TECHNICAL REPORT

IMPACT OF CLIMATE CHANGE ON CHILDREN: A MALAYSIAN PERSPECTIVE

Universiti Kebangsaan Malaysia
The National University of Malaysia

UMS
Universiti Malaysia Sabah

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August 2021

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Analysis of Impacts of Climate Change and Environmental Degradation on Children in Malaysia and Assessment of Child-Sensitivity of Current Adaptation and Mitigation Policies
Technical Report

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PREFACE

This report is a culmination of the findings from a research project assessing the impacts of climate change and environmental degradation in Malaysia on children's health and well-being. This project is an initiative by UNICEF Malaysia to gauge the current scenario in Malaysia. Universiti Kebangsaan Malaysia (UKM) was commissioned to carry out the research, with Universiti Malaysia Sabah (UMS) as a research partner.

The findings in this report are exploratory as this is the first study in Malaysia that specifically addresses children as a focal point in the context of climate change and environmental degradation. This report includes an extensive literature review of the relevant issues pertaining to the children in Malaysia, results of a time series data analysis of the health impacts of air pollution and haze on children, as well as climate change projection downscaling exercises to fit specific regions of interest in Malaysia in order to prepare mitigation actions in case of climate or environmental disaster.

At the ground level, community surveys and consultations were conducted on selected communities from three states in Malaysia. Although the results do not represent the children of Malaysia in its entirety, we were particularly focused on the children in conventionally marginalised communities for our case studies. The results of this pioneering research represent the worst-case scenario for children from the most vulnerable populations in Malaysia, in line with the United Nations 2030 Agenda for Sustainable Development's efforts to 'Leave No One Behind'.

The research team also probed into Malaysia's current national policies and laws on climate change and the environment. The outcomes were validated through eight strategic meetings, two stakeholder consultations on 13th August 2020 and 17th February 2021, and several bilateral strategic meetings involving policymakers (from government agencies) and non-governmental organizations (NGOs).

Based on these activities, this report presents beneficial and constructive information that can serve as a starting point for discussion and reference for future policymaking, formulation of interventions, and community action plans.

This work would not have been possible without the assistance and cooperation of all the internal and external research team members and the participants of meetings and workshops, as listed in Appendix 7. It is our hope that this work will pave the way for future intersectoral and interministerial synergy for the well-being of our future generation.

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EXECUTIVE SUMMARY

The impacts of climate change and environmental pollution and degradation are increasingly being felt in Malaysia. However, insufficient attention has been directed so far to assess the impacts of climate change and environmental degradation on the lives of families and children in Malaysia. In marginalised communities, climate and environment-related risks are further exacerbated by poverty, illiteracy and limited access to information. While children face a disproportionate share of the burden from climate change and environmental degradation, they have been consistently overlooked in the design and content of climate policies and related processes.

Therefore, this project is formulated to address the above issues through four objectives:

1. *Integrated analysis on the impacts of climate change and environmental degradation on children's health and well-being, including marginalised children.*
2. *Assessment of existing climate and environment policies and plans to identify gaps and opportunities.*
3. *Mapping key actors and interventions on climate change and environmental management.*
4. *Identify recommendations and areas for action by various stakeholders to address or minimise the negative impacts of climate change and environmental degradation on children in Malaysia.*

These study objectives are achieved through five study packages:

1. *A case series review summarising potential issues concerning children in Malaysia facing climate change and environmental degradation.*
2. *Four desk studies using secondary data for climate projections in Malaysia, and assessing the health impacts of air pollution and haze on children in Malaysia.*
3. *Three community case studies at three different locations, targeting marginalised groups and children on an island, a hill site (indigenous group), and urban poor to understand the impacts of climate change and environmental degradation on their health and well-being.*
4. *Content analysis of policy and legal documents to assess child sensitivity in the mitigation and adaptation to climate change and environmental degradation.*
5. *The project outcomes are supplemented by inputs from stakeholder engagement exercises, interviews, and focus group discussions among policy-relevant personnel to identify good practices, gaps, opportunities, and key actors to address these issues in Malaysia.*

This study is the first in Malaysia that puts children as the focus for actions towards climate change and environmental degradation. Thus, this study can be considered as an exploratory study of the current situation in Malaysia. Through continuous consultations with the relevant agencies, i.e. Ministry of Education (MOE), Ministry of Health (MOH), Ministry of Environment and Water (*Kementerian Alam Sekitar dan Air* or KASA), and Ministry of Women, Family and Community Development (MWFCD), this study also intends to gain insights into future needs for research and action plans among all actors.

The case series review is a collection of literature on issues relevant to children with regards to climate change and environmental degradation in the context of the global environment and Malaysia. The issues described encompass children's nutrition, infectious diseases, industrial pollution and hazardous wastes, and children's well-being, i.e. poverty, education, literacy, child trafficking and sexual abuse, and psychology.

In the desk studies, climate change projections suggested a continual increment of heat waves in terms of number, duration, and magnitude for Sabah. Heat wave duration and magnitude show considerable dependence on greenhouse concentration pathways. Rain spells were projected to become longer under the higher emission scenario, and dry spell length was projected shorter instead. The systematic review revealed that ambient air pollution was associated with acute and chronic childhood respiratory diseases, including respiratory-related mortality in Asia's lower- and middle-income countries (LMICs). In Malaysia, PM_{10} was found to be the main air pollutant affecting the daily number of childhood respiratory admissions.

Short-term exposure to air pollution was associated with increased respiratory admissions among children aged five to nine years in Sarawak. This finding provides evidence for the association between air pollution and children respiratory admissions. However, no clear association was observed between haze and under-five mortality in Malaysia. Nonetheless, lag patterns revealed the possibility of immediate effects on under-five mortality from the prolonged and intensified haze.

The community case studies present interesting findings on children's vulnerability and resilience towards the impacts of climate change and environmental degradation, especially in terms of their well-being. Children's vulnerability and resilience differed based on their socio-demographic and economic status and location. Communities that relied on climate-sensitive economic activities were particularly affected by climate variability. The community's economic status determined their access to basic social services, which influenced the well-being of children, especially those from large families. Education is important to build the resilience of these communities against the impacts of climate change and environmental degradation.

The assessments of national policies and action plans found that mitigation actions in the face of climate change and environmental degradation are embedded in national policies and actions plans across most sectors. The industrial sectors rely on environmental policies and laws to regulate their environmental impacts, including health. Among the documents assessed which mentioned health, this is mostly addressed from the perspective of the general population. Most documents acknowledged children by emphasising their education, awareness, and participation in the respective sectors. However, appropriate action plans have not been incorporated in the context of children, climate change, and environmental degradation. In terms of the national legal framework, laws in Malaysia are developed in response to different target groups with distinctive objectives. The environmental law in Malaysia is still lenient or otherwise outdated, with greater consideration given to economic priorities and limited scope in public health issues due to pollution. The Child Act, which is almost 20 years old, needs revision to align with new and emerging international climate change commitments and Sustainable Development Goals (SDGs).

This assessment found gaps in integrating and implementing child-sensitive climate change and environmental actions as a public agenda. Smart partnerships with various governmental, NGOs and civil society organisations (CSOs) locally and globally are recommended to ensure that the children are an essential part of climate change adaptation and mitigating strategies.

The main outcomes of this study are presented as a model, detailed in Chapter 6, on the impacts of climate change on children in Malaysia. This model consolidates the objectives, methods, and findings from our case studies on the ground and contextualises them within our current policy and legal framework. In Chapter 7, we identify the issues and gaps highlighted from the model within the scope of this study, followed by some proposed recommendations for key actors.

PROJECT OVERVIEW

The impacts of climate change and environmental pollution and degradation are being increasingly felt in Malaysia. As surface mean temperatures continue to rise, the country is expected to experience increasingly unpredictable weather systems. This, in addition to challenges associated with changes in land use and land cover, urbanisation, environment and air quality degradation, is expected to increasingly impact agriculture and food security, safe water supplies, public health and the delivery of essential social services. Children bear a disproportionate share of the burden from climate change and environmental degradation. Extreme weather events, flooding, droughts and an increase in temperature, together with anthropologic environmental pollution, pose unique threats to children's health and well-being.

Despite the many ways climate change impacts children, children are consistently being overlooked in the design and content of climate policies and related processes. In addition, insufficient attention has been directed to increase community understanding of the impacts of climate change and environmental degradation on the lives of families and children – particularly in vulnerable communities – and encouraging environmentally-friendly values and practices among children and young people. In marginalised communities, climate- and environment-related risks are further exacerbated by poverty, illiteracy and limited access to information.

Legislative, enforcement and other measures to prevent children from being exposed to environmental health risks are often inadequate or missing in national policy frameworks. For example, while the child's best interests should be at the heart of all decisions affecting the child, today, laws and policies around the world essentially permit children to be exposed to hazardous substances. Strong laws and policies, implemented well, play a crucial role in ensuring children's rights and best interests are upheld and protected. While Malaysia's laws and policies seriously attempt to engage with environmental issues and address the effects of climate change, children's issues have not been well recognized within existing national climate change and environmental frameworks. On the other hand, laws and policies relating to children or public health do not address climate change and environmental harms. Therefore, efforts should be undertaken to review the current framework holistically.

We address the major challenges in mobilizing more effective action on climate change and environmental degradation concerns in Malaysia, as listed below:

i. Our case series review (Chapter 2) and desk studies (Chapter 3) address the inadequate evidence to guide policies and plans on the likely impacts of climate change and environmental pollution and degradation on children's healthy growth, development, and socialization.

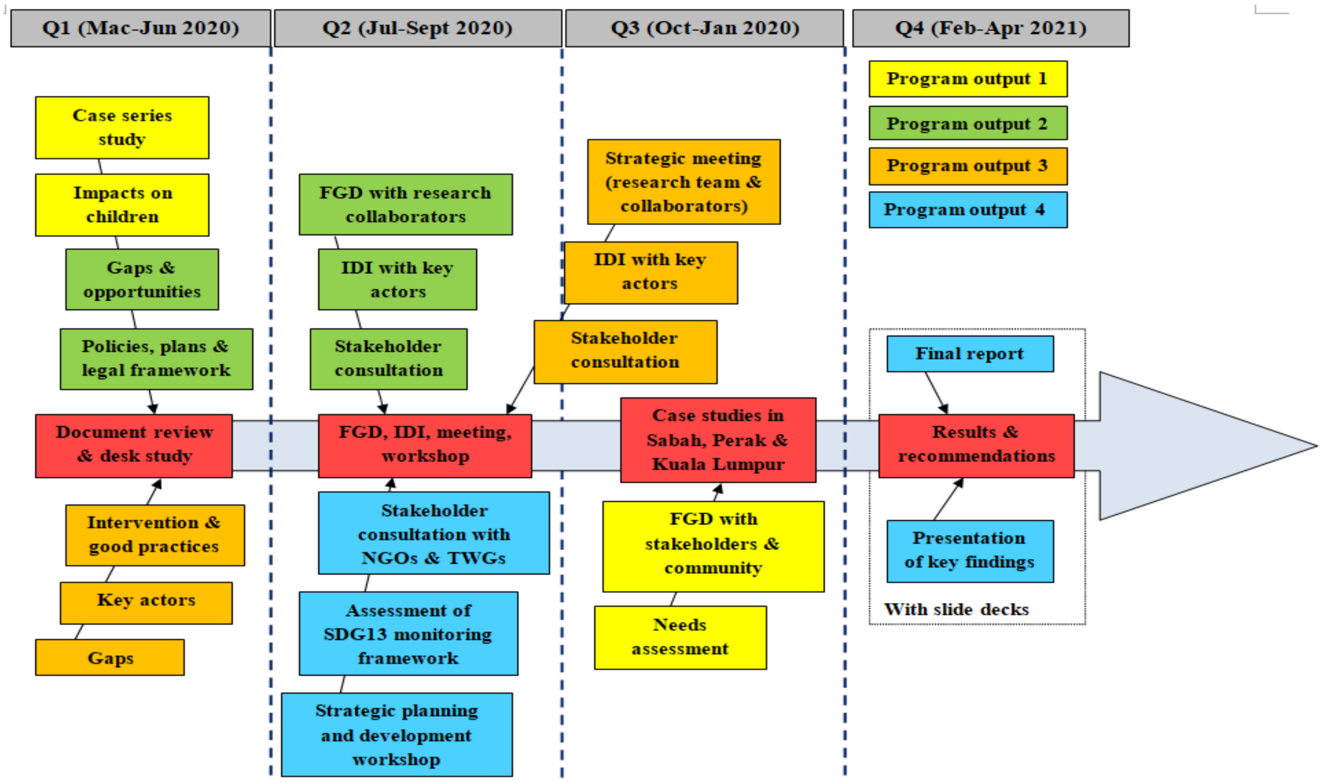
ii. Our case studies (Chapter 4) addresses the low levels of community consciousness of the impacts and adaptation measures required at the individual, family and societal levels.
iii. Our policy and legal assessment (Chapter 5) addresses:
    - inadequate legislative and policy protection for children from environmental and climate risks, particularly in marginalised communities.
    - lack of clarity about the extent to which current national policies, laws, and budgets are responsive to climate change and how broad climate change adaptation and mitigation measures are child-friendly.

UNICEF intends to understand to what extent national climate policies and plans are child-sensitive and provide recommendations on strengthening their focus on children's rights, including actionable and measurable results. The project is conducted by UKM as the main project team, in collaboration with UNICEF and UMS. Other collaborators include researchers and organisations from various local (University Technology MARA (UiTM), the International Islamic University (IIUM), Institute for Medical Research) and international universities and research institutions (Kyoto University and the National Institute of Environmental Studies (NIES), Japan). All researchers have different backgrounds and experiences with communities, policies and laws related to climate change, environmental degradation and children well-being.

This project is supported by a technical working group (TWG) formed by the members of the Malaysian government, civil society and the UNICEF review committee. The TWG's role is to review and provide advice on technical issues and provide linkages with relevant stakeholders. The results of this project will be used to inform the UNICEF – Government of Malaysia Country Programmeme 2022-2025, the 12th Malaysian Plan, and the respective government agencies in fulfilling commitments to the Paris Agreement and national aspirations for development, sustainability, and equity.

PROJECT ACTIVITIES

This project ran from March 2020 to April 2021. The activities carried out to meet our project outputs are listed in Table 1.2 (Appendix 1). Due to COVID-19 related restrictions, some project activities were delayed. Strategic meetings and stakeholder engagement and consultation workshops were organized throughout the project duration to consistently seek direction and guidance from the relevant agencies. The fishbone model in Figure 1 shows an overview of the project work plan according to the programmeme outputs.



Programmeme Output 1	Integrated analysis on the impacts of climate change and environmental degradation on children's health, nutrition, education, and poverty using existing data, including a case study with a focus on marginalised children as part of the global 'Leave No One Behind' effort to achieve the SDGs
Programmeme Output 2	Assessment of existing climate and environment policies and plans, and identification of gaps and opportunities
Programmeme Output 3	Mapping of key actors and interventions on climate change and environmental management, including private sector-led initiatives, and identification of good practices and gaps in child-centred climate action in Malaysia
Programmeme Output 4	Identifying recommendations and areas for action by various stakeholders to address or minimise the negative impacts of climate change and environmental degradation on children in Malaysia (at the national, state and local level)
Methodology over time	

Figure 1: Fishbone model of the project work plan

DEFINITION OF TERMS

Accessibility	The right or opportunity to use or benefit from something (Grecksch and Klöck 2020)
Adaptation	Behaviour change or act of individuals and groups to survive and function better in its environment
Adaptive capacity	The social and technical skills and strategies of individuals and groups that are directed towards responding to environmental and socio-economic changes[1]
Children	Individuals below 18 years old (Child Act 2001)
Indigenous	Refers to Orang Asal and Orang Asli ('original peoples' in Malay) in Malaysia (Khor and Shariff 2019)
Marginalised communities	Communities outside and peripheralised from the mainstream group or centre of society
Resilience	The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures (UNISDR 2004)
Vulnerability	Characteristics and circumstances of a person, community, system or asset that make it susceptible to the effects of climate change and other hazards (UNISDR 2009)

[1] Interdisciplinary Teaching about Earth for a Sustainable Future, https://serc.carleton.edu/integrate/teaching_materials/food_supply/student_materials/1059

1 INTRODUCTION

By Prof Dr Mazrura Sahani

This chapter provides a general introduction to all the different types of studies included in this study. All the studies in this chapter address Project Output 1: **Integrated analysis on the impacts of climate change and environmental degradation on children's health, nutrition, education, and poverty levels using existing data.**

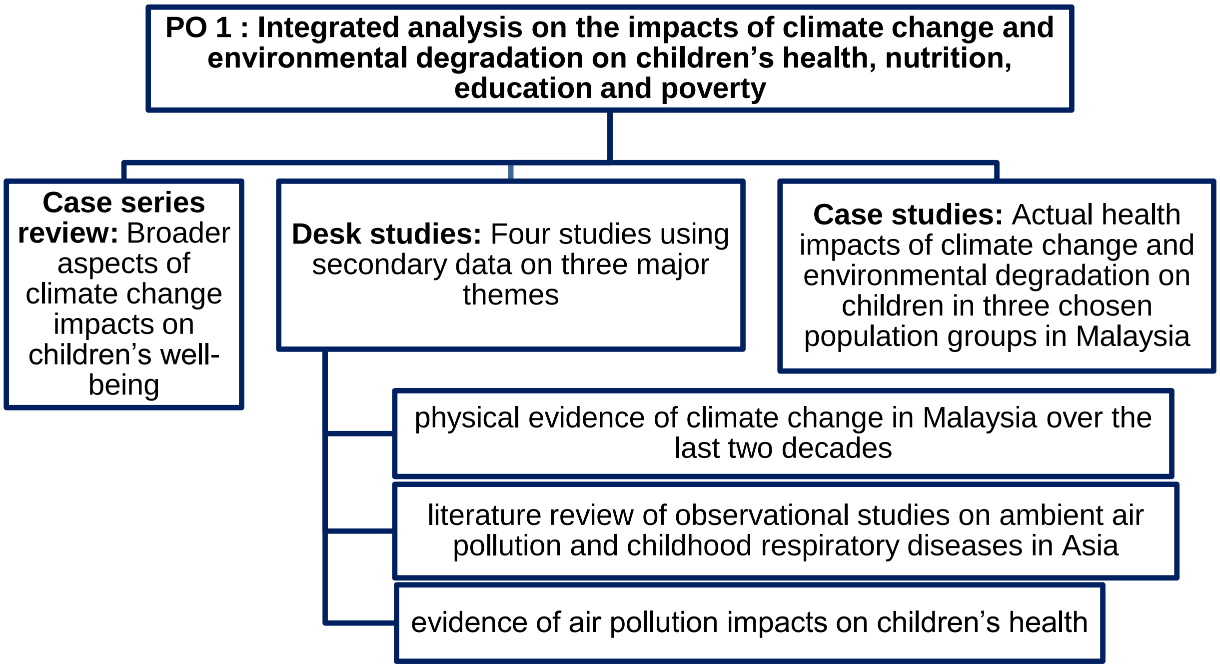


Figure 2: All studies included in Programme Output 1

1.1 Case series review

In our case series review, we look into the broader aspects of climate change impacts on children. Children were found to be vulnerable to climate change impacts in terms of their health, social relations, economy and ecology. Through various pathways, either direct or indirect, climate change has put additional stress upon the availability of clean air, water, and nutritious food. It thus poses a major threat to children's well-being. This case series review is summarized in

Table 1, which presents existing issues of concern locally and internationally.

Table 1: Summary of findings based on case series review

<table>
<tr><th>Well-Being Aspects</th><th colspan="2">Findings</th></tr>
<tr><td rowspan="4">Children's Health</td><td colspan="2">Direct</td></tr>
<tr><td>Heat waves, air pollution</td><td>Water availability, Food quality (Anderko et al. 2019).</td></tr>
<tr><td colspan="2">Indirect</td></tr>
<tr><td>Asthma is associated with climate change and affects about one-third of the child population (Castro et al. 2009).</td><td>Children are more susceptible to vector-borne diseases such as dengue, malaria, and diseases associated with poor water quality, inadequate sanitation and poor hygiene practices (such as diarrheal diseases) compared to adults (UNICEF 2015).</td></tr>
<tr><td>Malnutrition</td><td colspan="2">
The climate can affect nutrition and food security, food production systems, food safety, and safe drinking water (IPCC 2019, WHO 2019).
If malnutrition persists for a long time, it will disrupt children's development, resulting in low body weight, small stature, and low IQ (Bhavsar et al. 2012).
Malnutrition is a major outcome of drought in children, especially in LMICs (Belesova et al. 2019).
Reduced agricultural productivity from climate variability (such as drought and water stress) cause food shortages, increases food prices, and subject the poor to hunger as they also lose their income from crops.
</td></tr>
<tr><td>Access to Education</td><td colspan="2">
Education is vital for national development. It is also vital to reduce income inequality and poverty levels (Todaro 2003).
Several factors such as poverty, the emotional and financial pressure from living in the city, high costs for special needs education, and marginalised families may result in a lack of opportunities for children to get an education.
Poverty is associated with the lack of education (Rabi et al. 2020), reduced health status, lack of job opportunities, short lifespan (Buarque et al. 2006, Siti and Narimah 2018), and lower cognitive development among children (Murtaza et al. 2019). Children raised in poverty will spend most of their time working to sustain life. This will cause a lack of focus on education (Malaysia 2002), and some parents may not prioritise school education (Lino 1994, Siti and Narimah 2018).
Poverty often becomes intergenerational as parents may force children to work (UNICEF 2019), and children may face unconducive conditions to study at home (Rani 1995, Siti and Narimah 2018).
</td></tr>
</table>

In Malaysia, the climate and environmental issues particularly threatening to children's health include haze pollution originating from forest and peat fires, exposure to illegally dumped hazardous substances, the increasing frequency and severity of floods, and the increased transmission of vector-borne diseases like dengue. Based on this, we carried out our case series review to describe the state of children in terms of their social and environmental well-being both globally and in Malaysia. In the next chapter, we present desk studies that provide scientific predictions of future climatic models regionally and locally (with regards to temperature, extreme rainfall or drought and heat-related indices), the link between temperature and air pollution, and finally, the association between air pollution and haze (biomass) pollution to respiratory diseases, hospital admissions and mortality among children.

1.2 Desk studies

In our desk studies, we focus on three major themes: (1) physical evidence of climate change in Malaysia over the last two decades, (2) literature review of observational studies on ambient air pollution and childhood respiratory diseases in Asia, and air quality changes that contribute to the climate change (for example, haze episodes), and (3) air pollution impacts on children's health.

The first theme provides physical evidence of climate change in Malaysia over the last two decades. We refitted a regional climate model with data for Malaysia through a dynamic downscaling practice. This required a cascade of modelling exercises from global climate models (known as general circulation models, GCM) to regional climate models (RCM). We employed the latest version of the Southeast Asia Regional Climate Downscaling (SEACLID)/CORDEX-SEA (Ju Neng et al. 2016, Ngo-Duc et al. 2017, Cruz et al. 2017, Tangang et al. 2018) to be refitted with local data to identify the historical climate and project future changes over the study area.

Ambient air quality is sensitive to the effects of climate change and the weather (Hong et al. 2019, Perera 2017). Climate change can impact air quality, and at the same time, air quality can impact climate change. For our second desk study, the systematic review introduces evidence from Asia's LMICs and explores the association between ambient air pollution and respiratory diseases among children. This review utilises systematic methods to critically review all relevant published research to answer a formulated research question. The results from this systematic review will provide information to policymakers to assist their future policymaking and strategic planning processes.

In Malaysia, haze events due to forest fires have been common, especially during years with intensified dry weather (i.e. induced by the El-Niño phenomenon) (van der Werf et al. 2008). Forest and peatland fires (hereafter referred to as wildfires) have contributed to smoke haze events and poor air quality in Malaysia. In some years, the situation was intensified due to prolonged and intense dry seasons (Kanniah et al. 2016). The El Niño Southern Oscillation (ENSO) is a natural climatic phenomenon during which ocean temperatures in the equatorial tropical Pacific Ocean vary from the norm (NOAA 2019). The warming phase of ENSO, El Niño, is a periodic warming of sea surface temperatures in the equatorial Pacific Ocean. Such an imbalanced amount of heat in the sea surface and the atmosphere could lead to unstable weather, such as extremely hot and dry seasons.

Several 'haze emergencies' were declared due to severe haze episodes during which the Air Pollution Index (API) breached the value of 500 (a level considered hazardous to health). The issuance of a 'haze emergency' causes a temporary shutdown of schools and public facilities to allow the public and children to stay indoors (Kanniah et al. 2016). Although local activities such as agricultural biomass burning may have contributed to poor air quality in the country, high levels of transboundary pollutants due to wildfires in Indonesia have been reported during the haze periods (Sulong et al. 2017).

Many studies have linked exposure to ambient air pollution with respiratory diseases (Ismail et al. 2019, Ma et al. 2019, Nhung et al. 2019). Studies in Malaysia have also investigated the health effects of haze events (Sastry 2002, Mott et al. 2005, Sahani et al. 2014). It was shown that haze events are associated with increased mortality and hospital admissions, especially related to respiratory outcomes (Mott et al. 2005, Reid et al. 2016). Respiratory disease is a common cause of hospital admissions among children. Among children aged zero to 14 years, 85% of global mortality were among younger children aged below five years old (i.e. 5.3 million deaths) (Unicef, WHO, World Bank 2019).

Children are particularly vulnerable to air pollution due to both biological and socio-economic factors. Children's respiratory rate is faster than adults, resulting in children inhaling more pollutants (Malmqvist et al. 2017). Aside from the above, children breathe in a higher concentration of pollutants due to their height, which is shorter than an ordinary adult, as some pollutants are concentrated higher at ground level (Bisht et al. 2016). Thirdly, children are naturally active, and this activeness and outdoor physical activities lead to longer periods of exposure to ambient air pollution. Children from LMICs are at higher risk due to outdoor child labour, which continues to be a major public health challenge (Ibrahim et al. 2021). Lastly, children's exposure to air pollution is contributed by poor air quality resulting from rapid urbanisation and economic growth, particularly in developing countries, attributed by pollutants from agricultural burning, industrial operations, motor vehicles, and other activities.

However, only a few haze-related studies have been conducted in the Southeast Asian region (Wiwatanadate and Trakultivakorn 2010, Sahani et al. 2014, Othman et al. 2014). Among these studies, the impact of the intensification of smoke haze on health is still unknown. Air pollution's impacts on respiratory hospital admissions among children in Malaysia remain unclear, as no study examined the health effects of haze among children under five years old. Therefore, our third and fourth desk studies investigated the health impacts of air pollution and haze on children in Malaysia.

1.3 Case studies

Our case studies explored the actual impacts of climate change and environmental degradation on children well-being in three chosen population groups in Malaysia. These groups represent three community environments that were pre-determined to accommodate the short duration of this study. These environments were marginalised and include undocumented children on islands, indigenous children in forest reserves, and the urban poor in a major city. The locations of these case studies are shown in the map below (Figure 3Figure 3). These case studies aimed to profile the children's demographic and socio-economic backgrounds, including their mobility, and analyse the children's vulnerability by correlating the children's profiles with the local climate and environment.

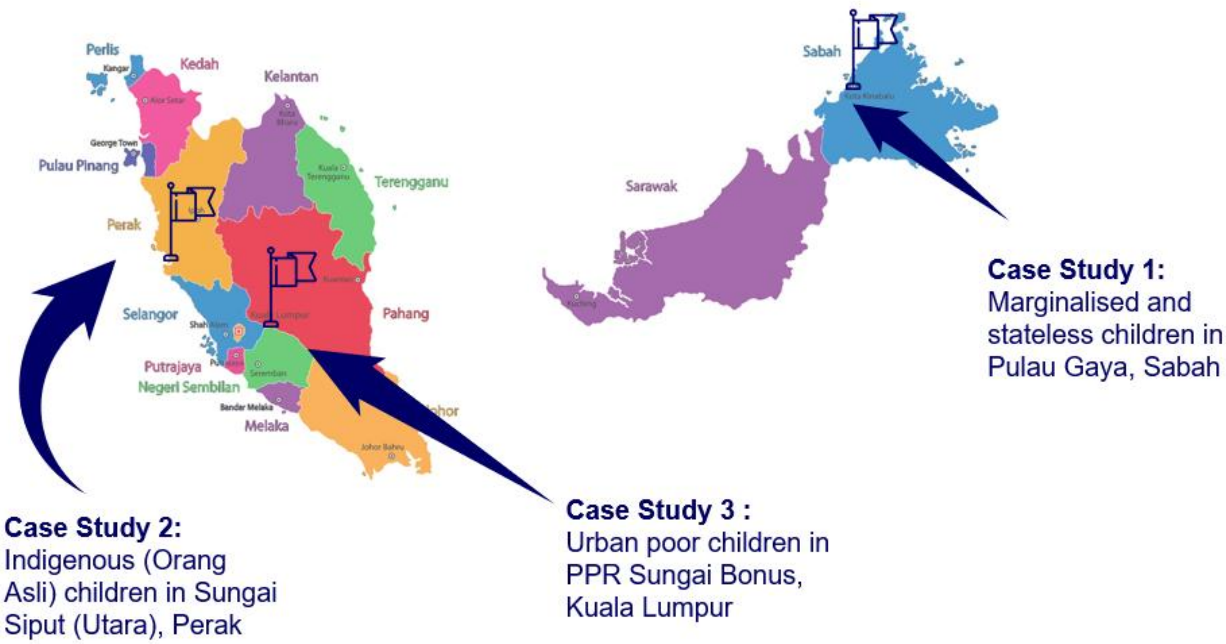


Figure 3: Geographical location of (1) Pulau Gaya, Sabah, (2) Sungai Siput (U), Perak and (3) PPR Sungai Bonus, Kuala Lumpur

1.4 Ethics approvals

Ethical approvals for studies involving human subjects have been obtained as below:

a. Desk Study 2:
Association between air pollution and childhood respiratory admissions: A time-series analysis in Sarawak, Malaysia

This study was approved by the Medical Research and Ethics Committee of the MOH Malaysia (NMRR-20-891-54456(IIR)) and the Ethics Committee of the Faculty of Medicine, UKM (UKM PPI/111/8/JEP-2020-427).

b. Desk Study 3:
Assessing the health effects of wildfire haze among children in Malaysia

This study was approved by the Medical Research and Ethics Committee of the MOH Malaysia (NMRR-18-2945-42784 [IIR]) and the Ethics Committee of the Graduate School of Engineering, Kyoto University, Japan (201902).

c. Case studies:

Approval from the Research Ethics Committee, UKM was obtained (Project code: UKM-NN-2020-041). The research ethics reference number is UKM PPI/111/8/JEP-2020-668. Participants' informed consent was obtained through the completion of an informed consent form before the data collection began. For children, i.e. students, their informed consent was received from their parents, guardian, or teacher. They were free to withdraw from the study at any time. The study also adheres to UNICEF's Guidelines on Ethical Research. All planned consultations with children and children with disabilities were discussed with UNICEF to ensure that they were aligned with UNICEF's child safeguarding policies and procedures.

The study examined data and information on communities, emphasizing children, regardless of ethnicity, religion, sex, social background, legal status or (dis)ability, except as stipulated in the study design. A key part of the study was identifying gaps in knowledge, evidence, and actions that will require further attention and follow-up for sustainability. Government agencies such as the Ministry of Science, Technology, and Innovation (MOSTI) and MOH, researchers, academia, UNICEF, and relevant stakeholders were engaged during and after the study to build further on the findings and allocate the necessary resources to tackle priority issues identified by the study.

2 METHODOLOGY

2.1 Case series review

The case series review presents an overview of the state of the children's health and well-being to understand how this links with several aspects of environmental degradation and climate change. This review focused on the Malaysian context.

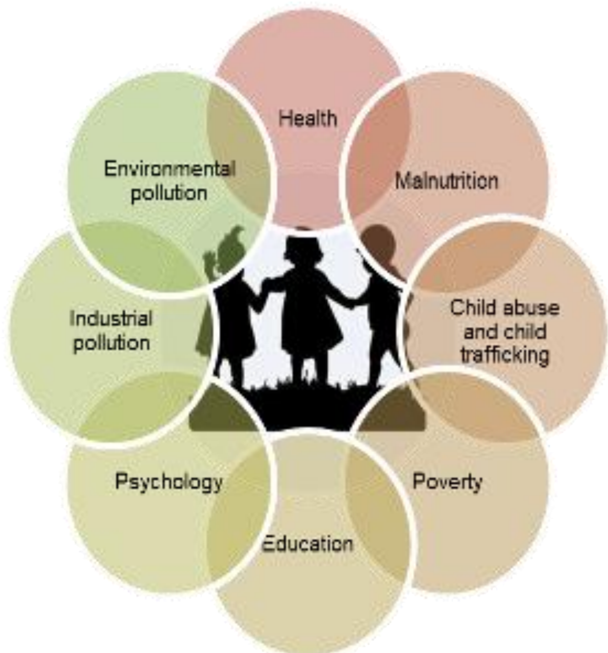


Figure 4: Overview of the case series review

2.2 Results and discussions

The case series review on children's health and well-being was constructed based on several aspects: health, malnutrition, education, poverty, child abuse, child trafficking, psychology, environmental pollution, industrial pollution and the COVID-19 pandemic (Figure 4). The complete version of the review is in Appendix 2.

2.2.1 Children's health

Climate change can cause an increase in the disease burden, particularly in poor and developing areas (Pronczuka and Surdub 2008). Children from low-income countries are exposed to a higher disease burden. They have limited adaptation capability and are more likely to be affected by climate change (UNICEF 2015). Flood and drought zones often overlap with areas of high poverty and poor access to important services such as water and sanitation. Thus, children and families already at a disadvantage due to poverty and have less ability to cope with the situation are most vulnerable to climate change (Ghani et al.

2017). In Malaysia, rising sea levels and temperatures are causing more floods, less food, and water shortages. Here, droughts and floods have been linked to increased water pollution and pesticides in food (Abdullah 2020). The low quality and availability of drinking water, lack of access to adequate sanitary facilities, poor hygiene practices, outdoor and indoor air pollution, vector-borne diseases, and chemical hazards are the primary environmental hazards related to climate change that can affect children's health (Pronczuka and Surdub 2008). Climate scientists have predicted that by 2030, about a quarter of Malaysia's population will be displaced because of climate change (The Star 2019).

Health problems related to climate change can be a result of direct exposure patterns (e.g. heat waves and air pollution) or indirect effects (e.g. water availability and food quality) (Anderko et al. 2019). Children are more susceptible to vector-borne diseases such as dengue, malaria, and diseases associated with poor water quality, inadequate sanitation and poor hygiene practices (such as diarrheal diseases) compared to adults (UNICEF 2015). Temperature changes have also been associated with acute respiratory tract infections in children (INEGI 2015). Asthma is one of the diseases associated with climate change and affects about one-third of the child population (Castro et al. 2009). Haze pollution events were associated with an increased risk of natural mortality in children under 14 years old in the Klang Valley region in Malaysia (Sahani et al. 2014).

2.2.2 Health literacy

Health literacy is defined as 'the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions' (Institute of Medicine 2004, Ratzan and Parker 2000, HHS 2000). Health literacy includes education, health services, social, cultural, and language factors (Nielsen-Bohlman 2004). The World Health Organization defined health literacy as cognitive and social skills that determine an individuals' motivation and ability to gain access to, understand, and use information in ways that promote and maintain good health (WHO 2009). Health literacy is crucial to empower people to improve their health and living conditions. Health literacy is vital for achieving the internationally agreed health and development goals and facing emerging threats such as pandemics, climate change and non-communicable diseases (WHO 2009). Health literacy is an important predictor of an individual's health outcomes (Tran et al. 2008).

A high level of health literacy is associated with a high proportion of the population being healthy (Haryati 2020). Several MOE programmemes were held to improve health literacy among children, including the My BFF@School (My Body is Fit and Fabulous at School) and the Dengue Patrol Programmeme (Ishak et al. 2019, Menon 2018). Other programmemes include the 'Tunas Doktor Muda' programmeme in preschools and IMFREE (tobacco-free programmeme) at the primary school level (Unit Perancangan Dasar dan Pelan Kesihatan, 2016).

2.2.3 Malnutrition

Malnutrition refers to both undernutrition (stunting, wasting, underweight, and deficiencies of essential vitamins and minerals) and overnutrition (obesity or over-consumption of specific nutrients) (Black et al. 2008). Children are vulnerable to malnutrition because childhood is the most important phase in human lives, and malnutrition will affect the growth of children (Ghani et al. 2017). There are four main nation-wide surveys conducted to assess children's nutritional status in Malaysia: the Southeast Asia Nutrition Survey (SEANUTS) Malaysia (Poh et al. 201, Karim and Razak 2019), the MyBreakfast study (Tee et al. 2018), the National Health and Morbidity Survey on Maternal and Child Health (NHMS MCH) (Institute for Public Health 2016) and the National Health and Morbidity Survey on Adolescent Nutrition (NHMS ANS) (Institute for Public Health 2017). Based on the findings from these studies, nutritional insufficiency and overnutrition coexist across the population (NHMS 2017).

The climate can affect nutrition and food security, food production systems, food safety, and safe drinking water (IPCC 2019, WHO 2019). If malnutrition persists for a long time, it will disrupt children's development, resulting in low body weight, small stature, and low IQ (Bhavsar et al. 2012). Malnutrition in children is a major outcome of drought in children, especially in LMICs (Belesova et al. 2019). Reduced agricultural productivity from climate variability (such as drought and water stress) cause food shortages, increases food prices, and subject the poor to hunger as they also lose their income from crops.

2.2.4 Children's education

Education is vital for national development. It is also vital to reduce income inequality and poverty levels (Todaro 2003). Children have the right to develop their physical, mental, and social potential according to the United Nations Convention on the Rights of the Child (UNCRC) 1989 (UNICEF, 2009). These rights are crucial for them to reach their high potential, and education is needed to achieve these rights (Omar and Abu Bakar Ah 2017). Several factors such as poverty, the emotional and financial pressure from living in the city, high costs for special needs education, and marginalised families may result in the lack of opportunities for children to get an education.

There is also the issue of varied perceptions of the importance of education among Malaysian parents. A good parent-teacher relationship is also important to ensure students' good school performance (Palik 2020). Cultural and religious factors also sometimes cause parents to refuse to send their children to school, especially among some Orang Asli and Rohingya communities (Johari and Nazri 2007, Er et al. 2010, Mohd et al. 2018, Palik 2020). In Kelantan and Sabah, it was found that the lack of transportation (Farazana et al. 2020) and other geographical factors (MOE Malaysia 2018, Haryati 2020) have caused an increase of dropouts among school children.

Climate change, including the more frequent occurrence of extreme weather events such as flooding, sea-level rise, increased levels of air pollution, and increased ambient temperature, will affect the delivery of education to children (Burke et al. 2018).

2.2.5 Poverty

Climate-related extreme events may lead to environmental chaos, affecting water availability and food production, which have a major impact on communities, especially low-income families. This will disrupt household income due to economic loss and eventually lead to poverty (Burke et al. 2018).

Despite many initiatives by the government, poverty remains an issue in some rural areas. Poverty is regarded as the major impediment in promoting the growth and development of individuals, communities, and the nation as a whole (Kapur 2019). Poverty is associated with the lack of education (Rabi et al. 2020), reduced health status, lack of job opportunities, short lifespan (Buarque et al. 2006, Siti and Narimah 2018), and lower cognitive development among children (Murtaza et al. 2019). Some may refuse to get health treatment as they struggle to survive (Chuah et al. 2018). Children raised in poverty will spend most of their time working to sustain life. This will cause a lack of focus on education (Malaysia 2002): school performance can be affected (Hassan and Rajah, 2011), and despite financial assistance, subsidies, and scholarships from the government, some parents may not prioritise school education (Lino 1994, Siti and Narimah 2018). Poverty can become intergenerational as some parents may force their children to work (UNICEF 2019), and children may face unconducive study conditions at home (Rani 1995, Siti and Narimah 2018). The situation may worsen as urban poverty becomes an increasingly common phenomenon (Chamhuri et al. 2016).

2.2.6 Child trafficking and sexual abuse

Climate change threatens the underlying social, economic, and environmental determinants of children’s health. Stability within the family and community context is crucial in determining children's healthy cognitive, biological, and behavioural development. When this stability is disrupted, such as climate change impacts on water and food availability or population displacements due to extreme weather events, these will affect the children’s short- and long-term survival (Burke et al. 2018).

Children are trafficked for armed conflict, child laundering, illegal adoption, begging, organ trade, drug peddling, and camel jockeying (SUHAKAM 2004, WAO 2017). Trafficking victims suffer from low self-esteem, mental issues, and problems in their social life. Trafficked children also often suffer from malnutrition, teething problems, stunted growth, reproductive issues, sexually transmitted infections, and other physical problems and diseases such as delays in cognition that can also affect future education and opportunities (WAO 2017).

Child trafficking is a symptom of the sex trade. The estimation of children trafficked worldwide for sexual exploitation or cheap labour is around 1.2 million. Human trafficking is the third-largest international crime worth billions of dollars (ECPAT and The Body Shop 2017). The high number of missing children in Malaysia may be related to this phenomenon: almost 8,000 children were reported missing from 2012 to 2014 (WAO 2017). The sex tourist map of Southeast Asia includes Malaysia, which suggests that child prostitution is a tourism strategy (Hong 1985, Lukman 2009a). Greenbaum (2018) defined a child trafficking victim as a child less than 18 years old engaging in any sexual activity involving the exchange of something perceived as valuable such as money, food, shelter, etc. The demand for sex drives child sex trafficking. Children easily become victims as they tend to be uneducated, easy to overpower, and easy to convince (ECPAT and The Body Shop 2017).

2.2.7 Child psychology

Psychological problems vary from simple diagnosis of trouble adjusting to stress, tantrums, separation anxiety, lying and stealing, to more definitive problems such as depressive disorders, conduct disorder, attention deficit hyperactivity problems (ADHD), autism spectrum disorders (ASD), and others. Mental health disorders are also sometimes associated with medical conditions such as asthma, dermatitis, diabetes, and obesity. These disorders, if left untreated, will cause severe disabilities when these children grow into adulthood (Hofstra, 2000). Certain risk factors are associated with such problems, including genetic factors, poverty, poor parental education, parental exposure to substance abuse, being raised by a single parent, poor parenting, abuse and neglect, parental mental health or criminality, crowded neighbourhoods, social isolation and peer pressure.

Recent studies have also shown that residential proximity to industrial activity (Downey 2005) and exposure to environmental pollutants such as toxic air, lead and pesticides may negatively affect children's development. Early recognition of such harsh conditions is thus important, as early alleviation of these conditions can ensure the normal development of children. In extreme weather events brought on by climate change, children exposed to these events are at risk of developing post-traumatic stress disorders (PTSD) and other mental health problems like depression, anxiety, phobias, panic attacks, sleep disorders and attention disorders (Burke et al. 2018).

Studies have confirmed that early detection and intervention are extremely important to prevent the deterioration of individual disorders. This indicates that early detection in terms of identifying risk factors are important (Costello 2016).

2.2.8 Impact of environmental pollution on children

Pollution is the largest cause of disease and premature death due to the environment in the world. It is accountable for approximately 9 million deaths per year (16% of all deaths worldwide), three times more deaths than the overall total of AIDS, tuberculosis, and malaria diseases (Landrigan et al. 2017). Air pollution is the main cause of pollution-related illness based on the Global Burden of Disease study data (Forouzanfar et al. 2015a, Forouzanfar et al. 2015b, Landrigan et al. 2019).

Children are more susceptible to pollution (Suk et al. 2016). They are more sensitive to environmental pollutants because their metabolic pathways are not fully developed. Therefore, they are unable to detoxify and excrete many toxic pollutants rapidly (NAS 1993). In addition, there exist windows of vulnerability in children during their development when even a very low dose exposure to toxic chemicals or environmental pollutants during this period can increase the risk of disease in children and across their lifespan (NAS 1993).

2.2.9 Impact of industrial pollution on children

Pollution from industries may affect all age groups in the surrounding community. However, children are among the most vulnerable groups by virtue of their young age and frequent outdoor activities. Despite various industrial pollution events in Malaysia, such as the industrial chemical waste pollution in Sungai (River) Kim Kim, there is a lack of scientific research on their impact on children's health in the surrounding community.

An article titled 'The Impacts of Illegal Toxic Waste Dumping on Children's Health: A Review and Case Study from Pasir Gudang, Malaysia' (Ibrahim et al. 2021, refer to Appendix 14) identified potential health risks to children associated with the illegal disposal of hazardous chemicals in Pasir Gudang, Malaysia. The risks identified included respiratory, cardiovascular and neurological health effects. They are at risk of developing as onset may develop 3 to 12 months after the traumatic event (Carty et al. 2006). Health was not the only aspect of the children's life that was affected by this industrial pollution. 111 schools had to be closed temporarily during this incident (Education Minister's Office of Malaysia, 2019). While things may have been worse if this incident had happened during the end of the year when major public examinations are held, these children were disadvantaged by having their education interrupted during this time.

Another issue concerning children and industrial pollution involves cottage industries. Cottage industries usually do not involve any mass production of goods. These goods are mostly hand-made using basic tools and require low energy inputs. Nevertheless, they may involve hazardous materials that are not recognized as dangerous by their users, such as those used in brassware and batik production. Children are often roped into this industry as it is considered a family business. Even if they are not directly involved with the work, they are often exposed to hazardous surroundings. Cottage industries may expose children to chemicals hazardous to health at levels that may be within the acceptable limit for adults but can be highly dangerous to children. This issue is rarely studied as it is regarded as an informal industry. Research on environmental pollution due to the cottage industries can inspire appropriate policies to safeguard the health of children in such contexts.

2.2.10 Impact of COVID-19 on children

A systematic review by Viner et al. (2020) assessed findings from 16 studies looking at the effects of school closures on COVID-19 outbreaks in China, Hong Kong, and Singapore. They found limited benefits in slowing the spread of the virus, and the authors stress that closures must be considered within the wider context of loss of essential workers due to childcare demands, restrictions in learning, socializing, and physical activity for pupils, and the substantial risks to the most vulnerable children, including those in low-income settings.

As the threat of COVID-19 blankets Malaysia and causes disruptions to our daily lives, those already living in poverty and at risk of things like malnutrition will be pushed into deeper vulnerability. Parents are concerned about not only the physical health of children and protecting them from the virus but their emotional and mental health as well. They are, however, hit the hardest by the psychosocial impact of this pandemic. Many of them are also daily wage earners who have lost their livelihoods in this challenging time. There is enormous uncertainty on the wide-ranging effects of COVID-19. Even after the pandemic ends, it will take time for vulnerable communities to bounce back, as the pandemic would likely have reordered society and impacted the economy (World Vision 2020). In Malaysia, 400,000 households live below the poverty line (household income of RM2,280). This is approximately 1.2 million children in Malaysia (Merdeka Centre 2020).

At least a third of the world's schoolchildren – 463 million children globally – could not access remote learning when COVID-19 shuttered their schools. Children may be unable to learn due to skill gaps among their teachers or lack of parental support. In Malaysia, based on a survey done from March to April 2020, the education ministry has reported that 37% did not possess any digital device, and only 15% of students have personal computers. This digital divide outlines the disparity and unequal home environments for learning during school closures. Children are also at an increased risk of abuse during school closures (Cluver et al. 2020).

3 DESK STUDIES

3.1 Desk Study 1: Simulating the downscaling of a general climatic model to a regional climatic model for specific health sector climate indices

By AP Dr Liew Ju Neng

3.1.1 Method

Desk Study 1 provides physical evidence on climate change in Malaysia over the last two decades. To this end, we refit a regional climate model with data from two regions from Malaysia, i.e. Kuala Lumpur and Pulau Gaya, using a dynamic downscaling technique.

