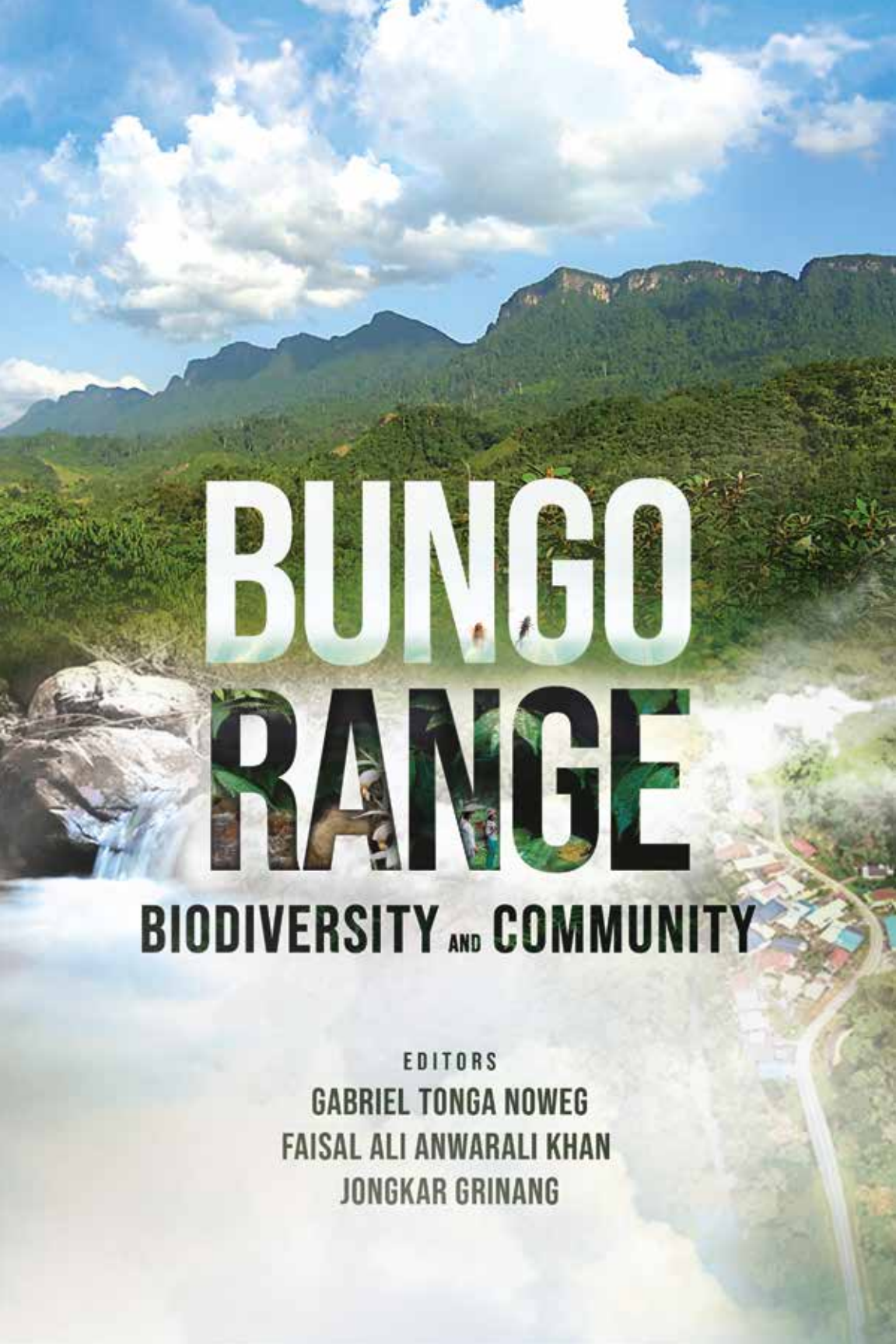

EDITORS
GABRIEL TONGA NOWEG
FAISAL ALI ANWARALI KHAN
JONGKAR GRINANG

BUNGO RANGE

BIODIVERSITY AND COMMUNITY

BUNGO RANGE

BIODIVERSITY AND COMMUNITY

EDITORS

GABRIEL TONGA NOWEG
FAISAL ALI ANWARALI KHAN
JONGKAR GRINANG

SUPPORTING EDITORS

CINDY PETER
RUNI SYLVESTER PUNGGA
ANDREW ALEK TUEN

UNIVERSITI MALAYSIA SARAWAK

BUNGO RANGE

BIODIVERSITY AND COMMUNITY

Published in Malaysia by
UNIMAS Publisher,
Universiti Malaysia Sarawak,
94300 Kota Samarahan,
Sarawak, Malaysia.

