenous people water activity areas to determine the value of physicochemical and bacterial concentration, to examine the influence of the human activities on the water quality and to evaluate the health risk of users associated with water exposure in Temenggor Lake. Water quality was determined by measuring physicochemical and microbiological parameters. For bacterial analysis, membrane filtration technique was used. The t-test was used to compare all the parameters between indigenous people and visitor areas to find out the differences of water quality in different water activities areas. Quantitative Microbiological Risk Analysis method had used to evaluate the risk of illness towards the water user. The risk was estimated by calculation of daily risk of infection, annual risk of infection and risk of illness per annual and per event. The results of this study has showed most of the parameter were within acceptable range for primary contact water activities. However, for certain parameters such as pH, enterococci and *E. coli* at station A03 and during wet seasons has shown the condition of the lake is deteriorating. The water quality during sampling in November 2021 at all stations was acidic (less than 5.5) may relate with rainfall events. This study revealed that water quality in indigenous people and visitor water activities areas was significantly different due to being affected by different types of human's activity and other factors such as geohydrological conditions, topography, land use, environmental conditions and events. Thus, identification of all possible contamination sources, awareness of changes that might negatively affect water quality, and provision of adequate information to the public are important preventive measures to protect public health. From the results of health risk assessment, water activities and recreational in certain areas of Royal Belum State Park were exposed varying degrees of health risk. Notably, indigenous people settlements areas record high risk of illness for both *E. coli* and *Salmonella* spp., mainly at station A03 (Kg. Sungai Tiang). This study provides baseline data to help in future management strategies to ensure the conservation of the natural landscape and economic viability, in addition to the protection of the local community.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Research Background

The Royal Belum State park area is about 117,500 hectares forming of Belum-Temenggor Forest Complex. The gazettation of Royal Belum State Park was in 2003. The location is about 45 km from Hulu Perak District, Perak, Malaysia. Within Royal Belum State Park, Temenggor Lake is the second-largest artificial lake in Peninsular Malaysia. Lake making is after the construction of the Temenggor Dam to generate electric power. Besides, Temenggor Lake was important as a water resource for local indigenous people, an ecosystem for aqua organisms, and a recreational water place for visitors. Sungai Tiang and Sungai Kejar originate east of the State Park, in addition to hundreds of smaller tributaries and streams that feed Temenggor Lake. Temenggor Lake is divided into three zones: Conservation Zone, Recreational Fishing Zone, and Commercial Zone. Conservation Zones include upstream of Temenggor Lake, such as Sungai Kejar, Sungai Tiang, and Sungai Gadong. Approximately 200 indigenous families, mainly comprising the Jahai and Temiar ethnic groups, live within Royal Belum (WWF-Malaysia & Perak State Park Corporation, 2011). They live around and near the lake, which serves as a water resource. Indigenous people prefer to live near water as it is easier to catch fish or perform daily chores, such as bathing, drinking, and washing dishes and clothes. Increased human population has resulted in new human settlements around lakes that acted as water resources. Jimenez et al. (2014) discovered that higher proportions of Indigenous populations correlated with lower levels of access to clean water in a recent review of the literature on Indigenous peoples and water, sanitation, and hygiene services. This obstacle will affect the health of the indigenous people. Across the country, approximately half of the population, including many people living in formally recognized Indigenous territories, lacks access to sewerage; poor land management, mainly deforestation and the resulting soil erosion, has resulted in intractable water quality deterioration (Cunha Libanio, 2014).

Royal Belum State Park recently became a high visit from eco-tourism and recreational users. The increase in tourists will contribute to the increase in sewage