The closest available meteorological station for Pulau Gaya is the Kota Kinabalu Airport station, about 5km away from the study area. For Kuala Lumpur, the data from the meteorological station at Subang Airport is used. The Malaysian Meteorological Department maintains both stations. The data is sent to the World Meteorological Organization's Global Telecommunication System and made available from the NOAA's National Climatic Data Center (NCDC) website (https://data.noaa.gov/dataset/dataset/global-surface-summary-of-the-day-gsod) as the global surface summary of the day data sets (GSOD). The data is available in daily resolution. There are several variables available. In the current study, the variables obtained and used include the maximum temperature (TX), minimum (TN) and precipitation (PREC). For the Kota Kinabalu Airport station, the data is available from 1976 to 2019, spanning 44 years, whilst data from Subang Airport station starts in 1997.

In the current study, we focused on extreme rainfall or drought and heat-related indices. These health sector-specific indices are depicted in Table 2 and identified by the Expert Team on Sector-Specific Climate Indices (ET-SCI). These selected indices are considered as proxies of the relevant hazards associated with climate extremes relevant to public health sectors and were computed from the CORDEX-SEA simulated daily meteorological variables, namely:

a. maximum near-surface air temperature,
b. minimum near-surface air temperature, and
c. precipitation of the grids (25kmx25km) that contain the Kota Kinabalu Airport Station.

The changes to these indices in the future were calculated as the differences between the future values and the historical reference values from the regional climate model's output.

Table 2: Health sector-related climate indices examined

Indices	Description
HWN	Heat wave number. A heat wave is defined as three or more days where T*X* > 90th percentile of *TX.*
HWD	Heat wave Duration. The length of the longest heat wave identified by HWN.
HWM	The mean temperature of all heat waves identified by HWN.
CDD	Consecutive dry days. The maximum dry spell length in a year.
CWD	Consecutive wet days. The maximum wet spell length in a year.

3.1.2 Evidence of climate change at Pulau Gaya

Based on the heat wave definition as per Table 2, heat wave events were not recorded until the early 2000s. The hottest and longest event recorded was in 2016, where an extremely high-temperature period extended over about ten days. This was in conjunction with the strongest El Niño event extending from 2015 to 2016 (Santosa et al. 2017). In 2016, much of the Southeast Asia Maritime region experienced record-breaking extreme heat events.

Thirumalai et al. (2017) has estimated that although the 2015-2016 El Niño event contributed to ~49% of warming during this period, anthropogenic global warming has contributed 29%. Therefore, global warming greatly increases the likelihood of record-breaking extreme heat events during El Niño over time. El Niño events have been associated with various disease outbreaks worldwide (Anyamba et al. 2019). In Malaysia, El Niño has been associated with heat wave events and haze pollution and related diseases such as heat stroke and respiratory and cardiovascular diseases. As a corollary, the increased likelihood of extreme heat events under a future warmer climate is also expected to increase the disease burden. Nevertheless, the proper quantification of such a relationship is challenging.

Figure 5 shows the projected changes in heat wave number for the three different epochs. The ranges of the bars are projected ranges of the changes. The heat wave number is projected to increase dramatically in the future, suggesting an increased risk posed to extreme health-related public health sectors. The likelihood of heat wave occurrences is projected to be three to seven times higher compared to the historical period. Nevertheless, it is noted that the increment of heat wave occurrences is less sensitive to emission scenarios. Both RCP4.5 and RCP8.5 project very similar future changes of heat wave occurrences. However, the changes in heat wave duration and magnitude are very dependent on emission scenarios.

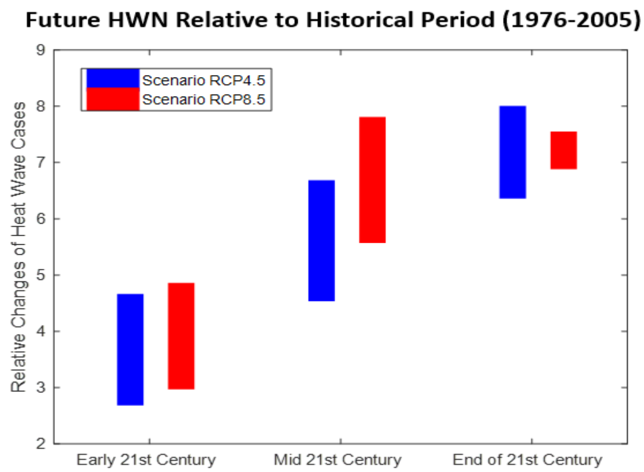


Figure 5: Relative changes of future heat wave numbers of the early 21st century, mid-21st century, and end of 21st century for RCP4.5 and RCP8.5 downscaled projections. Refer to the text for the definition of future time epochs

We also looked into the relative changes of heat wave duration and magnitude over the study areas, respectively. Similarly, heat wave magnitude also shows a remarkable difference between the two emission scenarios, particularly towards the end of the 21st century but with larger discrepancies towards the end of the 21st century. Here, changes in magnitude can be 1-1.8°C more compared to the historical period. Projections of future heat waves are generally consistent with the elevated heat in the climate system and increasing surface temperature. Compared to future temperature projections, rainfall projections have larger uncertainties and can be noisy (full report in Appendix 3-3.1). Overall, the increasing wet spell length in RCP8.5 suggests a likelihood that wet spells will continue to lengthen into the future if the future earth is tracking the worst-case scenario (Figure 6).

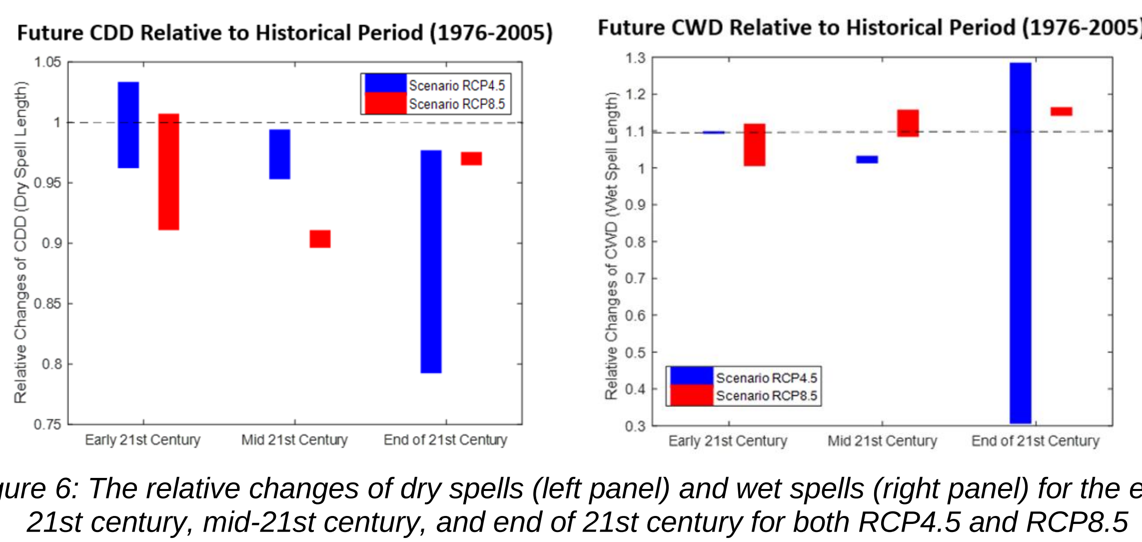


Figure 6: The relative changes of dry spells (left panel) and wet spells (right panel) for the early 21st century, mid-21st century, and end of 21st century for both RCP4.5 and RCP8.5 downscaled projections

3.1.2 Evidence of climate change in Peninsular Malaysia

Figure 3.3 shows the projected changes of heat wave number (changes in duration and magnitude are shown in Appendix 3-3.1), respectively, for the three different epochs. Like Kota Kinabalu, the heat wave number here is projected to increase dramatically in the future, indicating an increased risk of extreme heating issues in temperature-sensitive socio-economic sectors. The likelihood of heat wave occurrence is projected to be three to six times higher than the historical period of 1976-2005. The increment of heat wave occurrence is less sensitive to the emission scenarios. Nevertheless, heat wave duration and magnitude changes are sensitive to the emission scenarios considered in the projection and dependable on world socio-economic development. A higher emission scenario, i.e. RCP8.5, is expected to double the heat wave duration compared to the RCP4.5 toward the end of the 21st century. Similarly, the heat wave magnitude also shows a remarkable difference between the two emission scenarios, particularly toward the end of the 21st century (Figure 7). The projection of future heat waves is generally consistent with the elevated heat in the climate system and increasing surface temperature.

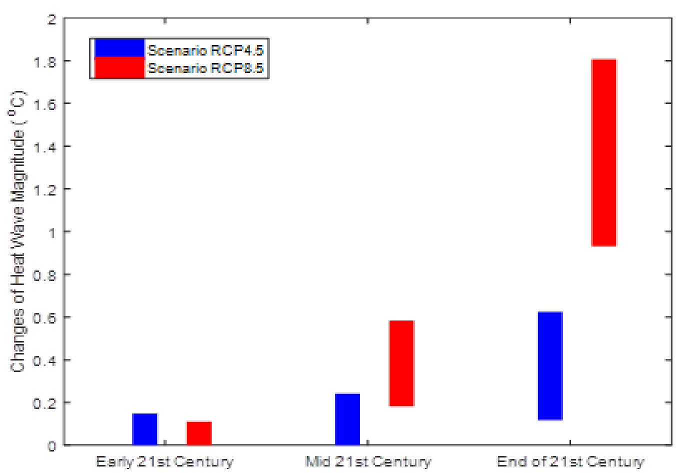


Figure 7: The relative changes of future heat wave magnitude at Subang for the early 21st century, mid-21st century, and end of 21st century for both RCP4.5 and RCP8.5 downscaled projections

3.1.3 Key findings on climate change

The changes of health-related climatic indices, i.e. wet and dry spells length, heat wave occurrence, duration, and magnitude, were analysed at two study locations – Kota Kinabalu and Subang. The observational data were obtained from the Malaysian Meteorological Department-maintained meteorological stations located close to or in the vicinity of the study areas. The full reference to this study is available in Appendix 3-3.1. It is evidenced that:

1. **Heatwaves have become more frequent after the 2000s. Changes can be observed in terms of heatwave number, duration, as well as magnitude. The historical observation also signifies lengthened wet spells and shortened dry spells.**

2. **The downscaled projection of the future climate based on a subset of CORDEX-SEA simulations output has suggested the high likelihood of a continual increment of heatwaves in terms of number, duration, and magnitude.**

3. **Heatwave occurrence frequency appears to be less sensitive to greenhouse concentration pathways, but its duration and magnitude showed considerable dependence on greenhouse concentration pathways. Both duration and magnitude appear more severe in the higher emission scenarios.**

4. **Rain spells are projected to become longer under the higher emission scenario, while future conditions remain uncertain under the lower emission scenario (RCP4.5). The dry spell length is projected to become shorter under both RCP4.5 and RCP8.5**

3.2 Desk Study 2: The effect of ambient air pollution on childhood respiratory diseases in Asia's low- and middle-income countries (LMIC): A systematic review

By Dr Mohd Faiz Ibrahim

3.2.1 Method

Desk Study 2 reviews the literature on ambient air pollution and childhood respiratory diseases in Asia and air quality changes contributing to climate change. Studies on the population below 18 years at baseline in Asia's LMICs were included. LMICs are defined as those with a Gross National Income (GNI) per capita in 2018 between USD1,025 and USD3,995 (World Bank n.d.). The Asian continent was based on geographical regions used by the Statistics Division of the United Nations (UNSD n.d.). The selection criteria were per the PECOS (Population, Exposure, Comparators, Outcomes and Study Design) statement (Table 3).

Table 3: PECOS statement approach

PECOS Element	Approach
Population	The age of the studied population is below 18 years
Exposure	Exposure to ambient PM_{10}, $PM_{2.5}$, CO, NO_2, SO_2, and/or O_3
Comparators	Children exposed to lower levels of air pollutants than the more highly exposed in Asia's LMICs
Outcomes	Morbidity and mortality of childhood respiratory diseases
Study design	Cohort, case-control, case-crossover, time-series and cross-sectional studies

A systematic search was conducted using PubMed, Ovid Medline and Scopus databases. Published articles were searched using the search terms combined with the Boolean operator 'AND' and 'OR'. The combined results were then refined by year of publication from 2010 until 2019 and filtered by language. Studies published other than the English language were not included in the review. The systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Quality and risk of bias of the included studies were assessed using the Appraisal tools for Cross-Sectional Studies (AXIS), Newcastle-Ottawa Scale (NOS) and Mustafic's quality assessment tools according to the study design. Each of the included studies was appraised using the adapted risk of bias assessment tool from the Office of Health Assessment and Translation (OHAT).

3.2.2 Results

This review synthesized 41 studies published between 2015 and 2019 and examined the links between ambient air pollutants and childhood respiratory diseases in Asian LMICs. Our key findings from this systematic review are:

1 **Ambient air pollution was associated with acute and chronic childhood respiratory diseases, including respiratory-related mortality.**

2 **Exposure to ambient air pollution was associated with the risk of outpatient/hospital visits, emergency department visits and hospital admissions for respiratory symptoms and diseases.**

3 **There was significant variability in study design, exposure assessment method, confounder adjustment and outcome assessment method. Due to age group variation, it was not possible to identify specific groups susceptible to the adverse effects of**

To our knowledge, this is the first and largest review and analysis of the current evidence investigating the impact of air pollution on childhood respiratory diseases in Asian LMICs. Our results would be helpful for public health policymakers to shape environmental strategies for action required to reduce exposure to ambient air pollution, especially among children. However, the current studies are concentrated in China, and there is a lack of evidence from other Asian LMICs with poor air quality, such as the South Asian and Southeast Asian countries. This work has recently been published (Ibrahim et al. 2021, Appendix 14). The references mentioned in Table 3 is available in Appendix 3-3.2.

3.3 Desk Study 3: Association between air pollution and childhood respiratory admissions: A time-series analysis in Sarawak and Kuala Lumpur, Malaysia

By Dr Mohd Faiz Ibrahim

3.3.1 Method

Desk Study 3 continues assessing studies estimating the risk of ambient air pollution on childhood respiratory diseases in Asia. Here, we conducted time-series analyses in Klang Valley and Sarawak, Malaysia (Figure 8). Klang Valley is a Malaysian urban area centred on Kuala Lumpur and encompassing cities and towns in the states of Selangor and Putrajaya. With a population of around 8 million people, Klang Valley is Malaysia's industrial and commercial heartland. In comparison, Kuching is the capital and most populous city of Sarawak, a state in East Malaysia. The city is located at the southwest tip of Borneo and has a population of approximately 325,132 people. This study included children under the age of 18 who lived in Klang Valley and Kuching. It is assumed in this study that sick children were transported from their homes to the nearest hospital.

The Department of Environment (DOE) Malaysia's Continuous Ambient Air Quality Monitoring Station (CAAQMS) provided daily ambient air pollution data, which included measurements of 24-hour PM_{10}, SO_2, NO_2, CO and O_3 between 1st January 2010 and 31st December 2018. Data on children's hospital admissions were obtained from two main sources. The first was the Malaysian Health Data Warehouse (MyHDW), derived from all MOH hospitals in Malaysia. The second was from an electronic database of Hospital Canselor Tuanku Mizan, a teaching hospital. A total of 17 hospitals in Klang Valley and Sarawak were included. Demographic information (including age and gender) was also obtained from the MyHDW. Relationships between air pollution and hospital admissions were investigated for both genders (male and female) and age groups (zero to four years, five to nine years and ten to 17 years).

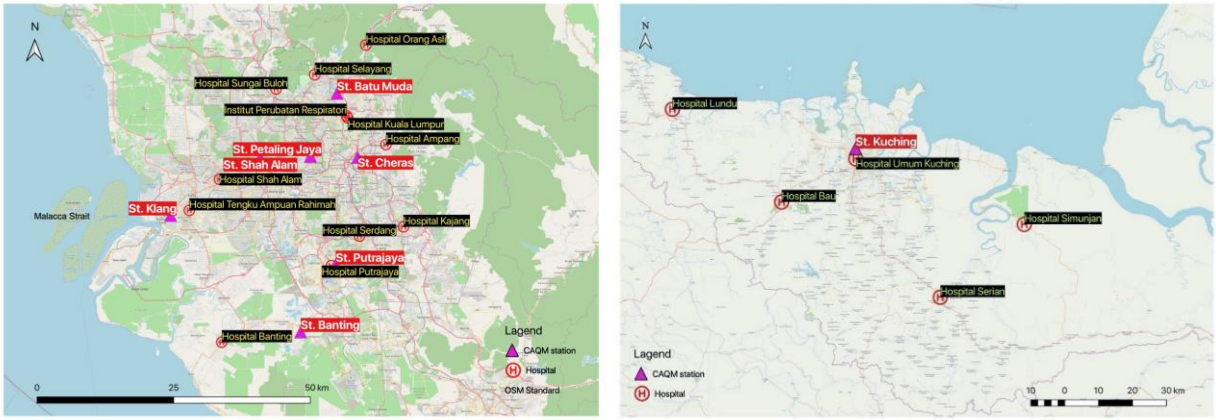


Figure 8: Location of included monitoring stations and hospitals in Klang Valley (left panel) and Kuching (right panel)

3.3.2 Results

Figure 9 below shows the total number of hospital admissions for respiratory diseases in Klang Valley and Kuching from 1st January 2010 to 31st December 2018 by gender.

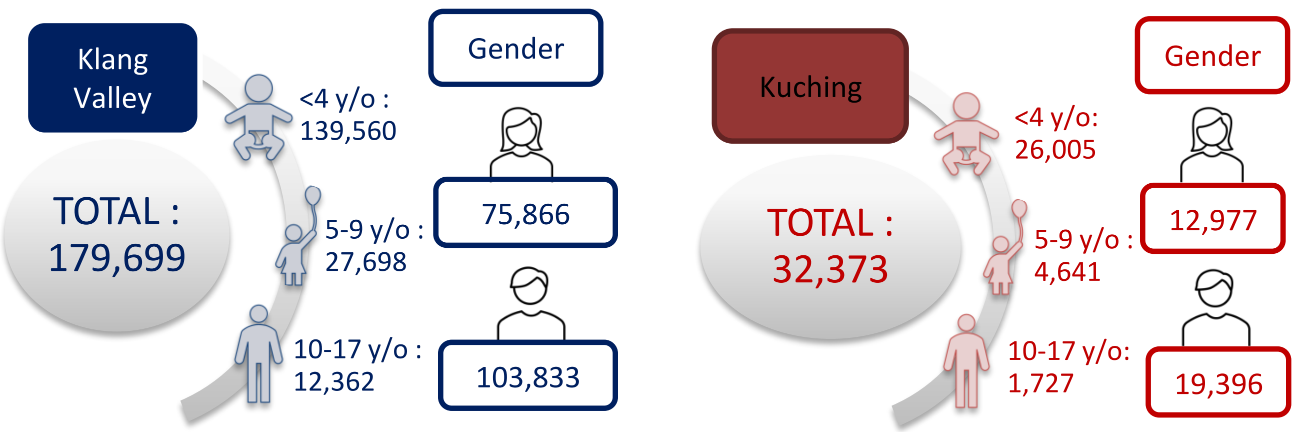
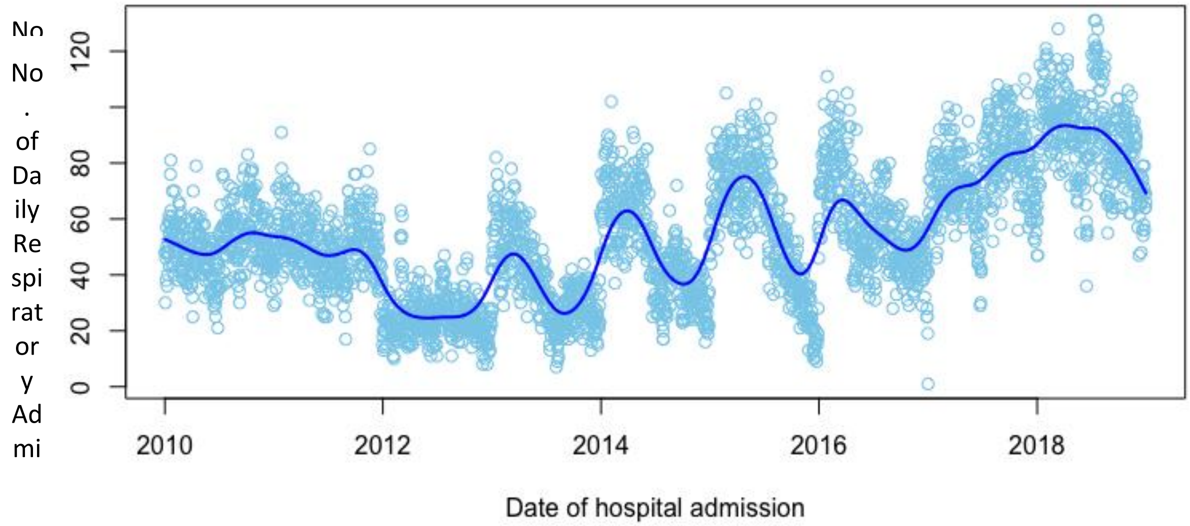


Figure 9: Total number of hospital admissions for respiratory diseases in Klang Valley and Kuching with gender breakdown

The trends of daily hospital admissions for respiratory diseases in Klang Valley and Kuching showed increased respiratory admissions throughout the study period (Figure 10).



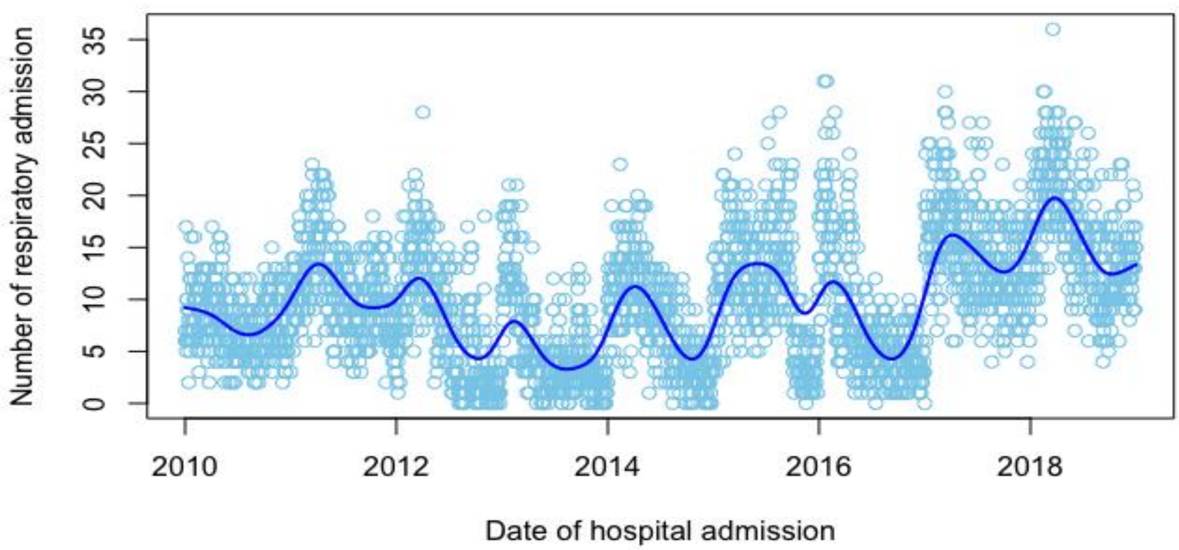


Figure 10: Daily count of hospital admissions for respiratory diseases and smoothed trend in (top panel) Klang Valley and (bottom panel) Kuching, 2010-2018

The results of the Pearson correlation test showed that there were significant correlations among most of the pollutants and meteorological factors. This finding indicates that as the temperature rose, so did the concentration of O_3. Significant negative correlations were also found between PM_{10} and humidity ($r = -0.21$, $p < 0.01$), SO_2 and humidity ($r = -0.18$, $p < 0.01$), and O_3 with humidity ($r = -0.10$, $p < 0.01$). These negative findings suggest that dry weather raises the concentration of air pollutants.

In Kuching, significant correlations were found between the pollutants except those between SO_2 with humidity, and NO_2 with temperature and humidity. The strongest significant correlation found in Kuching was between PM_{10} and CO ($r = 0.54$, $p < 0.01$), followed by O_3

and temperature ($r = 0.32$, $p < 0.01$). Similar to Klang Valley, there were significant negative correlations between PM_{10} and humidity ($r = -0.16$, $p < 0.01$), O_3 and humidity ($r = -0.05$, $p < 0.01$), and CO with humidity ($r = -0.04$, $p < 0.01$).

This study found that short-term exposure to ambient air pollution increases the risk of respiratory disease up to eight days (seven days lag) after the exposure. In Klang Valley, SO_2 and O_3 were significantly associated with increased respiratory hospital admissions, whereas in Kuching, only PM_{10} was significantly associated with increased total admissions for respiratory diseases among children. However, all pollutants except O_3 was found to be significantly associated with an increase in respiratory hospital admissions among children aged five to nine years old in Kuching.

The multi-pollutant models demonstrated that in Klang Valley, SO_2 was the most significantly associated pollutant with respiratory hospital admissions, while PM_{10} was the most significantly associated pollutant in Kuching.

This observation was expected due to the urban and dense population of Klang Valley, which leads to a higher level of SO_2, NO_2, CO and O_3 compared to Kuching. The high level of PM_{10} in Kuching is caused by local biomass burning and exacerbated by the annual transboundary haze from Kalimantan, Indonesia (Abdullah et al. 2020).

This study shows that both boys and girls in Klang Valley were susceptible to air pollution. However, gender was not a significant modifier in this study since no significant difference was observed between them, consistent with other epidemiological studies (Bai et al. 2018, Ding et al. 2017, J. Wang et al. 2019). However, the sensitivity of gender was inconsistent in published studies on the effects of ambient air pollution and respiratory disease in children. Previous studies found that the risk of ambient air pollution on respiratory disease was higher in boys than that in girls (Al Qerem et al. 2010, Dong et al. 2011, Spencer-Hwang et al. 2016). These results might be attributed to boys spending more time outdoor than girls, which expose them to more air pollution.

Based on age group, statistically significant associations were found for children aged zero to nine years but not for children aged ten to 17. These results showed that younger children (zero to nine years old) were susceptible to air pollution, but children aged five to nine in Kuching were more vulnerable to the effects of SO_2, NO_2, PM_{10}, and CO compared to children under five. This is because children aged five to nine years old tend to engage in outdoor activities more frequently than younger children. Children younger than five years old usually only go outside their house or preschool with an adult or caretaker. In Malaysia, children aged seven years old start attending school. They are involved in many outdoor activities such as travelling from home to school, playing sports, and participating in outdoor co-curricular activities.

3.3.3 Conclusion

The findings of this study have important population health implications because they demonstrate the association between a variety of air pollutants and hospitalisation for respiratory diseases among children in Malaysia.

> **Except for NO_2 in Klang Valley and several spikes of PM_{10} due to transboundary haze episodes in Klang Valley and Kuching, ambient concentrations level of air pollutants are relatively low in Klang Valley and Sarawak.**

The findings provide evidence that short-term exposure to ambient air pollution increases the risk of hospitalisation for respiratory diseases in children. Children's ages have been identified as a moderator of respiratory hospital admissions, with children five to nine being more vulnerable to ambient air pollution. In Klang Valley, gaseous air pollutants from urban activities increased the risk for respiratory admissions among children, while in Kuching, the risk increased due to PM_{10} from transboundary biomass burning. This study's findings can help address impartiality concerns on air pollution among reviewers and policymakers, leading to changes in decision-making towards evidence-informed policy decisions.

> **Short-term exposure to ambient air pollution increases the risk of hospitalisation for respiratory diseases in children.**

> **Children aged five to nine years are more vulnerable to ambient air pollution.**

> **In Klang Valley, gaseous air pollutants from urban activities increased risk for children respiratory admissions, while in Kuching, the risk increased due to PM_{10} from transboundary biomass burning.**

There are several limitations to our study. First, the exposure assessment was performed by averaging the air pollutant concentration from several fixed monitoring stations across the city to reflect daily city-wide exposure levels. Hence, the personal exposure levels of each subject were not evaluated. In addition, the concentrations of air toxins, such as diesel exhaust particles or surrogates, such as black carbon or soot, were not monitored. Second, this study does not measure personal behaviour and socio-economic status, such as child nutrition or time spent outdoors, which may affect the magnitude of the observed associations when compared to other studies with different behaviour profiles. Finally, our assessment is at a city level. Therefore, air pollutant concentrations in the study could not be representative of individual exposures. Hence, the results for the association should be interpreted carefully to avoid ecological fallacy. The full report and references for this desk study are available in Appendix 3-3.3.

3.4 Desk Study 4: Assessing the health effects of wildfire haze among children in Malaysia

By Dr Vera Phung

3.4.1 Method

Our fourth desk study investigates the health impacts of air pollution and haze on children in Malaysia. In epidemiological studies, exposure assessments of haze events are usually indicated via binary or categorical variables, which are derived from particulate matter (PM) concentration (Sahani et al. 2014), pollutant standard index (Ho et al. 2014), and visibility (Sastry 2002). Some studies also applied haze intensity (Faustini et al. 2015) and duration (Faustini et al. 2015, Kunzli et al. 2006). This study investigated the association between haze and under-five mortality in Malaysia by accounting for three aspects: duration, intensity, and time lag.

Using a generalized additive model, we examined under-five mortality related to haze in Malaysia from 2014 to 2016. Considering districts with over 500,000 population and available monitoring stations for exposure assessment, 12 districts were selected (Figure 11): Kuala Muda, Timur Laut, Kinta, Kuala Lumpur, Klang, Petaling, Melaka Tengah, Johor Bahru, Seremban, Kuantan, Kota Bharu, and Kuching.

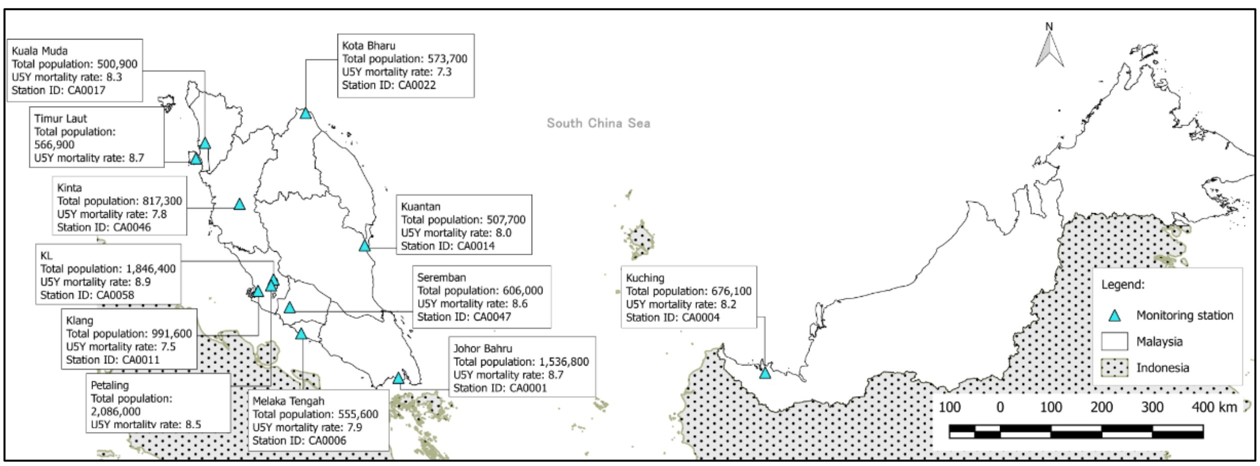


Figure 11: Map of Malaysia showing the districts included in this study

Health data was obtained from the Family Health and Development Division, MOH Malaysia. All-natural deaths (hereafter 'all-cause') (International Classification of Disease, 10th Revision (ICD-10: A00-R99)) were included, whereby deaths due to accidental, traumatic, and external causes were excluded (ICD-10: S00-Y98). Air pollutant and weather data were obtained from the Air Quality Division, DOE.

'Haze day' was defined by intensity and duration based on the PM_{10} concentration. Four levels of intensity were defined based on PM concentration, while three durations were defined if the haze day occurred for one, two, and three or more successive days. We also examined the lag effects of the association: single lag and moving average lags up to seven days. All the statistical analyses in this study were performed using the R statistical software (R Core Team 2018). Under-five mortality accounting results for each aspect are reported as an odds ratio (OR) with a 95% confidence interval (95% CI).

3.4.2 Results

We found an insignificant association between haze and under-five mortality. However, we observed that health effects could be more acute or immediate (i.e. at shorter lags) when a haze episode occurred for a longer duration and at a higher intensity. The patterns were also different when we stratified the analysis by 'low' or 'high' exposure (i.e. cutoff at the 95th-percentile of the district's PM_{10} concentration = 100µg/m3). The districts categorized as 'low' exposure were sensitive towards haze days defined at Intensity-2 (PM_{10} >75µg/m3), and districts categorized as 'high' exposure showed higher risks (odds ratio, OR) at Intensity-3 (PM_{10} >100µg/m3) and Intensity-4 (PM_{10} >150µg/m3). We observed a marginal positive association at Intensity-2 Duration-3 (OR: 1.210 (95% CI: 1.000, 1.464)). These findings suggest careful considerations when examining the health effects of different haze conditions. The full report and references for this desk study are available in Appendix 3-3.4.

Health effects could be more acute or immediate (i.e. at shorter lags) when a haze episode occurred for a longer duration and at a higher intensity.

The districts categorized as 'low' exposure were sensitive towards haze days with lower haze intensity (PM10 >75µg/m3) and districts categorized as 'high' exposure showed higher risks at higher haze intensity (PM10 >100µg/m3).

3.5 Key findings from desk studies

In conclusion, our findings from these desk studies provide emerging evidence that co-exposure to air pollution has synergistically augmented lung function reduction in children. The following are the main points that should be considered for further deliberation, particularly in drafting policy related to climate change and children.

Climate	**Historical Climate and Projected Future climate Changes in Malaysia** **Climatic projections showe the increased frequency of heatwave from year 2000 till the end of the 21st century; therefore children would be more susceptible to climatic changes.**
Systematic Review	**Air Pollution and Childhood Respiratory Diseases in Asian's Low- and Middle-Income Countries (LMICs)** **Short and long-term exposure to ambient air pollution is associated with increased childhood respiratory morbidity and mortality in Asian LMICs including Malaysia.**
Air Pollution	**Childhood Respiratory Diseases Attributed to Ambient Air Pollution in Sarawak and Klang Valley** **In Klang Valley, SO_2 from urban pollution and PM_{10} in Kuching significantly increases the risk of respiratory hospital admissions among children aged five to nine years.**
Haze	**Effects of Wildfire (Haze) Air Pollution on Mortality of Children Under Five (U5Y) in Malaysia** **When haze occurs for a longer duration and at a higher intensity, health effects would be more acute among very young children.**

4 CASE STUDIES

Marginalised groups, especially marginalised children, are particularly vulnerable to climate change because of their socio-economic status. Marginalised children are defined as children outside and peripheralized from the mainstream group or centre of society. They have little control of their lives, few resources available and face stigmatization due to negative public attitudes. In Malaysia, the estimate for marginalised children under 18 years old stands at approximately 290,000 in 2016.[2] These include children who were unregistered at birth, adopted, or abandoned, have parents who did not register their marriage, or are part of marginalised communities like indigenous peoples, refugees, undocumented peoples, or migrants.

Marginalised children from refugee, migrant, and asylum-seeker families often suffer from low health literacy. They are also more likely to suffer from health problems caused by environmental issues such as access to water and sanitation. Our team conducted case studies in three areas in Malaysia with a high population of marginalised children to identify how these children are particularly at risk to the impacts of climate change and environmental degradation.

4.1 Study locations and population groups

Case studies have been conducted in three different locations: Pulau Gaya in Sabah (6°1.0798'N 116°1.7909'E), Pos Kuala Mu, Sungai Siput (U), Perak (4°50.2499'N 101°20.0445'E) and People's Housing Project (*Projek Perumahan Rakyat* or PPR) Sungai Bonus, Setapak, Kuala Lumpur (3°11.1778'N 101°43.3215'E). The people living in all three locations consist of marginalised communities: documented and undocumented Bajau groups in Pulau Gaya, Temiar indigenous people (Orang Asli) in Sungai Siput (U), and B40 (bottom 40% low-income group) families in PPR Sungai Bonus, Kuala Lumpur.

These three communities live in three different geographical settings, an island, a mountainous region and a city at the confluence of the Klang and Gombak Rivers in a huge valley bordered by mountain ranges. These areas were chosen as locations for the case studies to demonstrate how climate change patterns and trends and environmental degradation affect the degree of behavioural changes among children living in these 'extreme' areas. By observing the impacts on these children, we can have a rough estimate of other children living in other parts of Malaysia.

[2] http://www.malaysiakini.com/news/385006#0S5iS1aSILHlk5k7.99

4.1.1 Pulau Gaya, Sabah

By Dr Lai Che Ching @ Abd Latif

Pulau Gaya is an island with an area of 1,465 hectares, located a 15-minute boat ride (Figure 12) from the capital of Sabah, Kota Kinabalu. More than three-quarters of the island falls under the jurisdiction of Sabah Parks, as it is one of the five islands gazetted within the Tunku Abdul Rahman Marine Park (Sompud et al. 2019). The majority of the villagers live in squatter settlements, but some build their houses on their own land or at the gazetted village areas (City Planning Department, Kota Kinabalu City Hall, 2013). The majority of the villagers are 'Bajau Laut' or 'sea gypsies' due to their seafaring skills (Said 2011). Besides Bajau, small minority groups such as Bisaya, Kagayan, Rungus, Chinese, Suluks, and Ubian also reside here (Krauss et al. 2014).

Figure 12: Distance from Pulau Gaya to Kota Kinabalu city, Sabah. Source: Google Maps

The houses of the villagers (Figure 13) sit along the island's beachfront. They are made from wood and built on pillars erected on the ocean floor. Usually, immediate or extended families will stay together, resulting in more than seven people residing in one house (Said 2011).

Figure 13: Houses of the villagers in Pulau Gaya

There are two types of schools available in Pulau Gaya, i.e. government schools and an Alternative Learning Centre (ALC) (Figure 14) under the management of the National Security Council (MKN), Sabah state branch. Figure 15 below shows the location of the government schools in Pulau Gaya, i.e. SK Pulau Gaya (primary school) and SMK Pulau Gaya (secondary school).

Figure 14: ALC in Kampung Lok Urai, Pulau Gaya

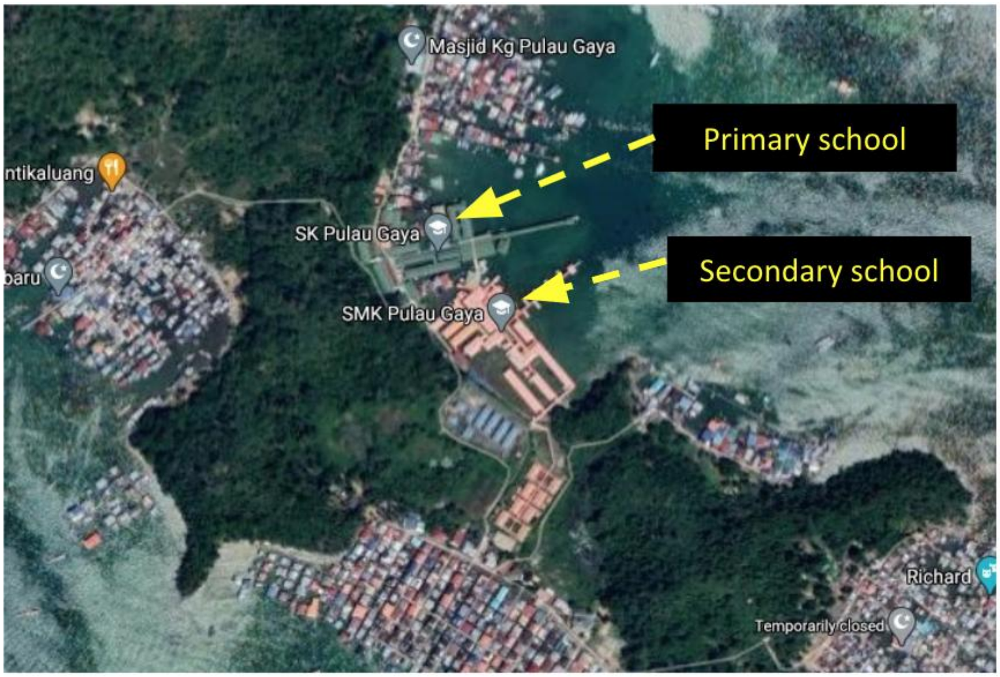


Figure 15: Primary and secondary school in Pulau Gaya. Source: Google Maps

There are no health facilities available on Pulau Gaya. The villagers need to go to clinics or hospitals on the mainland to seek medical treatment. Boat transport services are easily and cheaply available and serve as the main mode of transportation for the villagers to Kota Kinabalu (Said 2011).

4.1.2 Pos Kuala Mu, Perak

By Prof Dr Hidayatulfathi Othman

Pos Kuala Mu, one of the Orang Asli villages in Sungai Siput (U), Perak, is located on an elevated terrain in the Titiwangsa mountain range. It is a mountainous area surrounded by lush rainforests. There are four different villages (Kampung Kuala Mu, Kampung Gapeh, Kampung Toh, and Kampung Bersah) in Pos Kuala Mu, each headed by its village chief known as 'Tok Batin' in the Malay language. Figure 16 below show the villagers' houses and the river near the chalet area in Pos Kuala Mu.

Figure 16: Villagers' houses and the river near the chalet area in Pos Kuala Mu

The village is more than 60km away from Sungai Siput town (Figure 17), and the road towards the Pos was recently paved in 2018. The road that winds up the mountain is narrow and can only fit one large vehicle at a time. Other Orang Asli villages that can be found in Sungai Siput (U) Perak are Kampung Chenein, Kampung Bawong, Kampung Kajang, Pos Poi, Pos Piah, Pos Legap and Pos Perwor.

Figure 17: Distance from Pos Kuala Mu, Perak to Pekan Sungai Siput (U) Perak, Malaysia. Source: Google Maps

The nearest health facility, Lintang health clinic (Figure 18) is about 48.8km away from the Pos, while hospitals can be found in Sungai Siput town.

Figure 18: Lintang health clinic, Sungai Siput (U), Perak. Source: Google Maps

The primary school, SK Pos Kuala Mu, is only about 5km away from Kampung Bersah, the village where the focus group discussions (FGDs) and in-depth interview (IDI) sessions were conducted. Other primary schools that can be found in this area are SK Pos Piah, SK Pos Poi, SK Pos Kuala Mu, SK Pos Legap, SK Pos Perwor, SK Kampung Kenang and SK Pos Pelantok. There is only one secondary school, SMK Bawong. It is the first Orang Asli secondary school in Malaysia and was opened in 2016. This school provides boarding facilities for students who live far away from school. The opening of this school has benefited Orang Asli children from 57 villages around here, including Kampung Chenein, Kampung Bawong, Kampung Kajang, Pos Poi, Pos Piah, Pos Legap and Pos Perwor.

Recently on 9th November 2020, the Orang Asli One Stop Centre (OAOSC) Bawong Project Handover Ceremony was held. This OAOSC is one-of-a-kind in Malaysia and was built by the Department of Orang Asli Development (JAKOA) Malaysia and JAKOA Perak and Kedah states. This OAOSC has ten shop lots, a bus terminal, a hall and administrative complexes (JAKOA 2020).

4.1.3 PPR Sungai Bonus, Kuala Lumpur

By Associate Prof Dr Yanti Rosli

The PPR Sungai Bonus housing area is in Setapak, Kuala Lumpur. It is a low-cost leasehold flat situated in an urban area and consists of two blocks of 15 stories with 632 residential units. Each unit is not less than 700 ft^2 with three bedrooms and two bathrooms, a kitchen, and a hall. Figure 19 below shows Block G of PPR Sungai Bonus, Kuala Lumpur.

Figure 19: Block G of PPR Sungai Bonus, Kuala Lumpur

The PPR is part of a government programmeme for squatters' relocation and provides housing requirements for low-income earners. Thus, most of the tenants in PPR Sungai Bonus are B40 families. Eligibility requirements for PPR housing are that the applicant and spouse are Malaysian, do not own a house, are aged 18 years old and above, and have a gross household income of RM 3,000 per month or less. The applicants can either rent the units at RM124 per month or purchase the unit. Basic facilities found in PPR Sungai Bonus include the community hall/public space, surau, retail space, kindergarten, playground, and rubbish collection station (Appendix 4, Figure 2.1).

4.2 Data collection

Data collection for the case studies were carried out between August 2020 and December 2020. For Pulau Gaya, Sabah and Pos Kuala Mu, Perak, data collection was conducted primarily in schools (Appendix 4, Figure 70, Figure 71, Figure 72). For the quantitative studies, questionnaires were distributed to children (Appendix 4, Figure 73). Qualitative studies involving the IDI and FGD method were conducted with the children, teachers and community representatives (Figure 20, Figure 21). Details of participants involved for each community are as shown in Appendix 4 (Table 47). The sampling technique used for both types of studies was the purposive sampling method.

Figure 20: FGD sessions with the community in Pos Kuala Mu, Perak

Figure 21: FGD sessions with children in PPR Sungai Bonus, Kuala Lumpur

4.2.1 Quantitative study: Questionnaire survey

For the quantitative study, data was collected through a piloted questionnaire with six sections: demographic details, health status and well-being, socio-economic background and living conditions, accessibility and mobility to basic social services, the impact of climate change and environmental degradation, and coping mechanisms. This questionnaire was developed by the UKM and UMS teams through several discussion sessions and was modified based on their location area and target participants. A guided, self-administered technique was adopted for questionnaire data collection. The inclusion criteria for participants were children age six to 18 years old and healthy (in terms of intelligence).

4.2.2 Qualitative study: In-depth interviews and focus group discussions

As for the qualitative method, IDIs and FGDs were employed to gain insights into the community's current vulnerability. Semi-structured interview questions were developed by the UKM and UMS teams through several discussion sessions (Figure 22). The inclusion criteria for IDIs and FGD sessions were males or females of any age who consented to the study. Meanwhile, for the FGD session in PPR Sungai Bonus, Kuala Lumpur, the inclusion criteria were children aged six to 18 years old and mentally healthy. Each IDI and FGD session was completed within 30 minutes to 2 hours. A brief explanation about the study was given before starting the sessions. Both IDIs and FGD sessions were recorded with permission, and the audio was later transcribed into written text.

Basic structure of questions for IDIs and FGDs (children and community)

- Knowledge about the climate and its relation to weather changes and well-being
- Observed changes related to the climate and environment
- Impact of climate change and environmental degradation
- Strategies to prevent and minimize the impact of climate change and environmental degradation

Basic structure of questions for IDIs (teachers)

- Information about climate change and environmental degradation in school syllabus
- Impact of climate change and environmental degradation to students
- Attendance of seminars related to climate change and environmental degradation as part of teaching course
- Knowledge related to climate change and environmental degradation

Figure 22: Basic structure of questions for IDIs and FGDs

Principal Component Analysis (PCA) was used to analyse the children's opinions regarding their socio-economic background and living condition, accessibility and mobility, the impact of climate change and environmental degradation, and coping mechanisms in the questionnaire. From the PCA analysis of the questionnaire dataset, several components were identified and divided into three main themes: vulnerability, resilience and accessibility. Under these main themes, other indicators were grouped based on the respondents' answers: social support, safety, living conditions, supporting family, attitude towards the environment, gender equity, heat resilience, rain resilience, health facility, rain and mobility, and education.