Printed in Malaysia by

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

CONTENTS

FOREWORD

I am glad to note that this publication is another excellent milestone from Universiti Malaysia Sarawak through the Institute of Biodiversity and Environmental Conservation, in particular exploring and documenting the rich biodiversity and community in Sarawak. The biodiversity and environmental conservation is one of three niche areas of the university, which recognise the need to balance the biodiversity, habitats and human development. As such, the Research Innovation and Enterprise Centre, the university's centre responsible for research and innovation, has actively facilitated and supported research activities, and publications in various platforms available to scientific communities and the public.

I would like to thank staff of the Institute of Biodiversity and Environmental Conservation for continuously conducting good research and documenting crucial information that benefits many users including scientists across the region. It is well in line with the Institute's vision to become a leading center for research in tropical biodiversity and environmental conservation in Borneo and Southeast Asian region. I would like to congratulate the editors for their efforts in compiling and editing the data resulted from a multidisciplinary expedition in Bungo Range in December 2017 into a well indexed research book. I do believe that each article in this book serves its purpose as an important reference to academics, policy makers as well as public audiences. In particular, the findings would be a useful reference for the management plan of Bungo Range National Park that was gazetted on 26 February 2009.

To materialise the multidisciplinary expedition and the publication, the Institute had collaborated with various state agencies and local communities. Therefore, I am acknowledging their support and contribution (both financial and in-kind) to this project. They are Forest Department Sarawak, Sarawak Forestry Corporation,

Sarawak Biodiversity Centre, Sekolah Kebangsaan Tringgus, Pejabat Pendidikan Daerah Bau, Bau District Office, Bau District Council, Klinik Kesihatan Krokong, Bau District Police, Bau Fire and Rescue Station, Bau Hospital, and villagers from Tringgus settlement namely, Kg Bong, Kg Rotan and Kg Nguan. I hope similar collaborative efforts will be pursued in the near future to other protected areas in Sarawak.

To the authors, UNIMAS Publisher, and those who are involved in this publication, keep up with the good team spirit.

Finally, thank you for inviting me to pen my message in this great reading material.

Prof. Dr. Wan Hashim bin Wan Ibrahim
Deputy Vice Chancellor (Research and Innovation)
Universiti Malaysia Sarawak

PREFACE

This publication marks another significant output of the collaborative works between Universiti Malaysia Sarawak and Forest Department Sarawak on biodiversity study and conservation in the State.

In this book, the findings of multidisciplinary expedition to Bungo Range in December 2017 were compiled into 24 chapters covering biodiversity, environment and community under the theme "Bungo Range - Biodiversity and Community". The theme signifies the importance of the pristine mountainous forest of the Bungo Range that supports rich species of flora and fauna, and the uniqueness of community and their customs as well as cultures. The involvement of academics, researchers and the villages in the expedition has enhanced the exchange of knowledge, skill, and experience among the stakeholders, which are reflected in this book. In particular, the participation of the villagers in the expedition had indirectly conveyed the message of the Forest Department Sarawak on the importance of conserving the forest of Bungo Range and preserving local cultures. Ironically, the Bungo Range is becoming a popular tourism destination due to the outstanding sceneries such as mountains, waterfalls, reservoir, and the cultures (e. g., the last ring ladies). Indeed, this book will serve as a useful reading material for researchers, scientists and non-government organization in their research endeavour.

We would like to congratulate the editors, authors and those who contributed to the production of this book. We wish similar outputs shall be achieved from future collaborative work between Universiti Malaysia Sarawak and Forest Department Sarawak. Specifically, we would like to thank the community leaders and heads of department in Bau District for their support throughout the project. Yang Berhormat Miro Simuh for his strong supports of the expedition and launching of the event on 5th December 2017.