4.3 Results

4.3.1 Socio-demographic characteristics of participants from case studies

The socio-demographic characteristics of participants in Pulau Gaya, Sabah, Pos Kuala Mu, Perak and PPR Sungai Bonus, Kuala Lumpur for the quantitative studies are summarized in the following figure (Figure 23). In the questionnaire survey, the average age of the participants was between ten to 14 years old across the locations. The quantitative study for Pulau Gaya, Sabah and Pos Kuala Mu, Perak was conducted at school, and the number of female participants was higher than male participants for both communities. For PPR Sungai Bonus, Kuala Lumpur, the study was conducted among the community since the school was closed due to the COVID-19 pandemic. Here, the number of male and female participants was almost equal. The following figure depicts the number of participants based on the type of schools attended and the main race or ethnicity of the participants.

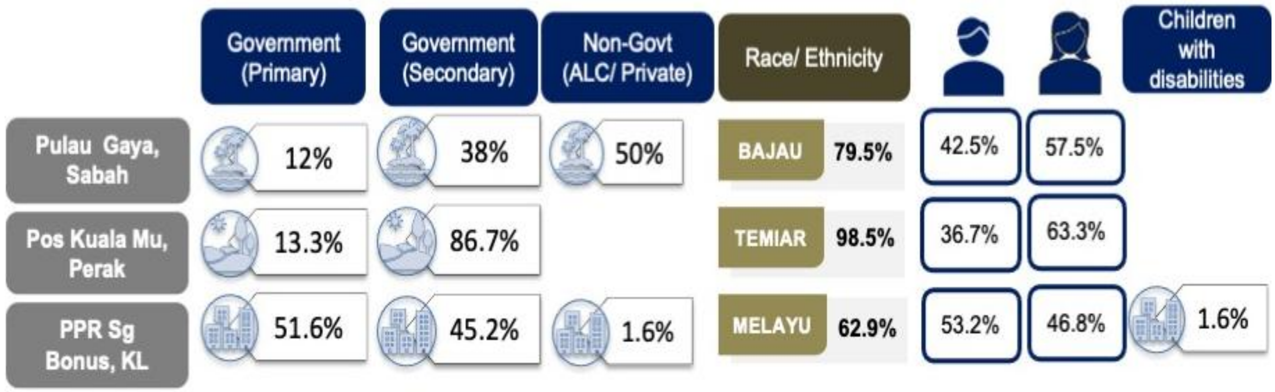


Figure 23: Brief socio-demographic characteristics of participants in case studies

About 70% of the participants from all three locations lived with their parents and the rest with legal guardians. Only one child with disabilities participated in this survey, and they were from PPR Sungai Bonus, Kuala Lumpur. The main participants of IDIs for Pulau Gaya, Sabah and Pos Kuala Mu, Perak were teachers from the primary and secondary schools and ALC, as shown in Appendix 4 (Table 49, Table 50). However, the IDIs with teachers were not carried out at PPR Sungai Bonus, Kuala Lumpur, due to school closure because of the COVID-19 pandemic (Table 4). Meanwhile, for Pos Kuala Mu, Perak and PPR Sungai Bonus, Kuala Lumpur, the IDI sessions were carried out with community members instead due to the lack of participants from the FGD session.

Table 4: Profile of respondents for IDIs

		Pulau Gaya	Pos Kuala Mu	PPR Sungai Bonus
IDI	**Teachers**	✓	✓	✗
	Age	20-60 years old		
	Gender	Male: 64.7% Female: 35.3%	Male: 42.9% Female: 57.1%	
	Service period (years)	11-15	1-5	
	Community	✗	✓	✗
	Age		40-70 years old	
	Gender		Male: 100 %	

We made a minor adjustment to the FGD participant recruitment process to ensure enough responses were collected. Our major hindrance was getting enough participants, as we had to adhere to COVID-19 related social gathering restrictions while carrying out this study. In PPR Sungai Bonus, the FGD sessions were conducted with children. Details of the FGD respondents are detailed in Table 5.

Table 5: Profile of respondents for FGDs

		Pulau Gaya	Pos Kuala Mu	PPR Sungai Bonus
FGD	**Children**	✗	✗	✓
	Age ***Gender***			10-18 years old Male: 56.6 % Female: 43.5%
	Adult	✓	✓	✓
	Age ***Gender***	Male: 50 % Female: 50 %	20-70 years old Female: 100%	Male: 50 % Female: 50 %

4.3.2 Socio-economic characteristics of participants

Table 4.2 shows the socio-economic characteristics of participants from communities in Pulau Gaya, Sabah, Pos Kuala Mu, Perak and PPR Sungai Bonus, Kuala Lumpur, obtained from the quantitative study. The researchers found that the estimated household income for most participants was below RM2,500 for all three case study areas (

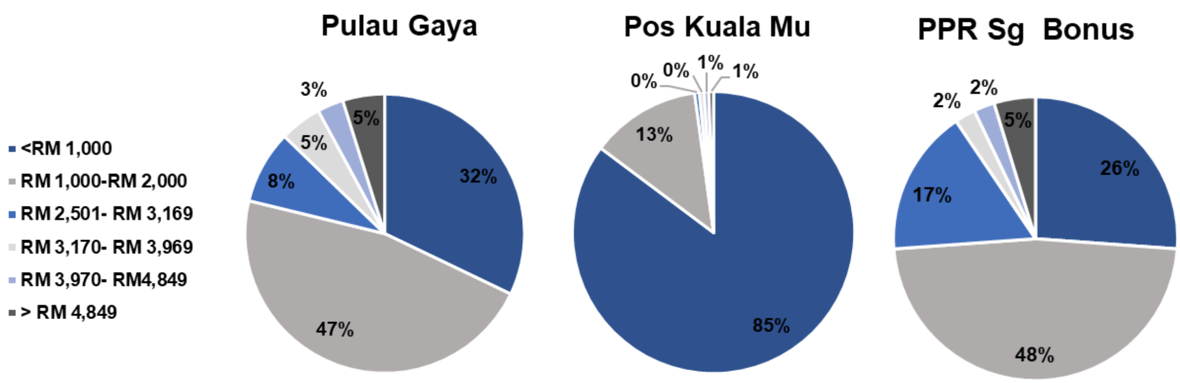
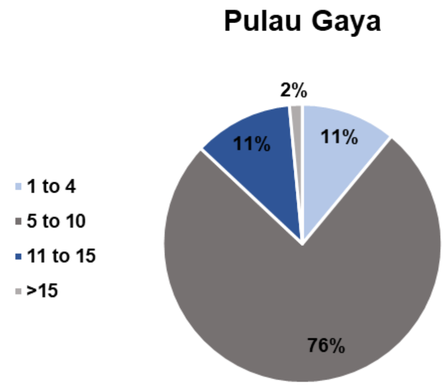


Figure 24). More than 80% of the participants for all communities live with more than five



family members per household (

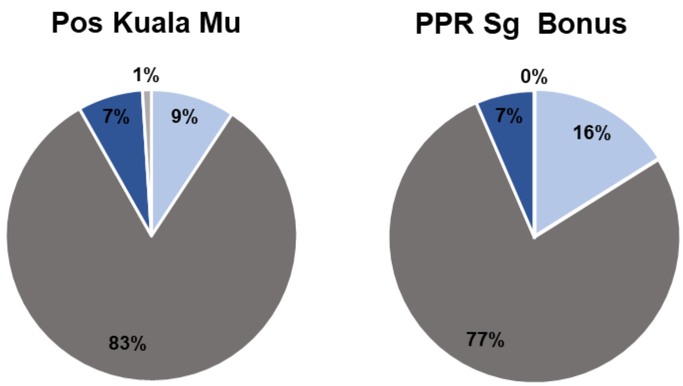


Figure 25). Most of the participants from Pulau Gaya, Sabah, and Pos Kuala Mu, Perak owned their house (Figure 26).

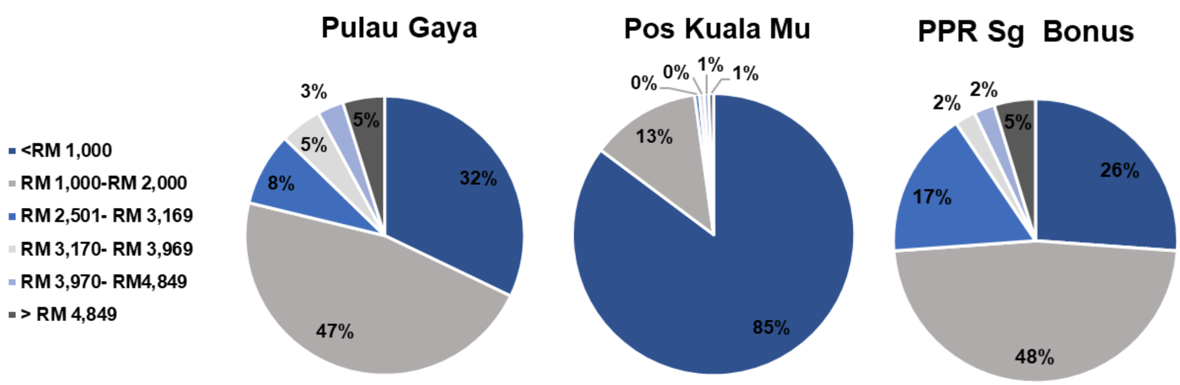


Figure 24: Estimated household incomes in the three study locations

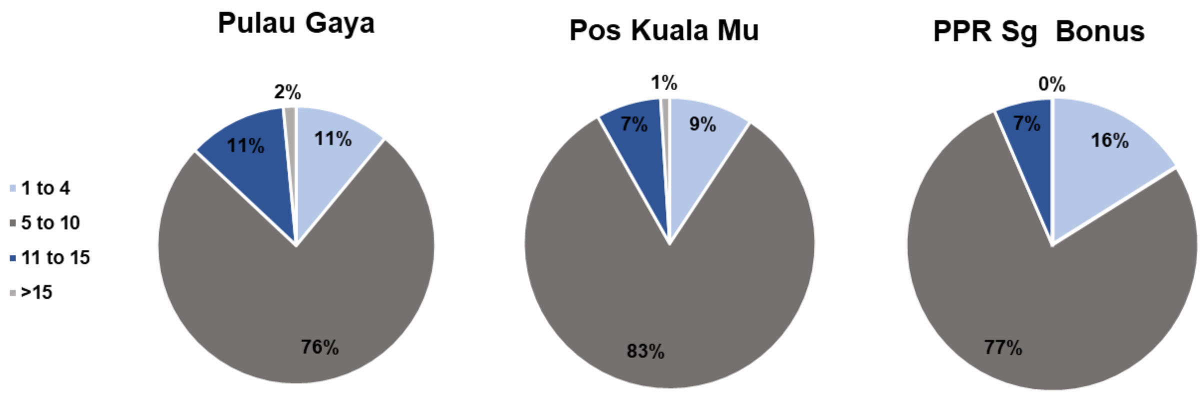


Figure 25: Number of people per household in the three study locations

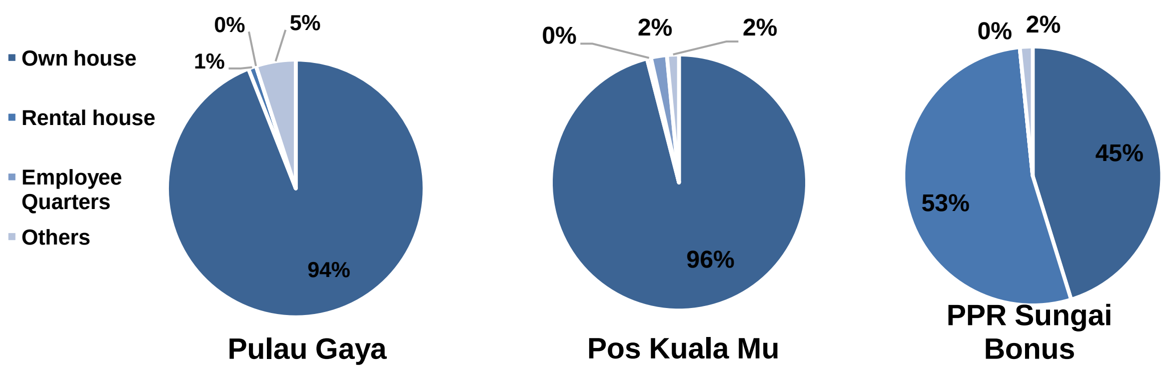


Figure 26: House ownership in the three study locations

4.3.3 Results: Triangulation of the main perceived risks of climate change and environmental degradation on children

By AP Dr Yanti Rosli

To understand how children in the three case study locations adapt to climate and environmental changes, we employed the PCA method to observe the three main perceived risks of climate change and environmental degradation on this target group. These perceived risks were classified as **Vulnerability, Resilience** and **Accessibility**, and each of them has indicators that may be unique to a location (Table 6). In the subsequent sections, we discuss each perceived risk for the three locations and integrate the findings from the qualitative studies (the IDIs and FGDs) to ensure the validity of both data sets through the convergence of information from our quantitative and qualitative studies.

Table 6: Perceived risks of climate change and environmental degradation on children in the three study locations

Location	Vulnerability	Resilience	Accessibility
Pulau Gaya	• Socialising ability • Citizenship status • Support system • Degree of literacy	• Climatic challenges • Sea-related extremes • Heat extremes • Rain extremes	• Medical • Living condition • Education • Clean water • Adequate food
Pos Kuala Mu	• Healthy lifestyle • Citizenship • Living conditions • Gender equity • Social support • Supporting family • Attitude toward the environment	• Heat resilience • Rain resilience • Immunization	• Rain and mobility • Resources
PPR Sungai Bonus	• Healthcare support • Social support • Safety • Living conditions • Supporting family • Attitude towards the environment • Gender equity	• Heat resilience • Rain resilience	• Health facility • Rain and mobility • Education

Vulnerability

Based on the survey, children living in Pulau Gaya perceived themselves as vulnerable on four indicators: socialising ability, citizenship status, the support system available to them, and their perceived degree of literacy. Sociability refers to the children's perceived social ability. Our research found that children who went to the ALC were perceived to be more sociable than children who went to the government schools in Pulau Gaya. The next indicator of perceived vulnerability among children in Pulau Gaya is the availability of a support system. The support system here is defined as the provision of support by parents. In this study, we found that girls are perceived to receive better support compared to boys. There are no clear differences of support in the three categories of age. Another indicator in measuring the Pulau Gaya children's perceived vulnerability is the degree of literacy. Obviously, the lower the degree of literacy, the more vulnerable the children are. In this study, it was shown that girls have a better degree of literacy compared to boys.

An additional interesting observation is that the number of people in the household can determine literacy among the children. Children from smaller households of five or fewer people are perceived to have better literacy levels than children from bigger households of more than five people. Children who study at the ALC perceived that their degree of literacy is much lower than their friends who went to the government school. Therefore, children in Pulau Gaya with low social skills, low support system, uncertainty about their citizenship status, and low degree of literacy would be categorised as vulnerable. This vulnerability is manifested in how the children deal with extreme weather, as indicated in the IDIs with the teachers at Pulau Gaya. The teachers observed that children are particularly vulnerable to extreme weather because of their dependence on adults to ensure their safety and well-being. Children are also vulnerable to climate change because of their potentially greater exposure, greater sensitivity to certain exposure, and dependence on caregivers for appropriate preparedness and response. According to the participants, the most common illnesses among children in Pulau Gaya are fever, heat-related illnesses, water-borne diseases such as diarrhoea, and vector-borne diseases such as malaria.

For the Temiar children in Pos Kuala Mu, those with an estimated monthly household income of less than RM1,500 reported that they felt vulnerable if they are not attentive towards their personal hygiene. Many reported that they perceived lack of personal hygiene as one of the major contributing factors towards succumbing to diseases like malaria:

> *'At the moment, this village has no Malaria cases. Recently in Pos Yum (another Orang Asli village in the area)…but not many get Malaria, only about two cases.'*
>
> (Pos Kuala Mu participant, interviewed on 18th September 2020)

Older boys (aged 14+ years old) and children from families with an estimated monthly household income of less than RM1,500 and more than five family members perceived themselves as persons lacking an attitude towards the environment. This shows that the Temiar children perceived having low personal hygiene will make them vulnerable to diseases. They also perceived that a lack of awareness about taking care of the environment would bring them harm in case of climate change, although they are not clear on how to mitigate these climate issues. The Temiar children perceived that having proper homes (either their own or prepared by JAKOA) that could withstand the weather, water supplies from the rivers, and farms on land provided by the state government are enough to make them feel sheltered from the possible impacts of climate change and environmental degradation. This 'innocent' sense of safety perceived by these children masked the harsh reality of their vulnerability, as accessibility would be a crucial issue should there be landslides after extended days of heavy rains, as predicted in our climate change modelling.

'When I first came here, all the area was still green. Now it has been explored...even up there. Before this, the air was fresh. But maybe because a lot of trees had been cut down, the air is not the same as before.'

'Deforestation can be found here because the forest was cut down for clearing (land clearing)…. yes (the land is for agriculture) palm oil, rubber, cocoa...'

'Maybe the trees….the villagers…when they want to make a farm, they will need to clear the area. Maybe when the trees are no longer there, the roots can no longer hold the ground. Thus it is easy for the landslide to occur when it is raining.'

(Pos Kuala Mu participant, interviewed on 17th September 2020)

Temiar girls (aged ten to 14 years old), especially from families with an estimated monthly household income of more than RM1,500 and regardless of the number of household members, prefer to work instead of going to school. Another pull factor for this preference is the lack of awareness about the importance of education and motivation or support from their parents. This adds another layer of vulnerability for the Temiar children, but this was not perceived by the children themselves. The community elders are the ones with the awareness of the importance of education for their people and took active roles in ensuring that the children have access to learning materials from school during the COVID-19 lockdown period.

The children from PPR Sungai Bonus perceived that the unit they are staying in is safe, with easy access to schools, shops, and the city. However, as the concept for PPR housing is rent-to-own, the 53.2% of families who are still renting and the 26.2% of families that earn less than RM1,000 monthly are at risk of being evicted should they fall behind the rental after a long period. According to the Department of Statistics Malaysia (2020) Malaysia's new poverty line income is RM2,208. 66.1% of the boys aged ten to 14 years old living in the PPR perceived that they need to leave school to help make ends meet as their parents' income was below RM2,500 a month. The situation is reversed with those with a family income of more than RM3,000 as the children perceived that they would need basic qualifications to hold a job in Kuala Lumpur. Interestingly, 41.9% of children aged between 15-18 years old perceived schools negatively and avoid going to school even before the COVID-19 pandemic. This is a huge vulnerability for the children of the PPR, even without the direct impacts of climate change and environmental degradation. They have easy access to schools yet prefer loitering instead of working and are almost totally dependent on their parents or guardians. In cases where their parents lost their jobs and source of income, the children are vulnerable in terms of their parents' income insecurity and the possibility of being evicted by the housing committee.

One of the characteristics of a community vulnerable to climate change is not managing its waste properly. While there are scheduled waste disposals at the PPR, the attitudes of the dwellers are worrying. The children here are perceived as being vulnerable in terms of physical safety due to injury from 'flying dumps':

> *'Sometimes when I walk around the flat area, there will be people throwing their rubbish from upstairs, soy sauce bottle or glass.'*
>
> *'The garbage house is there, but maybe they feel that this flat is too high, then they just throw their garbage (bag) out of their window.'*
>
> (PPR Sungai Bonus participant, Interviewed on 26th December 2020)

One more vulnerability perceived by girls in the PPR is having too many extended family members living in their small unit. This made them feel unsafe, lose their privacy and have no proper place to study or even sleep. This was more apparent during the pandemic lockdown. Children perceived being confined in a small unit with many family members as 'choking' and 'stressful' as they cannot be with their friends or play outside.

Resilience

The next observed pattern of behaviour among the children in Pulau Gaya is the degree of resilience. Children's perceived resilience is measured based on how the children adapt to climatic challenges, sea-related extremes, heat extremes and rain extremes. This perceived behaviour pattern is an essential indicator of how children face climate change and environmental degradation. Sea-related extremes refer to extreme ocean changes such as big tides and waves. Heat extremes refer to increased temperatures and prolonged dry seasons. Rain extremes refer to prolonged rainy seasons and an increase in rain volume.

We found that boys are perceived as more resilient to sea-related extremes but less resilient to heat and rain extremes. On the other hand, girls are perceived as less resilient to sea-related extremes but more resilient to heat and rain extremes. Children from families that earn less than RM1,500 monthly are perceived to have less resilience towards sea-related, heat, and rain extremes than those from families that earned more than RM1,500 per month. In other words, families with better income can provide better protection to their children, hence the high perceived resilience. This finding is consistent with findings from the IDIs conducted with teachers from the government schools and ALC. The teachers noticed that students lack focus during hot weather. They have also observed a 41% decline in school attendance during the rainy season. Because of the strong winds, rising sea levels, and lack of boats during the rainy season, parents concerned about their children's safety may not send them to school. One of the teachers stated:

> *'... If it's raining in the morning, they don't come to school the whole day ...'*

(Pulau Gaya participant, interviewed on 2nd September 2020)

Climate change adaptation among the Temiar children is slightly different from the children of Pulau Gaya. The Temiar children are more resilient to rain extremes than heat extremes in the high mountainous regions in Peninsula Malaysia. The children perceived rain extremes as rather dangerous for them to go to school due to possible landslides. Raised river levels also make crossing unsafe. However, 58% of them still go to school if it rains slightly.

> *'If the rain is heavy, then need to postpone it (not attend school)…(his child) can't go to school...it happens sometimes, but we will try to send them to school….using an umbrella or raincoat.'*

(Pos Kuala Mu participant, interviewed on 17th September 2020)

Extended rainy days are also perceived as 'too much of a good thing' as 40% of the community's harvest for the season will be ruined. In such cases, children perceive their help as essential in replanting for the next harvest. Despite the landslides and the raised river levels, the children will continue their activities like going to school and helping out in the community. The cycle continues, displaying resilience to climate change. Recently, the Perak State has built a full-board secondary school, SMK Bawong, mainly for the Orang Asli children living near Sungai Siput to ensure that the children are not disadvantaged in terms of education due to accessibility problems. This has helped many Temiar children complete their school education and obtain better skillsets to join the job market.

> *'Maybe in terms of transportation to school because most Orang Asli, they only have a motorcycle, they don't have a car. So when it rains, they can't send their children…and those who live far from school are staying at the hostel, but problems still arise if they go back during the weekend and come back on Sunday...if it's raining heavily on Sunday, there will not be many students on Monday. They either come back to the hostel on Monday afternoon or the next day if it's still raining on Monday.'*

(Pos Kuala Mu Participant, Interviewed on 17th September 2020)

In contrast to the Temiar children, the children of PPR Sungai Bonus, Kuala Lumpur, are more resilient to heat extremes and rain extremes. High-rise, high-density buildings like the PPR are vulnerable to heat waves and microclimates like the urban heat island phenomenon, where trapped and reflected heat from the buildings nearby are channelled through the corridors of the PPR units. This was experienced by the children living at PPR Sungai Bonus, yet many reported feelings *'ok'*. Rain extremes also cause chaos in terms of flash floods in some PPR. 53% of PPR Sungai Bonus children perceived that their house is rather safe during heavy rains, and once it stops, the children can go about their life as usual. About 80% of the students from PPR Sungai Bonus still go to school despite the heavy rains. This resilience to heat and rain extremes toughen the children of PPR physically to get jobs once they leave schools.

Accessibility

Children living in Pulau Gaya were also asked about their perceived accessibility towards several indicators such as medical services, living conditions, education, clean water, and adequate food. These are essential indicators to further understand the impact of climate change and environmental degradation on children. In an ideal world, children should have unlimited access to medical services, good living conditions, education, clean water, and food. Findings from the research show that in terms of gender, girls are perceived to have better access to food and water (91%) and medical services. Boys perceived that they are not as lucky as the girls in access to these three indicators. Only the boys perceived that they have access to education compared to girls.

From the context of income, children from families who earn less than RM1,500 a month perceived that they already have access to water and food but not education. This contrasts with children from families that earn more than RM1,500 monthly, who perceived that they have access to education but no access to water and food. Access to clean water in Pulau Gaya is still a major problem. Only certain villages received clean water from the mainland, while others depend on rainwater or buy water from the mainland through middlemen.

In terms of access to medical services, no medical facilities are available in Pulau Gaya. The islanders would need to go to the mainland to get medical attention if necessary. Children from both categories of family income perceived that they have access to medical services (75%). However, from the FGD, it was found that access to medical services is very much dependent on the weather and the availability of transportation from the island to the mainland. In that context, participants addressed the challenges of accessing and getting healthy food, clean water, and health services during extreme weather (i.e. rainy and windy seasons). As one participant (a mother) stated:

> *'…our child is sick… want to take him to Likas Hospital…we go knock on a neighbour's door…asking anyone who has a boat. Depending on the weather as well, if it is not heavy rain…we can go to the hospital… if it's heavy rain, there is a storm and strong waves, we can't go to the hospital…we fear that the boat will overturn…then if your child is really, really sick, you just have to wait.'*
>
> (Pulau Gaya Participant, Interviewed on 2nd September 2020)

The Temiar children perceived their accessibility to medical attention (54%) and education hubs are well provided for. The JAKOA and state government ensure that essential services are provided, with visiting medical doctors or clinics available near their villages. In emergencies, the services of JAKOA, the fire brigade, the Civil Defence Force (JPAM) and the police can be made available to extend care services. Clean water via pipes was not always available, but water ground pumps and electrical generators were also supplied, ensuring that living conditions are satisfactory and comfortable (74.5%). The state law also allows the Temiar and many other indigenous people to occupy state gazetted land provided it is only for their use. Therefore 64.3% of them can maintain their traditional lifestyle and steady food source. Hence, 88.7% of them said that they have meals three times a day. During landslides, where major roads were cut off, the government will ensure fresh supplies will be delivered or dropped into their villages.

The children of PPR Sungai Bonus also have similar accessibility, but with a wider choice of schools and a better range of health services, as they stay in downtown Kuala Lumpur. Clean water with proper sewer systems are made available at the PPR units and, with the option of rent-to-own, are perceived as good living conditions for 83.9% of the children in PPR Sungai Bonus. Our study reveals that 12.9% of the children here have a meal daily. However, 29% of the children perceived that their parents or guardians faced income insecurity and will be facing food insecurity as they need to buy food to survive.

We conclude this section with a diagrammatic representation summarizing the triangulation discussed above on the climate- and environment-related behavioural patterns of children from our case study locations (Figure 27).

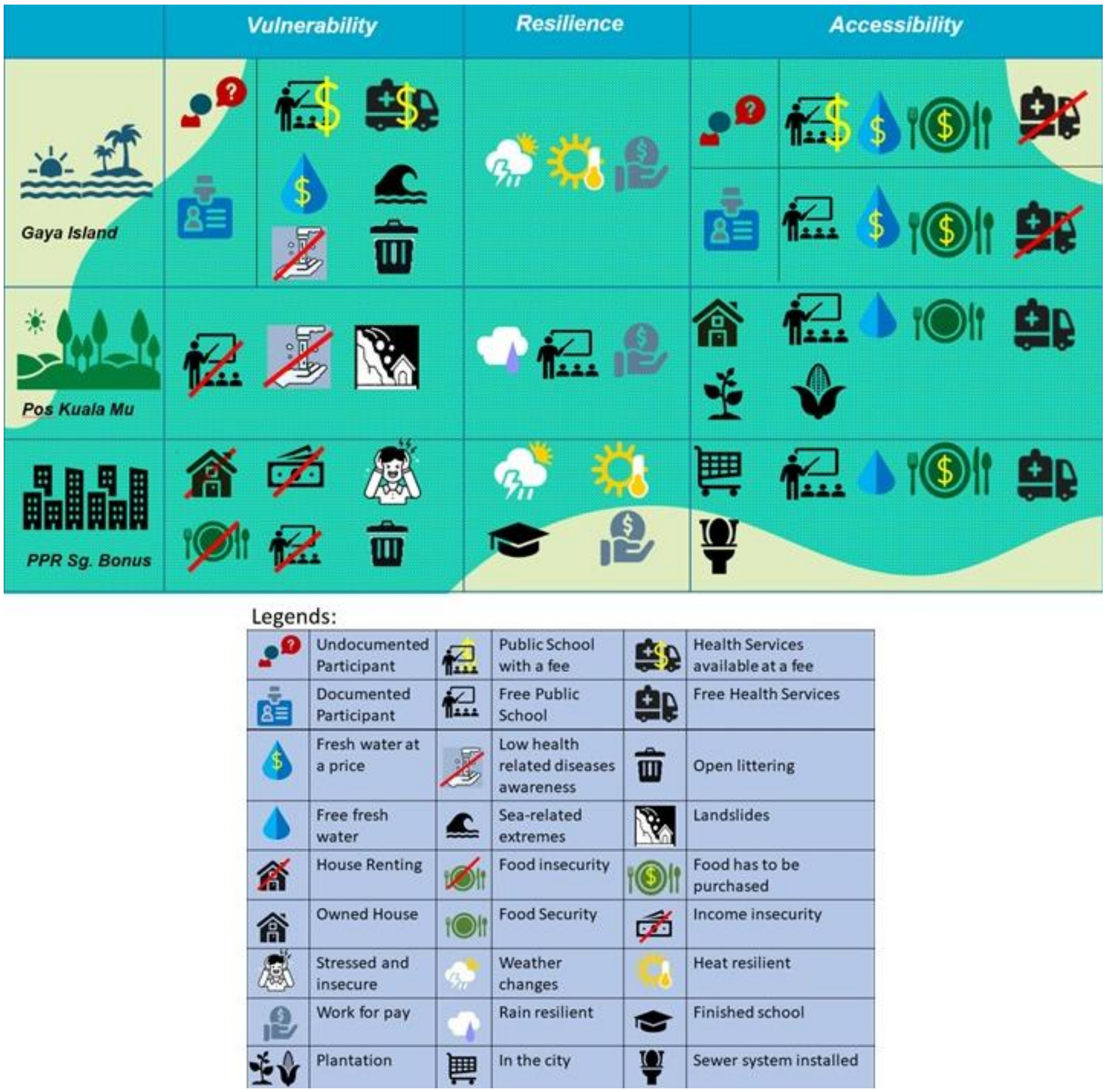


Figure 27: Perceived climate and environment-related risks among children in Pulau Gaya, Sabah, Pos Kuala Mu, Perak and PPR Sungai Bonus, Kuala Lumpur

4.4 Key findings

The following are the main points that should be taken into consideration for further deliberation, particularly in drafting policy related to climate change and children:

01 Children's socio-demographic factors affecting vulnerability

Table 7: Factors affecting vulnerability of children in the three study locations

Factors affecting vulnerability	Gender		Older children (> 14 years old)	Younger children (<10 years old)	Household size	
	Boys	Girls	Older children	Younger children	1-5	Above 5
Resilience towards climate variability	Perceived to be more resilient to climate issues and to be able to adapt better to storms.	Perceived to be able to adapt better to heat and rain .	Perceived to be more resilient to heat and rain extremes.	Perceived to be less exposed to climate challenges.		
Resource availability and accessibility			Exposed to food insecurities.	Less exposed to food insecurities.	Food, water, and access to education and health facilities are better when located near the cities. State-level services also ensure better accessibility.	
Income insecurity						The lower the income, the better their available support system, if they are a citizen. Support systems are available to non-citizens with a fee.
Income security					The higher the income, the more resilient they become and less vulnerable, e.g. food insecurity.	

02 Children's adaptive capacity in different locations are different in responding to the climate and their environment.

Table 8: Adaptive capacity of communities in the three study locations

Adaptive Capacity	An island (Pulau Gaya)	Village by the forest in a mountainous range (Pos Kuala Mu)	Urban area (PPR Sungai Bonus)
Health	Children are at risk of climate-sensitive diseases. They lack access to fresh water and face garbage disposal problems in the area.	Children are at risk of climate-sensitive diseases, i.e. malaria. They lack awareness of the importance of health and hygiene. Drinking unboiled water from wells will expose the children to water-borne diseases.	Children are at risk of climate-sensitive diseases, i.e. dengue and garbage issues in the area. They are also exposed to urban microclimates.
Education	Children face problems accessing school during the rainy season and comfort issues during the hot season.	Children face problems accessing school during the rainy season. For example, the secondary school is located at the lower part of the mountain (more than 39km from the village).	Limited family support for education and space for studying.
Family income and food insecurity	Since most islanders depend on climate-sensitive economic activities or work on the mainland, heavy rain will restrict their mobility.	Even with low family income, food insecurity is not a major problem since the parents are farmers with self-sustaining food supplies.	Since the children live in PPR flats, all food supplies must be purchased.
Safety	Lowland parts of Pulau Gaya will be underwater with sea-level rise.	Deforestation in the surrounding area may expose them to the risk of disasters such as landslides. Landslides may cut off the only road that connects them to lowland areas where most basic social services are located.	The high density of the PPR makes it prone to high levels of crime. There are also injury risks due to rubbish being thrown from high floors.

4.5 Conclusion and suggestions

The findings of the case studies on the three communities are summarized in the diagram below:

The availability and accessibility of basic amenities, i.e. primary health care, basic education, clean water, and proper sanitation, are key for children's development. Sufficient availability and accessibility to basic amenities are necessary to protect children against impacts of climate change and environmental degradation.

Income insecurity may have a snowball effect on the basic resources of the family, including access to basic amenities, especially those with large household numbers. This, in turn, will affect the well-being of the children in the family.

Raising awareness on the importance of education, health, hygiene, and environmental management is very important. This will contribute to their well-being, alongside building their resilience against climate change and environmental degradation impacts.

Socio-demographic factors can be strengthened with sufficient knowledge, resources, and support to enhance children's adaptive capacity to climate change. A robust adaptation plan and sufficient implementation may help them prepare against the impending impact.

4.6 Safety measures during data collection

Data collection was carried out during the COVID-19 pandemic. Hence, strict adherence to Standard Operating Procedures (SOPs) was implemented, emphasizing social distancing, wearing face masks, and frequently sanitizing hands with alcohol sanitiser. Face masks and hand sanitiser were provided to participants during data collection.

4.7 Study limitations

Data collection was done during the COVID-19 pandemic. Therefore, researchers were unable to obtain an equal number and type of participants for each location. Due to their shy personality towards outsiders and strangers, we could not recruit more participants from the Orang Asli community to be involved in the IDIs and FGD sessions. The language barrier was another challenge when conducting questionnaires and FGD sessions with Orang Asli children and community. Meanwhile, for PPR Sungai Bonus, Kuala Lumpur, we could not conduct IDI sessions with teachers since schools were closed at that time. Some of the residents in PPR Sungai Bonus, Kuala Lumpur were reluctant to allow their children to be involved in the study due to the COVID-19 risk. The full report and references for this case study are available in Appendix 4.

5 POLICY AND LEGAL ASSESSMENTS

Strong laws and policies, with proper implementation, play crucial roles in regulating environmental and climate change issues and dealing with their impacts. Similarly, strong laws and policies are vital to ensure children's rights and best interests are upheld and protected in all aspects, including environmental and climate change harm. Several policy and legal framework areas need to be examined for the purpose of this research, notably environment, climate change, public health, children and education. While the environment and climate change may share common issues, they may have distinct features, scopes, and objectives that need to be appreciated to understand their function, relevance, and gaps on matters involving children.

Climate change and environmental policies can cut across various sectors as each sector has its role in the mitigation and adaptation of climate change and environmental degradation. Environmental law as a subject matter encompasses a range of sub-specialities, including international environmental law, biodiversity law, conservation law and natural resources management. Climate change law is a new branch of law that emerged against the backdrop of intensifying scientific, economic, social, and political debates over the impacts of greenhouse gas emissions on the world's climate system. The law and policies can be used as tools for climate change adaptation either directly or incidentally by incorporating adaptive measures to reduce vulnerability to the effects of climate change.

Children's needs are particularly overlooked or otherwise given limited attention within climate and environmental law and policies. Likewise, laws and policies relating to child protection or public health do not address harms associated with environmental or climate change impacts. Therefore, efforts should be undertaken to review the current legal and policy framework. Through the review, gaps within the law and policies will be identified, and options proposed towards the betterment of environmental law and policies in protecting children's health from pollution and climate impacts.

As many of these Malaysian policies and plans approach the end of their referencing term in 2020, there is a need to review and assess these policies and plans for the next term. Issues relating to the impacts of climate change and environmental degradation on children based on current adaptation and mitigation measures are complex and require:

i. the identification of related legal and policy frameworks,
ii. the examination of linkages among these frameworks, both in relation to environmental protection, as well as regarding climate change mitigation and adaptation,
iii. the analysis of the framework and their linkages in the context of child sensitivity and identification of possible gaps in the existing law and policies.

5.1 Method

5.1.1 Policy assessment

A policy assessment was conducted using a content analysis method coupled with selected keywords count. The process started with the selection of documents that were relevant to our objectives. The documents were categorized into six major themes, i.e. climate change, environment, children, health, education, and development plans. Below are the inclusion criteria of our document selection:

- national policies, action plans, guidelines (health) and national reports,
- formulated or prepared by the government ministries,
- accessible,
- both in English and local Malay languages, and
- the most recent version.

We excluded country reports on Malaysia by international organizations (e.g. FAO, UN) and non-government entities from the assessment, as the analysis was meant to focus on national responses, policy, and guidelines. Table 5.1 shows the number of documents included by theme.

Table 9: Number of documents analysed according to the selected themes

Theme	Number of documents analysed
Climate change	15
Environment	9
Children	7
Education	2
Health	14
Development plans	2
Total	**49**

5.1.2 Legal assessment

The main issue examined is to what extent the environment and climate change legal framework in Malaysia is child-sensitive. This section examines the Federal Constitution and four sets of legal frameworks, namely:

- Environment
- Climate change
- Human health
- Children

This study employed qualitative methods of research which included content analysis and interviews to obtain the research output. This involved examining current policies and legal documents, identifying the inadequacies, drawbacks and other loopholes, and proposing improvement within the laws and policies. Primary materials included statutes, case law, government policy papers, government directives, speeches and reports of government and NGOs, and other legal and non-legal literature. The primary materials that were analysed include:

- The Federal Constitution
- Environmental Quality Act 1974
- Prevention and Control of the Infectious Diseases Act 1988
- Child Act 2001

Secondary materials included textbooks, journal and non-journal articles, seminar papers, media and reports. The information and data gathered from the primary and secondary materials were examined using content and contextual analysis, followed by summarizing and generating conclusions on what was available and what was lacking in resolving children's issues concerning climate change and environmental degradation. Further online discussions and semi-structured interviews with selected agencies or personnel were conducted to collect more information and viewpoints on the current position of the law and policy to justify the need for their revisions.

5.1.3 Assessment of the SDG 13 monitoring framework

The assessment of ‘SDG 13: Climate Action’ is one of the performance indicators of programmeme output 4. Looking beyond SDG 13, we also include a brief assessment of other relevant SDGs as listed:

- SDG 3: Good health and well-being
- SDG 4: Quality education
- SDG 6: Clean water and sanitation

The information for the assessment came from both local and international sources.

5.1.4 Study limitations

The documents included in the assessment might not be exhaustive due to the cross-sectoral nature of climate change and environmental issues. Furthermore, the assessment was mainly based on documents. The gaps and opportunities identified might have already been addressed during implementation at the ground level. However, this assessment is still significant as policies are the major reference to most plans and activities on the ground.

5.2 Assessment of policy framework

By Dr Kwan Soo Chen

The following sections present the assessment findings for the six policy document themes, i.e. climate change, environment, education, children, health and development plans. The policies included in this assessment are listed in Table 10 below.

Table 10: List of policies included in the assessment

CLIMATE CHANGE (15)	ENVIRONMENT (9)	EDUCATION (2)	HEALTH (14)	CHILDREN (7)
1. National Policy on Climate Change (2009)	1. National Policy on the Environment (2002)	1. National Education Policy (2017)	1. MOH strategic plan (2016-2020)	1. National Child Policy And Action Plan (2009)
2. National Green Technology Policy (2009)	2. National Water Resources Policy (2012)	2. Malaysia Education Blueprint (2013-2025)	2. MOH action plan (2016-2020)	2. National Child Protection Policy (2009)
3. Green Technology Master Plan Malaysia (2017-2030)	3. National Policy on Biological Diversity (2016 – 2025)		3. Malaysian Strategy for Emerging Diseases and Public Health Emergencies Workplan 2017-2021 (MySED II)	3. National Family Policy (2010)
4. National Energy Policy (1979)	4. National Forestry Policy (1978, revised 1992)		4. NEHAP (2013)	4. National Social And Reproductive Health Education Policy & Action Plan (2009)
5. National Renewable Energy Policy and Action Plan (2008)	5. National Solid Waste Management Policy (2016)		5. Disaster management plan (2015)	5. Malaysian Plan of Action for People with Disabilities (2016-2022)
6. National Biofuel Policy (2006)	6. National Cleanliness Policy (2019)		6. Flood management (2008)	6. National Strategy Plan On Addressing The Causes Of Child Marriage (2020)
7. Policy and Mechanism on National Disaster and Relief Management (1997)	7. Malaysia's Roadmap Towards Zero Single-Use Plastics (2018-2030)		7. Action Plan for Health Management from Haze (2020)	7. National Community Policy (2018)
8. National Agriculture Policy, National Agro-Food Policy (2011)	8. Environmental Impact Assessment Guidelines (2016)		8. Clinical Guidelines on Management of Heat Related Illness (2016)	
9. National Energy Efficiency Action Plan (2015)	9. Health Impact Assessment (HIA) In Environmental Impact Assessment (EIA) (2012)		9. National Strategic Plan for Dengue Prevention and Control (2016-2020)	
10. National Industry Policy 4.0 (2018)			10. Management Guidelines of Malaria in Malaysia (2014)	
11. National Transport Policy (2019-2030)			11. National Plan of Action for Nutrition of Malaysia III 2016-2025 (2016)	
12. Low Carbon City Framework (2011)			12. Typhoid case/outbreak Management Guidelines (2017)	
13. Intended Nationally Determined Contribution of The Government Of Malaysia (2015)			13. Guidelines for the Diagnosis, Management, Prevention and Control of Leptospirosis in Malaysia (2011)	
14. Third Malaysia National Communication Report & Malaysia Second Biennial Update Report to UNFCCC (2018)			14. Guidelines for Management of Scabies in Adults and Children (2015)	
15. Malaysia Biennial Update Report to UNFCCC (2020)				

DEVELOPMENT PLANS: 11th Malaysia Plan (2016-2020) & National Physical Plan 3 (2016-2020)

5.2.1 Climate change

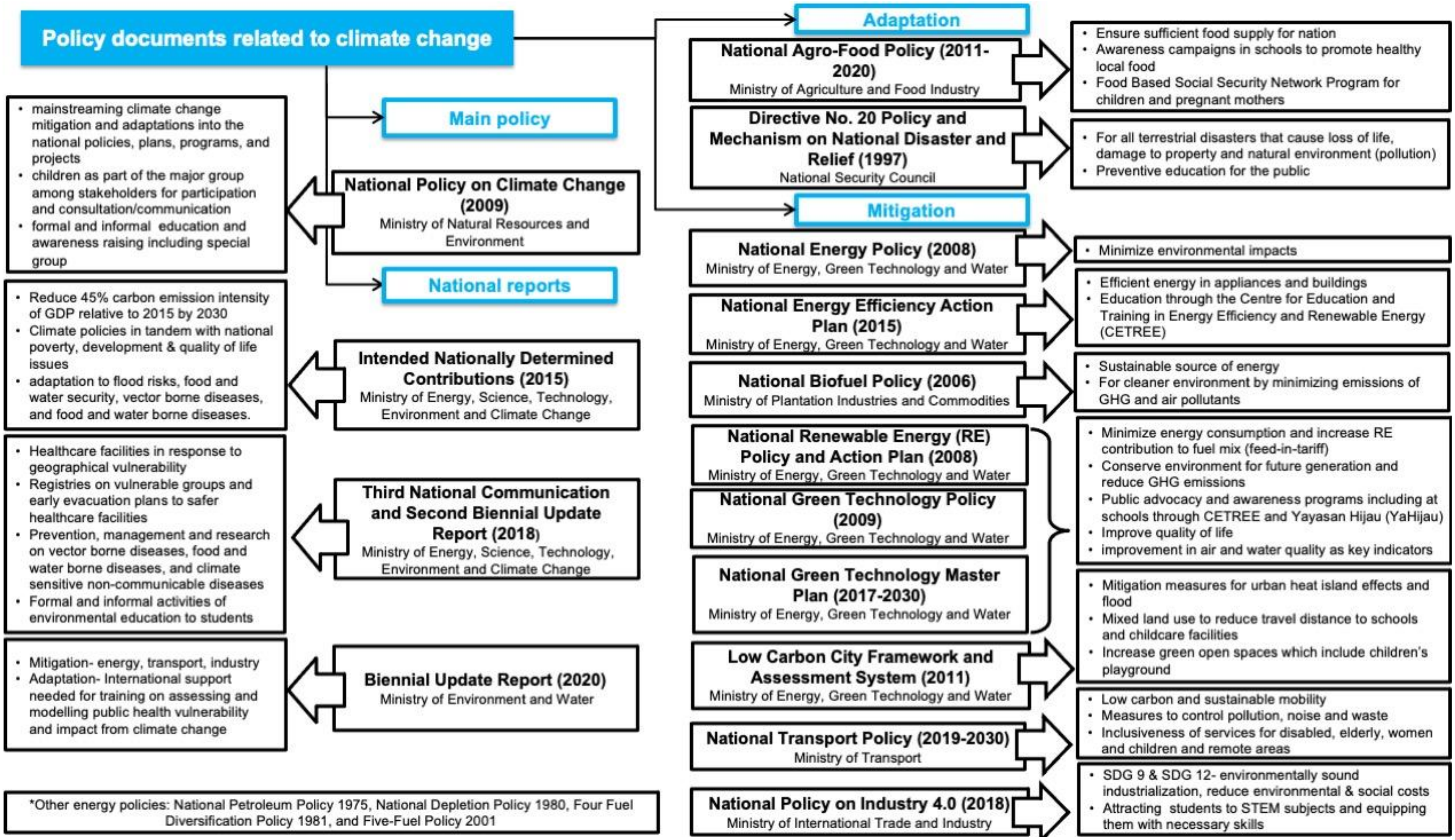


Figure 28: Content overview of policy documents related to climate change

Figure 28 shows an overview of the content of policy documents related to climate change. In general, climate change mitigating actions are embedded in the policies and actions plans across the sectors. The energy policies in Malaysia are inclined towards sustainable energy use, focusing on energy security through diversification of fuel sources and green energy. While health risks and co-benefits are missing in these industrial policies, industrial development projects that fall under the prescribed activities under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 are required to conduct an Environmental Impact Assessment (EIA) before the DOE approves the projects.

Below are some of the points to consider for these policies and reports assessed:

- The National Policy on Climate Change (NPCC) has not been revised since 2009.
- Besides relying on the EIA process, health considerations have not been incorporated into the industrial policies themselves. While considering different options in the industries, there is a need to strike a balance between economy, environment, and health.
- Among those documents that mention health, the nature of the reference is often merely descriptive and not translated into meaningful or targeted commitments and actions. For example, while the National Transport Policy mentions reducing carbon and air pollutant emissions, the relevant health issues have not been included, which could have triggered an alternative approach to the action plans to safeguard human health from the emissions.
- While all policies emphasize education, it is unclear if health elements concerning climate change and the environment have been taken into account.
- When health is mentioned, it is mainly addressed from the general population's perspective without considering the lower tolerance of vulnerable groups such as children.
- Children are not specifically identified under public education to prevent and prepare for disasters and health care during disasters.
- Both Nationally Determined Contributions (NDC) and the Third National Communication Report (TNCR) 2018 mainly focus on geographical and infrastructure vulnerability to disasters. Children are only mentioned in the TNCR in the context of registries on vulnerable groups and various education and awareness programmemes.

Although many of the policies do not mention specific groups (such as children) when addressing health impacts related to climate change and environmental degradation, from our consultation and strategic meetings with stakeholders, it is understood that many programmemes under these policies have included children as part of the general implementation plan. For example, the National Disaster Management Agency (NADMA) recognizes that children are among the most impacted populations during a disaster, per the Sendai Framework for Disaster Risk Reduction 2015.[3] As part of its public education, NADMA initiated the Community Based Disaster Risk Management (CBDRM) Programmeme, which includes a public education module on community's roles in disaster management. The module includes prioritizing the vulnerable groups such as children, the elderly, women and persons with disabilities before, during, and after disasters. The CBDRM has also been conducted at schools to enhance students' resilience and preparedness against disasters.

Post-disaster and crop damage social protection and relief services are provided by the Malaysian Department of Social Welfare. Services provided include (1) the provision and management of the centre for relief or evacuation and forward supply base, (2) the supply and distribution of assistance such as food, clothing, and other essential items, (3) the registration of disaster victims for rehabilitation purposes, and (4) the provision of post-disaster counselling services. Emergency financial assistance is also provided to families or individuals, with the amount of benefit paid dependent on an assessment of the damage. The formal system of social protection is supplemented by religious-based schemes, for example, the Muslim Zakat system, which also provides for those affected by natural disasters.

Nonetheless, as policies are meant to be the main reference in the planning of all projects and programmemes, it is recommended to explicitly address vulnerable populations such as children as part of the policies and action plans to ensure the inclusivity of the policies. Since the NDC and the NPCC 2009 of Malaysia are currently under review by the Ministry of Environment and Water (KASA), and the Climate Change Act is in the formulation process, these issues could be considered.

[3] Based on documents shared by NADMA

5.2.2 Environment

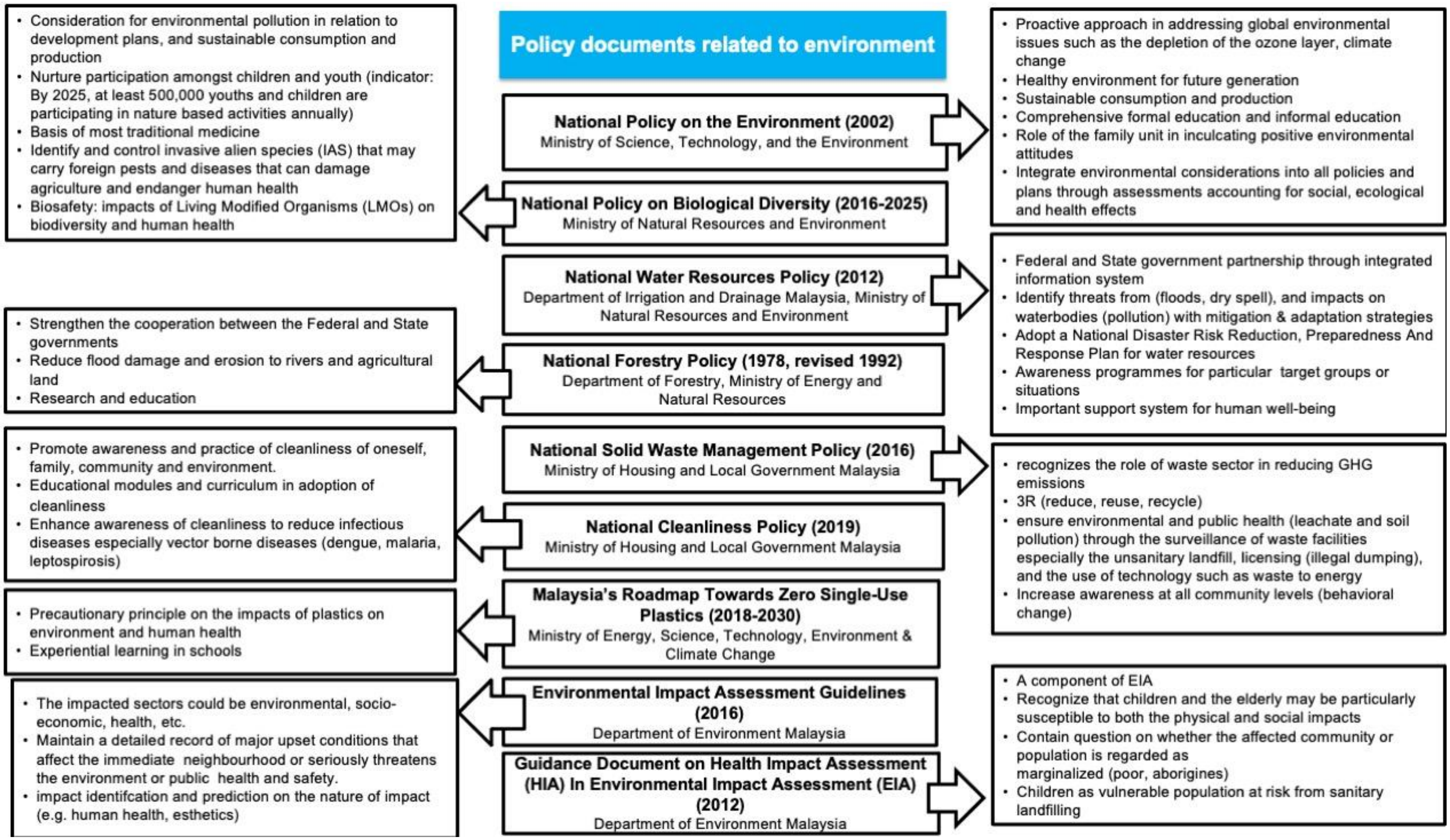


Figure 29: Content overview of policy documents related to the environment

Figure 29 shows an overview of the content of policy documents related to the environment. Environmental education has been emphasized in almost all policies through formal and informal channels, experiential learning, awareness programmemes, and teacher training organized by CSOs and NGOs, as reported in the TNCR 2018.

The health component is mainly found in the Guidance Document on Health Impact Assessment (HIA) in EIA (DOE, 2012). As mentioned in the climate change document assessment, the EIA process is a required process for all the industrial projects listed under prescribed activities according to the National Policy on Environment 2002. The EIA Guidelines 2016 provides an understanding of the EIA procedures, and the HIA is a component of EIA with a guidance document established in 2012. Children have been mentioned briefly as an example of a vulnerable population in the HIA in the EIA Guidance Document 2012 while being addressed as part of the larger community in other documents.

Below are some of the points to consider for the policy documents assessed in the scope of the environment:

- The National Policy on Environment 2002 relies on the EIA process in assessing the environmental health effects. However, not all industrial activities are classified under the prescribed activities that require the EIA process. Therefore, there may be a need to directly address the health component in the policy itself instead of depending on separate processes such as the EIA.
- While Malaysia agrees on the importance of a health response to climate change and environmental issues, the scope of existing policies is not extended to include factors pertinent to children. The policies do not contain specific strategies in dealing with the protection of children in the context of environmental and climate change. Thus, current focus areas such as air quality, water and sewage systems, solid waste, hazardous waste management, and climate change are meant to address these issues from the general public health perspective without a specific focus on children or other susceptible population groups. Instead of having policies that allow people to tolerate substantially higher pollution levels, a preventive approach to diseases and environmental risks needs to be adopted for children.
- As Malaysia embraces the concept of SDGs, which is about both inter-generational and intra-generational equity involving the fulfilment of responsibilities to ensure a safer, cleaner, healthier, and more inclusive environment for both today's children and their children, the SDGs are therefore a legitimate premise in the setting of policy and legal framework to take into consideration children's needs within each of the dimensions of economic and social development, and environmental sustainability.

Like the climate change policy documents, while most policies address the community as the larger population group, children have been addressed as one target group, especially in education activities.

5.2.3 Children

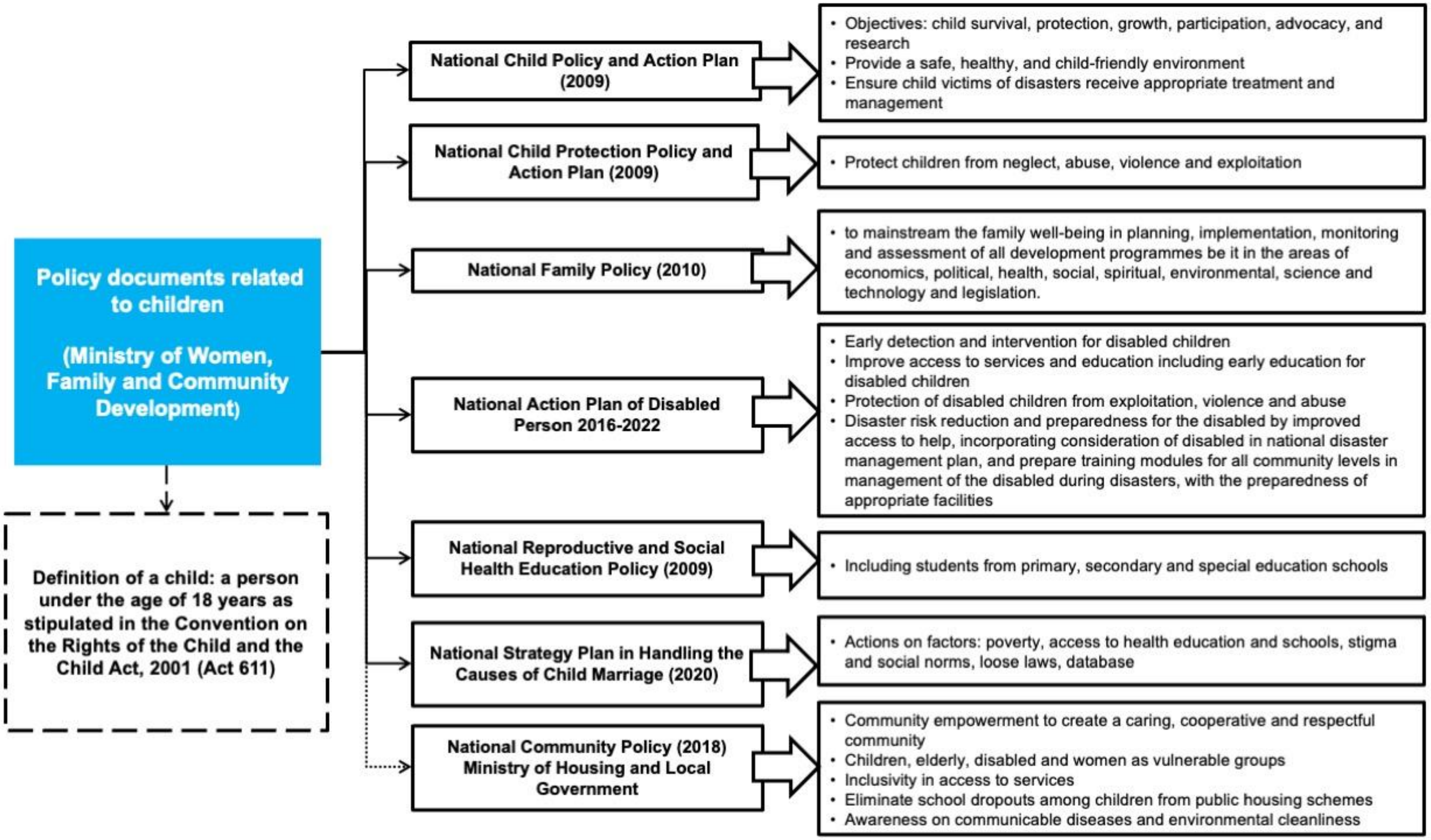


Figure 30: Content overview of policy documents related to children

Figure 30 shows an overview of the content of policy documents related to children. As a member of the United Nations, Malaysia has subscribed to the philosophy, concepts, and norms provided by the Universal Declaration of Human Rights 1948, which sets out the common standard of human rights and nations. As a state party to the UNCRC, Malaysia observes the Principals in this Convention, with an initial 12 reservations, to uphold its commitment to the protection and welfare of children, subject to seven articles that are at variance with national and Syariah laws.[4] The pursuit of Malaysia's child's protection is guided by the UNCRC as stated in the Preamble, that 'the child, by reason of his physical and mental immaturity, needs special safeguards and care, including appropriate legal protection, before as well as after birth'.

Below are some of the points to consider for the policy documents assessed under the theme of children:

- Even though the focus areas of the above policies include strengthening efforts to create a safer and more friendly environment for children, there are no distinctive efforts to protect the children's health and environment in terms of climate change and pollution.
- Most of the policies address children in the context of social issues such as neglect, abuse, violence and exploitation. These issues could be triggered or amplified by the impacts of disasters, especially on underprivileged communities such as the poor. Such issues can arise due to the negative impacts of climate change and environmental degradation, and the protection of children from them should also be considered.
- While the Malaysian Plan of Action for People with Disabilities 2016-2022 addresses disaster risk reduction and improved access to help the people with disabilities during disasters, it is unclear whether children with disabilities have also been addressed appropriately in its implementation.

Currently, the MWCFD has no programmemes relating children to climate change and environmental health. However, the National Child Policy, National Social Policy, and Child Act 2001 are currently under review. The Children Representative Council (Majlis Kewakilan Kanak-Kanak) Malaysia is the platform where children's concerns are sought during policy revisions. However, currently, most activities of the Children Representative Council have been confined to education and inculcating awareness on climate change and environmental degradation[5].

[4] Regulating Children's Rights, The Star Online, https://www.thestar.com.my/opinion/letters/2010/10/12/regulating-childrens-rights
[5] Strategic meeting with MWFCD on 18th Mac 2021.

5.2.4 Education

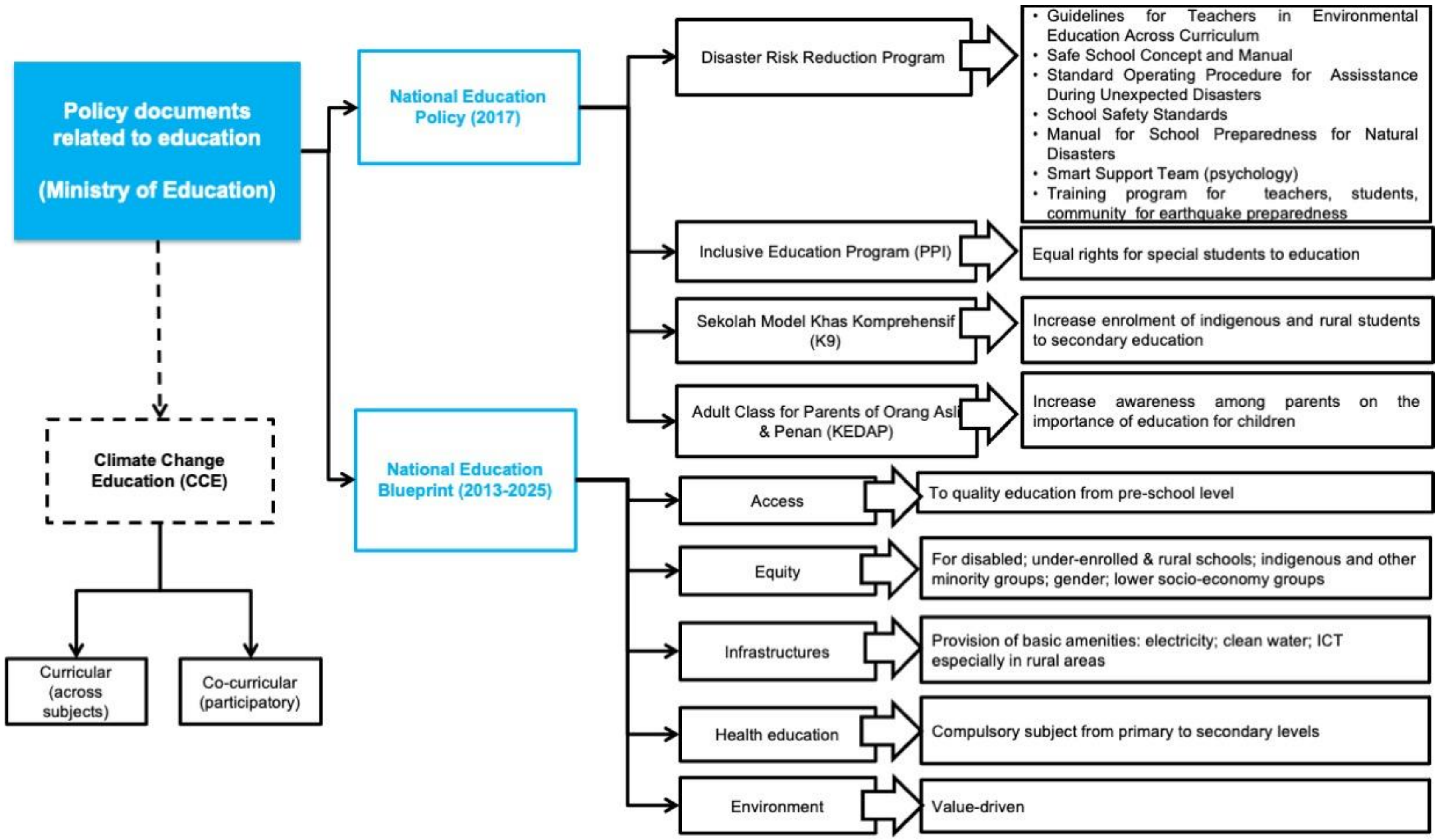


Figure 31: Content overview of policy documents related to education

Figure 31 shows an overview of the content of policy documents related to education. While climate change and environment are not formal individual subjects in the curriculum, these topics have been extensively incorporated into the textbooks across subjects such as Geography and Science, encompassing the issues (e.g. pollution), implications (e.g. diseases), and actions. The most recent initiative by the MOE is the Digital Educational Learning Initiative Malaysia (DELIMa),[6] a Global Citizenship Education programmeme on the 17 SDGs. Although disaster mitigation and adaptation strategies for children with disabilities in schools are not mentioned directly, it is understood that the MOE includes children with disabilities in the implementation of all programmemes.[7]

As education is the key channel for transmitting information on climate change and environmental health, especially to marginalised groups, including indigenous children, many educational programmemes have been organized by the related ministries such as the Ministry of Energy and Natural Resources, MOSTI, KASA, CSOs and private companies as reported in the TNCR 2018. However, as different educational programmes are conducted during both curricular and non-curricular activities organized by various agencies, difficulties present in evaluating the overall effectiveness of programmes in increasing the students' awareness of climate change and environmental pollution, which is also currently absent in the institutional system.

[6] https://sites.google.com/moe-dl.edu.my/gcedmalaysia/home?authuser=3
[7] Based on a strategic meeting with MOE (15th February 2021)

5.2.5 Health

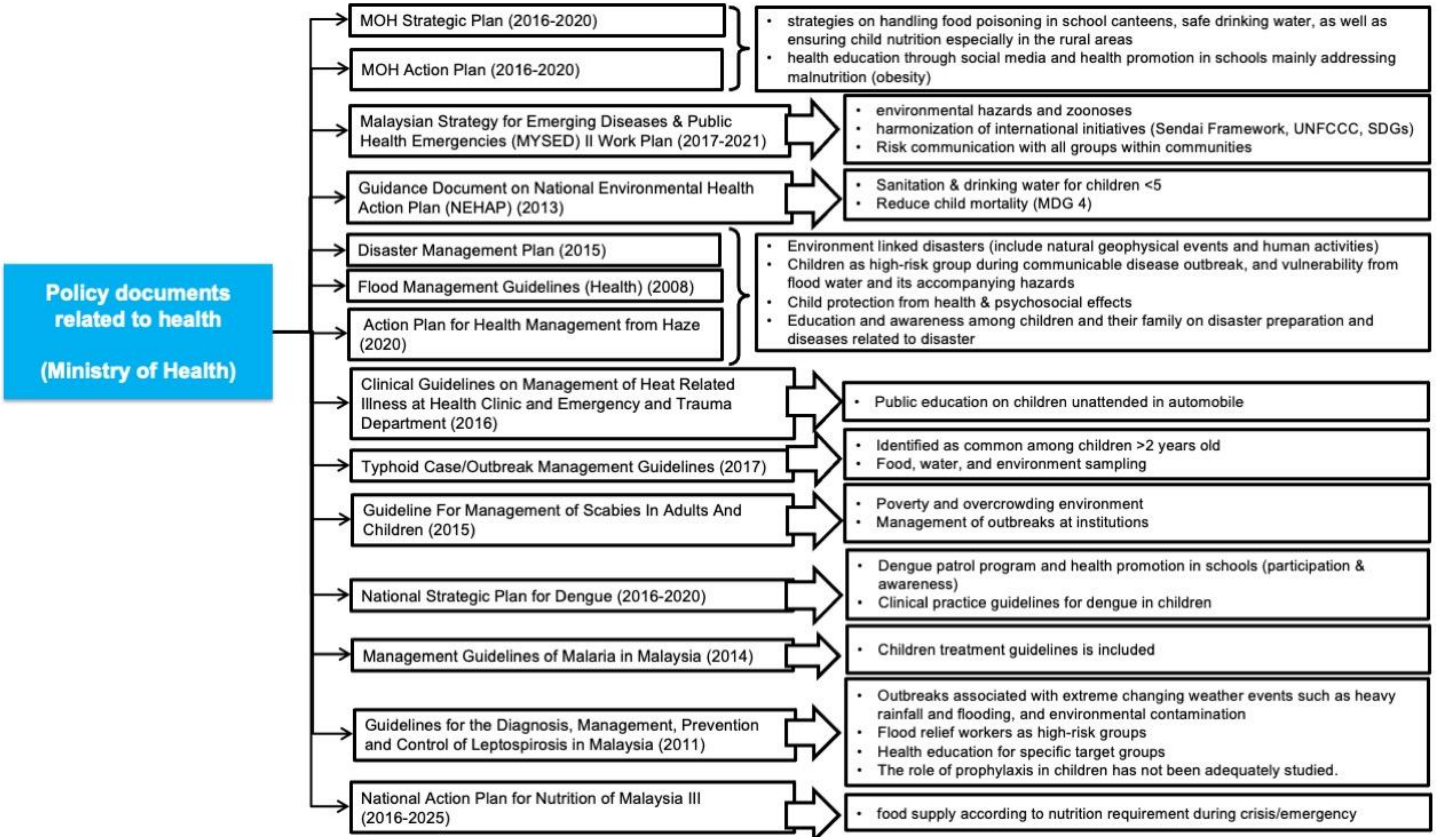


Figure 32: Content overview of policy documents related to health

Figure 32 shows an overview of the content of policy documents related to health. Malaysian health documents consist mainly of strategic action plans and management guidelines. In addressing the impacts of climate change and environmental hazards, the MOH has established health guidelines and action plans for events such as floods, haze, and climate-sensitive diseases. The health sector addresses the health impacts of climate change and the environment on the population and children based on the previous experiences and prevailing needs in the Malaysian community. Although children are not specifically mentioned in the macro-level strategic plans, children have been addressed as among the vulnerable population groups in most management guidelines, including attending to their mental health during disasters. Besides, teenagers' and children's health, including children with disabilities, has been addressed by the Family Health Development Unit of the MOH through programmes such as the School Health Programme.[8] However, none of the guidance documents mentioned climate change and environmental health impacts, so they are not included in this content analysis.

A recent publication by the National Environmental Health Action Plan (NEHAP) 2020 also lists children's environmental health as the priority of environmental health issues in Malaysia. This presents an opportunity to draw the attention of all sectors to the vulnerability of children's health in the face of climate change and environmental degradation in Malaysia. Therefore, while various guidelines on climate and environment-related diseases are available, it might be a good initiative for the MOH to establish a comprehensive child-centric guideline on all the health components or indicators related to climate change and environmental degradation needed to assess children's health. From here, risk assessment tools can be developed and incorporated into the existing periodic health screenings and monitoring programmes to identify at-risk children for preventive measures.

5.2.6 Development plans

The Economic Planning Unit (EPU) under the Prime Minister's Office is the coordinating agency for all government ministries in planning and budgeting for the SDGs. The five-year **11th Malaysia Plan (2016-2020)** (11MP) formulated by the EPU encompasses action plans across all sectors. Besides measures to promote clean energy and pollution control in the air, water, and waste, the plan also aims to improve the national economy and the quality of life of people, especially in disadvantaged communities. Children are mentioned especially in relation to education and equity. In the strategic thrust for green growth and sustainability, one of the initiatives is to incorporate education on sustainable consumption and production (SCP) into the school curriculum. Climate change adaptation is also included for flood mitigation and inculcating public awareness on health impacts from vector-, food- and water-borne diseases.

[8] http://fh.moh.gov.my/v3/index.php/kesihatan-sekolah

The **National Physical Plan 3 (2016-2020)** translates all national strategic plans in the context of spatial development in Malaysia. Sustainable development and climate change resilience is a strategic thrust in the plan, focusing on conserving the natural environment, low carbon development, and land-use planning for sustainable growth and disaster risk areas. In the same plan, children are addressed separately in the strategic thrust of inclusive communities, addressing access to facilities and services and public spaces for healthy growth. However, there is a lack of integration between both strategic thrusts. Besides the National Physical Plan, local plans are also developed, covering sustainability, environmental conservation, and specific adaptation strategies to disaster risks in physical planning. In both the 11MP and the National Physical Plan 3 (2016-2020), children have been masked under the general population.

5.2.7 Analysis of keywords

From the content analysis of the included policies and action plans, the web analysis of keywords in the documents (Figure 33) shows that documents related to climate change contain less than 1% of keywords related to children. While environment-related documents contain 2.12% of keywords related to children, 32 out of 38 keywords are from the National Policy on Biological Diversity (2016-2025), discussed as a vulnerable group. Although the climate-related documents contain 9.24% health-related keywords, 60% of the keywords come from the National Agro-Food Policy (2011-2020) on nutrition, while another 30% is in the TNCR (2018). Although the environment-related documents contain 31.77% of keywords related to health, 90% of the keywords are from one document, the Guidance Document on HIA in EIA (2012). In comparison, while the health-related documents also contain about 4.42% keywords on children, the percentage is well spread across all documents.

On the other hand, child-related documents contain only 2.52% of keywords related to climate change. This is mainly concentrated in the Malaysian Plan of Action for People with Disabilities 2016-2022, where a disaster risk reduction plan is outlined for persons with disabilities. The keywords on the environment are even less in child-related policies, at only 0.81%. This observation is similar in education policies in which climate change and environment-related keywords appear less than 1%, with the main focus being on children. On the contrary, education-related keywords were found with fairly high percentages across all documents in other themes, i.e. climate change, environment, health, and children. Nonetheless, all the themes have been covered in the development plans, with the highest percentages of keywords being related to climate change and well-being.

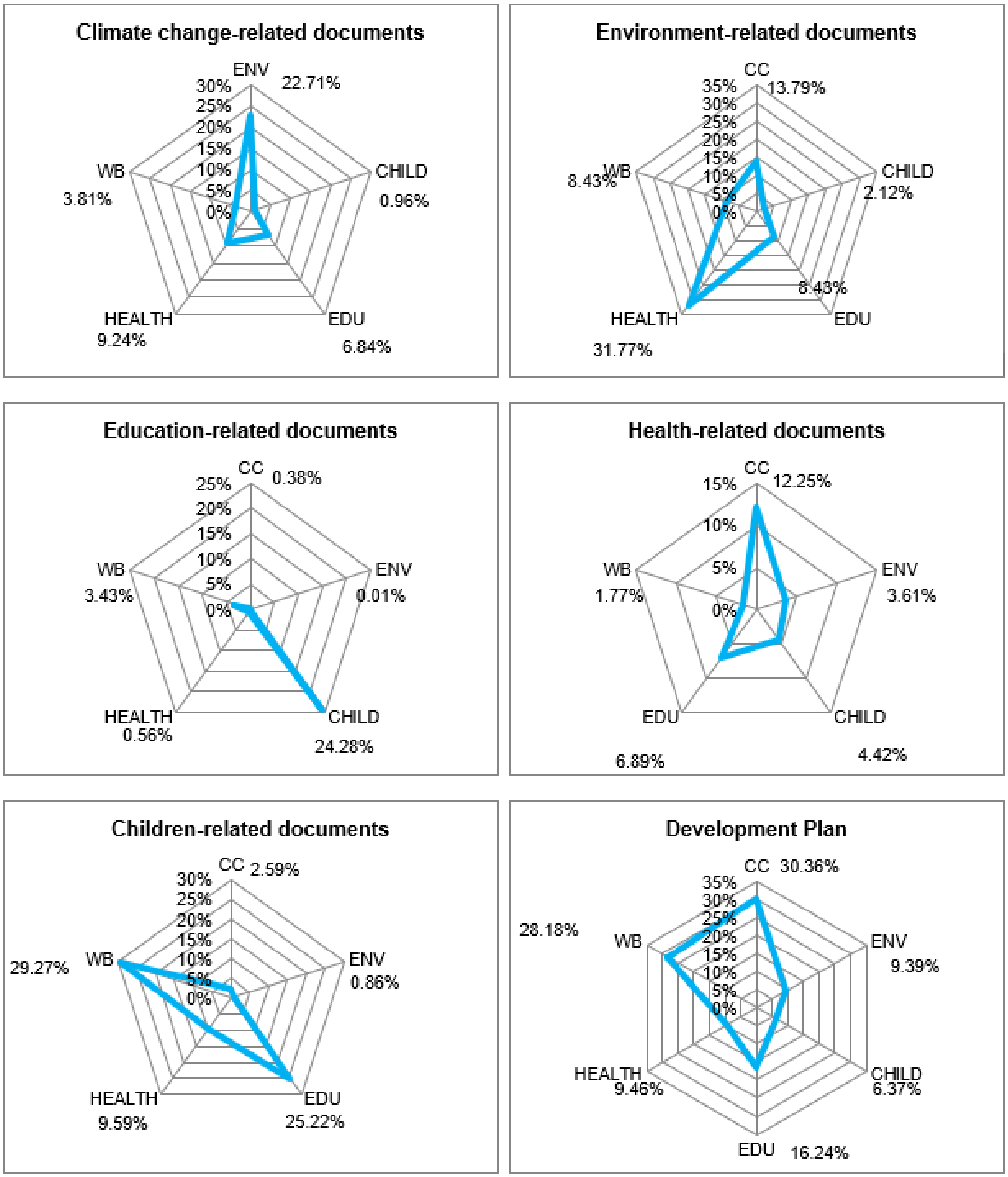


Figure 33: Web analysis based on keyword percentage in the documents of the respective theme. CC: climate change, ENV: environment, EDU: education, WB: well-being

Table 11 further summarizes the findings from the keyword analysis. The results show that the percentage of children-related keywords was low, i.e. below 5%, except for development and education documents.

Table 11: Summary of key findings from the keyword analysis

THEMES	CHILDREN-RELATED KEYWORDS	PERCENTAGE (%)
Themes of Documents	Climate change	0.96
	Environment	2.12
	Education	24.28
	Health	4.42
	Development	6.37

5.2.8 Conclusions

Climate change mitigation actions are embedded in the national policies and actions plans across all relevant sectors. However, it is unclear whether related industrial policies have incorporated considerations of health risks and co-benefits, especially pertaining to children. The control of health impacts from industrial environmental pollution on the population, including children, are mainly placed under the National Policy on the Environment. However, among those documents assessed, it is mostly addressed from the perspective of the general population. While vulnerable groups such as children may have been considered as part of the general community during policy implementation, it is suggested to include such groups in the policy content, considering children's additional risks of exposure and lower tolerance levels to the impacts of climate change and environmental degradation compared to adults.

- **It is not clear whether the related industrial policies have incorporated considerations of health risks and co-benefits to children in climate change actions, if available.**
- **Among those documents assessed that mention health, it is mostly addressed from the perspective of the general population.**

Most of the documents acknowledge children by emphasizing their education, awareness, and participation in the respective sectors. However, it is unclear whether the links between climate change, environment, and health have been included as part of education, as the policies and reports mostly describe education up to the extent of the environment only. For the education sector, while many activities and programmes have been organized by different agencies to address climate change and the environment, there is a lack of monitoring and evaluating systems to track the achievements. This is necessary to ensure that efforts made are not redundant and make optimal use of resources. On the other hand, while the environment is mentioned in child policies, climate change and environmental degradation need to be integrated into the action plans. From this assessment, the child-related documents have mainly addressed environmental issues from the social perspective, such as abuse, neglect, and exploitation. However, no emphasis has been given to the risks posed to children due to the impacts of climate change and environmental degradation.

Policies and reports mostly describe education up to the extent of environment only, and are unclear about the link to health.

There is a lack of monitoring and evaluating systems to track the achievements of educational activities and programmes organized by different agencies.

No emphasis has been given in child-related documents to the risks due to the impacts of climate change and environmental degradation.

In general, this assessment found a huge gap in the integration and implementation of children-sensitive and children-friendly climate change and environmental actions. Thus, there is a need for enhancing communication, coordination, and integration within and between various sectors' policies, plans, and programmes. As each sector has its own priority objectives and action plans, it is necessary to ensure that all sectors are aligned in addressing the impacts of climate change and environmental degradation, including disasters, along with the national aspirations of the Paris Agreement, Sendai Framework on Disaster Risk Reduction and the SDGs to address issues holistically.

there is a need for enhancing communication, coordination, and integration within and between various sectors' policies, plans, and programmes.

Figure 34 lists the main gaps and opportunities across the policy documents related to climate change and the environment, children and education, health and the current national plan.

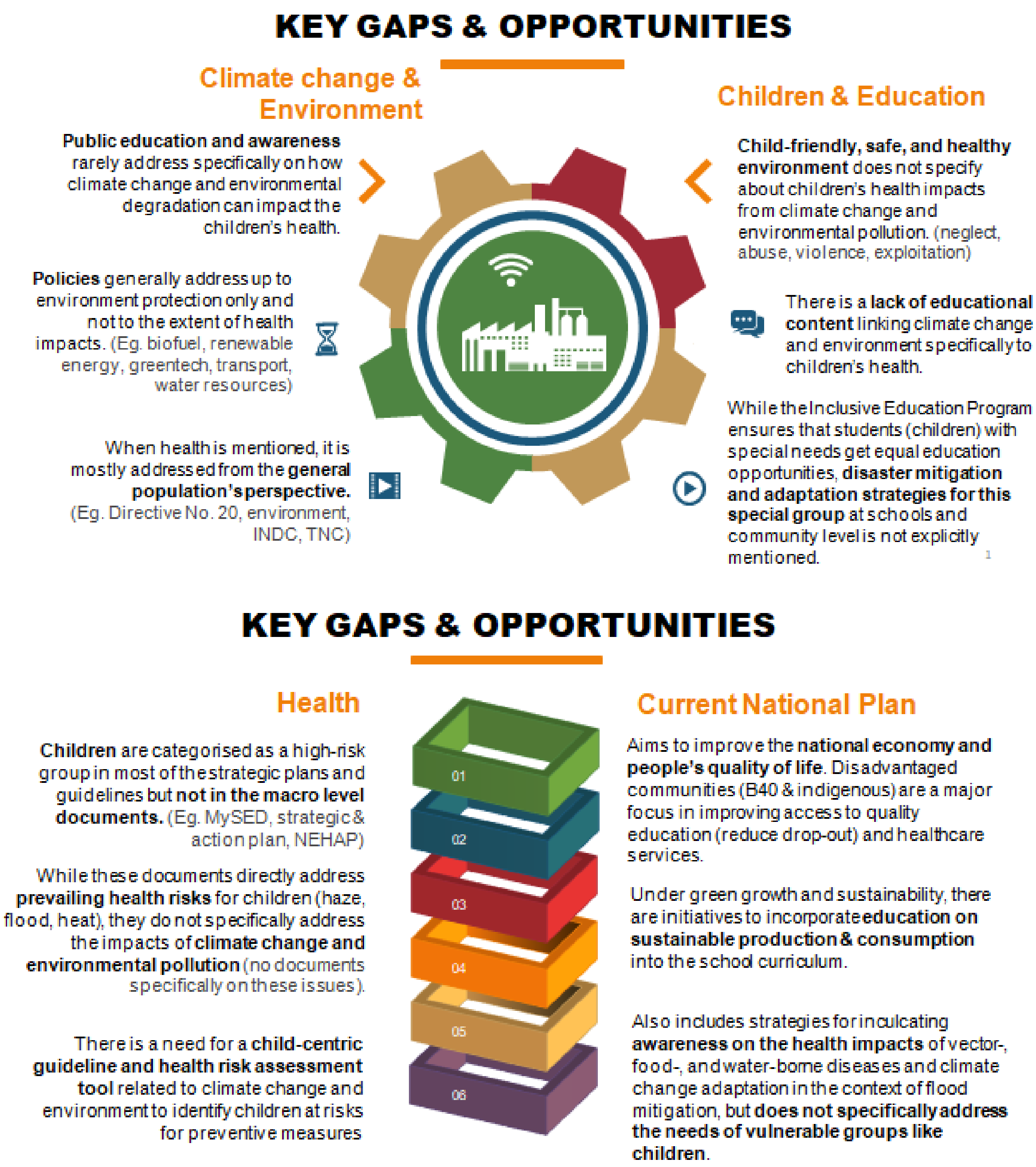


Figure 34: Main gaps and opportunities across the policy documents

5.3 Assessment of legal framework

By AP Dr Maizatun Mustafa

Figure 35 presents an overview of the assessment conducted on the Malaysian legal framework. Further details of the findings are detailed in Appendix 7. An article has been published (Mustafa et al. 2021) titled 'Analysis of children's health protection under the framework of environmental law and child law' (refer to Appendix 14).

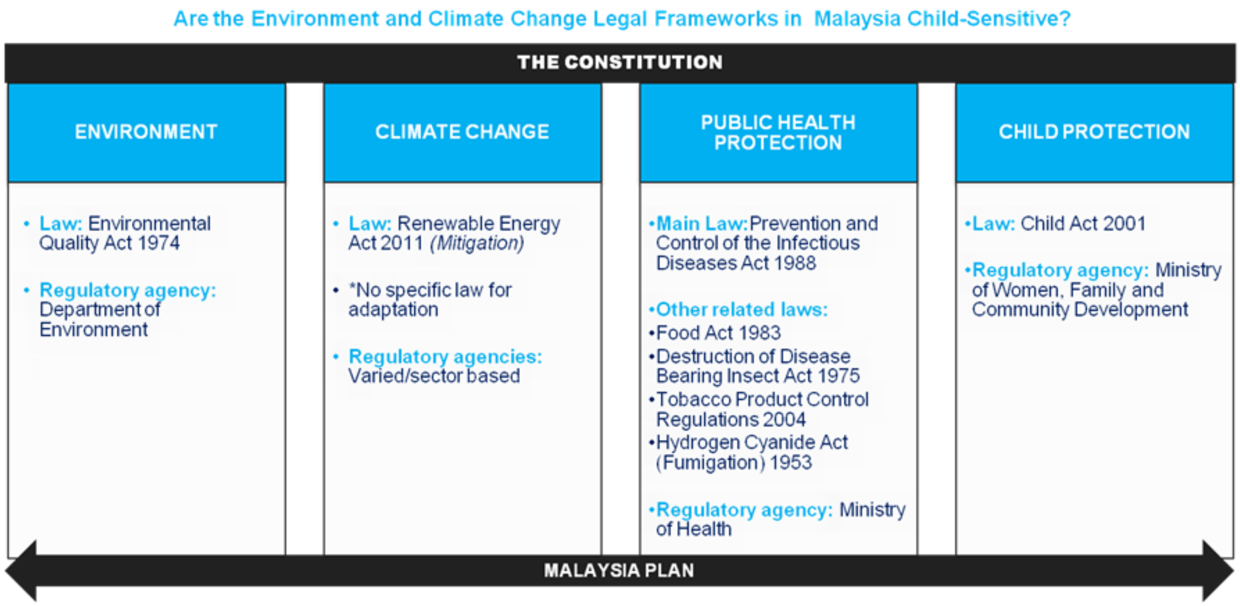


Figure 35: An overview of the assessment of the legal framework

5.3.1 Position of the Federal Constitution

Malaysia has a decentralized administrative jurisdiction of federal, state and local governments. To a large extent, environmental protection, climate mitigation, children's welfare and public health management patterns have been shaped by the system, the government, and the Federal Constitution, which is the supreme law. The complex setting of legal frameworks on the environment, climate change and children's protection stems from the Federal Constitution's distribution of powers as provided in the legislative lists under the Ninth schedule through List I (Federal List), List II (State List) and List III (Concurrent List).

Specifically, matters relating to medicine and health, including sanitation and child welfare, come under item 14 of List I, where the federal government (Parliament) has the jurisdiction to enact laws on the matter. However, matters relating to public health, sanitation (excluding sanitation in the federal capital) and the prevention of diseases are provided in item 7 of List III, where both federal and state governments have the power to enact laws. As for `environment' and `climate change', these two subject matters do not exist within any legislative lists of the Federal Constitution. However, aspects incidental to both matters could be found within the three lists as provided in Table 12 below.

Table 12: Ninth Schedule of the Federal Constitution

1	List I	Treaties with other countries, trade, commerce and industry, factories, water supplies, welfare of the aborigines, and control of agricultural pests
2	List II	Land, rivers, obnoxious trades and public nuisances in local authority areas
3	List III	Town and country planning, public health, sanitation and the prevention of diseases. Drainage and irrigation, protection of wild animals and wild birds, and national parks.

There is no specific provision in the Federal Constitution that speaks about recognising or protecting the public's right to a healthful environment. Consequently, Malaysia's approach to environmental management through policy and legal measures has not evolved from a Constitutional mandate to afford the public a right to clean air, water, and the environment. Rather, these measures are more a response to intolerable environmental conditions.[9] However, Article 5 of Part II of the Federal Constitution does contain a provision on fundamental liberties, which states that 'no person shall be deprived of his life or personal liberty save in accordance with the law'. While this article does not specifically deal with environmental rights, this article can be construed liberally to allow for the right to a healthy environment. Some Malaysian judges have indeed made efforts to deal with issues on the right to a clean environment in a more liberal manner.

In practice, the jurisdictional areas of federal and state governments as defined in the Federal Constitution can lead to non-uniform implementation, especially between states in Peninsular Malaysia with that of Sabah and Sarawak. Historically, the Federal Constitution made extensive changes to accommodate the special position of Sabah and Sarawak, allowing these two states to enjoy some executive, legislative, judicial, and financial autonomy not available to the 11 Peninsular states. This means that not all federal legislation enacted will apply to the whole of Peninsular Malaysia, Sabah, and Sarawak. For example, the Environmental Quality Act 1974 (EQA), a federal law, may apply to Peninsular Malaysia, Sabah, and Sarawak. However, certain provisions of the EQA, such as those on EIAs, are supported with other legal provisions in Sabah and Sarawak.

Gaps and challenges

- ➢ There is no specific provision in the Federal Constitution that speaks about recognizing or protecting the public's right to a healthful environment.
- ➢ Despite important progress made, children are yet to be viewed as key stakeholders in rule of law initiatives. Interventions are necessary to strengthen rule of law efforts

[9] See, Maizatun Mustafa, Clean Water: Right and Remedies Under Environmental Law in Malaysia, in Integrated Water Resources Management in Malaysia: Experiences and Practices 209–217 (Ann Anton et al. eds, Malaysian Water Partnership 2004).

in terms of justice for children, especially in relation to climate change and the environment.

- ➢ Justice for children's environmental and climate change issues should be systematically and liberally interpreted by the Federal Constitution and integrated into national policy and law.
- ➢ The legal situation in Sabah relating to children's environmental protection is complex as they involve both state and federal laws as well as and state and federal agencies.

5.3.2 Legal framework on public health law

In general, the national public health law is influenced by international law, especially that relating to human rights, the international spread of diseases, and public health standards. In a broader perspective, public health legislation, policies and institutions may also relate to other legislation and policies (environment, climate change, etc.) regulating national socio-economic development. In Malaysia, the public health law has evolved independently, leading to profound structure, substance, and procedures for detecting, controlling, and preventing injury and disease.

Public health law is a set of laws that provides the legal powers and duties of the government to assure the conditions for the population to be healthy, such as identifying, preventing, and ameliorating health risks. These functions are mainly undertaken by the public sector in Malaysia, largely by the MOH through its central, state and district offices.

The MOH is the main regulatory body supported by authorized medical and enforcement officers to enforce the law on public health. Enforcement activity includes issuing notices and compounds for offences such as breeding mosquitoes, smoking in gazetted non-smoking areas, selling tobacco products to minors (including minors in possession of tobacco products), or temporarily closing off premises for prevention and control activities. Prosecution in court will also be conducted for non-compoundable offences.

Gaps and challenges

- ➢ Health law, child protection law, and environmental law were developed with different aims and target groups. This is despite these areas of law being often concerned with the same subject matter or types of hazards posed.
- ➢ While existing public health laws provide for statutory public health protection services, the legal framework does not directly include provisions relating to impacts of environmental harm or climate change or any specific provisions on children.
- ➢ Matters relating to the control of non-communicable and communicable diseases, environmental protection, sanitation, and the prevention of injuries are under different regulatory bodies authorized to enforce different laws.

5.3.3 Legal framework on child protection

In 1995, the Government of Malaysia ratified the UNCRC, an international human rights treaty that upholds the civil, political, economic, social, health, and cultural rights of all children below 18 years. In order to fulfil the UNCRC, Malaysia enacted the Child Act in 2001. The Act is regarded as the most powerful Act introduced to consolidate and amend the laws relating to the care, protection, and rehabilitation of children. The preamble of the Act recognized that every child is entitled to protection and assistance in all circumstances. Section 2 of the Child Act, which is in line with Article 1 of the UNCRC, defines the 'child' as:

- a person under the age of 18 years, and
- (in relation to criminal proceedings) a person who has attained the age of criminal responsibility as prescribed in Section 8 of the penal Code [Act 574].

The scope of the Act in Section 31 provides an offence that carries a maximum fine of RM20,000 or a maximum imprisonment term of ten years or both if the guardian cares for the child in a manner likely to cause him physical or emotional injury. Specifically, Section 31 states that any person who, being a person having the care of a child: abuses, neglects, abandons, or exposes the child in a manner likely to cause him physical or emotional injury, or causes or permits him to be so abused, neglected, abandoned, or exposed, or sexually abuses the child or causes or permits him to be so abused, commits an offence.

One example which can be used to illustrate the application of Section 31 by the court is the case of *Pendakwa Raya v Asmarani bt Ghazali.*[10] The interesting point to be discussed in this case is the judge's definition of 'abuse' under Section 31 of the Child Act 2001 as a violation of an individual's human and civil rights by any other persons. It can be understood that there are two main elements to be given consideration:

- there was a violation of individual's human and civil rights
- the violation is done by any other persons

With regards to the first element, to prove whether the victim's human and civil rights were violated or not, it is necessary to determine whether the victim has any rights under any existing legislation. The best and most well-cited document that should be referred to is the United Nations Universal Declaration of Human Rights. This is the main international convention governing human rights at large, regardless of the individual gender, age, nationality and status. Even though the Federal Constitution does not refer to the words 'human rights', the Federal Constitution guarantees 'fundamental liberties' as preserved in Part 11.[11]

[10] Pendakwa Raya v Asmarani bt Ghazali [2019] MLJU 1719
[11] Rohaida Nordin, Malaysian Perspective on Human Rights, Jurnal Undang Undang, UKM, Jan 2010, p.19

Gaps and challenges

- ➢ The scope of the Act is very limited and confined to the provisions in Section 31 only. Section 31 (5) further extended that a person may be convicted if he causes suffering or injury to the child's health. Offences relating to the health and welfare of children are confined to ill-treatment, neglect, abandonment, or exposure. However, there is no specific provision under the Child Act 2001 in protecting children from any hazardous environment or climate change and any act that is detrimental to child health.
- ➢ The scope of `other person' is not extended to those who cause harm to children in the context of environmental or climate change risks. The Act sets out the punishment to parents, guardians, or person legally liable, but not to other offenders like companies, industries, or accused persons who have no relation with the child, under the definition of 'any person' in the definition of child abuse.
- ➢ To date, there is no criminal case where the accused person is charged under the Child Act 2001 for creating a harmful environment that endangers the child's health.