We hope this book serves the needs of the audiences either as academic reference or reading material in leisure time. Happy Reading!

Prof. Dr. Mohd Azlan Jayasilan

Director
Institute of Biodiversity and
Environmental Conservation
Universiti Malaysia Sarawak

Datu Hamden Haji Mohammad

Director
Forest Department Sarawak

INTRODUCTION

Sarawak government has voluntarily set aside more than 2.6 million hectares of lands and water bodies as conservation areas under the Heart of Borneo (HOB) Initiatives. The Sarawak's HOB area strech from the north in Limbang Division to the south at Tanjung Datu that boundaries with Sabah, Brunei and Kalimantan, Indonesia. Of the total HOB area, approximately 441,000 hectares are totally protected area comprising national parks, wildlife sanctuaries and nature reserves. The southern part of the HOB contains 10 protected areas many of which are tourism hotspots such as Bako National Park, Kubah National Park, Gunung Gading National Park, Matang Wildlife Centre and Tanjung Datu National Park.

Bungo Range is located at 10° 16' latitude and 110° 9' longitude of the southern side of the HOB, about 500 meter above the sea level. The mountainous primary forest of the area was gazetted as Bungo Range National Park on 26th February 2009 covering 8,096 heactares (**Figure 1.1**). Bungo Range is an important water catchment area in the upstream of the Sarawak Kiri River and Sarawak Kanan River, where the Bengoh Dam is built to provide water supply for Kuching population. The southern end of the Bungo Range is the boundary of West Kalimantan, Indonesia.

In 2017, a multidisciplinary expedition to Bungo Range was conducted as one of the activities organized in conjunction with UNIMAS's Silver Jubilee Celebration. The Institute of Biodiversity and Environmental Conservation had led the expedition with the support of Forest Department Sarawak and other Institutes as well as Faculties within the university. The goal of the expedition was to increase the visibility of UNIMAS not just to the Tringgus community, but also to answer the call of the Sarawak government that wants to emphasise the implementation of Digital Biodiversity

in this state. The expedition was conducted for two weeks with the launching of the event held on 5th December 2017 at Tringgus settlement area.

Despite the earliest exploration in the area back to year 1880s, there is a lack of information pertaining to biodiversity and socio-economy, which are neccesary to enhance biodiversity conservation, and boost local economic activities in the area. The expedition had produced substantial baseline data for the management of Bungo Range National Park, and highlight the area as a tourism destination, which eventually would benefit the local community in the area. The findings of the expedition are compiled herewith, comprising historical exploration in Bungo Range, water resource, aquatic biodiversity, floristics, mammals, birds, reptiles, amphibians, insects, and health and socio-economics of the locals. In summary, this book reported a total of 313 spcies of plants mainly orchids and zingers, and 298 species of wildlife among others are 105 birds, 39 mammals, 92 insects, 27 reptiles, 17 amphibians, and 59 aquatic lives. Additionally, the use of natural resources by local community in Tringgus is also presented in this book.

Because the expedition had only covered a small area of the southern section of the Bungo Range, gaps of information in this edition are expected, which suggest more explorations are needed in the near future. In this regard, the editors would like to acknowledge the contribution of the authors of each article in this edition. This edition may not stop here, and we wish to be working with you all again!

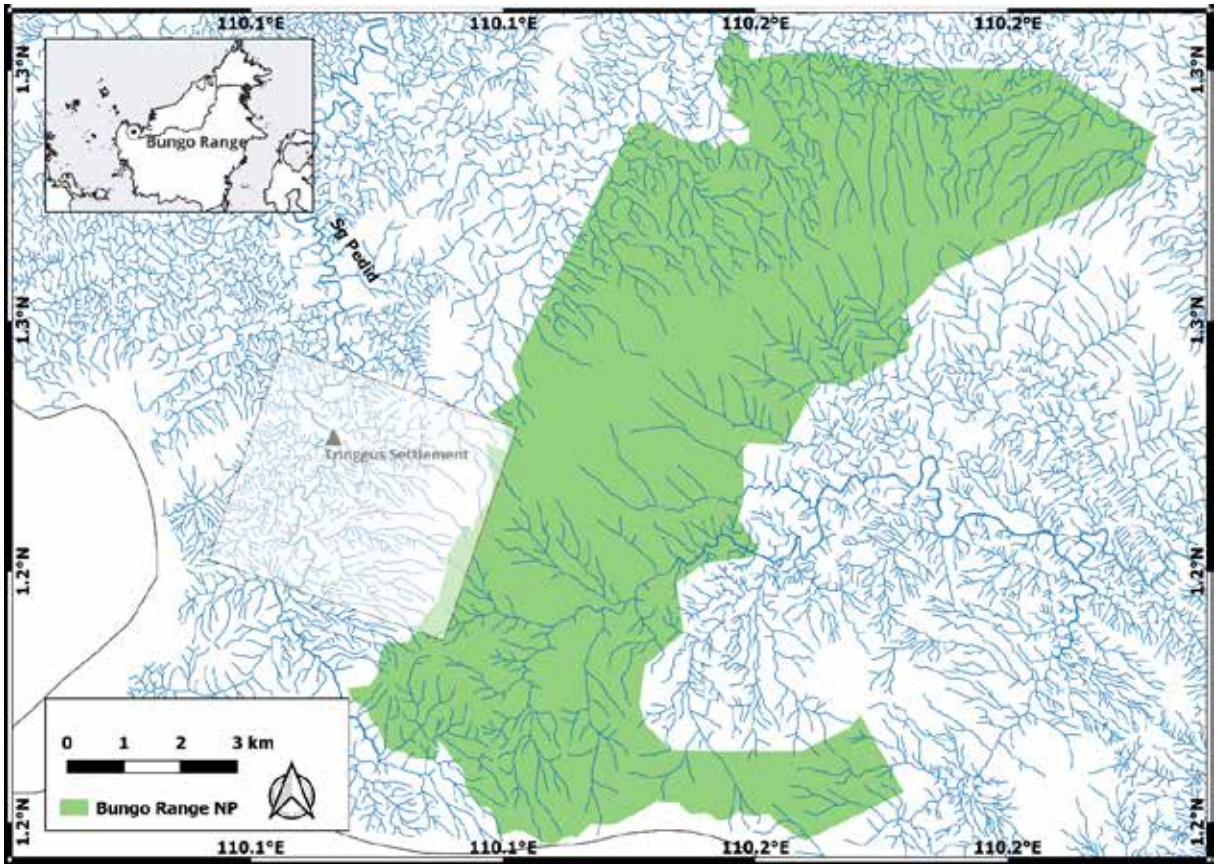

Figure 1.1. Map of Bungo Range National Park and the expedition area (shaded box).

WATERBORNE PARASITES IN TRINGGUS VILLAGES

Ahmad Syatir Tahar, Lesley Maurice Bilung, Kasing Apun, Yvonne Ai-Lian Lim, Reena Leeba Richard, Hashimatul Fatma Hashim, Elexson Nillian and Lau Seng

Waterborne parasites have caused two million mortalities annually particularly among those children below five-year-old children. Accessibility to clean water supply is a fundamental and global issue considering that water contamination by pathogens constitutes high potential to massive outbreaks that can impact economic and social development. Based on the recent statistics by UNICEF, 88% of rural population in Malaysia received basic water supplies from improved sources (i.e. free from outside contamination, principally from faecal matter) in 2015. Within that percentage, there are many rural communities that do not receive piped portable water since they are located remotely from the nearest water treatment facilities. Rural communities which are socially and economically underprivileged such as lack of basic water supplies, can be exposed to various infections sourced from the untreated water.

Figure 23.1. Location of Bong Village in Tringgus. It takes more than 40 minutes driving in a car from Bau Town to this village. Due to this remoteness, it is not connected with the municipal treated water from the nearest water treatment plant in Bau. So, villagers from Bong Village depend on natural hill water for daily uses through gravity-fed system.

Bong Village in Tringgus is inhabited by the Bidayuh tribe, that is not connected with the municipal treated pipe water due to its remoteness (**Figure 23.1**). Thus, gravity-fed system remains the only water source that utilises the basis of gravity flow at higher elevation to channel spring water from an impoundment (**Figures 23.2-23.4**). The impoundment is located at 150 m above sea level of a hill that channels water directly to houses, a school and filtration tanks. These receiving areas do not have any basic water treatment, except the filtration tanks (**Figure 23.5**). The catchment area where the system is located, has been enacted as a free-farming and cultivating zone by the Ministry of Health to preserve the water quality for safe human consumption. Pedid River, a stream from the downflow of the gravity-feed system, was included as a study point as it has close association with the daily activities of the community.