5.3.4 Legal framework on climate change

At the international level, Malaysia's direct involvement in the climate change process began when it ratified the United Nations Framework Convention on Climate Change (UNFCCC), followed by the Kyoto Protocol and the Paris Agreement. Under the Kyoto Protocol, Malaysia is categorized as a developing country with no mandatory greenhouse gas emissions target. While the Kyoto Protocol is not legally binding for Malaysia, as one of the Non-Annex 1 parties, Malaysia nevertheless pledged a voluntary reduction of up to 40% in terms of emissions intensity per unit of GDP by the year 2020 compared to emission levels in 2005, conditional on its receiving technology transfer and adequate financing from developed countries. In 2016 during the Paris Agreement, Malaysia renewed its pledge to reduce its greenhouse gas emissions intensity (per unit of GDP) by 45% by 2030 relative to the emissions intensity in 2005.

Article 3 of the Paris Agreement addresses climate change in a bottom-up approach through NDCs, which endorses flexibility for states to decide their climate actions based on their respective capabilities. Also important is the inclusion of adaptation, financing assistance, technology development and transfer and capacity building on top of mitigation actions. As a developing nation, Malaysia's NDC would be financially supported by developed states, on top of support to undertake climate change through technology and capacity building.

The mitigation provisions of the Paris Agreement, as stated under Article 4, have placed a greater burden on developing countries to undertake mitigation, as each successive NDC, which is scheduled every five years, will represent a higher ambition. Developing countries such as Malaysia are only required to move to economy-wide emissions reductions with no time limit. Regarding adaptation, Article 7 establishes that adaptation efforts of developing countries are recognized as part of a global goal to enhance adaptive capacity, strengthen resilience, and reduce vulnerability to climate change. Adaptation can be adopted through measures like sharing information, institutional arrangements, and scientific knowledge, taking into account vulnerable communities within societies and traditional knowledge and practices.

At present, the most relevant sectoral law in Malaysia pertinent to climate change is the renewable energy sector. Renewable energy for electricity generation is considered an effective measure to support the climate change regime and sustainable development. The increase of the renewable energy share in the total power generation is a predominant agenda in developing our climate change policy. Upon the NPCC 2009's identification of renewable energy generation as one of the main measures to reduce greenhouse gas emissions, the Renewable Energy Act 2011 was passed to provide a more comprehensive law on renewable energy. The Renewable Energy Act 2011 also formed a vital instrument to achieve the National Renewable Energy Policy and National Green Technology Policy objectives, which were introduced to boost the development of green technology and are expected to assist in mitigating climate issues.[12]

Gaps and challenges

Unlike many other countries which have already developed climate change laws as their main greenhouse gas emission reduction strategy, Malaysia's legal framework remains rudimentary with no specific law on climate change, except for the Renewable Energy Act. There are currently no holistic responses on mitigation and adaptation within the law. Below are gaps identified within the Act:

- The term `climate change' is not referred to in any part of the Renewable Energy Act 2011, and there is no mechanism to indicate that the Act serves to increase the share of electricity generation by renewable energy sources in a manner to promote sustainable development, climate change mitigation, and environmental protection.
- The Act is considered to represent the primary regulatory regime to increase renewable energy generation, help enhance the low carbon economy, and reduce air pollutant emissions from fossil fuels. However, no linkage is made between carbon emissions and human health, which is recognised as one of the most important causes of morbidity and mortality, particularly for children.

5.3.5 Legal framework on environmental protection

Malaysia's environmental policy and laws were highly influenced by the United Nations conventions, starting from the United Nations Conference on the Human Environment 1972, the 26 Principals of the Stockholm Declaration (of which Malaysia was a signatory), and the 126 recommendations of its Action Plan.

[12] Sustainable Energy Development Authority Malaysia (SEDA) http://seda.gov.my/ accessed 28th August 2018

The EQA is considered the most important environmental legislation in Malaysia concerned with the 'prevention, abatement, control of pollution and enhancement, and for the purposes connected therewith'.[13] The Act is primarily a pollution control law and forms the basic legislation for achieving national environmental objectives and policies. This Act is a federal law and applies to the whole of Malaysia.[14] It establishes powers to be exercised exclusively by the federal government, and it does not depend on parallel state enactments for its effectiveness within state boundaries.

The EQA is enacted to be a framework law. For its provisions to take effect, there is a need to make rules and regulations on that provision. Under Section 51 of the Act, the minister can make environmental protection and pollution control regulations. The regulations can prescribe standards or criteria, prohibit discharge, emissions or use of any equipment which is likely to endanger the environment, and determine the quantum of fines to be imposed. Generally, the EQA regulations which set environmental standards contain the following:

- a statement of the scope of the legal instrument, together with a definition of the applicable terms and concepts, specification of the responsible authorities, and of the parties, areas, and substances to whom or to which the instrument will apply,
- mention of applicable documents, such as other standards, specifications, and regulations,
- a detailed description of the requirements, including limits on pollutants, applicable tests, mandatory control methods, reporting requirements, etc. Where the requirements are to be implemented over a period of time, a timetable will be included,
- a specific statement of the monitoring, reporting, and inspection systems, and
- a statement describing applicable penalties for contraventions.

Similarly, relevant environmental terms defined in Section 2 of the EQA do not stand on their own but must be read with any relevant provision.

5.3.6 Interpretations

To identify the scope of the EQA in relation to climate change and human health protection, it is first necessary to refer to the interpretation section of the Act. The interpretation section would define words when a special meaning is to be attributed to that word. Such interpretation also sets the ambit of the statute. For example, when a word is defined to 'mean' something, the definition *prima facie* is restrictive and exhaustive. Some of the important words or terms interpreted by Section 2 of the EQA are as provided in Table 13 and able 14:

[13] Preamble of the Environmental Quality Act 1974.
[14] Section 1 (1) of the Act.

Table 13: Interpretation of words or terms under the EQA

Word / Term in Section 2	Interpretation	Sections applied		
'beneficial use'	means a use of the environment or any element or segment of the environment that is conducive to public health, welfare or safety and which requires protection from the effects of wastes, discharges, emissions and deposits	Section 3 Section 24 Section 51		
'element'	in relation to the environment means any of the principal constituent parts of the environment including water, atmosphere, soil, vegetation, climate, sound, odour, aesthetics, fish and wildlife	Section 21 Section 33 Section 47		
'environment'	means the physical factors of the surroundings of the human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factor of aesthetics	Section 3 Section 21 Section 29AA	Section 30B Section 31A Section 33 Section 34A	Section 47 Section 48B Section 49 Section 51
'environmental risk'	means any risk, hazard or chances of bad consequences that may be brought upon the environment	Section 31 Section 37 Section 51		
'environmentally hazardous substance'	means any natural or artificial substances including any raw material, whether in a solid, semi-solid or liquid form, or in the form of gas or vapour, or in a mixture of at least two of these substances, or any living organism intended for any environmental protection, conservation and control activity, which can cause pollution	Section 21 Section 22 Section 25 Section 29 Section 29AA	Section 30A Section 31 Section 31A Section 33	Section 36D Section 36E Section 37 Section 38 Section 51
'goods'	includes environmentally hazardous substances, pollutants and wastes	Section 2		
'pollutants'	means any natural or artificial	Section	Section 31	Section 37

	substances, whether in a solid, semi-solid or liquid form, or in the form of gas or vapour, or in a mixture of at least two of these substances, or any objectionable odour or noise or heat emitted, discharged or deposited or is likely to be emitted, discharged or deposited from any source which can directly or indirectly cause pollution and includes any environmentally hazardous substances	17 Section 21 Section 22 Section 25 Section 29	Section 31A Section 33	Section 38
`pollution’	Means an act or process, whether natural or artificial, resulting in the introduction of any pollutant into the environment in contravention of the acceptable conditions as specified in the regulations made under section 21	Section 3 Section 17 Section 22 Section 23 Section 24	Section 25 Section 31 Section 34 Section 36A Section 36E	Section 47 Section 48B Section 51
‘segment’	in relation to the environment means any portion or portions of the environment expressed in terms of volume, space, area, quantity, quality, or time or any combination thereof	Section 3 Section 21 Section 33 Section 47		
‘waste’	includes any matter prescribed to be scheduled waste, or any matter whether in a solid, semi-solid or liquid form, or in the form of gas or vapour which is emitted, discharged or deposited in the environment in such volume, composition or manner as to cause pollution	Section 3 Section 17 Section 18 Section 20 Section 21 Section 22 Section 25	Section 29 Section 31 Section 31A Section 33 Section 34B Section 36A	Section 36D Section 36E Section 37 Section 38 Section 46A Section 48 Section 52

Table 14: Comparison of the interpretation of the word 'pollution' under the EQA

Previous interpretation (before amendment)	Present interpretation (after amendment)
'pollution' means: any direct or indirect alteration of the physical, thermal, chemical, or biological properties of any part of the environment by discharging, emitting, or depositing environmentally hazardous substances, pollutants or wastes so as to affect any beneficial use adversely, to cause a condition which is hazardous or potentially hazardous to public health, safety, or welfare, or to animals, birds, wildlife, fish or aquatic life, or to plants or to cause a contravention of any condition, limitation or restriction to which a licence under this Act is subject.	'pollution' means: 'an act or process, whether natural or artificial, resulting in the introduction of any pollutant into the environment in contravention of the acceptable conditions as specified in the regulations made under Section 21' [Am. Act A953: s.2, Subs. Act A1441 of the year 2012]

Gaps and challenges

- Table 13 above shows that the EQA mainly applied a restrictive approach to defining a word or term. This is based on the employment of the word 'means', which shows that the definition enacted is hard and fast and that no other meaning can be assigned to the defined word.
- Terms like `sustainable development' and `climate change' are not present in the EQA, which is a concern as the EQA is supposed to be the main legislation to implement environmental policy directives targeting sustainable development.
- Another concern relates to the word pollution, as shown in able 14. It is a concern that this narrow interpretation strictly confines the meaning of pollution within the scope of Section 21 without any linkages being made to human factors such as public health or welfare. The implication of such interpretation would be that pollution's adverse impact on human health, including that of children, would not be a factor to be considered when enforcing the law.

5.3.7 The EQA parameter limits for human health protection

The EQA addresses environmental and human health protection with different strategies (limits of emission, discharge license, fines, environmental standards) targeting anthropogenic inputs and receiving environmental compartments. The EQA has developed emission limits on industrial discharges to air and effluent limits on those to water. These standards are generally set to either control emissions to environmental media and/or protect a vulnerable receptor, such as human beings or the environment. These standards are usually a combination of science and policy (e.g. society's attitude to risk, achievability, costs), international agreements, the UN mandate, or WHO standards.

An example is the Environmental Quality (Clean Air) Regulations 2014, within Regulation 24 on Prohibition order (See Table 10 below). It states that in the event of any undesirable occurrence as specified in the Sixth Schedule, and wherein the opinion of the Director-

General, the continued operation should not be permitted in order to safeguard public health, safety, or welfare, the Director-General may by notice in writing issue an order to the owner or occupier of a premise prohibiting the further operation of such premises for such period as they may direct, or until remedial requirements as directed by them have been complied with.

In relation to water pollution, strategies applied by the EQA are regulated based on particular effluent standards, which prescribe the allowable limit or acceptable conditions of effluent to be discharged. A person is prohibited from discharging any waste into any inland waters in contravention of allowable standards unless he is licensed to do so. At present, 'acceptable conditions' for inland waters pollution are provided within the relevant regulations:

- Environmental Quality (Industrial Effluent) Regulations 2009
- Environmental Quality (Sewage) Regulations 2009

Within these two Regulations, specific effluent standards limit, in terms of concentration and/or volume, any wastewater discharge from a point source, i.e. industrial plants and municipal sewerage systems. They are meant to protect receiving waters and their associated aquatic ecosystems and protect public health from the harmful effects of untreated sewage. The control of pollution through licenses under the EQA is used in two different contexts. Firstly, all industries or municipal discharges must abide by general standards promulgated in the said Regulations. Secondly, any person unable to comply with those standards may apply for a license to discharge pollutants or effluents over the prescribed standards.

Gaps and challenges

- ➢ In relation to allowable limits for air pollution emission, apart from determining the allowable limits for the ‘normal healthy’ population, consideration must also be given to high-risk groups such as infants and young children, the elderly, or pregnant women, or those exposed to excessive amounts of the pollutant. However, it is also understood that the current air quality guidelines established are based on the national baseline data with reasonable considerations to economic factors[15]. In addition, in the EIA process, industries must maintain the same level of air quality as the baseline study. For school children, school activities are confined when the API reaches 100 and schools are closed when the API reaches 200.
- ➢ The risk to human health is not the sole or major criterion for the control of pollution. The EQA also takes into consideration economic factors to strike a balance between costs and benefits. Thus, the law considers matters such as choice or selection of control technology in imposing allowable pollution limits.
- ➢ In relation to water pollution, the issuance of a license for effluent discharge into the river is administrative. It does not consider factors such as the impact of pollution on public health and the environment.

[15] Strategic meeting DOE Malaysia (31st March 2021)

- ➢ The two standards of effluents, Standard A and Standard B, made no consideration for the river loading capacity, which refers to the greatest amount of pollutants that a river can assimilate without causing the water to get polluted. Consequently, even if all factories comply with the regulatory standard in discharging their effluent to rivers, the cumulative impact of these discharges may cause pollution if the river's capacity to dilute them is overshot.
- ➢ While existing air and water pollution standards are meant to protect public health and the environment, there is no explicit requirement relating to risks to infants and children in the administrative licensing process.

5.3.8 Scheduled wastes regulation under the EQA

The appropriate handling and disposal of hazardous, toxic, and clinical waste generated from industries, hospitals and other health facilities are essential to mitigate adverse health and environmental consequences. This concern has resulted in clinical waste being classified as a scheduled waste controlled under the Environmental Quality (Scheduled Wastes) Regulations, 2005. One form of public health protection under the Environmental Quality (Scheduled Wastes) Regulations 2005 is the requirement that hazardous wastes be properly packaged, labelled, and stored from the time the waste is generated to its final disposal.

Gaps and challenges

While the EQA regulates most hazardous wastes that are ignitable, reactive, corrosive or toxic under the Environmental Quality (Scheduled Wastes) Regulations 2005, there is no specific regulation on hazardous household wastes which are generated by normal household activities such as detergent for cleaning, except for those relating to solid wastes which are regulated by the relevant local authority's law. At present, there is no specific law to require households to monitor the use, storage, and disposal of products with potentially hazardous substances in their homes. Improper disposal of hazardous household wastes can include pouring them down the drain, on the ground, into storm sewers, or in some cases, putting them out with the regular trash. The dangers of such disposal methods might not be immediately obvious. However, improper disposal of these wastes can pollute the environment, threaten human health, and present hazards to children and pets if left around the house.

The consumer safety of such products is governed by the Ministry of Domestic Trade and Consumer Affairs, where product safety is categorized into General Safety Regime and Specialized Safety Regime.[16] The General Safety Regime is based on Part III: General consumer product safety under the Consumer Protection Law 1999 [Act 599]. Specialized Safety Regimes are regulated by the respective ministries such as the MOH (medicines)

[16] https://mysafe.kpdnhep.gov.my/portal/post/2

and Ministry of Agriculture (pesticides). Thus, consumer education plays an important role in addressing this issue.

5.3.9 Environmental Impact Assessment

An EIA assesses the short-term and long-term effects of any proposed action (or absence of action), including policies, legislative proposals, programmes, projects, and operational practices, on the population and the physical, biological, and socio-economic environment. It employs a structured approach to the evaluation of the impact of a development of any prescribed activity (e.g. hydroelectric installation, nuclear power plant, industrial complex) on human health and the environment.

Possible measures to prevent or control the impact of the various associated forms of environmental pollution are also considered during the decision-making process. This allows decision-makers to select the option that results in the least pollution or stop the project entirely. Where standards exist, the persons proposing the development, programme, or policy are required to state how they intend to comply with such standards.

The principle of public participation is a required process in the EIA and holds that those affected by a decision have the right to be involved in the decision-making process. Arguably, strong public participation in environmental governance could increase the commitment among stakeholders, strengthening the compliance and enforcement of environmental laws.

Gaps and challenges

- ➢ In the EIA process under the EQA, children’s rights and intergenerational justice is weak and may not include social-structural issues and environmental degradation, including children’s vulnerability.
- ➢ Even where legally mandated for some activities under the EQA, public participation is still often weak and patchy and rarely involves children.

5.3.10 The Environmental Quality Council under the EQA

Considering that the EQA is a framework legislation, it is important that subsidiary legislations (Rules, Order, Regulations) are introduced to ensure that the Act's main provisions can take effect. The authority empowered to gazette the regulations is the Minister in charge of the environment (and not health). Under Section 51, such power includes regulations to prescribe standards or criteria, prohibit discharge, emissions or use of any equipment likely to endanger the environment or human health, and determine the quantum of fines to be imposed. In undertaking such tasks, the Minister must seek advice from an advisory board known as the Environmental Quality Council (EQC) (Section 4), whose main duties are:

- to advise the Minister on matters pertaining to this Act, and
- to advise the Minister on any matter referred to it by the Minister.

In relation to the EQA, while the Minister has the ultimate authority over the subsidiary legislations of the Act, on a general policy-making level relating to the Act, the Minister is advised by the EQC, which comprises 18 members who are representatives of relevant bodies concerned with the environment and pollution.

Gaps and challenges

In Malaysia, matters relating to the environment cut across the normal jurisdictions of government departments. When drawing up laws and pollution standards governing environmental pollution and relating to memberships of the EQC, it is important to ensure that all relevant sectors are adequately represented and that all perspectives are taken into account during the decision-making. The EQC members currently do not include agencies concerned with children. Currently, the MWCFD, the custodian of children's welfare, has only been involved in the social impact assessment of the EIA and has yet to be included in the EQC.

5.3.11 Licensing system under the EQA

An integral part of the EQA's pollution control strategy is the requirement for activities that are causing pollution or natural resources degradation to apply for licenses or permits, which are the central instruments used to ensure compliance with environmental law. The emission of pollutants exceeding the permitted limit is an offence unless the person who commits such emission is licensed. This administrative scheme of licensing system is common under the EQA to control water pollution and air pollution.

There is a general presumption that the discharge of polluting matter into the atmosphere is illegal unless licensed. This administrative scheme of licensing or permitting is granted subject to conditions and can be revoked if conditions are not fulfilled.[17] A license or permit is generally subject to several conditions to reduce the effects on the environment and allow enforcement agencies close and continuous control over activities that are causing harm.[18]

However, under Section 11 of the EQA, before varying any conditions or attaching new conditions to the license, several considerations need to be taken into account as required by Section 11 (4) as provided in Table 15 below:

[17] See for example provisions within statutes such as the Environmental Quality Act, National Forestry Act 1984 and Wildlife Conservation Act 2010

[18] Mustafa, M. *Environmental Law in Malaysia* (4th edn, Kluwer Law International 2019)

Table 15: Section 11(4) of the EQA

(a) whether it would be practicable to adapt the existing equipment, control equipment or industrial plant to conform with the varied or new condition,
(b) the economic life of the existing equipment, control equipment or industrial plant having regard to the date of purchase,
(c) the quantity or degree of cut-back of emission, discharge or deposit of wastes to be achieved by the varied or new condition,
(d) the estimated cost to be incurred by the licensee to comply with the varied or new condition, and
(e) the nature and size of the trade, process or industry being carried out in the premises.

Gaps and challenges

- ➢ The licensing strategy which is applied to regulate the potentially harmful activities of polluters may become problematic. Complaints may be made upon ‘legitimate’ business practices since licensed pollution is lawful, while unlicensed pollution is prohibited.
- ➢ The EQA’s licensing system and enforcement mechanisms for water, air and hazardous wastes are lenient or otherwise outdated, with greater considerations given to the economic well-being of the industry instead of environmental or human welfare. This can be seen within the EQA’s provision on contravention license, which allows for the discharge of pollution exceeding the limit despite the possible impact on human health or the environment.
- ➢ From the five factors provided as consideration factors by Section 11 (4) above, conspicuously lacking is financial, health or environmental costs incurred by affected communities or groups such as children by the non-imposition of varied or new conditions. The provisions seem to give higher consideration to the 'practicality’ and expenses of license holders/polluters.

5.3.12 Interviews

To validate the findings, interviews were conducted with legal and judicial personnel (R1-R6) on the position of existing legal frameworks concerning children's environmental and climate change protection and to gain insights into the way forward. The respondents were selected based on their levels of expertise with the issues concerned.

As a whole, one theme across the interviews was the inadequacy of law and enforcement to protect children from being exposed to environmental and climate change harm, including procedural law. All the respondents often said that the law needs to be revised to include provisions that protect children against such harm. The interview results have validated findings of the doctrinal research relating to the gap within the existing legal frameworks in addressing the said issues and implementing measures that could lead to more effective and sustainable solutions that adequately reflect the rights of the present and future children. The details of the interviews can be found in Appendix 7.

5.3.13 Conclusions

At present, there is a clear gap within the law in linking and enforcing policy objectives and considering the important concern of child sensitivity. The collection of slides in Figure 36 below shows the main findings and gaps in legal frameworks related to climate change, environment, health, and children in Malaysia.

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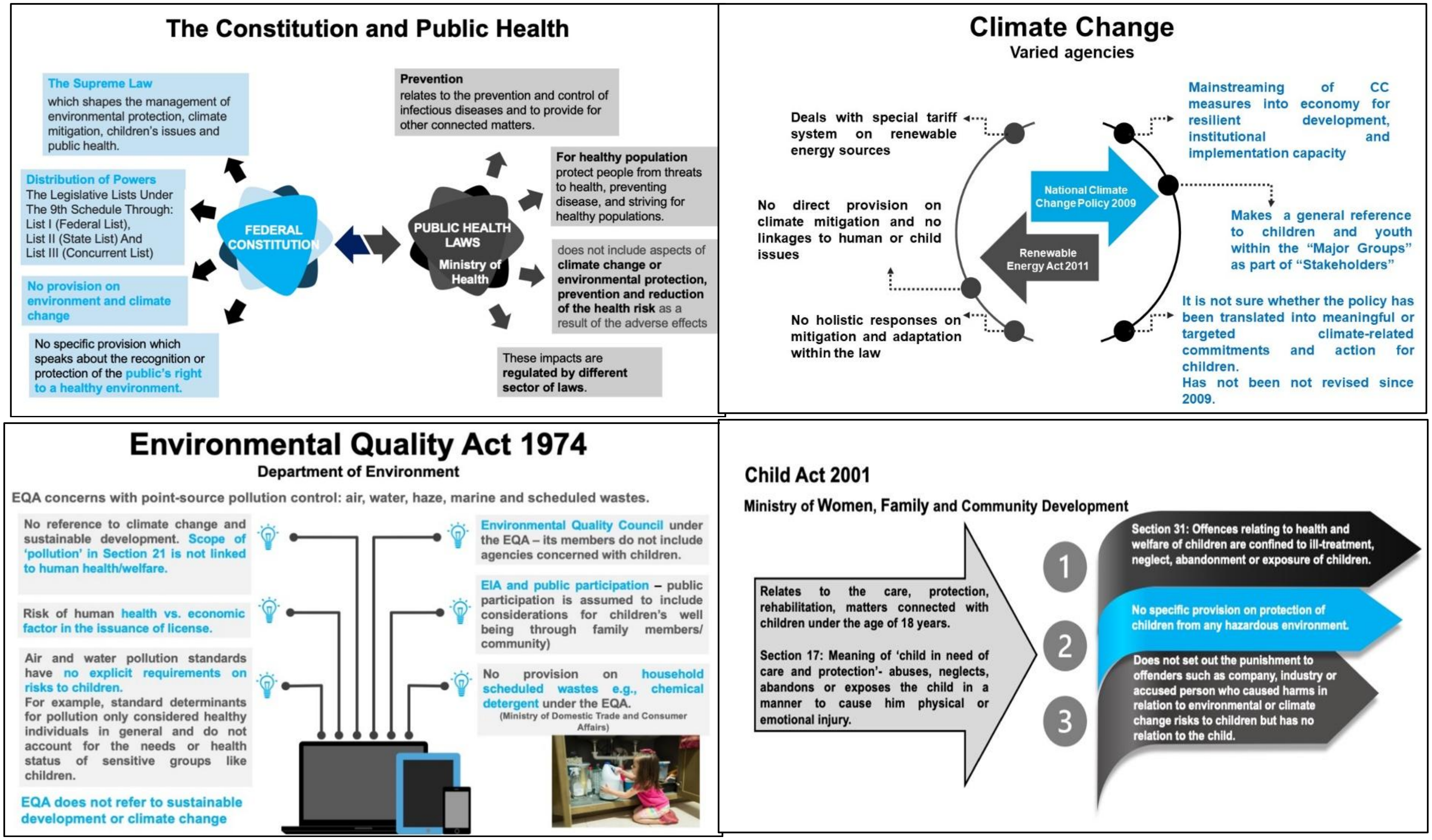

Figure 36: Main findings and gaps in the legal framework

A summary of the key issues for consideration are found below:

1. **While areas of law such as environmental law and public health law were developed in parallel, they respond to different target groups to achieve distinct objectives.**

2. **The EQA, the most important environmental law in Malaysia, has a limited scope in dealing with public health issues due to pollution.**

3. **The EQA is lenient or otherwise outdated, with greater considerations given to economic priorities instead of environmental or human welfare through the licensing mechanism.**

4. **Under the law, the pollution emission standards represent the minimum environmental standards or practices that do not produce adverse effects. Such limits establish necessary safety margins for pollution control targets and strategies. Therefore, the law should consider not only healthy individuals but also vulnerable population groups whose particular make-up or state of health need to be taken into account, such as that of children.**

5. **The EQA and other environment-related laws were passed long before the recognition of the current national and international climate change commitments. Thus, they appear uncoordinated, do not reflect important climate concerns, nor the attainment of the SDGs, which are pertinent in the environment and public health agenda.**

6. **The Child Act, which is almost 20 years old, needs revision to align with new and emerging international climate change commitments and SDGs. Children-related policy documents do not recognize the negative aspects of climate change nor prescribe strategies on climate mitigation and adaptation in the context of children.**

5.4 Sabah policy and legal framework

5.4.1 Sabah legal framework

As discussed in the earlier section, it should be noted that the three main principles of the NPCC are climate change mitigation, climate change adaptation, and capacity building. In this context, this section examines the extent to which Sabah's legal framework and state's policies on environmental issues reflects those principles, particularly on children's well-being as impacted by climate change.

Being one of the states in the Malaysian federation, the state government has to ensure that policies carried out in Sabah are in line with those formulated at the federal level. The federal-state relation is fundamentally governed by the Federal Constitution and the Ninth Schedule. It provides matters within the jurisdiction of the state, the federal government, and those under concurrent jurisdiction (Faruqi 2019). At *prima facie*, it is clear that the environment and matters related to the environment, such as land, forestry, and agriculture, fall under the State List of the Federal Constitution. However, in case of conflict between state law and federal law, the federal law shall prevail as stipulated in Article 75 of the Federal Constitution. Being the supreme law of the land, provisions in the Federal Constitution should be upheld (Harding, 2012).

In this assessment, the relevant legal instruments are selected as listed below:

- Sabah Environment Protection Enactment 2002
- Sabah Biodiversity Enactment 2000
- Sabah Water Resources Enactment 1998
- Forest Enactment 1968
- Wildlife Conservation Enactment 1997
- Sabah Land Ordinance 1930
- Park Enactment 6/1984

Gaps and challenges

- ➢ An examination of the above legislation reveals no specific provisions that cover any issues on climate change. However, indirect interpretation and implementation of the provision may cover issues that are related to climate change.
- ➢ There is no specific provision on climate change and the effect of climate change on environmental resources, including the human population. Most notably, the impacts of climate change on vulnerable groups of the community, particularly children, are not included in the content.
- ➢ It should be pointed out that all of the related enactments came into existence before climate change became a global issue. One clear example is the Sabah Land Ordinance 1930. Due to this, the content of those enactments is also not in

tandem with Malaysia's pledge to commit to climate change issues at the international level, particularly after Malaysia's ratification of the Paris Agreement 2016.

- Thus far, there has not been any effort to amend the existing state legislation to integrate and implement the three main principles enumerated in the NPCC. The latest enactment on the environment in Sabah is the Environment Protection Enactment that came into existence in 2002. At that time, Malaysia has yet to develop the NPCC even though the Kyoto Protocol was ratified in the same year. The NPCC was announced eight years after the ratification of the Kyoto Protocol.

5.4.2 Sabah State Policy on the Environment 2018 and Sabah Environmental Education Policy 2009

Two of the most recent policies are selected for close examination. Preliminary general observation on those two policies reveals that there is no mention of the words 'children' or 'children's well-being' in both policies.

The Sabah State Policy on the Environment 2018 is the first of its kind among all the states in Malaysia. No other state has taken such initiatives at the time it was announced by the Sabah state government. This policy contains principles that form the general direction on five environmental aspects: air, water, land, biodiversity, and the social dimension.

Of all these aspects, the policies on air and water reflect the principles and guidelines of those in the NPCC. The Sabah state policies on managing greenhouse gas emissions encompass guidelines to mitigate and adapt to the impacts of climate change. The general guideline on the aspect of air is spelt in the following manner: '…Sabah will actively participate in national and global efforts to mitigate negative effects of climate change due the increase of greenhouse gases and to adapt to unavoidable global changes, which may affect the livelihood of the peoples of the State.'

Similarly, on the aspect of water, this policy also contains guidelines in sync with those in the NPCC. Directions on implementing a state-wide water resource monitoring programme, management of surface water, and catchment-based planning clearly contain precautionary measures to avoid the risk of floods. On the aspect of flood control, it was spelt out that the impact of climate change is taken into account. The guideline is formulated in the following manner: 'impact of climate change on coastal flooding will be taken into consideration for all future developments'.

The Sabah Environmental Education Policy 2009 was an official state policy formulated under the Bornean Biodiversity and Ecosystems Conservation Programme Phase I (BBEC I). Ultimately it is an environmental education programme, and its objective is 'to instil environmental stewardship and sustainable lifestyle among the people in Sabah'.

Essentially, this policy runs parallel with the National Policy on the Environment 2002. Article 2.1 of this policy defines environmental education as ‘a learning process in which individuals and groups acquire awareness, knowledge and skills about the total environment, resulting in attitudinal and behavioural changes, thus contributing towards environmental conservation and sustainable environmental management.’ Having examined the definition of environmental education in this policy and its objective, it can be concluded that this policy is not specifically drafted to cater to the transfer of knowledge regarding climate change and its impacts specifically. Rather, this policy is a broad and general guideline on environmental education.

5.4.3 Recommendations and suggestions

Our recommendations are based on how the existing policies can be improved to incorporate concerns on climate change impacts on the children. The social dimension aspect of the Sabah State Policy on the Environment can be enhanced to encompass children’s well-being due to the effects of climate change. The social dimension aspect stresses the responsibilities of individuals. Knowledge and understanding were emphasized as the guide to foster the social dimension. This aspect should be enhanced to include knowledge and understanding of climate change impacts on society, emphasizing vulnerable groups, including children and people with disabilities.

With regards to the Sabah Environmental Education Policy, specific education programmes that emphasize climate change and its mitigation and adaptation strategies should be included. In addition, there should be a specific education programme on climate change and children as environmental stewardship depends largely on the well-being of the future generation. Public awareness, training, and education on climate change has been identified as important measures in encouraging all members of the society to be actively involved in climate change mitigation and adaptation activities (Abdul Rahman 2018)

Apart from enhancing the existing policies, new legislation, policies, and enabling institutions should also be established at the state level. The game-changing actions that could facilitate the establishment of a better governance structure to deal with climate change issues at the state level are as follows:

i. To create an official centre/unit to coordinate the state government initiatives to tackle climate change issues.
ii. To form a specific State Action Plan on Climate Change (adaptation, mitigation, and capacity building). Within this plan, impacts on vulnerable groups must be included (note: Sabah has had various state action plans on specific animals threatened with extinction. The time is right for a specific action plan on impacts of climate change to be initiated), and

iii. To endorse a specific enactment on Climate Change, the Sabah Climate Change Enactment.

5.4.4 Conclusion

In summary, below are the key takeaways moving forward as an outcome of this assessment of the legal framework and government policies on environmental issues in Sabah.

1. **Future action should be specific, i.e. with specific emphasis on children's well-being as impacted by climate change.**
2. **Actions have to identify children as the main subject matter or target directly.**
3. **Action should be two-pronged, i.e. at the national level, followed by the state level. As such, the proposed concerted actions should focus on a specific target (children) with emphasis on a specific issue (climate change impacts).**
4. **To take efforts to enhance and improve the content of the existing relevant policies.**
5. **To enact new state legislation focusing on climate change and all relevant matters for mitigation, adaptation, and capacity building.**

5.5 Assessment of SDG 13 monitoring framework

The EPU under the Prime Minister's Office is responsible for the observation of the SDGs in Malaysia. It allocates funds across all ministerial departments in achieving the SDG targets. The SDGs are distributed into five working committees under the National SDGs Council:

- Inclusivity
- Well-Being
- Human Capital
- Environment and Natural Resources
- Economic Growth

The assessment of Malaysia's SDG monitoring framework for four key SDGs is presented in Appendix 8. Malaysia has reported some indicators and actions corresponding to almost all the SDG targets in local or international periodic reporting. For SDG 13 (Climate Action), Malaysia has emphasized disaster risk reduction, especially in flood mitigation and adaptation planning. For SDG 3 (Good Health and Well-Being), there have been improvements in malaria incidence and water-borne diseases due to improved sanitation since 1990. For SDG 6 (Clean Water and Sanitation), Malaysia achieved 99.7% access to sanitation facilities for its population and has a fair distribution of commitment in integrated water resource management. For SDG 4 (Quality Education), there have been increased literacy levels, and education for sustainable development has been incorporated in formal syllabi.

6 CONCLUSIONS

This report concludes the successful execution of this research project as per the four project outputs. We looked into several parameters from different perspectives and methodologies. The parameters, outcomes, and stakeholder input are integrated and interlinked, as shown in our model on the impacts of climate change on children in Malaysia (Figure 37).

This model presents the interconnections between climate change challenges and children's health and well-being. The climate challenges include rain, heat and sea extremes that give rise to secondary challenges, including various environmental problems such as floods, reduced agricultural productivity, and insufficient water resources, which are particularly detrimental to children's health. Concurrently, we also highlighted the association between climate challenges and social challenges that exacerbate the health problems of disadvantaged groups such as the poor and migrants. In this model, we included social and well-being issues such as education, abuse, and citizenship status among children that could be affected by climate change. This model is aligned with the research methods (case series review, desk studies, case studies, and policy and legal assessments) in this project, as indicated by the coloured boxes. This research has covered most of the pertinent issues presented under climatic, environmental, and social challenges at the ground and policy decision levels.

In summary, although being the preliminary findings on the status of children in Malaysia, the convergence of all the evidence in this report underscores the importance of addressing children's issues specifically and not as part of the general population. It is timely to relook at current policies, action plans and international documents on national commitments on climate change and environmental degradation in the context of children. It is hoped that this report will be widely disseminated within relevant networks for further actions to be taken at both the community and the policymaking levels through effective intersectoral strategies and implementation and synergies across all parties.

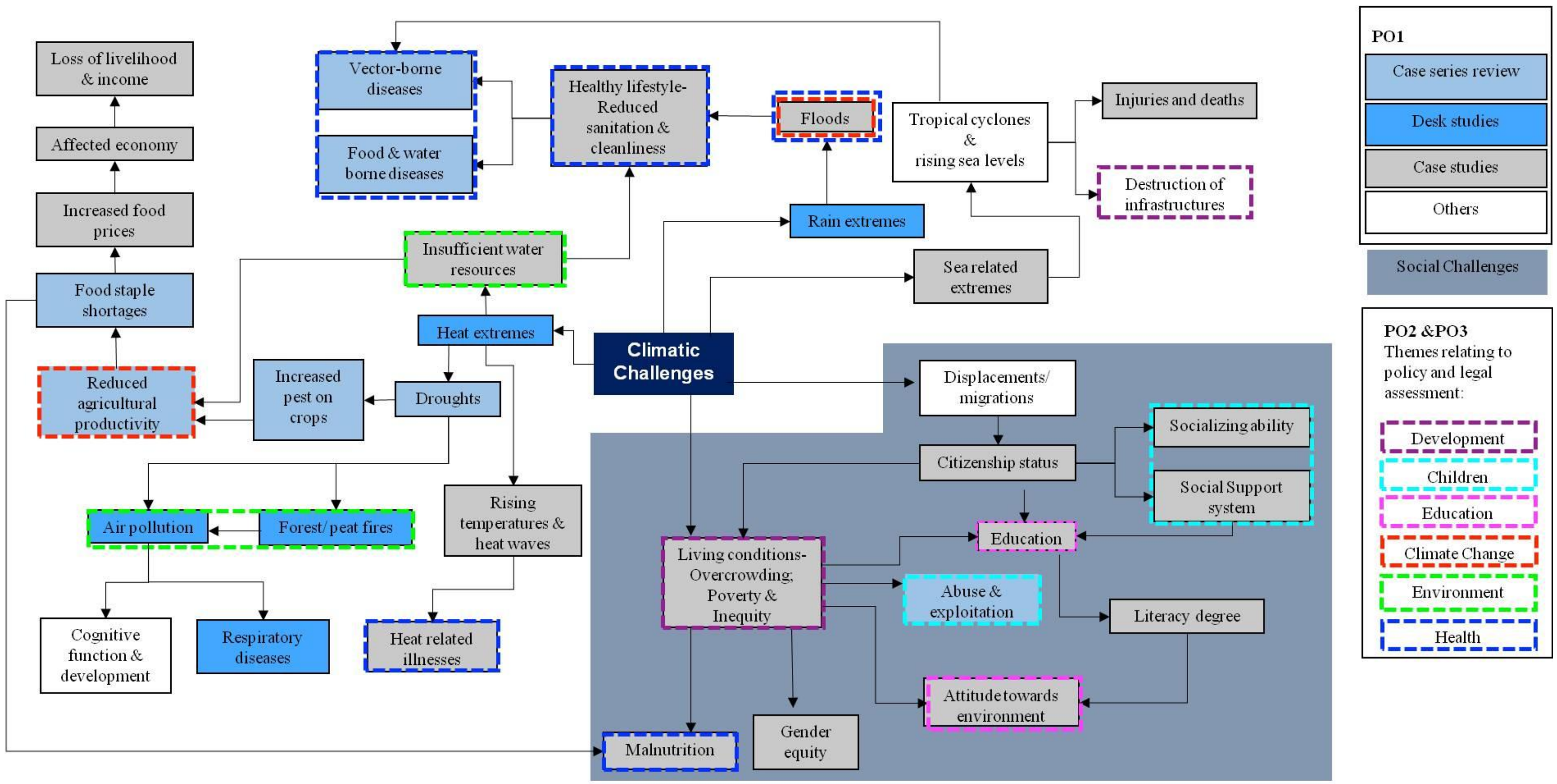

Figure 37: Model on the impact of climate change on children in Malaysia

7 RECOMMENDATIONS

This chapter covers recommendations based on gaps and opportunities from the main findings of this study, as summarized in Table 16 below. It is hoped that these recommendations will be presented to the Malaysian government, UNICEF Malaysia, and other stakeholders to address the challenges of climate change and environmental degradation on children's well-being in Malaysia and mobilise more effective action. All recommendations should be child-sensitive with intersectoral and interministerial synergy, as climate change and environmental degradation are cross-cutting issues.

Table 16: Issues, recommendations and key actors

Sectors	Issues (refer to Figure 37)	Recommendations	Time frame
Health	Vector-borne diseases Food and water borne diseases Respiratory diseases Social Support system Heat related illnesses Healthy lifestyle - Reduced sanitation and cleanliness	1. **To establish a Children Environmental Health (CEH) Programme/Policy** – To establish a comprehensive child-centric guideline addressing children's environmental health (specially dedicated programme for children) – To utilize the national priority areas in environmental health by NEHAP towards the prioritization of children's health in the context of climate change and the environment	Short term
		2. **To include children's health considerations within climate change and health policies**	Medium term

(Short term: 1-2 years, Medium term: 3-5 years, Long term: >5 years)

Sectors	Issues (refer to Figure 37)	Recommendations	Time frame
Education	Education Social support system	**1. To enhance environmental health education and evaluation** – To supplement the current curriculum and extra-curricular delivery system with climate change and health content • To develop a booklet focusing on children's health and well-being, climate change and environment degradation as a guide for teachers • To develop a training module for teachers – To explicitly include education on climate change, the environment and sustainable development in the education blueprint – To develop a cross-ministerial evaluation framework on the effectiveness of educational programmes on climate change and environmental degradation, both for teachers and children – Support system (e.g. resources, facilities) for learning	Short term

(Short term: 1-2 years, Medium term: 3-5 years, Long term: >5 years)

Sectors	Issues (refer to Figure 37)	Recommendations	Time frame
Children	Abuse and exploitation Gender equity Living conditions - Overcrowding, poverty and inequity	**1. To enhance advocacy for children's rights to a healthy environment and social well-being** – To prioritise children in achieving SDG1 (poverty), SDG3 (good health and well-being), and SDG4 (education) in line with the global 'Leave No One Behind' efforts – To strengthen/update children-related policies and laws to include climate change and environmental impact considerations. – To strengthen action plans for vulnerable children (especially persons with disabilities) in the context of climate change and environmental impacts – To include considerations for children in disaster management planning **2. To include MWFCD as a member of the EQC to advocate for children's rights**	Short and medium term

(Short term: 1-2 years, Medium term: 3-5 years, Long term: >5 years)

Sectors	Issues (refer to Figure 37)	Recommendations	Time frame
Climate change and Environment	Vector-borne diseases Rain extremes Heat extremes Forest/ peat fires Air pollution Insufficient water resources Injuries and deaths Floods Tropical cyclones and rising sea levels Destruction of infrastructure	1. **To update the National Policy on Environment and Climate Change Policy to consider children's health**	Short term
		2. **To establish the Climate Change Act with the inclusion of children's health perspectives** – To consider the 17 SDGs (which include children) in all policies and laws	Medium term
		3. **To include children's health in reporting, e.g. UNFCCC National Communication Report, NDCs**	Short term
		4. **To enhance advocacy for vulnerable groups** – To consider effects on children in the limits of environmental parameters – To involve Children Representative Council as a stakeholder	Short, medium and long term
		5. **To enhance risk communication** to **all levels of society,** e.g. early warning system – To enhance coordination in disaster management, e.g. to include MWFCD in disaster management planning	Short, medium and long term

(Short term: 1-2 years, Medium term: 3-5 years, Long term: >5 years)

Sectors	Issues (refer to Figure 37)	Recommendations	Time frame
Governance	Fragmentation in policies and implementation	**1. To establish a Federal-State Commission for the environment for coordination across sectors** – To form a specific State Action Plan on Climate Change (adaptation, mitigation, and capacity building), including impacts on vulnerable groups (note: Sabah has had various state action plans on specific animals threatened with extinction. The time is now right for a specific action plan for impacts of climate change) – To endorse a specific enactment on Climate Change (Sabah Climate Change Enactment)	Medium to long term
		2. To consider children's vulnerability in development plans, e.g. spatial and physical development plans	Medium term

(Short term: 1-2 years, Medium term: 3-5 years, Long term: >5 years)

APPENDIX 1 INTEGRATED PROJECT FRAMEWORK

Table 17: Integrated project framework

DRIVING FORCE

ANTROPOGENIC STRESSES
- Ozone depletion
- Desertification/deforestation
- Forest fires
- Loss of Biodiversity
- Population growth
- Urbanization upsurge
- New industrialization
- Non-sustainable consumption
- Transboundary chemical transport

CLIMATE DRIVERS
- Extreme rainfall
- Drought
- Temperature rises
- Tropical cyclones

IMPACT DRIVERS
- Flood
- Heat waves
- Infectious diseases
- Air pollution
- Water pollution
- Pervasive poverty and inequity

PROGRAM OUTPUT (PO)

PO1
Integrated analysis on the impacts of climate change and environmental degradation on children's health, nutrition, education and economic status using existing data.

PO2
Assessment of existing climate and environment policies and plans and identification of gaps and opportunities.

PO3
Mapping of key actors and intervention on climate change and environmental management, and identification of good practices and gaps in child-centred climate action in Malaysia.

METHOD APPROACH

Desk studies
- Air pollution and temperature
- Wildfire haze
- Rainfall and heat

Systematic Review
Case series report

Community case studies
- Gaya Island, Sabah
- Klang Valley

Questionnaire surveys, focus group discussions (FGD), in-depth interviews (IDI) with community (marginalized children, parents, teachers)

Content analysis of policies/ plans on
- Climate change and the environment
- Relevant Sustainable Development Goals (SDGs) targets children's well-being, education, development, health, economic status

FGDs, IDIs and consultation workshops with government, UN, NGOs, private sector and youths

EXPECTED OUTPUT

Environmental Health
- Respiratory diseases
- Respiratory mortality
- Hospital admissions
- Burden of diseases
- Risk estimates of air pollution, rainfall and heatwaves

Well-being
- Extent of poverty
- % access to formal education
- Nutritional status (% obesity and stunting)
- % crime rate
- Health status: children and family health indicators
- Health education
- % access to basic infrastructure (water and electricity)
- Access to healthcare
- Gender
- Child labour
- Social inclusion

Disaggregated by gender, age, socio-economic status (SES) and disability

- Gap analysis
- Mapping of key actors
- Adaptation and mitigation: interventions and good practices

KEY STAKEHOLDER

PO 4
Recommendations to UNICEF Malaysia, government agencies and other stakeholders on how to tackle issues affecting children caused by climate change and environmental degradation.

Ministry of Health (MOH)
- Family Health Development Division
- Disease Control Division
- Environmental Health Unit
- Institute of Medical Research (IMR)

Ministry of Environment and Water (KASA)
- Climate change unit
- Environmental Management Unit
- Department of Environment (JAS)
- Malaysia Meteorological Department (MMD)
- National Hydraulic Research Institute of Malaysia (NAHRIM)

Ministry of Women, Family and Community Development (MWFCD)
- Department of Social Welfare Malaysia (JKM)
- International Relations Division
- Children Policy Unit

- Ministry of Energy and Natural Resources (KeTSA)
- Ministry of Housing and Local Government (KPKT)
- Ministry of Rural Development (KPLB)
- Economic Planning Unit (EPU)
- National Disaster Management Agency (NADMA)
- Malaysia Green Technology and Climate Change Centre (MGTC)
- Child Commissioner of Malaysia (SUHAKAM)

Ministry of Education (MoE)
- Educational Planning and Research Division

The four project outputs above are broken down into multiple projects led by experts in the respected areas listed in Table 18.