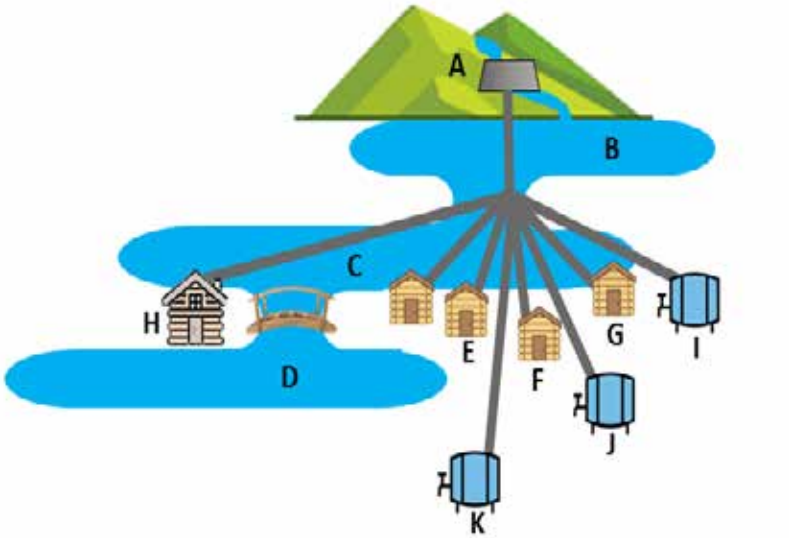

Figure 23.2. Schematic representation of 11 sampling points at Bong Village which comprises a water impoundment (A), three streams (B, C, D), three houses (E, F, G), a school (H) and three water filtration tanks (I, J, K). It is clearly illustrated of how gravity-fed system forms a network of supplying pipes that channel water to the downstream populations.

A total of 33 water samples were collected from 11 sampling points (as shown in **Figure 23.2**) at Bong Village in Bau district. Overall, ten water samples (30.3%) were positive with waterborne parasites. The highest occurrence (i. e. based on the number of positive samples) was *Cryptosporidium* (24.24%; 8/33), followed by *Giardia* (6.06%; 2/33) and *Clonorchis* (6.06%; 2/33). Water samples collected from the impoundment were detected with *Cryptosporidium* (range: 0.1 - 0.8 oocysts/L). At upstream of the Pedid River, the samples were positive with *Cryptosporidium* (0.1 oocysts/L) and *Giardia* (0.1 cysts/L). Whilst, at midstream of the river, the water was detected positive with *Cryptosporidium* (0.1 oocysts/L), whereas downstream was contaminated with *Cryptosporidium* (range: 0.1 and 0.2 oocysts/L). At house 1, the water was contaminated with *Clonorchis* (0.1 ova/L). At house 2, the water was detected positive with *Cryptosporidium*

(0.1 oocysts/L) and *Giardia* (0.2 cysts/L), whereas at house 3, the water was contaminated with *Cryptosporidium* (0.1 oocysts/L). No waterborne parasites were detected from the school, community water filtration tanks 1, 2 and 3.

Figure 23.3. Villagers in Bong rely on this water impoundment in order to obtain their daily source of potable water. Previously, they used to depend on the rainwater harvesting system that is no longer used prior to the introduction of the current gravity-fed system.

Figure 23.4. Our experienced porter, Mr. Sogoh anak Habi, emphasising how important the impoundment to the community as a sole water source. He is responsible for periodically making sure there is no blockage of leaves and branches which may cause water shortage to the downstream population.

Figure 23.5. The sampling process was adventurous and literally "muddy". It was an uphill job for us to get up the hill, whilst our porter did not even break a sweat!

All houses including a school at Bong Village in Bau receive water directly from water impoundment at 150 metres uphill of the Tringgus hill. The water is used for drinking and other domestic activities and even without being pretreated such as at points-of-use and points-of-entry. Of 11 sampling points at Bong Village, the water impoundment was detected positive with the highest concentration of *Cryptosporidium* (range: 0.1 - 0.8 oocyst/L). Even though the concentrations are seemingly lower compared to the parasites' infective doses (*Cryptosporidium*: 10-83 oocysts; *Giardia*: 10-100 cysts), the risk still does exist because the water is used

for drinking and domestic purposes by the community. The high *Cryptosporidium* concentration could be caused by the barrier to hold the water resulting in parasite accumulation in the impoundment. Despite being free-farming zone (i.e. free-contamination from faecal of domestic animals), the water at the impoundment was still contaminated with *Cryptosporidium*. As the area is on the hill and surrounded with the protected natural forest, this occurrence might be associated with the existing wild animals such as wild boars that could be a source of contamination.

The presence of *Cryptosporidium* and *Giardia* from the in-house water pipes (i.e. at houses 2 and 3) demonstrates the existing direct exposures of parasitic infections. Even though the water for drinking is practically boiled, potential of infections still exists. The risk of infections can happen during washing vegetables and hands before eating. This study also revealed contamination of *Clonorchis* ova which is a liver fluke trematode in two samples from house 1 (0.1 ova/L in each). However, the parasite is only infectious if humans ingest the metacercariae from consumption of undercooked freshwater fish.

Three community water filtration tanks installed at Bong Village were not found contaminated with any parasites (0.00%; 0/9). The absence of parasites in the water filtration tanks is attributed to the filtration system that can filter out contaminants in the raw water measuring as low as 15 nanometres (**Figure 23.6**). The tanks are located distant to each other and not piped to each house. For that reason, villagers need to bring their personal barrels or bottles to collect water from the tanks. The water is considered safe for consumption as revealed by this study to be free from waterborne parasites, nevertheless it is not a main water source for consumption due to far distance and available in-house gravity-feed water pipes.

Of nine total samples collected from upstream, midstream and downstream of the catchment area, four samples were positive with *Cryptosporidium* (range: 0.1 – 0.2 oocyst/L) and *Giardia* (0.1 cyst/L). The water flows from the hill (i.e. including from the water impoundment) and was not abstracted for drinking and other domestic purposes. However, it was included as the studied points because of routine swimming and recreational activities especially by children as shown in **Figure 23.7**. Swimming in contaminated water may represent a critical source of infection because many of previous outbreaks have been associated with person-to-person transmissions. Swimming-associated cryptosporidiosis and giardiasis can occur if the swimmers swallow a mouthful of contaminated water. Houses and animal pens located adjacent to the river can also contaminate the water (**Figure 23.8**).

Figure 23.6. Three community water filtration tanks, located distantly to each other at the village, provide safe drinking water. Despite that, they are rarely utilised because of the far distance and having to bring personal barrels or bottles for collection.

Figure 23.7. The "playground" of these local, close-to-nature Bidayuh teenagers may expose them to various waterborne infections from the environment.

Figure 23.8. Villagers here practise self-sustained agricultures to maintain their lives. Animal farms can be seen along the river that can cause polluted runoff (carrying microorganisms) to the river water bodies.

INDEX

BUNGO RANGE

BIODIVERSITY AND COMMUNITY

This book highlights the significant findings from the Multidisciplinary Expedition in Bungo Range conducted on 5-10 December 2017. The expedition was organized by the Institute of Biodiversity and Environmental Conservation, UNIMAS with support from the Forest Department Sarawak. This volume is illustrated in 24 chapters covering the historical exploration of Bungo Range, a geological feature of the mountain, water resources, aquatic biodiversity, floristics, mammals, birds, reptiles, amphibians, insects, and health and socio-economics of the Tringgus community. It is reported herewith in the book that there are a total of 313 species of plants mainly orchids and zingers, and 298 species of wildlife, among them 105 birds, 39 mammals, 92 insects, 27 reptiles, 17 amphibians, and 59 aquatic lives. Additionally, the use of natural resources by the local community in Tringgus is also presented. This book can serves as a useful reference for the development and management of Bungo Range National Park, and the communities living surrounding the area.

UNIMAS
UNIVERSITI MALAYSIA SARAWAK

ISBN

UNIMAS PUBLISHER