Table 18: List of sub-projects and lead investigators

No	Sub-Projects	Lead Investigator
1.	Desk Study 1: Simulating the downscaling of a general climatic model to a regional climatic model for specific health sector climate indices	Associate Professor Dr Liew Ju Neng, Centre for Earth Sciences and Environment, Faculty of Science and Technology, UKM
2.	Desk Study 2: The effect of ambient air pollution on childhood respiratory diseases in Asia's low- and middle-income countries: A systematic review	Dr Mohd Faiz Ibrahim, Faculty of Medicine, UKM
3.	Desk Study 3: Assessing the health effects of wildfire haze among children in Malaysia	Dr Vera Phung, National Institute for Environmental Studies (NIES), Japan
4.	Desk Study 4: Association between air pollution and childhood respiratory admissions: A time-series analysis in Sarawak, Malaysia	Dr Mohd Faiz Ibrahim, Faculty of Medicine, UKM
5.	Case series report	Associate Professor Dr Rozita Hod, Faculty of Medicine and Dr Siti Shahara Zulfakar, Faculty of Health Sciences, UKM
6.	Case Study 1: Pulau Gaya, Sabah	UMS and UKM team
7.	Case Study 2: Sungai Siput (U), Perak	UKM and University Technology MARA (UTM) team
8.	Case Study 3: PPR Sungai Bonus, Kuala Lumpur	UKM and University Technology MARA (UTM) team
9.	Assessment of national policies and legal frameworks	Associate Professor Dr Maizatun Mustapha, Dr Zuraini Ab Hamid, Ahmad Ibrahim Kulliyyah of Laws, International Islamic University Malaysia, IIUM
10.	Assessment of national policies and plans	Dr Kwan Soo Chen, Dr Asif Raihan, Associate Professor Dr Rawshan Ara Begum, UKM

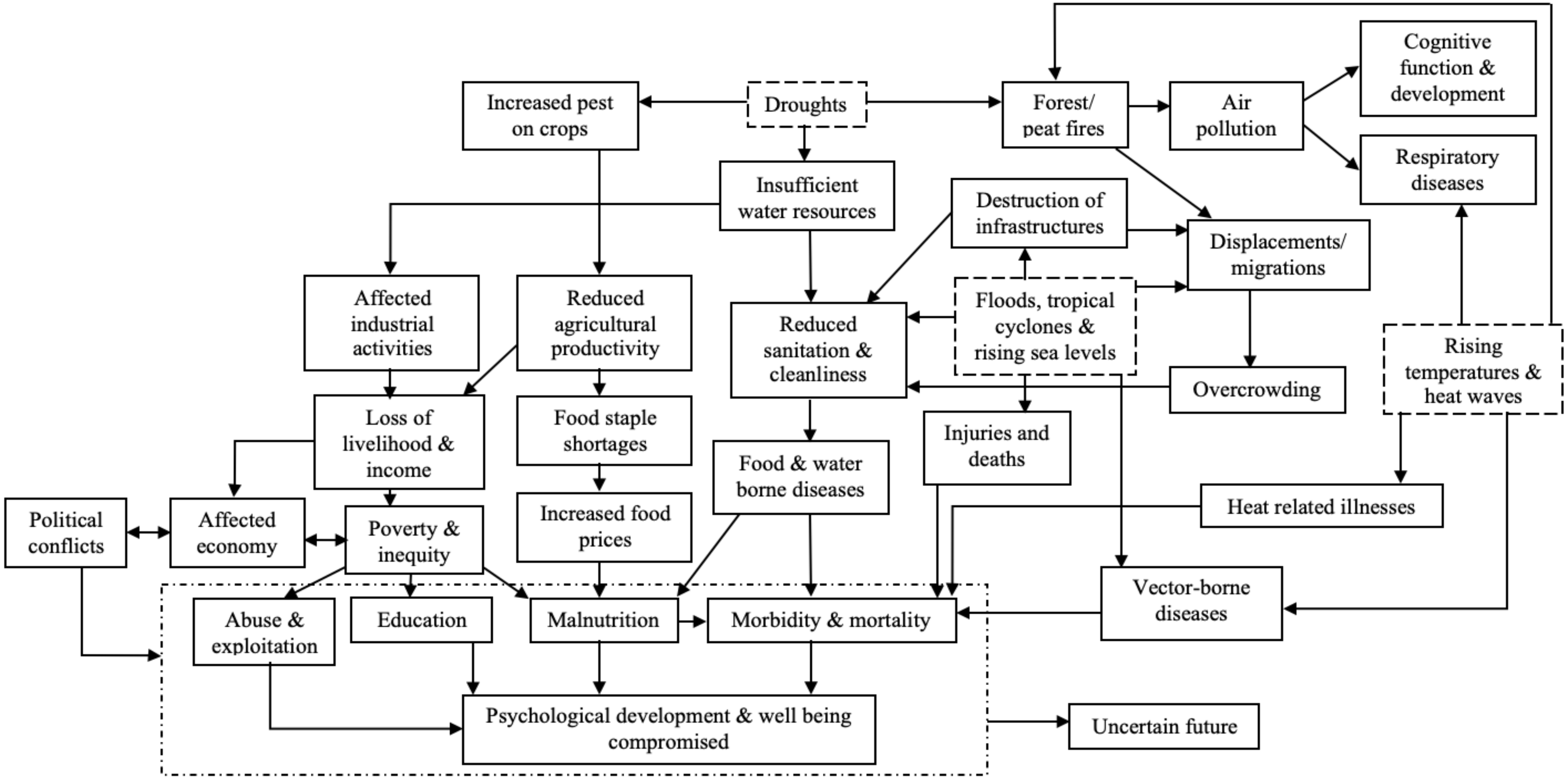

Figure 38: Impacts of climate change on children's health and well-being (created by Dr Kwan et al. (2020), based on Clifford et al. 2016; UNICEF 2015)

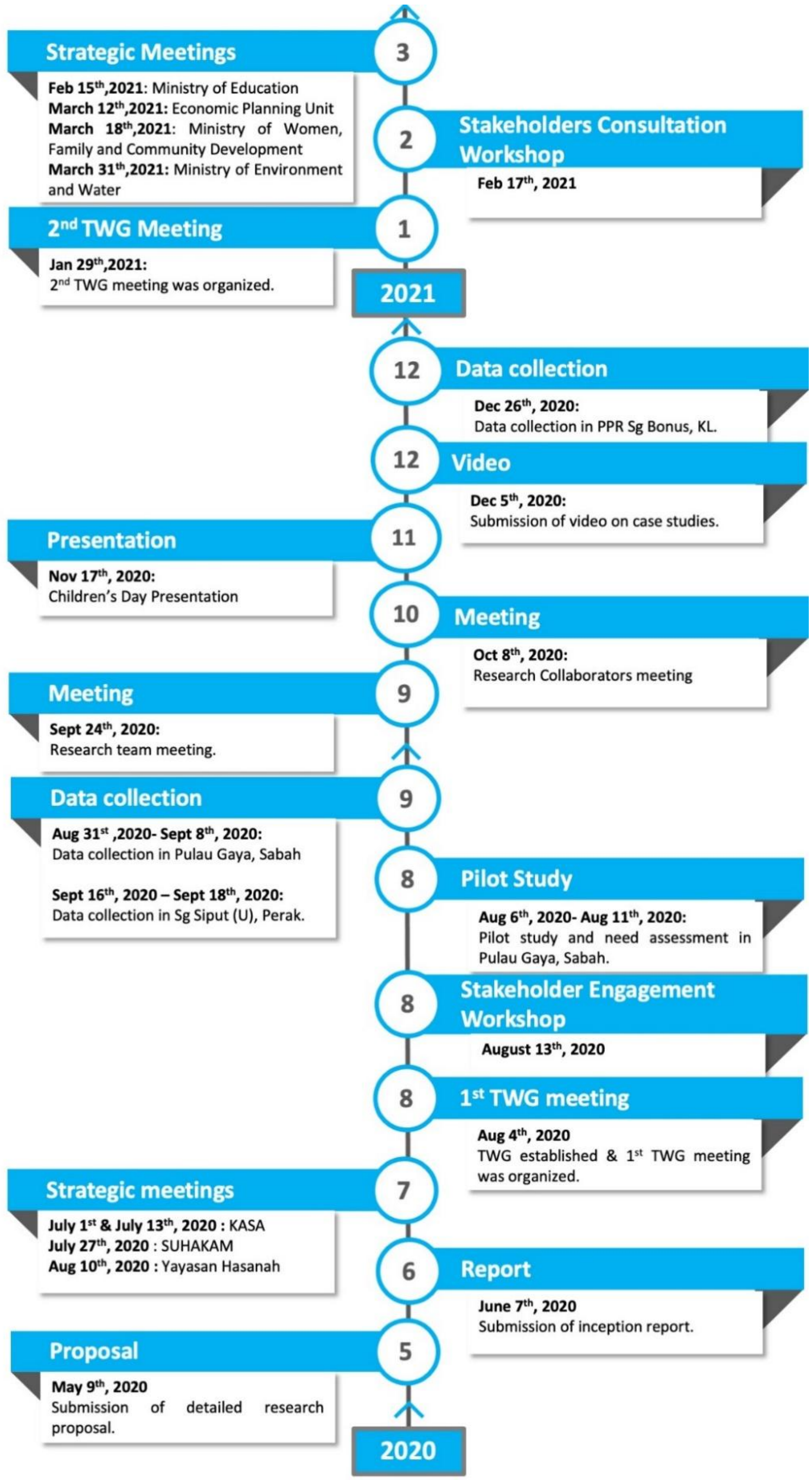

Figure 39: List of activities conducted

APPENDIX 2 CASE SERIES REVIEW

1 Climate change and children's health

Climate change is an inevitable global challenge. It has considerable adverse effects on the environment, ecosystem and ultimately on the human population. Children are the most vulnerable group of the community that would be significantly impacted by climate change socially, economically, and especially in terms of their health. The UNCRC defines a child as a human being below 18 years under the law applicable to the child (Fahisham Taib 2012). Currently, there are 2.3 billion people below 18 years old. These are our children, our future generations (Menke and Schleussner 2019). The global average temperature is already $1^{o}C$ above the pre-industrial times, so the likelihood of these children to experience a world that is on average 1.5^{o}, 2^{o} or 3^{o} above pre-industrial times is significantly higher than adults. Children born in 2020 will be 30 in 2050, and they will be 80 years old in 2100. The world that they will live in will certainly be different from the world we live in now. Climate change poses a significant threat to children's health because children have unique metabolism, behaviour, physiology, cognitive and development characteristics (Xu et al. 2012, Anderko 2019) compared to adults.

Climate change is altering the earth's systems in many ways that threaten children's physical and mental well-being (Currie and Deschenes 2016). Through various pathways, either direct or indirect, climate change has put additional stress upon the availability of clean air, water, and nutritious food. It thus poses a major threat to children's health. Climate change has also potentially expanded the scope of infectious diseases, further amplifying this threat (Bernstein and Myers 2011). The impacts of climate change can be divided into direct impacts or indirect impacts (Watts 2019). An example of a direct impact is increased air pollution, either from local or transboundary sources. Examples of local sources would be traffic-related air pollutants, industrial waste incinerators, land clearing and open burning. Children represent a subpopulation that is highly sensitive to air pollution. They often suffer from respiratory diseases such as asthma, bronchitis, and severe respiratory distress in bad air conditions.

As the surface temperatures rise, there will also be an increase in the replication of pathogens (protozoa, bacteria, and viruses) in water. Contaminated water is the major cause of malnutrition and diarrheal disease, which remain a leading cause of death in children under five years old. Most of the causes of mortality among children, including malaria, food- and water-borne diseases, and malnutrition, are very sensitive to climatic conditions and are expected to worsen due to climate change. During weather-related disasters such as floods, droughts, forest fires, and cyclones, children suffer more severe outcomes than adults. More frequent and intense heat waves result in severe medical outcomes in children, especially the younger ones. They are more prone to suffer heat stress, hyperthermia, and children's renal disease.

Climate change alters the earth's hydrologic cycle, which speeds up the melting of sea ice. When the sea ice melts, rising sea levels may cause salt-water intrusion into groundwater. Evaporation from seas and other surface waters becomes more accelerated, increasing the frequency and intensity of precipitation in some areas while triggering droughts in other areas. In the events of droughts, the ground and surface water supplies become diminished. Increasing precipitation results in unprecedented storms and floods, which can compromise the clean water supply. This will cause decreased water quality and quantity. In extreme events of droughts and floods, there will be food shortages and greater exposure to toxicants. At the global level, it is reported that half a billion live in countries that are increasingly prone to dangerous flooding, such as Bangladesh. In contrast, more than 160 million children currently live in drought-prone areas. By 2040, that number is expected to increase to every 1 in 4 children.

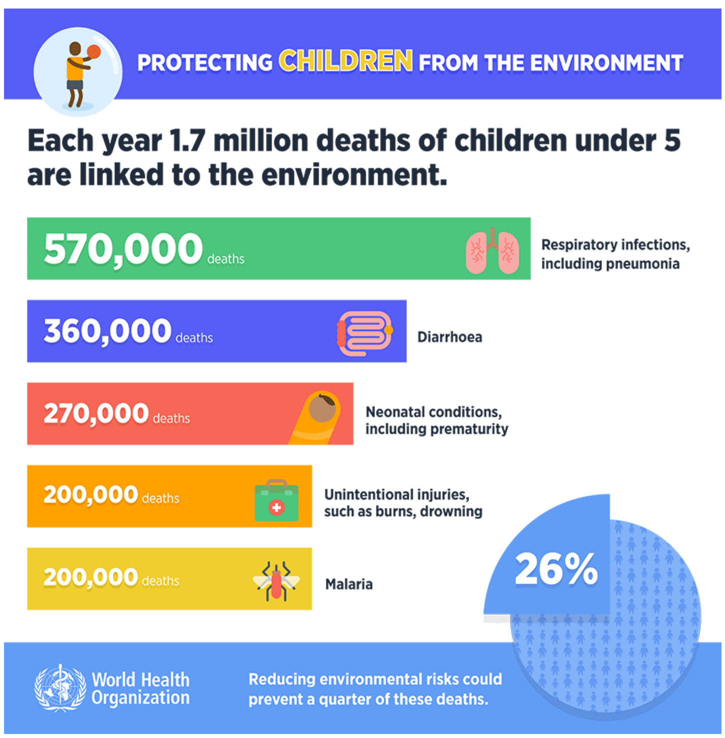

Figure 40: Death of children under five related to the environment

The Malaysian economy is the most competitive economy among the developing countries in Asia. It was ranked 25th out of 140 economies in the World Economic Forum's Global Competitiveness Report (Schwab 2019). The growth of the economy and the population has created an added burden on the environment, including higher greenhouse gas emissions, accelerated environmental degradation, and increased waste generation. In Malaysia, rising sea levels and temperatures are causing more floods, less food, and water shortages. Here, droughts and floods have been linked to increased water pollution and pesticides in food (Abdullah 2020). Climate scientists have predicted that by 2030 about a quarter of Malaysia's population will be displaced because of climate change.

Figure 41: Children were among the flood victims in Johor 2018. Source: The Star

Figure 42: Children playing in floodwaters. Source: Nam News Network

A teenage Swedish girl, Greta Thunberg, was selected as the Time's Person of the Year 2019. This 16-year-old is the face of the youth climate movement. Millions of young people around the world have joined her in pushing the climate debate. These young people have marched on the streets to demand that global leaders act fast against the climate crisis.

In Malaysia, there are 9.3 million aged 18 and below. The little voices in Malaysia may not have been as loud, but they too have reverberated across schools, homes, and generations. Schoolchildren had come forward on their own to express their concerns, for example, during a protest organized by Klimate Action Utara Malaysia and Klima Action Malaysia. In a joint statement, the two groups said the schoolchildren 'had, with the permission of their school and parents, organized a peaceful rally to deliver their stance. These were done under the supervision of their parents and their school's approval (FMT 2019). According to a survey of 1,101 young Malaysians by YouGov commissioned by The Star recently, 64% stated that they are concerned about climate change. Many of them also said that they have either experienced or are aware of its effects. However, only 5% believe Malaysia is prepared for it (The Star 2019).

Figure 43: A peaceful rally by young Malaysians

Like their peers elsewhere globally, many young Malaysians feel that their leaders are doing far too little to combat the impacts that climate change have caused and will cause. Even at COP25, world leaders are jostling over trivial details and personal interests instead of taking faster action on the climate crisis. As UNICEF noted, only 42% of countries' Paris Agreement climate action plans mentioned children or youth. That is why many of our youth are not happy and fear for the well-being of their generation and their future.

Like their peers, these young Malaysians are calling for our leaders to treat climate change like the emergency that it is. Governments worldwide need to urgently commit to mitigation measures such as reducing carbon pollution emissions and adaptation measures like early warning systems and post-disaster counselling to identify and prevent severe mental health complications. Governments need to listen to these youth and think harder about how to include children in those plans. We need to look at how we can increase education on environmental issues and give our youth more tools and space to contribute to policymaking.

2 Climate change and children's nutritional status

One of the critical factors for the healthy development of children is their nutritional status. Many studies have shown that poor nutritional status during childhood will increase the risk of contracting various chronic diseases when they become adults (Case et al. 2005). The FAO (2007) has defined nutritional status as the 'physiological state of an individual, which results from the relationship between nutrient intake and requirements and the body's ability to digest, absorb, and use these nutrients.

Two primary references are being used globally to assess children's physical developmental growth as an indicator for nutritional status: the WHO Growth Standards/

Reference (2006, 2007) and the United States Centers for Disease Control and Prevention (CDC) Growth Charts (Kuczmarski et al. 2000). Both references help detect any acute or chronic malnutrition among children and their risk of non-communicable chronic diseases.

2.1 Overall nutrition status and nutrient intake among children in Malaysia

There are four main recent nation-wide surveys conducted to assess children's nutritional status in Malaysia: the Southeast Asia Nutrition Survey (SEANUTS) Malaysia (Poh et al. 2013, Karim and Razak 2019), the MyBreakfast study (Tee et al. 2018), the National Health and Morbidity Survey on Maternal and Child Health 2016 (NHMS MCH) (Institute for Public Health 2016) and the National Health and Morbidity Survey on Adolescent Nutrition 2017 (NHMS ANS) (Institute for Public Health 2017). All these studies used the WHO Growth Standards (0-5 years old) and WHO Growth Reference (five to 19 years old) (WHO 2006, 2007) in the interpretation of their data. Table 19 shows an overview of the overall distribution of nutritional issues (thin, overweight, obese, and stunting) among children in Malaysia based on these studies.

All studies have shown that the prevalence of overnutrition (overweight and obesity) in children was higher than thinness, except for the findings from NHMS MCH (2016). The distribution of thinness prevalence, overweight and obesity between strata is quite similar between children living in urban and rural areas, where the differences were less than 2% except for findings from the SEANUTS Malaysia study. In this study (Poh et al. 2013), it was reported that the prevalence of obese children is higher (with a difference of 4.5%) in urban areas as compared to children living in rural areas. All studies had reported a higher prevalence of thin children among boys as compared to girls. However, the prevalence of overnutrition between genders varies across all studies. Most studies reported a higher prevalence of overweight among girls, whereas boys had a higher prevalence of obesity.

However, the MyBreakfast study (Tee et al. 2018) reported that boys showed a higher prevalence of overnutrition than girls. As for stunting among children in Malaysia, most studies showed a similar overall prevalence (ranged between 7.2-8.5%) except for the NHMS MCH study, which reported a prevalence of 20.7% stunted children in their study. It can be concluded that stunting issues were more prevalent among young children. A similar observation was also reported by the SEANUTS Malaysia study, where the prevalence of stunting was higher among children below one year old. A higher prevalence of stunting was observed among children living in rural areas across all studies where prevalence between genders varies. Stunting in children is measured based on height-for-age indices and could indicate long-term insufficient nutrient intake and recurrent chronic illness.

Based on the National Health and Morbidity Survey (NHMS) 2017: Adolescent Nutrition Survey 2017, the prevalences of stunting for adolescents aged 10 to 17 years in Sabah and Sarawak were 11.9% and 10.2%, respectively, which were higher than the overall adolescents at 8.2%. However, the prevalence of thinness were comparable at 5.9% and 6.8% respectively in Sabah and Sarawak, and 6.6% in the overall adolescents. In contrary, the prevalences of overweight and obesity among these adolescents were 14.1% and 9.9% respectively in Sabah, which are lower than the overall adolescents (15.6% and 14.8%), and 16.1% in Sarawak, which are higher than the overall adolescents comparatively.

Table 19: Distribution of thin, overweight, obese, and stunted boys and girls in urban and rural areas

Nutritional Status	Overall	Urban	Rural	Boys	Girls
SEANUTS Malaysia[1] (Age group: 6 months – 12 years old)					
N	3 542	2102	1440	1762	1780
Thin (%)	5.5	5.2	6.0	6.0	4.9
Overweight (%)	9.8	9.7	9.9	9.6	9.9
Obese (%)	10.8	12.7	8.2	12.9	8.6
Stunted (%)	8.5	8.3	8.8	9.7	7.1
National Health and Morbidity Survey on Maternal and Child Health (NHMS MCH) 2016[2] (Age group: <5 years old)					
N	14793	8750	6043	7646	7147
Thin (%)	11.2	11.1	11.4	12.9	9.4
Combined overweight and obese (%)	6.4	6.9	5.5	6.1	6.7
Stunted (%)	20.7	19.23	23.34	22.2	19.2
MyBreakfast Study[3] (Age group: 6 - 17 years old)					
N	8661	5919	2742	4017	4644
Thin (%)	6.4	6.3	6.7	7.1	5.8
Overweight (%)	14.0	14.4	13.2	14.4	13.7
Obese (%)	14.4	14.4	14.6	18.5	11.0
Stunted (%)	7.2	6.7	8.4	7	7.4
National Health and Morbidity Survey on Adolescent Nutrition (NHMS ANS) 2017[4] (Age group: 10 - 17 years old)					
N	40047	23444	16603	19651	20396
Thin (%)	6.6	6.6	6.6	7.7	5.5
Overweight (%)	15.6	16.2	14.9	15.2	16.0
Obese (%)	14.8	15.0	14.7	17.7	12.0
Stunted (%)	8.2	6.8	10.2	7.3	9.2

Adopted from [1]Poh et al. 2013, [2]Institute of Public Health 2016, [3]Tee et al. 2015 and [4]Institute of Public Health 2017.

In terms of nutrient intake status, findings from these studies showed that the prevalence of anaemia, iron and Vitamin A deficiency among children in Malaysia is at a relatively low level of public health significance. However, it should be highlighted that those children in Malaysia did not achieve the Malaysian Recommended Nutrient Intakes (RNI) for Calcium, Vitamin D and Vitamin E, with insufficient Vitamin D being of greatest concern.

Malnutrition among children can result from an inadequate intake of nutrients for energy and cause underweight and stunting issues. In contrast, excessive nutrient intake will cause overweight and obesity. Based on the findings from these Malaysian studies, it can be concluded that nutritional insufficiency and overnutrition coexist across the population (NHMS 2017). However, the focus should be on overnutrition issues due to their higher prevalence and increasing trend.

2.2 How does climate change affect children's nutritional status?

2.2.1 Environmental pollution

With extreme weather, natural disasters, higher temperatures, increased precipitation, and other adverse events, the level of environmental pollution will subsequently be increased. Researchers who have conducted nationwide nutritional status studies have concluded that high air pollution levels contribute to the higher prevalence of Vitamin D insufficiency in children living in urban areas (Poh et al. 2013). It has been reported that certain components of air pollutants may indirectly reduce the availability of sunlight to children (Holick 1995). High levels of air pollution and increasing high temperatures could also be why some parents or children prefer to stay indoors instead of engaging in outdoor activities. This reduces sunlight exposure and subsequently affects the intake of Vitamin D.

The level of water pollution may also be increased because of climate change. The mobilization of environmental pollutants from the soil in agricultural sites and other contaminated areas due to increased flooding events will increase the risk of contamination of persistent environmental pollutants in water bodies. Therefore, a safe water supply to the public will be compromised. The increasing temperature could also affect the rate of degradation of chemical pollutants in the environment. For example, it has been reported that higher ocean temperatures could facilitate mercury methylation, thus increasing methyl mercury uptake in fishes.

2.2.2 Food safety

Climate change will also adversely affect the global food safety system. It has been established that climate change will modify the occurrence, transmission, and persistence of pathogenic organisms (viruses, bacteria, algae, fungi, and food-borne vectors) in the environment and thus increasing the risk of food-borne diseases. Increasing temperature and humidity will favour the growth of bacteria and fungus in the food production system. Fresh produce will be at risk of high contamination of pathogens and spoilage microorganisms, resulting in reduced food production. Some farmers may resort to selling unsafe food products or being forced to consume the spoilt products themselves. Increasing temperature has also been reported to stimulate the expansion of algal blooms and fish-poisoning associated dinoflagellates, causing increase incidences of cases such as Paralytic Shellfish Poisoning, Ciguatera Fish Poisoning, and other related outbreaks.

To adapt to the changing climate, farmers and food producers may have to increase chemical interventions such as pesticides, herbicides, and veterinary drugs to ensure adequate food production. The increased usage of these chemical compounds in the food production system will eventually lead to the accumulation of toxic chemical residues in the environment and the produce itself, hence jeopardizing the safety of the food products. With the reduced availability of safe food in the market, consumers' diets would also be affected, subsequently exposing the public to the risk of malnutrition.

2.2.3 Food security

The increased frequency and severity of weather extremities will affect the food production system. There may be reduced production yields of crops due to increasing nutrient deficiencies, environmental pollutants, and microbe and pest populations, which will all affect the health of plants. Livestock production may be affected due to the inability of these animals to overcome heat stress, the unavailability of adequate nutritional feed, and the effects of climate change on the health and growth of the animals. In these ways, climate change will affect the adequate supply of nutritious food to the population. The population's dietary pattern will be shifted to a less healthy diet.

This combination of increased food-borne diseases and reduced availability and access to nutritious food supply will threaten the nutritional status of the population, especially vulnerable groups like children.

3 Climate change and infectious diseases in Malaysia

Malaysia has been exposed to climate change such as altered rainfall patterns, rising temperatures and life-threatening weather conditions (Sakar et al. 2013). Floods, landslides, mudslides, tropical storms, and other weather-related events in Malaysia are due to heavy rainfall (Mohamed Shaluf and Ahmadun 2006). Floods are common in Malaysia as the monsoon season causes heavy and regular downpours from October to March. Despite that, floods outside monsoon affected areas in Johor Bahru (Southern Peninsular Malaysia) in December 2006 are signs of climate change impacts (Chang 2010). Water contamination and the increasing number of breeding sites for disease vectors due to floods, droughts and storms can increase the risk of health problems. Furthermore, an unhealthy environment, lack of sanitation, and a contaminated water supply can assist the transmission of these diseases (Alhoot et al. 2016).

The impact of climate change on health is a great concern in Malaysia, especially related to the emergence and increase of climate-related food-, water-, and vector-borne diseases (Alhoot et al. 2016, Commonwealth Secretariat 2009). Cholera, typhoid, hepatitis A, malaria, dengue, and chikungunya are examples of climate-sensitive diseases in Malaysia (Alhoot et al. 2016). Typhoid fever, cholera, dysentery, and hepatitis A are major water-borne diseases with incidence rates of 0.73, 0.58, 0.28 and 0.41 per 100,000 population (MOH Malaysia 2014). Weather events such as floods and droughts can contribute to the outbreak of these diseases due to contamination of the water supply and inappropriate sewage disposal, and unhygienic personal and environmental conditions (Alhoot et al. 2016).

Frequent rainfall and sea levels rise in certain parts of the country increase the number of flood occurrences in Malaysia (Aliagha et al. 2015). In developing countries, those who live in flood-prone areas are especially exposed to threats of infections, with the elderly and children being the most vulnerable among them (Ahern et al. 2005). Many pollutants can be found in floodwater that can affect human health, including pathogenic bacteria (Ten Veldhuis et al. 2010). Diseases such as cholera, skin conditions, diarrhoea, and leptospirosis are often present after floods. These diseases have been linked to a lack of clean water, unsanitary environment, and inadequate sewage treatment (Abas et al. 2017).

3.1 Climate change, food- and water-borne diseases in Malaysia

Disruption in human conditions, pathogens, ecosystems, and the environment can facilitate the occurrence and spread of diseases (Wu et al. 2016). In Malaysia, increases in leptospirosis and typhoid fever have been linked to such disruptions due to severe floods.

Leptospirosis is caused by spiral-shaped bacteria from the genus Leptospira. Epidemics and outbreaks of leptospirosis occur after extreme weather events, especially floods. The bacteria are usually transmitted through water contaminated with urine from carrier animals such as cattle, pigs, dogs and rodents like rats (Radi et al. 2018, WHO 2014). Changes in the environment after a flood can increase the contact between human and carrier animals and provide favourable conditions for the bacteria (Lau 2009). Leptospirosis incidences in Malaysia show an increasing trend, from 1.0 to 30.2 per 100,000 population from 2004 until 2015, with a mortality rate increasing from 0.16 to 0.31 per 100,000 population from 2012 until 2014 (Zainuddin 2015).

Leptospirosis is endemic in Malaysia. The highest number of leptospirosis cases in Malaysia were recorded in the eastern state of Kelantan in July 2015, several months after a severe flood in December 2014 (Radi et al. 2018). Radi et al.'s (2018) study found that the number of leptospirosis cases in Kelantan before, during, and after the 2014 flood was about 29%, 12%, and 59%, respectively. The number of leptospirosis cases started to increase two weeks post-flood, and cases continued to increase for about three months after the flood (Radi et al. 2018). Leptospirosis incidences in the post-flood period were more concentrated in urbanized, densely populated, central areas with proximity to garbage accumulation and clean-up sites. Garbage accumulation and clean-up sites provide favourable surroundings for rodents to thrive, thus increasing contact between humans and rodents (Radi et al. 2018). Water can also be contaminated easily during seasonal floods making it an ideal medium for leptospirosis transmission (Aidid et al. 2018).

The 2014 flood in Kelantan is an example of an extreme weather event associated with global climate change. It was the worst flood in the state's recorded history, as confirmed by the Malaysian National Security Council (Azlee 2015). It was caused by a long period of heavy and continuous rainfall, exceeding 600mm within a week in many areas (Radi et al. 2018). The resulting population displacement led to an infectious disease outbreak. Simultaneously, synergistic risk factors like the loss of clean water supply and disruption in septic and wastewater management increased the population's susceptibility towards existing pathogens for disease transmission. (Md Akhir et al. 2018). The flood caused severe loss and damage to public and private property, human livelihood, and health. Climate change will bring more frequent extreme weather events, including floods, which might increase the outbreak of leptospirosis and other flood-related communicable diseases (Hashim and Hashim 2016).

There is also the possibility that typhoid fever will occur after flood events (Davies et al. 2015, Dewan et al. 2013, Vollaard et al. 2004). This is because surface and groundwater can be contaminated with floodwater during these events (Akpor and Muchie 2011). *Salmonella typhi* that causes typhoid fever can survive in water and soil for several months. If the groundwater is contaminated with this bacterium during floods, it can be an environmental reservoir for disease transmission (Md Akhir et al. 2018, Tran et al. 2005). Inadequate wastewater management can also increase typhoid fever risk (Saat et al. 2018). Faecal substances contained in septic tank overspills can contaminate floodwaters. As the flood subsides, the remaining water will drain into wastewater drains. If wastewater management is inadequate, the contaminated floodwater might not be drained away and become a stagnant reservoir for *Salmonella typhi* (Md Akhir et al. 2018).

In 2015, there was an increase in typhoid disease incidences in northeastern Malaysia following the 2014 flood, at a rate of 10.6 per 100,000 population. This was ten times higher than the national level and the five years median incidence rate. Md Akhir et al. (2018) stated that the lack of clean water and sanitation were the main environmental factors that led to the increased incidences of typhoid fever in northeastern Malaysia during this time.

3.2 Climate change and vector-borne diseases in Malaysia

Aedes aegypti and *Aedes albopictus,* which transmit dengue diseases, are very sensitive to environmental conditions. An extrinsic incubation period is important for the virus to reach the mosquito's salivary glands and be transmitted to the host. This incubation period can be reduced by environmental factors, for instance, shortening the time needed for the virus to replicate and circulate in the mosquito (Githeko et al. 2000). Climate factors such as temperature, humidity, and precipitation are important for mosquito survival, reproduction, growth, and strength, hence dengue transmission (Er et al. 2011a, Er et al. 2011b, Sahani et al. 2012, Shafie 2008, Shafie 2011). Relatively high temperatures can affect larva growth and adult mosquito behaviour related to food and gonotrophic cycles. The mosquito can reach maturity rapidly in warmer conditions compared to colder conditions. Humidity factors can increase the survival of the mosquito (Er et al. 2011b, Sahani et al. 2012). Generally, the mosquito lives longer and moves over a greater distance when humidity is high. Their biting activity will increase because they can feed on human blood and transmit the virus. While rains accumulate water for mosquitoes breeding sites (Azman and Karim 2018, Er et al. 2011a, Er et al. 2011b), humidity influences the evaporation rates for these sites (Promprou et al. 2005),

Dengue has been endemic to Malaysia since the 1980s (Bains 2017, Ong 2016, Teng and Singh 2001, Packierisamy et al. 2015, Shepard et al. 2012). In Malaysia, dengue is an urban disease that particularly affects children and young adults between ten and 30 years (MOH Malaysia 2008). Malaysia is on the list of Southeast Asian and Western Pacific regions with a high number of reported dengue incidences based on WHO findings (WHO 2015). In 2013, 450,000 children under four and another 500,000 children 15 years and below contracted dengue (Woon et al. 2016). In 2013 and 2014, children made up one in ten cases of fatal dengue in Malaysia (Woon et al. 2018). Warm temperatures, high humidity, and abundant rainfall create suitable conditions for the development of the Aedes mosquito, viral replication, and the transmission of dengue throughout the year here (Barrera et al. 2011, Campbell et al. 2015, Hii et al. 2009, Er and Abdullah 2016). Climate change, such as increased temperatures, humidity, and rainfall frequency for the last four decades, has affected dengue transmission in Malaysia (Banu et al. 2011).

Ruzman and Rahman (2017) found that climate factors like rainfall and humidity were the main contributors to dengue cases in Subang Jaya and Sepang for 2013 and 2014. Most studies in Malaysia have reported the relationship between dengue, temperature, and rainfall with lag periods between 7 to 51 days (Hii et al. 2016). The severe El Niño weather phenomenon that affected Malaysia in January 2016 was a major contributor to the 50% increase in dengue cases. This was because the mosquito's life cycle length from egg to adult was reduced to less than seven days, thus increasing the mosquito population (Sofian 2016). Normally, the mosquito's life cycle is between 7 to 9 days (Azman and Karim 2018). A study conducted in several Malaysian states (Hulu Langat and Seremban) found that hot weather and high temperatures accelerate the life cycle of the Aedes mosquito.

4 Children's environmental health issues

In Malaysia, children's environmental health is an important agenda in the NEHAP 2019. Air pollution, pesticide exposure, and water pollution are the three major concerns in this context. Table 20 compiles relevant studies on the main environmental health issues faced by children in Malaysia.

Table 20: Environmental issues in Malaysia

Scope	Issues	References
Air pollution	Bad indoor air quality (IAQ) due to the presence of indoor air pollutants such as carbon monoxide (CO), carbon dioxide (CO_2), particulate matter (PM), volatile organic compounds (VOCs), nitrogen dioxide (NO_2) and airborne microbes.	Choo and Jalaludin (2015), Rawi et al. (2015)
	Traffic-related air pollutants (TRAP) linked to acute respiratory infection among children.	Rahman et al. (2017)
	Asthma attacks among children were significantly related to the PM_{10} and NO_2 levels in the air.	Zailina et al. (1997), Afroz et al. (2003)
	Lead exposure in indoor and outdoor air was significantly (16 times) higher in urban areas than in suburban areas.	Zailina et al. (1996)
	Impact of transboundary outdoor air pollution on respiratory disease.	Sahani et al. (2014), Sulong et al. (2017)
	Health risk assessment of road dust exposure towards children.	Wahab et al. (2020), Othman et al. (2020)
Pesticide and/or food	Effects of organophosphate pesticide mixture exposure on the neurodevelopment of primary school children in paddy farming areas.	Hashim (2015)
	Pesticide residues in fruit and vegetables.	Zawiyah et al. (2007)
Water	Health impact of bauxite exposure in the environment (air and water) due to bauxite mining in Pahang.	Abdullah et al, (2016), Kusin et al. (2018)

Modified from: Abdullah (2020)

Air pollution, both indoor and outdoor, is one of Malaysia's most important environmental health issues. In an urban environment, traditional air pollutants and hazardous air pollutants are emitted from traffic-related combustion and industrial activities. The emitted particles are made up of elemental carbon and various inorganic and organic compounds. Children are particularly vulnerable to poor air quality. Children breathe in more air than adults. Hence, they inhale a relatively higher proportion of pollutants when adjusting for body weight. Besides that, their lungs and brains are not fully developed, make them more susceptible to pollutants.

Studies done by Gauderman et al. (2015) and Korten et al. (2017) show that exposure to air pollution during infancy and early childhood increases the risk of lung damage and impairs lung growth, leading to asthma, pneumonia, and chronic obstructive pulmonary disease. According to Grigg (2004), specific concerns related to environmental pollutants and children's health fall into four categories, namely (1) acute toxicity, (2) actually or potentially very bio accumulative, (3) organic substances may persist in the environment for decades, and (4) substances may cause sublethal effects but may also result in population-level effects.

Persistent organic pollutants (POPs) that are highly stable and transported over long distances are extremely hazardous to children due to their ability to accumulate in fatty tissues and become biomagnified in the food chain. Such POPs, including pesticides, polychlorinated-biphenyls (PCBs) and dioxins, are chemicals of special concern. Due to their bio-persistence, children remain actively exposed to dioxins and PCBs when present in food and breast milk. Safe (2001) indicated that the adverse effects of dioxins in children are due to their ability to bind to the aryl hydrocarbon receptor (AHR), which greatly influences gene transcriptions.

Pesticides are widely used around the world and play an important role in agriculture. However, pesticides may also have detrimental effects on human health, with young children being among the most vulnerable. In many countries, including Malaysia, chemical pesticides must be registered, particularly organophosphates, organochlorines, pyrethroids, and carbamates. Organophosphates mainly target organs in the nervous system by altering the effects of enzymes that regulate selected neurotransmitters. Recent research suggests that even low pesticide exposure levels can affect young children's neurological and behavioural development. Evidence shows a link between pesticides and neonatal reflexes, psychomotor and mental development, and attention-deficit hyperactivity disorder (Liu and Schelar 2012)

The effects of lead on children are among the most studied and clearly understood areas in environmental health. Children are more susceptible to the toxic effects of lead through their gastrointestinal tract. The dominant route for lead exposure among children is oral ingestion of food, water, soil and dust. Children's hand to mouth behaviour and play activities on the ground further increases their exposure. Those under five years old are particularly at risk, as systemically circulating leads that reach their brains could damage the central nervous systems. Lidsky and Schneider (2003) stated that the neurotoxicity of lead is mainly due to its interactions with cellular mechanisms that normally perform calcium-mediated functions.

5 Industrial pollution, hazardous wastes and children

Pollution from industries and hazardous wastes may affect all age groups of a surrounding community. However, children are among the most vulnerable groups not only by virtue of their young age but also by their frequent exposure to outdoor activities. An exposure study among children living close to a coke oven plant in Germany showed increased PAH metabolite levels in their urine (Eberwein et al. 2008). The prevalence of allergic symptoms was also high among children exposed to high chromium and nickel levels from a steel mill.

Hazardous waste management has been a long-standing issue in Malaysia (Sari and Mokhtar 2014). According to a UNEP report (Jain et al. 2017), Malaysia generated about 1,600,000 tons of all hazardous waste classes per year, the third among ASEAN countries behind Thailand and the Philippines. Malaysia's manufacturing sector is the leading sector generating toxic and hazardous waste (Aja et al. 2016). As waste generation is expected to rise with population growth and economic development, Malaysia will likely experience continued growth of hazardous waste generation.

The DOE under KASA is responsible for ensuring that industries comply with environmental protection rules and regulations. The Environmental Quality (Scheduled Wastes) Regulations 2005 (amendment 1989) defines scheduled wastes as any waste falling within the categories listed in the first schedule, which includes 77 scheduled waste code categories (The Commissioner of Law Revision 2006). Some categories of waste in this schedule are classified as hazardous waste due to their toxic characteristics. However, several obstacles present challenges to the implementation of scheduled waste policies. These include the lack of political support, low stakeholder commitment, and limited resources and capacity to deliver the task of monitoring and enforcing environmental requirements. One of the main challenges is scheduled waste management, which involved collecting, transportation, treatment, and disposal of the scheduled waste. Since 1995, Kualiti Alam Sdn Bhd was given exclusive rights and responsibilities to integrate the collection, treatment, and disposal of scheduled waste.

Despite existing regulations and policies on scheduled waste management policies, illegal dumping of hazardous waste still occurs in the country. In 2004, Metal Hydroxide sludge from Taiwan was illegally imported and stored at Simpang Renggam, Johor (Anon 2004). Another similar incident was in Segamat, Johor, which caused the evacuation of 300 villagers from their homes after 300 tons of toxic waste buried at an illegal dumpsite emitted ammonia fumes (Anon 2006). The Straits of Johor has been categorized as a hotspot for metal contamination (Zulkifli et al. 2010). The scientific literature argues that the high levels of heavy metal in the Straits of Johor is due to anthropogenic activities (Yap et al. 2004, 2006, 2010). Shipping activities and coastal development along the Straits of Johor have also affected the water quality in this waterway (Maadin et al. 2016).

5.1 Case study: Illegal dumping of toxic waste in Pasir Gudang

Pasir Gudang is an industrial town located in the southwestern sector of the Johor Bahru district, Johor, Malaysia. Established in 1918, Pasir Gudang was formerly a fishing village transformed into a rubber estate during the British occupation. After that, it was developed by the Johor State Government into a residential and industrial area (MPPG n.d.). Pasir Gudang residents are at risk of environmental pollution because of the area’s rapid development and industrialization. Before the illegal toxic waste incident in 2019, the environment in Pasir Gudang and areas around the Johor Straits had already been polluted due to anthropogenic activities (Koh et al. 1991, Yap et al. 2019). Sungai Kim Kim, a 15km long river originating from the Masai sub-district and flowing southward through Pasir Gudang into the Straits of Johor, was considered one of the most polluted rivers in Johor Bahru. Zakaria et al. (2018) has investigated the concentrations of total Polycyclic Aromatic Hydrocarbons (PAHs) on the surface of Sungai Kim Kim and found that the high level of PAHs in the river can increase the risk of cancer, while the PAHs in the river's sediments posed a low-to-moderate risk of cancer.

On the morning of 7th March 2019, several students from Sekolah Kebangsaan Pasir Putih and Sekolah Menengah Kebangsaan Pasir Putih had trouble breathing, coughing, nausea, eye and throat irritation, and vomiting after inhaling unpleasant odours in their school compound (Tuah 2019). Some of Taman Pasir Putih residents also noticed a strong chemical smell in their residential area early in the morning. An emergency response team from Klinik Kesihatan Pasir Gudang went to the schools after receiving calls from both schools. Due to the high numbers of victims, the response team had called for backup from Hospital Sultan Ismail and Klinik Kesihatan Masai. A total of 35 people, mostly students, were sent to Hospital Sultan Ismail. Out of the 35 victims, 21 were admitted for inhalation injuries, three into the Intensive Care Unit (ICU), five were under observation at the emergency unit, and the rest were treated as outpatients (Anon 2019b). The two schools were closed on the same for cleaning. The number of victims hospitalized rose to 79 people in the following days (Nordin 2019).

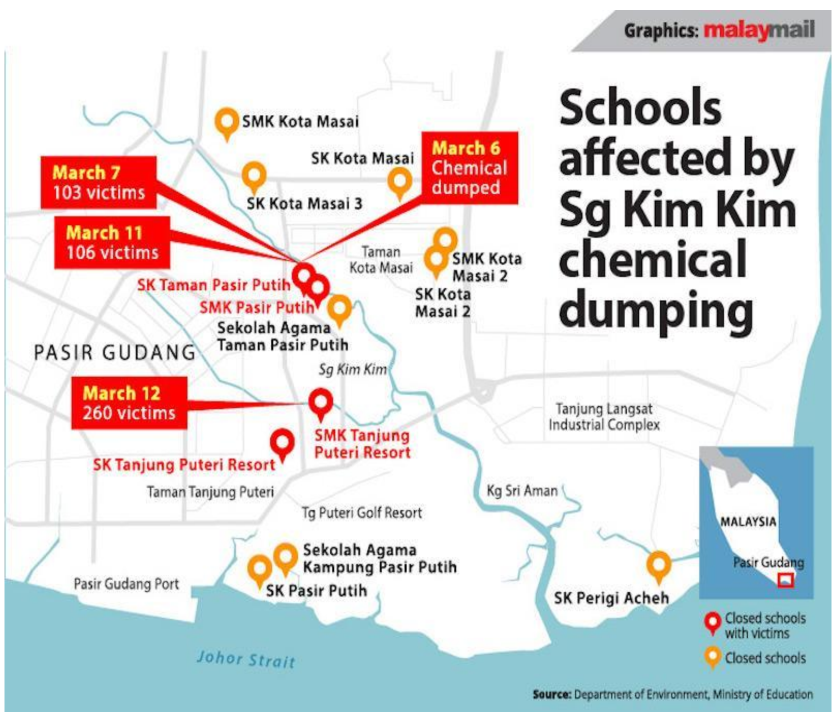

Figure 44: Location of the dumping site and schools affected by Kim Kim River chemical dumping. Source: Malay Mail 2019

Figure 45: Pollution incident in Pasir Gudang caused by toxic waste released into the Kim Kim River
Source: BERNAMA 2019. https://www.bernama.com/en/news.php?id=1738635

Figure 46: Chronology of pollution in Kim Kim River, Pasir Gudang since 7th March 2019
Source: BERNAMA 2019 https://www.bernama.com/bm/news.php?id=1704462

On the 11th of March, the second wave of chemical poisoning occurred a few hours after the two schools reopened. More than 200 students reported difficulty breathing and were sent to the nearest clinics and hospitals (Anon 2019a). As the number of victims grew to more than 500 people by the 14th of March 2019, the Education Ministry ordered all 111 schools in Pasir Gudang to be closed (Anon 2019e). A medical base was set up at the Pasir Gudang Indoor Stadium to receive chemical inhalation-related illness and coordinate the medical response by the MOH, private agencies, and NGOs. Until the 19th of March, more than 4000 people were treated for exposure to hazardous chemical waste dumped into Sungai Kim Kim (Palansamy et al. 2019).

According to officials, the Sungai Kim Kim pollution incident was due to the illegal dumping of scheduled waste into the river. A tanker lorry believed to be from an illegal tyre recycling factory dumped some 2.43 tons of chemical waste (Shah 2019b) containing benzene, acrolein, acrylonitrile, hydrogen chloride, methane, toluene, xylene, ethylbenzene and d-limonene into the Sungai Kim Kim under a bridge in Kota Masai (Anon. 2019f, Chung 2019, Hammim 2019). The two schools, Sekolah Kebangsaan Pasir Putih and Sekolah Menengah Kebangsaan Pasir Putih, were located 500 meters from the dumping site (Figure 44). The contamination of Sungai Kim Kim caused huge economic losses. The cleaning operation of 1.5km of river cost approximately RM10 million (Anon 2019c). The Johor State Government approved an emergency aid of RM6.4 million for cleaning works and distribution to the children exposed to the hazardous chemicals (Anon 2019d).

On the 20th of June, another incident of hazardous chemical pollution occurred in Pasir Gudang after 15 students from Sekolah Agama Taman Mawar in Pasir Gudang suffered from breathing difficulty and vomiting (Shah 2019a). The incident later caused 475 schools in Pasir Gudang, including government and private schools, higher educational institutions, and private pre-schools, to be closed for several days (Benjamin and Shah 2019). This incident was believed not to be linked to the previous Sungai Kim Kim contamination but from a different source that has yet to be identified (Tan 2019).

5.1.1 Short- and long-term health effects on children

Exposure to the mixture of benzene, acrolein, acrylonitrile, hydrogen chloride, methane, toluene, xylene, ethylbenzene and d-limonene during the incident has caused serious effects on the health of Pasir Gudang residents, especially the children there. The crowded and closed classroom conditions increased the risk of children being exposed to more pollutants than private residences. Furthermore, some of these pollutants are more concentrated at ground level, which means that children, who are generally shorter than adults, would breathe in higher concentrations of these pollutants (Bisht et al. 2016). While the identified chemicals are known to cause both short- and long-term health effects, it is unclear whether the incident has increased cancer risk among the exposed children because the levels of chemical concentrations were not released to the public. Table 21 shows a summary of the known health effects of chemicals that contaminated the Sungai Kim Kim.

Table 21: List of chemicals found at the dumping site and their health effects

Chemical	Exposure Route	Symptoms	Cancer Risk (IARC)
Benzene	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation to eyes, skin, nose, and/or respiratory system, dizziness, headache, nausea, staggering gait, anorexia, lassitude (weakness and exhaustion), dermatitis, bone marrow depression	Carcinogenic to humans. May cause leukaemia
Acrylonitrile	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation to eyes and/or skin, asphyxia, headache, sneezing, nausea, vomiting, lassitude, dizziness, skin vesiculation, scaling dermatitis	Possibly carcinogenic to humans. Increased risk of tumours in the brain, lung, and bowel cancer

Chemical	Exposure Route	Symptoms	Cancer Risk (IARC)
Acrolein	Inhalation, ingestion, skin and/or eye contact	Irritation to eyes, skin, and/or mucous membrane, decreased pulmonary function, delayed pulmonary oedema, chronic respiratory disease	Not classifiable as to its carcinogenicity to humans
Hydrogen Chloride	Inhalation, ingestion, skin and/or eye contact	Irritation to nose, throat, and/or larynx, cough, choking, dermatitis	Not classifiable as to its carcinogenicity to humans
Methane	Inhalation, ingestion, skin and/or eye contact	Breathing difficulties (i.e. suffocation and increased breathing rate), nausea and vomiting, loss of consciousness, weakness, headaches and dizziness, loss of coordination	Probably not carcinogenic to humans
Toluene	Inhalation, ingestion, skin and/or eye contact	Headaches, dizziness, loss of consciousness, loss of coordination, sleepiness	Not classifiable as to its carcinogenicity to humans
Xylene	Inhalation, ingestion, skin and/or eye contact	Irritation to eyes and/or throat, headaches, dizziness, sleepiness, trembling, lack of coordination	Not classifiable as to its carcinogenicity to humans
Ethylbenzene	Inhalation, ingestion, skin and/or eye contact	Irritation to eyes and/or throat, chest constriction, dizziness	Possibly carcinogenic to humans
d-limonene	Inhalation, ingestion, skin and/or eye contact	Breathing difficulties, skin irritation	Not classifiable as to its carcinogenicity to humans

Source: Agency for Toxic Substances and Disease Registry (ATSDR), International Agency for Research on Cancer (IARC), Public Health England

Exposure to traumatic events, either by experiencing or witnessing a harmful situation, also poses a threat to an individual or population’s mental health. These events may include natural disasters, motor vehicles accidents, physical injuries, and hazardous material spills. Approximately 10% of children exposed to such events will develop post-traumatic stress disorders (PTSD) (Charnsil et al. 2020). Children with PTSD may experience intrusive memories, avoidance, negative changes in thinking and mood, and changes in physical and emotional reactions. Although PTSD was not reported among children following the events in Pasir Gudang, they are at risk of developing PTSD as onset may develop 3 to 12 months after the traumatic event (Carty et al. 2006). Even though children are generally exposed to the same spectrum of stressors as adults, they are more vulnerable because their emotions and cognition are still immature. They have limited life experience and lack coping strategies.

Health was not the only aspect of the children's life that was affected by this industrial pollution. 111 schools had to be closed temporarily during this incident (Education Minister's office of Malaysia, 2019). While things may have been worse if this incident had happened during the end of the year when major public examinations are held, these children were disadvantaged by having their education interrupted during this time. Following this incident, 42 schools within a 5- to 9km radius from the dumping area were monitored for air quality, including oxygen, carbon monoxide, volatile organic compounds, and hydrogen sulfide levels (DOE Malaysia, 2019).

Based on this incident, it can be seen that poor compliance among industries in abiding with health and environment-related legislation and poor enforcement by related agencies may expose children to hazardous industrial waste. Nevertheless, there is a lack of knowledge of how industries perceive this issue of compliance. A study by Khoo et al. (2018) found that manufacturing industries in the state of Malacca generally had poor compliance to all three occupational and environmental health-related laws in Malaysia, the Occupational Safety and Health Act (OSHA) 1994, the Environmental Quality Act (EQA) 1974, and the Guided Self-Regulation Environmental Mainstream Tools (EMT).

5.2 Industrial pollution in cottage industries

Industrial pollution in cottage industries is a related issue. Cottage industries usually do not involve the mass production of goods. Products are mostly hand-made using basic tools which require low energy inputs. Nevertheless, this process may involve hazardous materials that users do not recognise as dangerous, such as in brassware and batik production. Children are often included in these production processes as cottage industries are often considered family businesses. Even if they are not directly involved with the work, they are often exposed to these hazardous surroundings. Such circumstances may expose children to hazardous chemicals at a level that may be within the acceptable limit for an adult but not for children. This issue is rarely studied as it is regarded as an informal industry. One notable example, an investigation of an outbreak of neurotoxicity among children exposed to lead produced by an artificial jewelry cottage industry in a slum area in India, emphasized the importance of environmental history among children (Akhil and

Chowgule, 2019). More research on cottage industry-related environment pollution may encourage appropriate policies to safeguard children's health under such conditions.

6 Child poverty

Poverty is regarded as a major impediment in promoting the growth and development of individuals, the community, and the nation (Kapur 2019). Poverty is associated with a lack of education (Rabi et al. 2020), reduced health status, lack of job opportunities, short lifespan (Buarque et al. 2006, Siti and Narimah 2018), and lower cognitive development among children (Murtaza et al. 2019). Limited family income may also lead to insufficient access to healthcare services (Inkelas et al. 2008). Some may refuse to get health treatment as they struggle to survive (Chuah et al. 2018). Other economic factors like unemployment and high monthly expenditures increase mental pressure for the poor (Dora 2011).

Child poverty is an issue both in developed and developing countries. Countries with high levels of child poverty include China and South Africa. Those with intermediate child poverty levels include Portugal and New Zealand, while countries with low levels of child poverty include Denmark and Finland (OECD, 2018). Children growing up in these conditions generally suffer poor health outcomes, including birth outcomes (infant mortality, low birth weight), obesity, injuries, mental health issues, and increased communicable and non-communicable diseases (Gupta, Wit, and McKeown, 2007). Poverty can also be linked to death due to malnutrition and acute diseases like respiratory infection (Ngoma et al. 2017). Poverty does not only affect childhood health but persists to adulthood (Aizer, 2017). In these ways, a child's poverty rate is a vital indicator of the child's well-being. By extension, it will also reflect the country and society's health and well-being.

Child poverty is also an issue in Malaysia. A study conducted in 2013-2015 within Citizen's Housing Projects in urban and rural areas in Malaysia showed a high level of well-being among children, but 20% still received inadequate education, healthcare, access to services, and materials (Noralina and Siti Hajar, 2017). The study, however, only focused on two areas in Malaysia. On a broader scale, the situation may be worse as urban poverty is an increasing phenomenon (Chamhuri et al. 2016). The main determinants of urban poverty in Malaysia are household size, race, and regions (Mok et al. 2007).

In Malaysia, poverty is measured by the Poverty Line Index (PLI), which considers minimum household expenditure related to food, clothing, footwear, and other non-food items such as house rentals. **Error! Reference source not found.** shows the PLI in Malaysia, with Sabah and abuan having the highest poverty rate. Those in Kuala Lumpur and Putrajaya displayed the highest income per capita for Malaysia (Table 23). Even though Malaysia's poverty rates are not high, vulnerable groups of people are experiencing poverty due to various societal and geographical conditions. Furthermore, the UN has questioned if official poverty levels reflect the reality in Malaysia (Astro AWANI 2019, Ismail 2019). For example, the PLI monthly minimum rate of RM980 per household may not be realistic due to current increases in living costs and prices of goods (Yusof 2019).

Table 22: Poverty Line Index in Malaysia, 2019

POVERTY INDICATORS	PENINSULAR MALAYSIA	SABAH/LABUAN	SARAWAK	MALAYSIA
Incidence of Poverty (%)	4.4	19.5	9	5.6
Poor Households	249,407	99,869	56,165	405,441
Mean Poverty Line Index (RM monthly)	2,226	2,537	2,131	2,208

Source: Department of Statistics Malaysia, 2019

Table 23: Income per capita in Malaysia by state

	Monthly income per capita (RM)	
State	**Mean**	**Median**
Johore	1,613.14	1262.13
Kelantan	9,36.55	662.50
Kedah	1,235.04	871.56
Malacca	1,594.15	1252.68
N. Sembilan	1,600.07	1210.53
Pahang	1,173.86	899.90
Penang	1,716.56	1293.78
Perak	1,297.24	988.08
Perlis	1,203.51	900.18
Selangor	2,229.31	1636.00
Terengganu	1,136.04	861.67
Sabah	1,337.33	888.39
Sarawak	1,414.15	997.42
Kuala Lumpur	3,300.92	2185.08
Labuan	2,039.47	1334.65
Putrajaya	3,008.49	2179.13

Source: Nai et al. 2019

Poor and vulnerable children in Malaysia include street children (Ahmad 2017), children living near waste disposal areas (Md Wahid and Chamhuri 2007), and children with single parents or no parents (Mok et al. 2007). Poverty affects their school performance (Hassan and Rajah, 2011), although there have been efforts by the Malaysian government to provide financial assistance, subsidies, and scholarships to these children. Malnutrition is also an issue (Shahar et al. 2020, Shariff et al. 2000, Wong et al. 2014). While healthcare workers perform consistent child health monitoring and assessments, some low-income families refuse these services. These children may also be especially vulnerable to pandemics like COVID-19 (Danielle et al. 2020).

7 Education

Education is vital for national development. Previous studies have shown proof of the positive correlation between education level and lifetime earnings (Siti and Narimah 2018). People with high education levels will also get better job opportunities and community recognition (Aminah 1993, Raja 1991, Siti and Narimah 2018), while low levels of education will necessitate individuals to work in non-professional fields that do not require any academic qualifications (Buarque et al. 2006, Bao 2006, Siti and Narimah 2018).

The World Economic Forum has recognized Malaysia as a country with a highly competitive level of education. According to its latest report, Malaysia ranks nineteenth, better than developed countries like the United Kingdom (UK) at the 20th spot, France (26) and Japan (31). It ranks second after Singapore among ASEAN countries. Sixteen global indices or criteria were used to arrive at this ranking, including basic literacy, multicultural literacy, moral or religious value literacy, aesthetic and ethical literacy, economic and financial literacy, and science and technology literacy (Sinar Harian 2019).

In 2019, Malaysia invested 20% of its entire budget for education, accounting for RM 60.2 billion (Ministry of Finance 2018). Children in Malaysia get the privilege of free education from primary to secondary level (Ujang 2015). The Malaysian government's commitment to giving priority to education has translated to a conducive atmosphere for education, including great facilities in schools and tertiary institutions supported by the latest curriculum enhancements (Sinar Harian 2019).

Formal education starts with early childhood education catering to children from 4+ to 5+ (UNESCO 2014). Although this preschool education is not compulsory, it was reported that almost 91% of children in this age group were enrolled in some form of preschool education (Chang et al. 2018, Malaysia 2015). As of January 2019, the MOE reported 205,200 enrolments in 6,152 early childhood education institutions under MOE. Additionally, another 613,247 students were enrolled in 19,048 preschools under other agencies, including ABIM (197), JAIN (798), PERPADUAN (1,781), KEMAS (8,494) and private preschools (7,778) (MOE 2019).

Preschool education is followed by six years of primary education, which is compulsory. Students start from Standard 1 at the age of 7 and proceed to Standard 6 at 12 (UNESC0 2014). The table below shows data on the number of government primary schools and government-aided primary schools in Malaysia from 2000 until 2015. The total number is steadily increasing, from 7,231 schools in 2000 to 7,763 schools in 2015. According to the Malaysia Informative Data Centre, Sarawak had the highest number of primary schools in Malaysia, with 1,264 schools in 2015. In contrast, Selangor was recorded as the state that built the newest primary schools, with 115 new schools built that year (Malaysia Informative Data Centre 2020).

Table 24: Number of government and government-aided primary schools by state, Malaysia 2000-2015

Negeri *State*	**2000**	**2002**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Malaysia	7,231	7,326	7,421	7,504	7,562	7,601	7,616	7,623	7,644	7,664	7,695	7,714	7,722	7,744	7,758	7,763
Johor	824	843	856	869	881	886	888	888	889	889	888	889	893	903	904	904
Kedah	504	509	515	521	525	527	528	528	528	530	535	539	539	542	545	547
Kelantan	406	406	407	409	410	412	413	413	414	415	417	417	418	418	418	418
Melaka	219	222	222	222	222	224	224	224	231	231	232	234	234	236	236	236
Negeri Sembilan	331	335	336	339	342	342	343	343	343	343	344	345	347	348	349	349
Pahang	489	500	512	519	521	525	526	526	527	529	535	538	538	536	537	537
Perak	814	826	842	846	847	847	844	844	845	845	848	849	849	852	852	852
Perlis	65	66	67	68	69	69	69	70	74	74	74	74	74	74	74	74
Pulau Pinang	244	248	255	259	261	263	263	263	264	268	270	271	271	271	271	271
Sabah	1,057	1,050	1,054	1,057	1,057	1,060	1,063	1,064	1,064	1,065	1,069	1,070	1,070	1,070	1,072	1,071
Sarawak	1,250	1,249	1,249	1,253	1,255	1,260	1,261	1,261	1,262	1,266	1,266	1,265	1,264	1,263	1,265	1,264
Selangor	540	560	585	610	627	633	637	631	633	637	642	646	648	651	654	655
Terengganu	310	315	321	328	336	343	344	346	346	346	348	349	349	350	351	352
W.P. Kuala Lumpur	178	182	183	187	192	193	196	197	198	198	199	200	200	200	200	202
W.P. Labuan	-	15	17	17	17	17	17	17	17	17	17	17	17	17	17	17
W.P. Putrajaya	-	-	-	-	-	-	-	8	9	11	11	11	11	13	13	14

Sumber: Kementerian Pendidikan Malaysia
Source: Ministry of Education, Malaysia

Nota/*Notes*:

Data 2000-2014, seperti pada 30 Jun
Data 2000-2014, as at 30 June
Data 2015, seperti pada 31 Okt
Data 2015, as at 31st Oct
Termasuk Prasekolah yang berada di Sekolah Rendah, Sekolah Model Khas, Sekolah Sukan, sekolah jenis **kebangsaan** cina dan **sekolah** jenis kebangsaan tamil
Includes Pre-schools that is part of Primary Schools, Special Model Schools, Sports Schools, national type chinese and national type indians
\- **Tiada**/*Nil*

The table below (Table 25) shows the enrolment rate in primary schools from 2001 to 2016. In 2016, Malaysia's enrollment rate was 97.24%, with Negeri Sembilan having the highest enrollment rate at 103.15% and Kelantan having the lowest rate of 85.74% (Malaysia Informative Data Centre 2020). As of 2019, it was reported that 237,317 students were enrolled in primary schools (MOE 2019).

Table 25: Enrolment rate for primary education, Malaysia 2001-2016

Negeri *State*	**Tahun** *Year*															
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Malaysia	**95.05**	**94.47**	**95.30**	**95.27**	**96.31**	**95.25**	**96.21**	**95.50**	**95.65**	**96.19**	**95.88**	**96.42**	**96.59**	**97.94**	**97.15**	**97.24**
Johor	98.49	98.42	99.67	99.42	103.06	102.42	101.64	103.17	99.96	100.96	99.55	96.98	98.30	99.53	98.47	98.83
Kedah	99.46	98.92	99.34	99.00	97.61	97.62	97.86	100.49	95.62	98.33	97.98	99.24	96.70	99.51	98.92	98.06
Kelantan	90.00	89.67	89.92	89.49	88.16	86.27	86.29	88.22	84.62	85.27	87.14	88.36	87.48	87.32	86.75	85.74
Melaka	94.78	94.87	96.24	96.87	95.36	95.63	95.76	99.79	97.90	98.36	99.33	100.15	99.95	101.66	101.49	102.46
Negeri Sembilan	102.75	103.59	104.50	104.84	104.18	104.00	103.53	104.29	101.20	101.18	101.54	102.15	101.74	103.60	102.27	103.15
Pahang	96.00	97.11	97.94	98.71	98.28	96.11	96.29	96.29	93.97	95.39	95.01	95.86	96.72	98.58	97.61	98.29
Perak	94.18	95.18	95.85	95.41	95.50	92.84	92.74	93.44	89.80	90.28	90.56	92.57	92.62	95.05	94.96	95.45
Perlis	98.12	99.10	98.87	98.52	98.19	93.80	94.02	98.58	95.60	95.67	95.88	97.17	98.16	99.79	100.01	99.02
Pulau Pinang	95.57	95.12	94.32	96.00	97.41	97.72	97.82	99.89	97.74	98.60	99.08	100.14	100.29	102.42	102.24	102.16
Sabah	80.80	77.16	78.32	76.77	81.22	78.66	89.40	88.21	87.00	91.04	93.70	95.91	97.63	99.39	98.48	96.74
Sarawak	97.87	97.71	98.04	97.83	98.12	97.30	96.76	97.02	94.90	95.42	95.80	96.75	97.66	98.31	97.91	98.17
Selangor	107.65	106.48	107.58	107.52	107.48	109.03	108.67	108.07	103.45	104.84	103.00	101.63	101.30	99.34	97.08	95.84
Terengganu	94.75	94.51	95.26	95.45	96.55	94.24	93.80	96.03	92.49	92.14	92.15	91.84	91.57	92.45	91.94	92.20
W.P. Kuala Lumpur	82.73	81.41	81.64	81.95	80.43	79.58	79.27	81.18	81.22	83.56	85.96	87.74	91.95	90.23	99.57	101.91
W.P. Labuan	na	na	na	99.91	106.93	80.37	81.17	87.24	85.99	92.79	87.28	86.89	89.44	90.57	91.40	93.15

Sumber: Kementerian Pendidikan Malaysia
Source: Ministry of Education Malaysia

Nota/*Notes*:

Data termasuk KPM, BPS, SRAN, SRAR, DOSM
Data are inclusive of MOE, BPS, SRAN, SRAR, DOSM

n.a **Tidak diperoleh**/*Not available*

Ringkasan/*Abbreviation:*

KPM	**Kementerian Pendidikan Malaysia** *Ministry of Education Malaysia*
BPS	**Bahagian Pendidikan Swasta** *Private Education Division*
SRAN	**Sekolah Rendah Agama Negeri** *State Religious Primary School*
SRAR	**Sekolah Rendah Agama Rakyat** *People's Religious Primary School*
DOSM	**Jabatan Perangkaan Malaysia** *Department of Statistics Malaysia*

The table below (Table 26) shows the primary school completion rate in Malaysia. The latest data in 2016 found that the national completion rate was 98.37%. Putrajaya had the highest completion rate in primary education with 103.48%, whereas Kuala Lumpur was the state with the lowest completion rate with 91.93% (Malaysia Informative Data Centre 2020).

Table 26: Completion rate for primary education, Malaysia 2001-2016

Negeri *States*	**Tahun** *Year*															
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Malaysia	**97.02**	**95.78**	**95.74**	**98.33**	**98.09**	**98.63**	**97.43**	**99.10**	**98.80**	**97.17**	**98.70**	**99.06**	**99.17**	**99.18**	**98.41**	**98.37**
Johor	98.31	97.99	98.60	98.94	98.85	99.59	99.37	98.30	98.24	95.70	98.02	98.00	98.76	99.07	98.68	99.06
Kedah	100.91	100.49	100.48	101.46	101.15	101.72	101.34	101.58	101.48	100.70	101.14	100.90	101.39	100.58	100.53	99.97
Kelantan	98.40	97.49	96.44	99.60	99.25	100.30	97.66	100.12	101.50	92.47	101.09	101.10	100.60	100.24	100.71	100.32
Melaka	102.46	100.62	102.41	102.33	102.01	101.66	101.26	103.07	101.36	100.24	102.95	101.20	98.96	99.56	99.02	98.92
Negeri Sembilan	101.43	98.60	99.19	102.08	102.02	102.39	96.34	102.14	101.35	97.62	100.03	99.80	99.06	99.38	98.92	98.29
Pahang	95.44	95.07	96.45	97.08	97.85	98.63	98.31	98.81	99.05	92.33	99.48	99.80	100.26	100.04	97.53	97.72
Perak	99.64	97.73	96.51	99.03	99.54	99.90	98.92	98.81	99.16	91.49	98.85	99.30	98.98	99.41	98.54	98.83
Perlis	100.18	100.90	103.44	101.15	101.75	102.07	93.10	103.95	103.05	94.30	107.25	104.70	101.81	102.77	101.92	101.66
Pulau Pinang	98.46	99.34	96.72	99.15	99.69	98.69	93.51	101.20	98.44	99.86	97.10	97.60	97.08	96.96	96.80	96.55
Sabah	80.20	79.58	80.34	85.85	83.53	87.16	89.77	93.92	94.73	94.90	98.50	100.20	100.75	101.04	99.83	99.75
Sarawak	94.25	94.00	93.69	96.97	96.85	97.12	97.76	97.64	97.93	93.45	98.19	98.60	99.11	99.36	98.92	99.40
Selangor	103.92	100.20	100.69	103.86	103.85	103.34	99.66	101.74	99.80	108.29	97.58	98.40	98.55	98.27	97.06	96.86
Terengganu	99.24	96.95	97.35	99.97	99.46	100.34	100.24	100.36	100.96	90.92	100.44	99.90	100.41	100.64	99.76	100.43
W.P. Kuala Lumpur	94.15	91.14	89.42	91.43	91.63	92.83	91.78	92.91	92.42	93.22	93.03	93.30	93.01	93.18	92.57	91.93
W.P. Labuan	n.a.	n.a.	n.a.	n.a.	n.a.	88.28	88.60	89.46	86.19	94.79	89.69	94.00	95.22	94.68	92.75	95.05
W.P. Putrajaya	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	128.50	123.53	115.76	108.59	103.48

Sumber: Kementerian Pendidikan Malaysia (KPM)
Source: Ministry of Education Malaysia (MOE)

Nota/*Notes* :

Hanya sekolah KPM/*Only MOE schools*
n.a. **Tidak diperoleh**/*Not available*

After completing primary education, students move on to lower secondary education (Forms 1 to 3) and then complete two years of upper secondary education before finishing eleven years of school (UNESCO 2014). The table below shows the number of government and government-aided secondary schools from 2000 until 2015. In 2015, there were 2,397 schools in Malaysia, with Selangor having the highest number of schools (Malaysia Informative Data Centre 2020).

Table 27: Number of government and government-aided secondary schools by state, Malaysia 2000-2015

Negeri *State*	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Malaysia	**1,645**	**1,726**	**1,819**	**1,902**	**1,976**	**2,028**	**2,047**	**2,058**	**2,181**	**2,219**	**2,248**	**2,282**	**2,307**	**2,347**	**2,375**	**2,397**
Johor	176	166	198	210	232	235	236	237	240	243	242	247	250	271	273	274
Kedah	141	146	149	153	155	158	159	159	173	174	177	178	181	182	190	200
Kelantan	117	118	125	126	127	131	132	132	133	155	160	164	171	173	173	174
Melaka	59	62	64	64	66	66	66	66	73	74	75	76	77	77	77	77
Negeri Sembilan	87	89	91	93	98	98	98	101	116	116	117	117	117	119	121	124
Pahang	123	138	153	161	166	171	174	175	180	181	187	189	192	194	194	194
Perak	179	191	204	210	213	213	213	213	236	237	240	241	243	242	245	246
Perlis	22	23	24	24	24	24	24	24	26	26	27	27	27	29	30	30
Pulau Pinang	82	86	95	102	105	109	109	109	119	124	125	125	125	127	127	127
Sabah	182	180	183	187	190	197	204	205	207	208	208	213	214	216	219	219
Sarawak	153	153	155	158	166	173	176	177	177	177	179	184	184	185	185	187
Selangor	165	181	196	221	232	237	237	232	256	257	261	265	269	272	275	275
Terengganu	80	82	88	91	101	113	116	119	135	135	136	140	141	143	144	147
W.P. Kuala Lumpur	79	83	85	93	92	94	94	94	94	94	96	97	97	97	101	102
W.P. Labuan	-	8	9	9	9	9	9	9	9	9	9	9	9	9	10	10
W.P. Putrajaya	-	-	-	-	-	-	-	6	7	9	9	10	10	11	11	11

Sumber: Kementerian Pendidikan Malaysia
Source: Ministry of Education, Malaysia

Nota/*Notes*:
Data 2000-2014, seperti pada 30 Jun
Data 2000-2014, as at 30 June
Data 2015, seperti pada 31 Okt
Data 2015, as at 31st Oct
Termasuk Sekolah Model Khas, Sekolah Sukan dan Sekolah Seni
Includes Special Model Schools, Sports Schools and Arts School
- Tiada/*Nil*

The total number of secondary schools are increasing to accommodate the number of students. The table below shows (Table 28) that in 2019, there were 2,436 government and government-aided secondary schools, with 53.3% located in rural areas (MOE 2019).

Table 28: Total number of secondary schools in 2017, 2018 and 2019

Type of Schools	2017			2018			2019		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Regular	943	1,047	1,990	937	1,045	1,982	935	1,049	1,984
Fully Residential	34	35	69	34	35	69	34	35	69
Religious	27	30	57	27	32	59	27	33	60
Technical	8	1	9	8	1	9	8	1	9
Vocational College	45	35	80	49	38	87	49	38	87
Special Education	5	1	6	5	1	6	5	1	6
Special Model	3	8	11	3	8	11	3	8	11
Sports	4	1	5	4	1	5	4	1	5
Arts	3	0	3	3	0	3	3	0	3
Government Aided Religious School (GARS)	54	126	180	54	126	180	54	126	180
Bimbingan Jalinan Kasih	1	0	1	1	0	1	1	0	1
Form Six College	0	0	0	9	5	14	14	7	21
TOTAL	**1,127**	**1,284**	**2,411**	**1,134**	**1,292**	**2,426**	**1,137**	**1,299**	**2,436**

Note : Data as of 31st January 2019
Source : Educational Planning and Research Division

The table below shows that there are also 262 secondary schools under institutions under other government agencies in 2019 (MOE 2019).

Table 29: Total number of secondary schools under other government agencies

Type of Schools	2019
People Religious Secondary School (SMAR)*	96
State Religious Secondary School (SMAN)*	111
MARA Junior Science Colleges (MJSC)	54
Royal Military College (RMC)	1
TOTAL	**262**

Note : Data as of 31st January 2019
* Data as of 28th February 2019
Source : State Religious Department (SMAR, SMAN); MARA; Royal Military College

In 2016, Malaysian students' enrolment rate into secondary schools was 90.02%, with Negeri Sembilan having the highest enrolment rate compared to other states (Malaysia Informative Data Centre 2020).

Table 30: Enrolment rate in secondary schools in 2001-2016 by state, Malaysia

Negeri *State*	**Tahun** *Year*															
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**[r]	**2014**	**2015**	**2016**
Malaysia	**86.85**	**86.95**	**86.42**	**87.13**	**87.02**	**88.31**	**87.74**	**89.11**	**90.01**	**88.61**	**88.81**	**90.18**	**90.38**	**90.00**	**88.30**	**90.02**
Johor	92.65	93.10	94.01	96.10	88.76	94.36	95.13	88.81	94.94	92.77	94.70	97.11	97.72	97.74	94.67	96.08
Kedah	95.00	94.88	94.58	93.16	90.76	96.89	94.78	95.08	95.46	95.83	95.25	93.81	89.79	92.14	89.81	89.40
Kelantan	71.55	72.57	73.57	75.80	98.67	90.05	88.10	86.49	96.57	87.22	84.90	83.90	78.63	81.07	78.46	81.14
Melaka	87.48	88.84	90.38	91.18	94.18	98.05	96.76	97.64	99.34	98.91	99.49	98.89	97.75	96.81	95.98	98.31
Negeri Sembilan	100.78	100.73	100.79	101.15	95.68	104.24	106.20	104.74	109.49	108.30	107.34	106.37	104.96	104.23	100.65	103.80
Pahang	80.73	79.27	79.78	85.10	86.32	88.96	89.04	84.10	84.08	89.35	81.30	87.55	87.58	86.51	84.14	87.61
Perak	88.36	89.36	91.30	90.58	95.83	89.64	89.18	90.37	93.04	92.56	92.95	91.03	91.34	89.26	86.91	89.01
Perlis	99.13	100.32	101.37	100.71	104.44	117.03	102.20	98.61	100.92	99.59	97.10	102.33	100.73	101.04	99.58	101.65
Pulau Pinang	89.66	91.14	86.96	91.41	93.02	93.12	92.51	91.03	93.20	94.81	92.70	95.87	96.75	96.38	95.18	97.43
Sabah	65.40	64.28	64.35	62.67	52.54	61.40	61.39	58.34	61.75	63.80	66.86	70.47	73.55	76.65	79.00	82.75
Sarawak	83.72	83.46	85.15	84.01	86.81	86.70	86.34	84.25	86.77	85.99	86.42	87.14	87.46	85.74	84.74	86.35
Selangor	98.44	99.25	101.42	104.07	75.83	104.95	98.68	99.75	100.66	100.53	102.46	100.32	100.04	98.11	94.18	93.33
Terengganu	86.87	86.65	86.09	87.11	94.44	88.94	82.25	94.33	94.51	94.70	94.89	89.68	89.11	87.14	85.52	86.40
W.P. Kuala Lumpur	80.09	79.58	78.56	76.90	95.23	77.05	76.79	67.73	75.93	79.75	78.57	77.87	80.83	75.34	81.56	85.00
W.P. Labuan	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	63.75	64.56	65.55	66.92	73.08	77.75	87.88	82.97	81.98

Sumber: Kementerian Pendidikan Malaysia
Source: Ministry of Education Malaysia

Nota/*Notes* :

Data termasuk KPM, BPS, SMAN, SMAR, MTD, MARA, DOSM
Data are inclusive of MOE, BPS, SMAN, SMAR, MTD, MARA, DOSM
Data tidak termasuk Tingkatan 6
Data does not include Form 6
n.a. Tidak diperoleh/*Not available*
r **pindaan**/*revised*

Ringkasan/*Abbreviation:*

KPM	**Kementerian Pendidikan Malaysia** *Ministry of Education Malaysia*
BPS	**Bahagian Pendidikan Swasta** *Private Education Division*
SMAN	**Sekolah Menengah Agama Negeri** *State Religious Secondary School*
SMAR	**Sekolah Menengah Agama Rakyat** *People's Religious Primary School*
MTD	**Maktab Tentera Di Raja** *Royal Military College*
MARA	**Majlis Amanah Rakyat** *People's Council Trust*
DOSM	**Jabatan Perangkaan Malaysia** *Department of Statistics Malaysia*

The table below shows the total number of students at the secondary level in government and government-aided schools from 2000 to 2015. In 2015, 2,072,162 students registered at the secondary level, with Selangor having the highest number of students (Malaysia Informative Data Centre 2020). However, the latest data reported by MOE show a reduction in secondary school students with 182,587 (MOE 2019). The enrolment rate of upper secondary education (excluding upper and lower form 6) has increased from 45% in the 1980s to 82% today.

Table 31: Number of students at the secondary level in government and government-aided schools from 2000 to 2015

Negeri *State*	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Malaysia	**1,998,781**	**2,038,282**	**2,062,958**	**2,088,817**	**2,168,215**	**2,218,088**	**2,228,068**	**2,263,383**	**2,310,860**	**2,331,801**	**2,242,341**	**2,327,427**	**2,326,488**	**2,320,300**	**2,169,908**	**2,072,162**
Johor	240,302	244,436	244,834	252,832	259,846	266,100	268,114	273,662	277,902	281,870	272,358	280,520	280,400	285,936	266,837	255,534
Kedah	155,805	158,347	161,789	166,189	169,346	173,477	172,983	173,866	179,290	181,001	174,869	181,768	181,327	179,274	164,865	158,332
Kelantan	139,598	146,043	151,863	157,912	163,028	168,269	166,406	165,924	164,943	164,110	150,274	157,366	154,466	150,636	136,527	128,932
Melaka	65,664	65,735	65,791	65,978	67,511	68,652	69,046	70,194	72,930	74,244	71,633	74,227	74,608	74,710	69,531	66,822
Negeri Sembilan	91,394	90,165	90,392	91,871	91,966	93,936	93,219	93,713	95,795	96,035	93,102	96,588	95,513	96,042	89,647	85,657
Pahang	126,093	128,495	127,528	129,670	132,906	135,248	132,327	130,511	129,075	127,440	120,070	122,717	121,402	119,784	111,347	105,689
Perak	224,053	223,483	221,477	223,594	224,585	225,456	221,981	221,030	224,786	223,690	213,086	219,551	216,891	212,619	193,699	182,522
Perlis	23,908	24,352	24,664	24,526	24,971	25,029	24,489	24,204	24,987	24,760	23,260	24,022	23,906	23,347	21,206	20,431
Pulau Pinang	110,211	110,741	109,200	105,411	112,488	114,455	113,957	115,504	117,859	120,422	118,029	122,998	124,091	124,053	114,962	109,388
Sabah	171,744	171,479	172,304	177,524	182,049	190,522	193,375	196,070	197,807	200,415	190,308	204,626	207,754	210,398	195,448	191,223
Sarawak	172,497	179,931	182,970	189,716	197,577	208,795	211,718	213,032	213,870	215,501	201,132	210,989	210,686	210,641	194,755	188,484
Selangor	266,141	273,241	277,626	287,936	301,967	317,408	330,376	341,492	367,232	378,814	380,614	393,814	398,449	401,090	382,886	370,349
Terengganu	98,685	103,487	106,627	109,780	112,591	115,220	114,413	113,607	122,072	119,865	112,219	116,891	116,632	113,806	105,696	100,786
W.P. Kuala Lumpur	112,686	112,398	110,362	110,382	109,786	110,770	109,698	111,386	111,203	111,993	109,593	110,106	107,503	105,754	99,677	95,189
W.P. Labuan	-	5,929	5,529	5,496	5,598	5,731	5,964	6,066	6,098	6,208	5,985	6,031	6,307	6,409	6,029	5,824
W.P. Putrajaya	-	-	-	-	-	-	-	4,122	4,811	5,543	5,810	6,213	6,563	6,801	6,796	7,000

Sumber: Kementerian Pendidikan Malaysia
Source: Ministry of Education, Malaysia

Nota/*Notes*:

Data 2000-2014, seperti pada 30 Jun
Data 2000-2014, as at 30 June
Data 2015, seperti pada 31 Okt
Data 2015, as at 31st Oct
Termasuk Sekolah Model Khas, Sekolah Sukan dan Sekolah Seni
Includes Special Model Schools, Sports Schools and Arts School
\- Tiada/*Nil*

Post-secondary education may be pursued through a two-year Form 6 programme leading to a certificate or a one- or two-year matriculation programme, all of which are considered preparatory courses for university entrance.

Table 32: Number of higher education institutions by type, Malaysia 2000-2015

Jenis Institusi *Type of Institution*	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Jumlah *Total*	**55**	**58**	**61**	**64**	**65**	**67**	**103**	**110**	**118**	**139**[r]	**146**[r]	**149**[r]	**159**	**161**	**172**	**175**
Institut Pendidikan Guru *Teacher Education Institutes*	27	27	27	27	27	28	28[a]	28[a]	28[a]	28[a]	28[a]	28[a]	28[a]	28[a]	28[a]	28[a]
Politeknik *Polytechnics*	12	13	16	19	20	20	20	24	27	27	27	30	30	32	33	34
Kolej Komuniti *Community Colleges*	5	7	7	7	7	7	35[b]	38[b]	43[b]	64[b][r]	71[b][r]	71[b][r]	81[b]	81	91	93
Universiti Awam *Public Universities*	11	11	11	11	11	12	20	20	20	20	20	20	20	20	20	20

Sumber: Kementerian Pendidikan Malaysia
Source: Ministry of Education, Malaysia

Nota/*Notes* :
- [a] **Termasuk Pusat Pengajian Bahasa Inggeris, Malaysia**
  Includes English Language Teaching Centres, Malaysia (ELTC)
- [b] **Termasuk Kolej Tunku Abdul Rahman (KTAR) dan Kolej Komuniti**
  Includes Kolej Tunku Abdul Rahman (KTAR) and Community Colleges
- [r] **Disemak semula**/*Revised*

By 2015, there were 175 government institutions of higher learning in Malaysia, ranging from Teacher Education Institutes, Polytechnics, Community Colleges, and Public Universities. Malaysia's achievement in education enrolment is significant (Chang et al. 2018). Based on the MEB annual report 2018, students' enrolment for all education levels increased in 2018 compared to 2017. Preschool enrolment increased from 84.3% to 85.4%, and upper secondary enrolment increased from 86.6% to 87.2%. Primary and secondary school enrolment remains at more than 95%. The percentage of student dropouts has reduced from 0.29% to 0.15% for primary schools and from 1.36% to 1.21% for secondary schools.

There remains the difficult task of reaching the remaining few percentages of children who, for different reasons, never enrolled or dropped out before completing basic education. Further analysis will be needed to identify who these children are, whether they are poor, immigrants, or belonging to the indigenous population. It is estimated that around 44,000 children in Malaysia are born to illegal immigrants, live in the streets, and do not attend schools (UNICEF 2012). The Zero Student Dropout Programme (Programme Sifar Murid Cicir – PSMC), which started in 2018 to identify dropout students and ensure that they would continue their education until Form 5, discovered that most cases of dropouts in Kulai, Perlis, and Kelantan are related to low family incomes, poverty, parents with disabilities, divorced parents, and lack of transport to school. This shows the importance of ensuring equitable access to quality education for all (UNESCO 2014).

7.1 Major issues in education in Malaysia

Malaysia continues to face several challenges in ensuring a high quality of education for all children. Firstly, poverty remains an issue in some rural areas. Statistical evidence generally supports the view that students from better-endowed families perform better in examinations. The adverse effects of poverty on student performance are well documented (Osman and Rajah 2011). Due to constraints of financial resources, available time, and parental educational skills, low-income parents often have difficulty becoming active partners in their children's education (Hawkins 2001, Lino 1994, Siti and Narimah 2018, UNICEF 2019). They will also likely face an unconducive atmosphere to study at home (Rani 1995, Siti and Narimah 2018). Students from families residing in poor neighbourhoods and rural locations perform less favourably than students from rich neighbourhoods and urban locations. Lee (2010) established from a sample of youth criminals in Malaysia that there is a strong relationship between poverty and crime and that poor criminals exited school early.

Sabah has the highest poverty rate among all states in Malaysia, which is 2.9% compared to the national rate, which is 0.4% (Department of Statistics Malaysia 2017). Within the Sabahan labour force, 32% is made up of children between 15 and 19 years old, which is also the highest in Malaysia (Department of Statistic Malaysia 2017, UNICEF 2019). The 'Lost Boys' phenomenon in Sabah results from economic pressure that forces most males to work (UNICEF 2019). These boys also seem to enjoy working and are demotivated to continue schooling. Education is vital to reduce income inequality and poverty levels (Todaro 2003). Narrowing the achievement gap between children from different income groups (Rabi et al. 2020) will also result in less conflict with the law (Rabi et al. 2020) and increase employment opportunities (Kapur 2019) among students in lower-income groups.

There is also the issue of varied perceptions of the importance of education among Malaysian parents. A child's attitude towards education and academic performance is influenced by their parents or caregivers (Mohd et al. 2018, UNICEF 2019). A good parent-teacher relationship is also important to ensure students' good school performance (Palik 2020). In Sabah, the 'Lost Boys' phenomenon is closely related to gender roles. Males in the family are perceived to be responsible for the family's economy, and males tend to obtain higher wages than females (UNICEF 2019).

Cultural and religious factors also sometimes cause parents to refuse to send their children to school, especially among some Orang Asli and Rohingya communities (Johari and Nazri 2007, Er et al. 2010, Mohd et al. 2018, Palik 2020). However, urbanization has transformed the economy, culture, and attitude of the Orang Asli (Siti 2015), which has increased the interest of Orang Asli children to pursue education (Mohd et al. 2018). Through an education transformation programme for Orang Asli and indigenous communities (MOE 2018), there has been an increase in the percentage of attendance to 87.4% (2018) from 83.5% (2017) among these communities and has inspired these children to aspire to become teachers, police officers, and other professional careers (Mohd et al. 2018).

Another issue is schools located far from home, which restricts accessibility and can reduce the child's interest in school (Mazdi et al. 2014, Syazwani et al. 2012, Mohd and Nor 2009, Faris et al. 2018). In Kelantan and Sabah, it was found that lack of transportation (Farazana et al. 2020) and other geographical factors (MOE Malaysia 2018, Haryati 2020) have caused an increase of dropouts among school children. To address this, JAKOA has started providing school buses for free for Orang Asli children (Mohd et al. 2018).

There is also a lack of access to education among children with disabilities. Some children require specific learning interventions, which can be costly. Other challenges include special needs school locations far from home (UNICEF 2019), shortage of specialized teachers, overcrowding in the classroom, inadequate infrastructure, and the lack of assistive technology (Faris et al. 2018). The Ministry has provided three special education settings: special schools, integrated programmes, and inclusive programmes (Ali et al. 2006, Faris et al. 2018). This strategic method increased the participation of children with special needs in schools to 50.49% in 2018 (MOE 2018). There is still a need to establish or improve procedures for early detection of children with special educational needs and early intervention provision. This is important in ensuring that these children will have the same opportunity to succeed (UNESCO 2014).

Marginalised children are also at an educational disadvantage. Marginalised children are defined as children outside and peripheralized from the mainstream group or centre of society. They have little control of their lives, little resources available to them and subject to stigmatization with negative public attitudes. In Malaysia, the estimate for marginalised children under 18 years old stands at approximately 290,000 in 2016 (Nortajuddin 2020, Ching 2017). These include children who were unregistered at birth, adopted, or abandoned, have parents who did not register their marriage, or are children of refugees or undocumented migrants (Chuah et al. 2018, Roslina et al. 2019, Nortajuddin 2020). The issues surrounding marginalised children are unique due to proxy decision making, ethical dilemmas on consent, confidentiality and right of autonomy (Fahisham Taib 2012). Besides being denied access to education, being marginalised can also affect a child's development and well-being, healthcare, and other services (Chuah et al. 2018, Roslina et al. 2019, Nortajuddin 2020).

The MOE has developed the Malaysia Education Blueprint (MEB) 2013-2025 to transform the education landscape in Malaysia and prepare Malaysia's children for the needs of the 21st century (MOE Malaysia 2013). As the master plan for education sector development in Malaysia, the MEB came about due to a comprehensive review of the education system in 2011. It affirms the critical role of education in turning Malaysia into a knowledge-based economy to compete in the increasingly globalized economy. The MEB's main objectives are (1) to determine the challenges and improve access to education, raise standards, maximize system efficiency, and close the gaps, (2) to establish a clear vision and aspiration for individual students and the education system for the next 13 years, and (3) to outline a comprehensive transformation programme for the system, including key changes to the Ministry (MOE Malaysia 2013).

The Blueprint puts five system aspirations at the forefront: Access, Quality, Equity, Unity, and Efficiency. Student aspirations should be based on Knowledge, Thinking Skills, Leadership Skills, Bilingual Proficiency, Ethics and Spirituality and National Identity. The ambitions contained in the Blueprint are to be accomplished through eleven Shifts (changes) and in three Waves (periods). In Wave 1 (2013 to 2015), the focus is on strengthening vocational education and creating alternative pathways and ways of improving opportunities for students with special needs. In Wave 2 (2016-2020), the MOE will focus on scaling up programmes piloted under the first Wave, and in the final Wave (2021-2025), refining of individual pathways and greater involvement of the private sector is envisioned (UNESCO 2014).

The Eleven Transformation Shifts are as follows:

- Provide equal access to quality education of an international standard
- Ensure every child is proficient in Bahasa Malaysia and the English language and is encouraged to learn an additional language

- Develop values-driven Malaysians
- Transform teaching into the profession of choice
- Ensure high-performing school leaders in every school
- Empower JPNs, PPDs and schools to customize solutions based on need
- Leverage ICT to scale up quality learning across Malaysia
- Transform Ministry delivery capabilities and capacity
- Partner with parents, community and private sector at scale
- Maximize student outcomes for every ringgit
- Increase transparency for direct public accountability (UNESCO 2014).

In line with this vision, facilities provided in schools have been improved since 2018. Throughout 2018, 394 dilapidated schools have been upgraded compared to just 120 schools before (2017). The same year, 1,260 science laboratories were upgraded in 560 schools (MOE Malaysia 2018). As a result of the Ministry's initiative to increase efficiency in teaching and learning (PdP: Pembelajaran dan Pengajaran) in schools, a 2018 report shows a 56% increase in the usage of VLE (Virtual Learning Education) by teachers and students through various mediums (MOE 2018).

To further increase and improve the quality of education in Malaysia, the education system needs to be continually revamped to ensure that students are more marketable to meet the Fourth Industrial Revolution requirements. According to the former Deputy General of Education (Lesson Operation Sector), studies have predicted that 60% of current professions will be obsolete under IR4.0. Hence students must be trained early for new and emerging professions. In preparing for such professions, subjects such as science, technology, engineering, and mathematics (STEM) need to be prioritized so that students can think critically and innovate to embrace the 21st century successfully. Malaysia's current education system is cluttered, with too many branches of subjects. Hence by revamping the curriculum, more focus can be placed on subjects that will bear more importance for the future (Berita Harian Online 2018).

7.2 Education among stateless children and children of migrants and refugees

Migration and displacement are two global challenges that interact with education in many ways. Both affect those who move, stay, and host immigrants, refugees, or other displaced populations (New Straits Times 2018). The most obvious challenge facing stateless children is the lack of educational opportunities. While some countries offer free primary education to stateless children, many do not. In Malaysia, stateless children of Indian, Filipino, or Indonesian descent in Selangor and Sabah are identified as foreigners on their birth certificates. Furthermore, the absence of a birth certificate means they cannot attend public school (Jannah 2018, New Straits Times 2018, Gurd and Kohn 2011), a common issue among stateless persons in Sabah. These stateless persons still live in fear and face a hard time accessing affordable education and other basic rights (Augustin 2018).

Another issue is education among children of migrants or refugees. Although these children's rights are increasingly recognized on paper, it is challenged in classrooms, schools, and denied outright by a few governments (New Straits Times 2018). Malaysia is a developing country that is flooded with immigrants and foreign workers attracted by ample job opportunities. These individuals are often willing to work for low wages. Unfortunately, it is difficult to determine the specific number of immigrants in Malaysia due to illegal immigration (Astro AWANI 2019).

Within these immigrant and foreign communities in Malaysia, there are children who also should be given equitable access to education. The education sector in Malaysia supports lifelong learning stretching from early childhood care and education to tertiary and postgraduate education (UNESCO 2014). However, the Global Education Monitoring (GEM) report by the United Nations Educational, Scientific and Cultural Organization (UNESCO) reported that Malaysia’s progress is too slow in making education more inclusive for children of migrants and refugees. Discrimination among migrant children largely stems from their uncertain migration status in Malaysia (UNICEF 2012). Malaysia is not a state party of the 1951 Convention Relating to the Status of Refugees and its 1967 Protocol (The UN Refugee Agency 2013). Therefore, these refugees do not have access to basic services, including formal education (Letchamanan 2013). There are also issues within these communities that limit access to education. Some refugee parents prefer to keep their children at home due to legal issues (Farzana et al. 2020). Furthermore, some refugee families with limited means kept children with disabilities out of school in favour of sending their siblings (New Straits Times 2018).

Not all school heads are aware of these issues. They are rarely motivated or equipped to lead the development of intercultural understanding in their schools to embrace diversity. They lack guidance from the government and have little autonomy for adaptation (New Straits Times 2018). The GEM report listed seven recommendations for the education of migrants and displaced people: (1) their rights be protected, (2) they are included in the national education system, (3) their education needs to be understood and planned, (4) their histories represented in education accurately to challenge prejudices, (5) teachers prepared to address diversity and hardship, (6) their potential harnessed and their education supported through humanitarian, and (7) development aid.

8 **Literacy**

Literacy is a significant issue for all nations (National Literacy Trust 2012). Students must master literacy skills to succeed academically. Research suggests that low academic achievement is closely linked to the lack of strong literacy skills. Students with poor literacy skills will struggle in school and throughout life (Mohd Asraf et al. 2016, Clark and Burke 2012, National Literacy Trust 2012). As education levels increase, students will need to read and write across a wide variety of disciplines, genres and materials with increasing skill, flexibility and insight (Snow and Biancarosa 2003), as well as to read, understand and learn from an increasing level of demanding texts, which require that they master words and vocabulary, expand their knowledge and also be able to think openly and critically (Mohd Asraf et al. 2016, Chall and Jacobs 2003).

Research indicates that strong literacy skills in children are developed when given early experiences with reading, which contributes to later success or failure in learning to read (Ferreiro and Teberosky 2009). Indeed, there is strong evidence to indicate that the consequences of a slow start in literacy become enormous over time and continue to adulthood without proper intervention (Grossen 1997, Slavin and Madden 1989). Given the importance of literacy and its relationship to academic achievement, it is important to ensure that students master these skills during their early school years (Mohd Asraf et al. 2016).

According to Chew (2012), literacy proficiency is the foundation and aspiration of the Malaysian national education system and boosting students' literacy proficiency is the immediate priority. The Literacy and Numeracy Screening (LINUS) programme is conducted to identify students with difficulty reading, writing, and basic arithmetic and provide all children in Malaysia with a sound base in basic literacy and numeracy skills within the first three years of their primary school education. It was initiated under the Malaysian Government Transformation Programme (GTP) 1.0 as one of the focus areas of the National Key Result Areas (NKRAs) (Chang, 2011a, 2011b, Nazariyah Sani and Abdul Rahman Idris 2012, MOE 2012).

The LINUS programme, which was first started in 2010, assesses students from Grades 1 to 3 on literacy and numeracy performance. Two screenings are carried out, one in May and the other in September or October (Mohd Asraf et al. 2016, MOE 2013c). The second iteration of the programme (LINUS 2.0) showed an overall increment in literacy from 2016 to 2018 (Bahasa Melayu Literacy: 80.4% to 97.9%, English Language Literacy: 73.9and to 95.8%, Numeracy: 87.3% to 98.5%). However, beginning in 2019, the Education Ministry will no longer conduct the LINUS programme in schools. Instead, schools will determine their own ways to tackle literacy difficulties faced by their students (Daily Express 2018).

Malaysia's MOE also set up a programme focusing on reducing the number of nonliterates among indigenous adults, mainly in the Orang Asli communities in Peninsular Malaysia and the indigenous peoples of Sabah and Sarawak. The programme, known as the Adult Class for Indigenous Parents or *Kelas Dewasa Ibu Bapa Orang Asli dan Peribumi* (KEDAP), was launched in 2008. Since its launch in 2008, the number of participants for KEDAP classes has reached 18,195 students. Research has found that the programme has brought many positive changes to the participants: they are more articulate, more concerned about their personal appearance, and eager to attend classes. Their children are also more motivated after noticing their parents' enthusiasm. However, research also identified some issues that need to be addressed. These include the need to improve the teaching modules and methodologies and resolve transport problems due to distance and travelling costs (UNESCO 2014).

The graph below shows that Malaysia is on track to reach its target for adult literacy. In 2012, the literacy rate (based on the definition of attending or had attended school) had reached 94.1%, only 0.9% short of the 2015 national target. The Malaysia Population and Housing Census's assessment of the national literacy rate for the year 2000 was 91% for Malaysian citizens aged ten years and above, with a significant gap between the urban and rural populations. The urban population's literacy rate was 94.3% compared to 85.4% of the rural population. Kelantan and the two states in East Malaysia, Sarawak, and Sabah had a literacy rate of less than 90%, with 85.8% for Kelantan, 81.6% for Sarawak, and 84.6% for Sabah. These three states also scored the lowest rural literacy rates: Sarawak at 72.1%, Sabah at 79.2% and Kelantan at 83.1% (UNESCO 2014).

Literacy rates for the population aged ten and above increased between 2000 and 2010 from 91% to 95%. The literacy rate for the three states of Kelantan, Sarawak and Sabah (that had the lowest rates in the 2000 census) reached 92.1%, 89.3%, and 93.4%, respectively. Literacy rates have also increased in the rural areas of the three states, Sarawak, which had the lowest rate in 2000 improved from 72.1% to 82.1% in 2010. This suggests that the government's effort to increase primary school education access for young citizens has been fruitful (UNESCO 2014). The table below shows that literacy rates for those aged ten and above have increased, with 96% in 2016 and 96.3% in 2017 and 2018. Literacy rates among adults aged 15 years and above also have increased, with 95.6% in 2016 and 95.9% in 2017 and 2018. A gender breakdown determined that males had higher literacy rates compared to females in these years. However, literacy rates among youth aged 15 to 24 years old are declining slightly from 99.3% to 99.1%, with females having higher literacy rates than males in 2016, 2017 and 2018 (MOE 2019).

Table 33: Literacy rates for children aged ten and above in Malaysia, 2016-2018

	2016			2017			2018		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
Literacy Rate, Age 10+ (%)	97.50	94.60	96.0	97.79	94.80	96.30	97.60	94.90	96.30
Literacy Rate Adult (Age 15+) (%)	97.20	94.00	95.60	97.50	94.20	95.90	97.40	94.40	95.90
Literacy Rate, Youth (Age 15-24) (%)	99.20	99.40	99.30	99.00	99.20	99.10	99.00	99.30	99.10

Note:

1. Definition of literacy: has received formal education
2. Population figures are derived from the Labour Force Survey and exclude non-Malaysian citizens

Sources: Department of Statistics Malaysia

Overall, in Malaysia, youth literacy has risen from 88% in 1980 to near-universal literacy at 99% today, while adult literacy has increased even more dramatically, from less than 70% to over 92% in the same time frame (UNESCO 2014).

8.1 Health literacy

An individuals' health literacy is defined as 'the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions' (Ratzan and Parker 2000, U.S. Department of Health and Human Services, 2010). The World Health Organization (WHO 2009) defined health literacy as the cognitive and social skills that determine individuals' motivation and ability to gain access to, understand, and use information in ways that promote and maintain good health.

Health literacy is crucial to empower people to improve their health and living conditions. It is vital to achieve the internationally agreed health and development goals and face emerging threats such as the current pandemic, climate change, and non-communicable diseases (WHO 2009). Health literacy is an important predictor of an individual's health outcomes (Tran et al. 2008) and a good predictor of the extent to which families follow standard operating procedures related to health status, like immunization schedules. A high level of health literacy is associated with a high proportion of the population being healthy (Haryati 2020). Low levels of health literacy have a huge impact on the nation, such as increased hospital admissions and readmissions, poor medication adherence, high prevalence of health risk factors, and increased healthcare costs (Dodson et al. 2015). Individuals with low health literacy often display self-deception on the severity of diseases (Chang 2011), have low levels of interaction with care providers, and low treatment expectations (Shone 2009).

Marks and Higgins (2012, Lum 2009) mentioned three core aspects of health literacy in their book entitled 'Health Literacy and School-based Health Education'. They are basic literacy, interactive and participatory literacy, and critical literacy. Functional or basic literacy includes reading, interpreting numbers and instructions, and comprehending health information (Marks and Higgins 2012). Basic literacy is the key to understanding fundamental information about human physiology and the nature of illnesses (Lum 2009, Shone 2009). This is vital to prevent misinformation given by the patients to healthcare providers. Interactive and participatory literacy includes the ability to participate in health discussions and act on the information. Critical literacy includes weighing scientific facts and competing alternatives (Marks and Higgins 2012). These concepts are essential for children to recognize the importance of health literacy in their daily lives

The first nationwide survey on health literacy in Malaysia was the National Health and Morbidity Survey (2015). Here, the level of adequate health literacy among Malaysian adults was only 6.6%. This survey showed a significant difference in inadequate health literacy between the urban population (7.8%) and the rural population (2.3%). The prevalence of adequate health literacy was highest among the Chinese (10.6%), followed by Indians (10.1%), Malays (6.0%), Bumiputras (2.4%) and others (1.8%). The findings from this survey showed that the level of health literacy decreases with increasing age. Single respondents (8.3%) have higher levels of adequate health literacy than married couples or widows (5.8%, 5%). Perak was the state with the highest prevalence of adequate health literacy (19.5%), followed by Putrajaya (16%) and Kedah (12.6%).

A systematic review done in Malaysia on health literacy levels (Abdullah et al. 2019) highlighted past research done on public purchase of unregistered drugs (Zulkifli et al. 2016), knowledge on acetaminophen (Seak et al. 2015), and health literacy of diabetes mellitus patients (Skau et al. 2016). There is a lack of research done on health literacy among children. Previous studies in Malaysia mainly focused on the health literacy level of parents or caregivers regarding oral health (Fabillah et al. 2015, Ismail et al. 2018), mental health issues (Khan et al. 2010, Loo et al. 2012, Mohamad et al. 2012, Abdullah et al. 2019, Siti et al. 2020), and weight issue among adolescents (Eltayeb et al. 2016, Ishak et al. 2019).

Health literacy is linked to education, health services, social, cultural and language factors (Nielsen-Bohlman 2004). An article written by Dr Milton Lum listed a few factors contributing to a lack of health literacy among Malaysians in general (Lum 2009). Cultural differences include different health practices and beliefs and may influence an individual’s choice between allopathic and traditional medicine (Lum 2009), which may impact patients' optimal health outcomes. Gender becomes an issue when there is a dominance of resources and decision-making power among males in the family and society, even though females have a higher level of health literacy than males. This is the case in Malaysia. Ethnicity also matters as different ethnic groups have different lifestyles, diets, and religious regimes that contribute to different health risks (Amarasinghe et al. 2009, Lum 2009). There is a slight difference in health literacy levels among different ethnicities in Malaysia (Malays: 46.7%, Chinese: 22.7% and Indians: 39.1%). One’s socio-economic status and education level (Balan et al. 2016, Borges et al. 2017) may also influence one’s health literacy level (DeWalt et al. 2004, Inkelas et al. 2008). This was reflected in a study among Klang Valley residents, where lower-income households had lower health literacy levels (Siti et al. 2016). In rural areas, poverty and low levels of education can be a barrier for these people to obtain health information (Haryati 2020). Dr Lum also found that technical jargon was a barrier between healthcare professionals and the public (Lum 2009). However, today, most healthcare professionals are trained in medical communication to help narrow the health literacy gap among the public.

A major concern with regards to health literacy is information overload via traditional and new media. Parents, children, youth, teachers, and other segments of society are exposed and have access to plenty of verified and unverified information on health issues via mediums like the internet and social media (Ng 2018). Less advantaged families that lack basic literacy and numeracy skills may find it difficult to access health information via new media (Haryati 2020) and, more importantly, to identify correctly from false health information (Lee 2009). To boost health literacy, individuals should develop health-seeking behaviours, boost communication skills (Shone 2009, Borges et al. 2017) and learn about health preventive measures (Shone 2009) from credible websites (Siti et al. 2016, Nutbeam 2000).

In remote areas like Sabah, geographic locality and low development levels pose constraints to health literacy. For example, a study in four districts of Sabah, Kota Belud, Ranau, Beaufort, and Nabawan, emphasized that television was the only medium available for the community to get health information due to poverty. However, television is not a consistent and entirely accurate source of health information (Haryati 2020). In such cases, face-to-face communication with health authorities should be the main source of credible information. The focus should also be on improving infrastructure facilities and increasing health education programmes in these remote areas (Haryati 2020).

8.2 Health literacy among children

Health literacy is crucial for healthy development and good health-related decision-making among children. Parents, family members, health authorities, and teachers are the key people responsible for delivering correct and helpful health information to children in accessible and proactive ways.

Parents are a big influence on a child's decision-making skills (Bernado 2010). Parents with limited health literacy may not practice health preventive measures at home (Lum 2009, Borges et al. 2017). For example, obesity among children can be prevented with parents showcasing healthy eating habits and adopting an active lifestyle. If parents showcase a sedentary lifestyle and consume unhealthy foods like fast food, this could encourage obesity among their children. Parents need to stimulate a healthy environment at home. Parents can also prevent misinformation from reaching their children, for example, by restricting television advertisements that promote fast food and soft drinks (Marks and Higgins 2012). Siti et al. (2016) found that moderate health literacy among adolescents was possibly due to inadequate health care and health promotion at home.

A problematic family and home environment can also hinder learning processes among children, including health education. A problematic family is one going through a divorce, inadequate childcare, child abuse, domestic violence, and other family conflicts (Dora 2011). Based on a study in Johor, problematic families mostly consist of single-parent families (49.7%), divorced parents (26.6%), family members with juvenile cases (15.4%), and families with wife and child abuse (8.4%). Such situations often breed negligence, stifles communication between family members (Dora 2011), and reduces quality time spent with children, which are all and is unhealthy for child development.

Marginalised children from refugee, migrant, and asylum-seeker families often also suffer from low health literacy. Refugees in Malaysia do not have access to basic services, including free healthcare (Letchamanan 2013). Furthermore, their limited health literacy and the language barrier can harm their health status. They may not seek healthcare as they are not aware of their healthcare options and fear getting caught by the authorities (Chuah et al. 2018). Marginalised children raised in these conditions will suffer huge impacts on their physical, emotional, and social well-being (Sanson and Burke 2020).
Health literacy works together with health education. When this succeeds, it raises awareness of health determinants through interaction, participation, and critical analysis. Schools are ideal places to help children and youth to become health literate (Lee 2009). Malaysia's current health education syllabus consists of 75% on reproductive and social health, 15% on diet and nutrition, and 10% on first aid (Ng 2018). This syllabus is not diversified (Ng 2018), does not promote health (Marks and Higgins 2012), and is not revised based on current health issues (Ng 2018). Furthermore, the topics covered are repetitive from Standard 1 until Form 5 (Ng 2018).

Dr Ng Rui Jie, a medical officer at the National Institute of Health, recommends that students should get exposure beyond the current Health Education syllabus (Ng 2018), particularly on healthcare systems operations, the nature of work of healthcare staff, credible sources of health information (Ng 2018), and the ability to communicate and discuss with peers, teachers, and parents on health-related issues (Marks and Higgins 2012). The rapid development in medical technology and knowledge also means that the health educations syllabus should be updated frequently (Lum 2009). Health literacy skills need to be fostered through such systematic measures to prepare children and youth to navigate the health challenges of modern society (Marks and Higgins 2012).

The dedication and support of teachers in schools are extremely important in enhancing children's interest and understanding of health education. This will help instil positive health behaviours among children, which will reduce gaps between healthcare staff and patients (Ng 2018). Teachers can utilize information mediums like YouTube to gain more knowledge of health and effective teaching skills. Lesson plans that are sequential and action-oriented, using various mediums of instructions, need to be incorporated into the health syllabus to better promote health literacy in the school environment (Lee 2009).

MOH's Strategic Plan 2016-2020 acknowledged the importance of health literacy among schoolchildren. Several programmes were held in collaboration with the MOE to improve health literacy among this cohort. The My BFF@school (My Body is Fit and Fabulous at School) programme contained elements of physical activity, nutrition, and psychology (Unit Perundangn Universiti Malaya 2018). As a result of this programme, there was a measurable improvement in family functioning, physical well-being, emotional improvement, school functioning and friend functioning (Ishak et al. 2019). The Dengue Patrol programme aimed to raise awareness and a sense of responsibility among school children on dengue prevention. It helped to increase community involvement in anti-dengue programmes (Menon 2018). Other programmes include the 'Tunas Doktor Muda' programme in preschools and IMFREE (Tobacco-free programme) at the primary school level (Unit Perancangan Dasar dan Pelan Kesihatan, 2016).

9 Child trafficking and sexual abuse

9.1 Child trafficking

Human trafficking is the third-largest international crime and is an industry worth billions of dollars (ECPAT and The Body Shop 2017). Human trafficking in women and children is a violation of human rights that threatens the world community, especially in transmitted diseases such as HIV/AIDS (SUHAKAM 2004). Trafficking victims often suffer from low self-esteem, mental problems, and low social functioning. In Malaysia, women and children are trafficked to Singapore, Hong Kong, Taiwan, Japan, Canada, the USA, Europe, and Australia for sexual trade. In contrast, women and children in Cambodia, China, Cambodia, Ecuador, India, Indonesia, Laos, Myanmar, Philippines, Russia, Thailand, Uzbekistan, and Vietnam are trafficked into Malaysia (The Protection Project, 2008, ECPAT Factsheet). Trafficking routes into and from Malaysia to other countries are illustrated in Figure 47.

Trafficked children often find themselves in dire conditions such as armed conflict, begging rackets, child laundering, illegal adoption (WAO 2017), the organ trade, drug peddling and camel jockeying (SUKAHAM 2004). It is estimated that around 1.2 million children are trafficked worldwide for sexual exploitation or cheap labour. Trafficked children often suffer from malnutrition, teething problems, stunted growth, reproductive issues, sexually transmitted infections, and other physical problems such as delays in cognitive development, affecting future education and career opportunities (WAO 2017). Joint efforts by legislators, law enforcement agencies, and regional and national NGOs are needed to break the networks involved in child trafficking (SUHAKAM 2004).

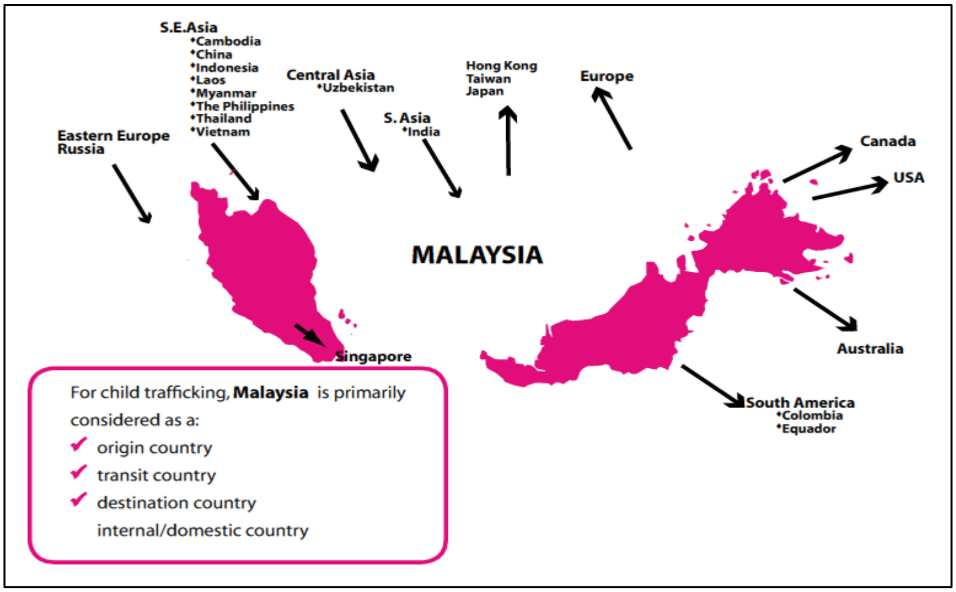

Figure 47: Women and children trafficked into Malaysia and to other countries. Source: ECPAT and The Body Shop, Factsheet Malaysia 2017

9.2 Child prostitution

Child trafficking is a major component of the sex trade. Greenbaum (2018) defines child sex trafficking as a child less than 18 years old engaging in any sexual activity that involves the exchange of something of perceived value such as money, food, and shelter. Children are often exploited because they are uneducated, easy to overpower, and easy to convince (ECPAT and The Body Shop, Factsheet Malaysia 2017). Children involved in prostitution may suffer worse effects than adults involved in prostitution, as this experience often impairs and damages the child's development (Lukman 2009a). Children that run away from home are especially vulnerable to child prostitution. In most cases, these runaways have histories of child abuse or sexual abuse by family members before leaving home (Lukman 2009b).

Children in Malaysia who become victims of sex trafficking have been found in neighbouring countries such as Thailand and Indonesia. The high number of missing children in Malaysia may be related to this phenomenon: almost 8,000 children were reported missing from 2012 to 2014 (WAO 2017). The sex tourist map of Southeast Asia includes Malaysia, which suggests that child prostitution is a tourism strategy (Hong 1985, Lukman 2009a). While child prostitution is amoral, it is also illegal in Malaysia. However, this problem has grown alongside the national economy hidden from the public eye (Lukman 2009a).

9.3 Child sexual abuse

Child sexual abuse includes child pornography, genital manipulations, and sexual intercourse (Kassim and Kasim 1995). As reported by Broaddus-Shea et al. (2019), about 18% of girls and nearly 8% of boys experience sexual abuse, including sexual assault or rape during childhood. Among the 101 cases investigated under the Suspected Child Abuse and Neglect (SCAN) Team of the Kuala Lumpur General Hospital, around 40% of the children were between five- to nine-year-old. Factors leading to sexual abuse included the absence of another adult at home, family unemployment, and a history of drug abuse in the family (Kassim et al. 1994). Unemployed male adults with a history of drug abuse living in unprotected housing conditions pose a danger for female children (Kassim et al. 1995). Communities and societies need to empathise with abuse victims and provide protection to these children.

10 Children and psychology

More and more children are affected by psychological problems, otherwise known as emotional and behavioural problems. Studies have shown that many of the children affected are not referred to mental health specialists (Rodriguez-Hernandez P 2012). Psychological problems vary from simple issues like problems adjusting to stress, tantrums, separation anxiety, lying, and stealing to more definitive problems such as depressive disorders, conduct disorders, attention deficit hyperactivity problems (ADHD), autism spectrum disorders (ASD), and others. Mental health disorders are also sometimes associated with medical conditions such as asthma, dermatitis, diabetes, and obesity. If left untreated, these disorders will cause severe disabilities when these children grow into adulthood (Hofstra 2000). Children with psychosocial problems often perform poorly in academics, occupational, and social functioning, including future relationships. Psychological problems among children can also have significant negative effects on the family and community.

The prevalence of psychological problems varies between different cultures, ethnicities, and countries. Prevalence can vary between 5% to 50% among different countries, depending on the child's living conditions (Nikapota 1991). For example, prevalence is lower in high socio-economic countries than children living as refugees or in countries ravaged by war. Differences in defining psychological problems, however, add to the difficulty in quantifying their prevalence.

Studies have confirmed that early detection and intervention are extremely important to prevent the deterioration of individual disorders. This indicates that early detection of risk factors is important (Costello 2016). Risk factors can include genetic factors, living in poverty, poor parental education, parental exposure to substance abuse, being raised by single parents, poor parenting, abuse and neglect, parental mental health or criminality, crowded neighbourhoods, social isolation, and peer pressure. Recent studies have also shown that residential proximity to industrial activity (Downey 2005) and exposure to environmental pollutants such as toxic air, lead, and pesticides may harm children’s development. Mental health specialists need to be aware of these risk factors (Jordan 2017). Mental health facilities need to be improved in coordination with other specialities such as paediatrics, child psychology, public health, and primary care specialists (Ogundele

2018). Early alleviation of such adversities can help ensure the normal development of children.

11 COVID-19 and children

COVID-19 has rattled our world, with devastating impacts on children and families across the globe. From job loss to supply shortages, parents and children have been faced with new and evolving sources of stress. Parents are concerned about not only the physical health of children and protecting them from the virus but their emotional and mental health as well. Children were quickly removed from their schools and daycares to reduce their risk and transmission, and later, parents were faced with the difficult decision to have them return or not. Childcare support became unstable, and the previous routines and structures were no longer attainable. As parents engage in the balancing act of working from home while ensuring children participate in their education, they also worry about providing children with stimulation and activity while maintaining safety.

Many children are not directly affected by Covid-19 illness or death. International data indicate that the number of children who are symptomatic, test positive for, or die from the virus is very small compared to older age groups (Our World in Data 2020). They are, however, hit the hardest by the psychosocial impact of this pandemic. All children of all ages and in all countries are being affected, particularly by the socio-economic impacts and, in some cases, by mitigation measures that may inadvertently do more harm than good. Moreover, the harmful effects of this pandemic will not be distributed equally. They are expected to be most damaging for children in the poorest countries, the poorest neighbourhoods, and those in already disadvantaged or vulnerable situations.

As the global economy plunges into a recession, families lose their sources of income due to COVID-19. This causes more households to fall into poverty. For the poorest families, including those who do not have access to any aid, the situation is dire. The global socio-economic crisis caused by the pandemic could push 142 million more children into poor households in developing countries by the end of the year, according to projections as of November 2020. The total number of children living in poor households globally could reach just over 725 million without any mitigating policies. Nearly two-thirds of these children live in sub-Saharan Africa and South Asia. In Malaysia, 400,000 households live below the poverty line (household income of RM2,280). This is approximately 1.2 million children in Malaysia (Merdeka Centre 2020).

In the long run, the results of this pandemic on the education of today's young generation are potentially crippling. 188 countries imposed countrywide school closures during the pandemic, affecting more than 1.6 billion children and youth. Even before the pandemic, children's learning was in crisis. The pandemic has only accentuated these inequities, hitting schoolchildren in poorer countries particularly hard. Globally, many schools lack the resources to invest in digital learning, and many children from poorer households do not have internet access. At least a third of the world's schoolchildren – 463 million children globally – could not access remote learning when COVID-19 shuttered their schools. Moreover, the actual number of students who cannot be reached is likely significantly higher than this estimate.

In many situations, despite remote learning policies and the necessary technology at home, children may be unable to learn due to skill gaps among their teachers or lack of parental support. Short disruptions in children's schooling can have long-lasting negative impacts due to factors including the lack of structured programmes for catching up. In the past, school closures have led to increased child marriage and child labour which often prevent children from continuing their education (UNICEF 2020). In Malaysia, based on a survey done from March to April 2020, the education ministry has reported that 37% did not possess any digital device, and only 15% of students have personal computers. This digital divide outlines the disparity and unequal home environments for learning during school closure.

While children appear to be largely spared the direct mortality impacts of COVID-19, the indirect effects of strained health systems and disruptions to life-saving health services such as immunization and antenatal care can result in devastating increases in child deaths. The pandemic threatens to reverse decades of progress made around the world toward eliminating preventable child deaths. According to a study covering 118 low- and middle-income countries by the Johns Hopkins Bloomberg School of Public Health, an additional 2 million under-five deaths could occur in just twelve months due to reductions in routine health service coverage levels and an increase in child wasting (acute malnutrition). COVID-19 is also likely to increase the number of stillbirths. Nearly 200,000 additional stillbirths could occur in 12 months as women are less likely or able to access health services. This senseless loss of life can often be prevented with quality antenatal and delivery care. However, even before the pandemic hit, few women received the necessary care to prevent stillbirths (UNICEF 2020).

Lockdowns measures can expose children to a range of risks. Several factors related to confinement measures are likely to result in heightened tensions in the household, added stressors placed on caregivers, economic uncertainty, job loss or disruption to livelihoods, and social isolation. Children are vulnerable and at an increased risk of abuse during school closures (Cluver et al. 2020). These are well-known risk factors for violence at home. Moreover, as the risk of violence against children has increased due to the COVID-19 pandemic, child protection services have been weakened due, in part, to measures implemented to control the spread of the virus. 1.8 billion children live in the 104 countries where violence prevention and response services have been disrupted due to COVID-19. The COVID-19 crisis could also lead to the first rise in child labour after 20 years of progress. Child labour has decreased by 94 million since 2000, but that gain is now at risk.

Among other impacts, COVID-19 could increase poverty and, therefore, increase child labour as households use all available means to survive.

12 References

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APPENDIX 3 DESK STUDIES

3.1 Desk study 1: Simulating the downscaling of a general climatic model to a regional climatic model for specific health sector climate indices

3.1.1 Method

The analysis focuses on two locations, i.e. Kuala Lumpur and Pulau Gaya. The closest available meteorological station for Pulau Gaya is the Kota Kinabalu Airport station, about 5km away from the study area. For Kuala Lumpur, the data from the meteorological station at Subang Airport is used. The Malaysian Meteorological Department maintains both stations. The data is sent to the World Meteorological Organization's (WMO's) Global Telecommunication System (GTS) and made available from the NOAA's National Climatic Data Center (NCDC) website at https://data.noaa.gov/dataset/dataset/global-surface-summary-of-the-day-gsod as the global surface summary of the day data sets (GSOD). The data is available in daily resolution. There are several variables available. In the current study, the variables obtained and used include the maximum temperature (TX), minimum (TN) and precipitation (PREC). For the Kota Kinabalu Airport station, the data is available from 1976 to 2019, spanning 44 years, whilst data from Subang Airport station starts in 1997.

For future climate prediction, a subset GCMs-RCMs combination from the CORDEX-SEA downscaling experiments was used. These include the RCA4 regional climate model driven by two GCMs, namely CNRM-CM5 and HadGEM2-ES. The CNRM-CM5 is a global earth system model developed by the National Centre for Meteorological Research, France, whilst HadGEM2-ES was developed by the Hadley Center, U.K. Meteorological Office. Both these GCMs participated in the 5th Phase of Couple Models Inter-Comparison Project (CMIP5) and contributed to the massive GCMs ensemble used in the IPCC's 5th Assessment Report. The only regional climate model used here was the RCA4 (Rossby Centre Regional Atmospheric Model version 4), developed by the Swedish Meteorological and Hydrological Institute (SMHI) (Strandberg et al. 2015).

The complete experiment design of CORDEX-SEA can be found in Tangang et al. (2018). Two Representative Concentration Pathways (RCP) scenarios, i.e. RCP4.5 and RCP8.5, were considered in this study. The RCPs represent the greenhouse gas concentration pathways throughout the 21st century, related to different radiative forcing stabilization levels by 2100 (Moss 2010). RCP4.5 corresponds to a stabilization scenario without overshooting pathways to 4.5 W m^{-2}, while RCP8.5 characterizes a rising pathway leading to 8.5 W m^{-2} by the end of the 21st century. The CORDEX-SEA data is made available from the Earth System Grid Federation (ESGF) at https://cordex.org/data-access/esgf/.

Future changes of key indices relevant to health sectors are examined based on the CNRM_CM5/RCA4 and HadGEM2-ES/RCA4 simulations output of the CORDEX-SEA experiments. In the current study, we focused on extreme rainfall or drought and heat-related indices. These health sector-specific indices are depicted in Table 3.1 and identified by the Expert Team on Sector-Specific Climate Indices (ET-SCI). The software package 'Climpact' (https://climpact-sci.org/) (Alexander and Herold, 2016) was used to compute the climate extreme indices. These selected indices are considered as proxies of the relevant hazards associated with climate extremes relevant to public health sectors and were computed from the CORDEX-SEA simulated daily meteorological variables, namely,

- maximum near-surface air temperature,
- minimum near-surface air temperature and
- precipitation of the grids (25kmx25km) that contain the Kota Kinabalu Airport Station.

The changes to these indices in the future were calculated as the differences between the future values and the historical reference values from the regional climate model's output (Table 2).

3.1.2 Results

a. Kota Kinabalu International Airport

Based on the heat wave definition as per Table 2, heat wave events were not recorded until the early 2000s. The hottest and longest event recorded was in 2016, where an extremely high-temperature period extended over about ten days. This was in conjunction with the strongest El Niño event extending from 2015 to 2016 (Santosa et al. 2017). In 2016, much of the Southeast Asia Maritime region experienced record-breaking extreme heat events. Thirumalai et al. (2017) has estimated that although the 2015-2016 El Niño event contributed to ~49% of warming during this period, anthropogenic global warming has contributed 29%. Therefore, global warming greatly increases the likelihood of record-breaking extreme heat events during El Niño over time. El Niño events have been associated with various disease outbreaks worldwide (Anyamba et al. 2019). As a corollary, the increased likelihood of extreme heat events under a future warmer climate is also expected to increase the disease burden. Nevertheless, the proper quantification of such a relationship is challenging.

We next examined future changes in heat wave and rain spells characteristics based on the CNRM_CM5/RCA4 and HadGEM2-ES/RCA4 simulations output of the CORDEX-SEA archive. Future periods were divided into three 30-years epochs. The early 21st century spans from 2011-2040, mid-21st century from 2041-2070 and late 21st century from 2071-

2100. The changes are expressed as future values relative to the simulated historical value. Figure 5 shows the projected changes in heat wave number for the three different epochs. The ranges of the bars are projected ranges of the changes. The heat wave number is projected to increase drastically in the future, suggesting an increased risk posed to extreme health-related public health sectors. The likelihood of heat wave occurrences is projected to be 3-7 times higher compared to the historical period. Nevertheless, it is noted that the increment of heat wave occurrences is less sensitive to emission scenarios. Both RCP4.5 and RCP8.5 project very similar future changes of heat wave occurrences. However, the changes in heat wave duration and magnitude are highly dependent on emission scenarios.

Figure 48 show the relative changes in heat wave duration and magnitude over the study areas, respectively. A higher emission scenario, i.e. RCP8.5, is expected to double the heat wave length compared to the RCP4.5 towards the end of the 21st century. Note that during the early 21st century, the differences between the two representative concentration pathways were not apparent. Similarly, heat wave magnitude also shows a significant difference between the two emission scenarios, particularly towards the end of the 21st century (Figure 48-right). However, the models tend to have larger discrepancies in projected magnitude, where changes in magnitude can be 1-1.8°C more than the historical period. Projections of future heat waves are generally consistent with the elevated heat in the climate system and increasing surface temperature.

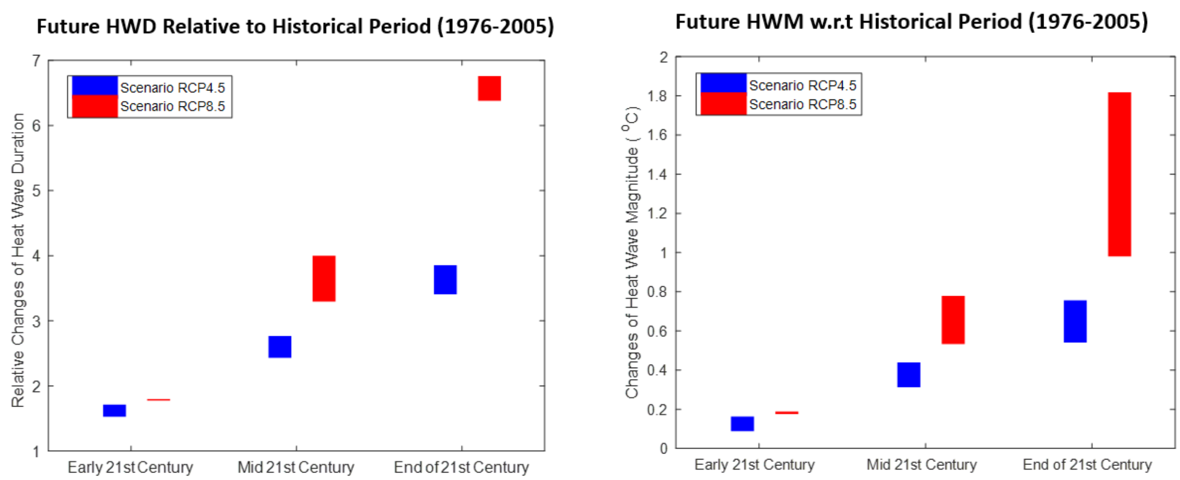

Figure 48: Heat wave duration and magnitude

Compared to future temperature projections, rainfall projections have larger uncertainties and can be noisy. Figure 6 shows the projected changes of consecutive dry days (dry spells) and consecutive wet days (wet spells) in the three future epochs considered. It is noted that only the dry spells length shows a reduction in the future period. By the end of the 21st century, the dry spell length is expected to reduce to 80-90% of the historical period. However, the change of this quantity is not remarkably clear during the early 21st century. Also, note that the separation of the dry spell length change signal is not clear for both the low and high emission scenarios, although both the RCP4.5 and RCP8.5 projected decreasing signals.

On the other hand, projected changes of wet spell length are rather noisy and uncertain. Only under the high emission case, i.e. RCP8.5, the projection estimated an increment of 10-20% in wet spell length. For RCP4.5, projections have very large uncertainties, especially toward the end of the 21st century when the projections show contradictory climate change signals. Rainfall can respond non-linearly to different strengths of radiative forcing and, therefore, may be dominated by large uncertainties. Overall, the increasing wet spell length in RCP8.5 suggests a likelihood that wet spells will continue to lengthen into the future if the future earth is tracking the worst-case scenario Figure 6.

b. Subang Airport

Figure 49, Figure 50 and Figure 7 show the projected changes in heat wave number, duration, and magnitude, respectively, for the three different epochs. Like Kota Kinabalu, the heat wave number here is projected to increase dramatically in the future, indicating an increased risk of extreme heating issues in temperature-sensitive socio-economic sectors. The likelihood of heat wave occurrence is projected to be 3-6 times higher than the historical period of 1976-2005. The increment of heat wave occurrence is less sensitive to the emission scenarios. Nevertheless, heat wave duration and magnitude changes are sensitive to the emission scenarios considered in the projection and dependable on world socio-economic development. A higher emission scenario, i.e. RCP8.5, is expected to lengthen the heat wave duration by double compared to the RCP4.5 toward the end of the 21st century. Similarly, the heat wave magnitude also shows a remarkable difference between the two emission scenarios, particularly toward the end of the 21st century (Figure 7). The projection of future heat waves is generally consistent with the elevated heat in the climate system and increasing surface temperature.

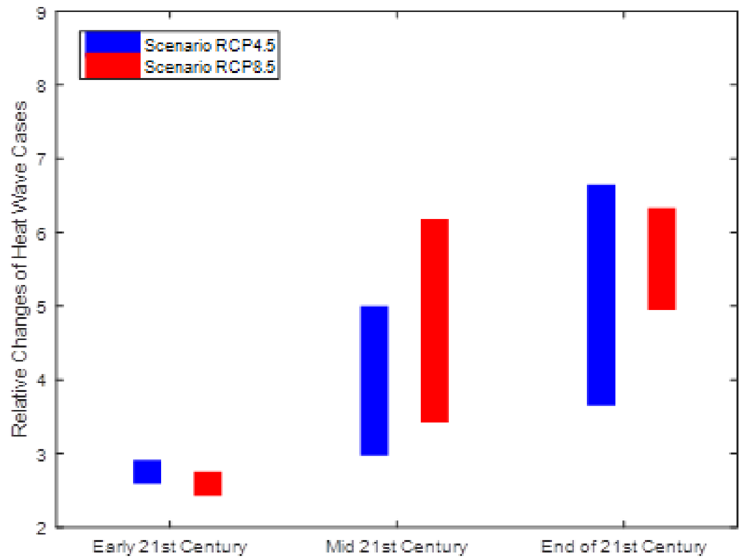

Figure 49: The relative changes of future heat wave number at Subang for the early 21st century, mid-21st century, and end of 21st century for RCP4.5 and RCP8.5 downscaled projections. Refer to text for the definition of future time epochs

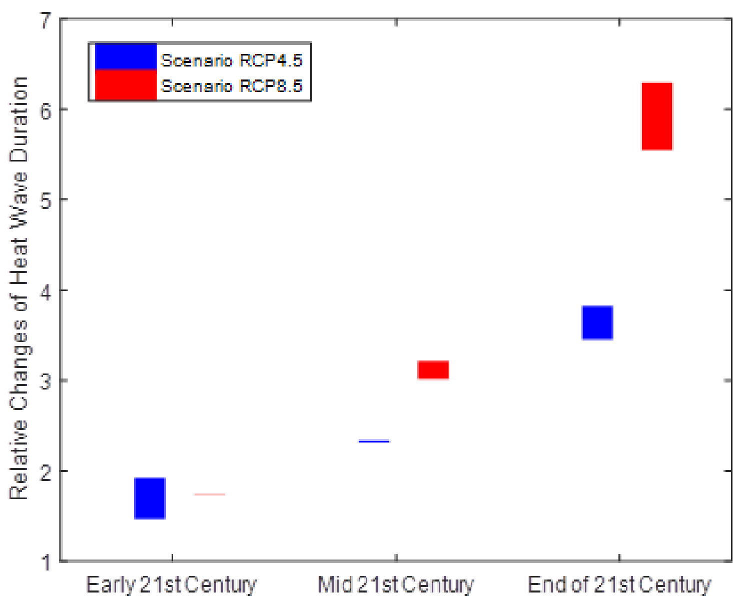

Figure 50: The relative changes of future heat wave duration at Subang for the early 21st century, mid-21st century, and end of 21st century for RCP4.5 and RCP8.5 downscaled projections

3.1.3 Conclusions

The changes of health-related climatic indices, i.e. wet and dry spells length, heat wave occurrence, duration, and magnitude, were analysed at two study locations – Kota Kinabalu and Subang. The observational data were obtained from the Malaysian Meteorological Department-maintained meteorological stations located close to or in the vicinity of the study areas. It is evidenced that:

1. Heat waves have become more frequent after the 2000s. Changes can be observed in terms of heat wave numbers, duration, as well as magnitude. The historical observation also signifies lengthened wet spells and shortened dry spells.
2. The downscaled projection of the future climate based on a subset of CORDEX-SEA simulations output has suggested the high likelihood of a continual increment of heat waves in terms of number, duration, and magnitude.
3. Heat wave occurrence frequency appears less sensitive to greenhouse concentration pathways, but its duration and magnitude showed considerable dependence on greenhouse concentration pathways. Both duration and magnitude appear more severe in the higher emission scenarios.
4. Rain spells are projected to become longer under the higher emission scenario, while future conditions remain uncertain under the lower emission scenario (RCP4.5). The dry spell length is projected to become shorter under both RCP4.5 and RCP8.5 scenarios.

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3.2 Desk Study 2: The effect of ambient air pollution on childhood respiratory diseases in Asia's low- and middle-income countries (LMIC): A systematic review

3.2.1 Main health outcomes of the selected studies

Table 34: Main health outcomes of the selected studies

Authors and year	City/ Country	Country income group	Study period	Main findings
Abdul Rahman et al. (2017)	Klang Valley, Malaysia	UM	2006-2010	PM_{10} contributes to a high risk of acute bronchiolitis
Alizadeh et al. (2016)	Tehran, Iran	UM	2009-2011	There was a significant correlation between NO_2 and SO_2 and admission due to asthma in children.
Asa and Jinsart (2016)	Rayong, Thailand	UM	2011-2014	Symptoms among children within 1km from the industrial were significantly higher compared with those who live within 10km from the industrial area
Bai et al. (2018)	Hefel, China	UM	2015-2016	NO_2, $PM_{2.5}$ and CO were significantly associated with increased hospital visits for acute childhood bronchitis
Çapraz et al. (2017)	Istanbul, Turkey	UM	2013-2015	Hospital admissions for respiratory diseases are associated with a 10mg/m^3 increase in $PM_{2.5}$ and NO_2
Chen et al. (2016)	Shanghai, China	UM	2007-2011	Each 10µg/m^3 increase in O_3 and PM_{10} was associated with increased outpatient visits for allergic rhinitis.
Dastoorpoor et al. (2018)	Ahvaz, Iran	UM	2008-2015	Exposure to O_3, PM_{10}, and NO_2 increased the risk of respiratory mortality in Ahvaz, Iran
Deng et al. (2018)	Changsha, China	UM	2011-2012	Each 10µg/m^3 increase in PM_{10}, $PM_{2.5}$, SO_2, $NO_{2,}$ and CO were associated with increased hospital visits for asthma
Ding et al. (2017)	Chongqing, China	UM	2013	SO_2 was significantly associated with persistent cough symptoms, and NO_2 was significantly associated with current wheezing symptoms
Enkh-Undraa et al. (2019)	Ulaanbaatar, Mongolia	LM	2015-2016	$PM_{2.5}$ was associated with ILI risk among school children
Feng et al. (2016)	Beijing, China	UM	2008-2014	PM_{10} showed adverse effects on asthma in children

Authors and year	City/ Country	Country income group	Study period	Main findings
Ge et al. (2018)	Guangzhou, China	UM	2012-2015	Each 10μg/m^3 increased in O_3 and PM_{10} were associated with increased outpatient visits for allergic rhinitis
Ismail et al. (2019)	Kajang and Hulu Langat, Malaysia	UM	2018	$PM_{2.5}$ and PM_{10} were significantly associated with cough and wheezing. However, there was no significant association between CO, NO_2 and SO_2 with respiratory health symptoms
Jiang et al. (2018)	Changsha, China	UM	2011-2012	Childhood pneumonia was associated with postnatal exposure to outdoor PM_{10}
Li et al. (2018)	Ningbo, China	UM	2014-2015	Each 10-μg/m^3 increase in $PM_{2.5}$, PM_{10}, NO_2, and SO_2 were associated with the increase of hospital visits for pneumonia in children
Li et al. (2018a)	Hefei, China	UM	2014-2015	Every 10mg/m^3 increase in PM_{10}, $PM_{2.5}$, SO_2, NO_2 and CO concentration were associated with an increase in URTI
Liu et al. (2016)	Shanghai, China	UM	2011-2012	Exposure to NO_2 (increment of 10 μg/m^3) during the first year of life was significantly associated with asthma and allergic rhinitis
Ma et al. (2018)	China	UM	2009-2012	Each 10μg/m^3 increment in NO_2 concentration was significant with a 2.04% increased hospital emergency admissions for respiratory diseases.
Ma et al. (2019)	China	UM	2009-2010	Exposure to $PM_{2.5}$ was associated with increased hospital visits for asthma was for children under eight years old
Nakhlé et al. (2015)	Lebanon	UM	2012	Respiratory admissions among children were associated with $PM_{2.5}$ and PM_{10} concentrations
Nhung et al. (2018)	Vietnam	LM	2007-2014	Increments of an interquartile range (21.9 μg/m^3) in the 7-day-average level of NO_2 were associated with a 6.1% increase in pneumonia hospitalizations
Nhung et al. (2019)	Vietnam	LM	2007-2016	An IQR increase in O_3 concentrations (85.8 mg/m^3) was associated with a 5% decrease in the odds of discharge from hospital among children with ALRI
Norbäck et al. (2018)	China	UM	2010-2012	NO_2 was associated with asthma and rhinitis. Meanwhile, PM_{10} was significantly associated with nocturnal cough

Authors and year	City/ Country	Country income group	Study period	Main findings
Norbäck et al. (2019)	China	UM	2010-2012	NO_2 was associated with asthma, rhinitis and current wheeze
Norbäck et al. (2019a)	China	UM	2005-2012	NO_2 and PM_{10} were associated with decreased remission of wheeze and rhinitis. Exposure to $PM_{2.5}$ was associated with a higher prevalence of wheeze
Qiu et al. (2018)	China	UM	2015-2016	An increase of 10µg/m^3 in PM_{10} was associated with an increase in total respiratory admissions among children (≤14 years)
Shan et al. (2016)	China	UM	2014	Children visits with wheezing increased from 0 to nearly 20 % with every interquartile increase of $PM_{2.5.}$
Song et al. (2018)	China	UM	2013-2015	Each 10µg/m^3 increase of NO_2, $PM_{2.5}$, and SO_2 corresponded to an increase of 0.66%, 0.13% and 0.33% in daily hospital outpatient visits for children with respiratory diseases, respectively.
Xia and Yao (2019)	China	UM	2014	A 10-µg/m^3 increase in $PM_{2.5}$ was associated with a 4.3% increase in acute lower respiratory infection.
Zhang et al. (2019)	China	UM	2015-2016	NO_2 was significantly associated with cumulative effects of asthma in single- and multi-pollutant model
Zheng et al. (2017)	China	UM	2014-2015	PM_{10}, $PM_{2.5}$, SO_2, and NO_2 were associated with hospital visits for acute upper respiratory infections
Zhu et al. (2019)	China	UM	2016-2018	PM_{10}, NO_2, and SO_2 raised uncontrolled-asthma rate

Abbreviations: CI=confidence interval, CO=carbon monoxide, ER=excess risk, ERR=excess relative risk, NO_2=nitrogen dioxide, O_3=ozone OR=odds ratio, PM_1=particulate matter 1, PM_{10}=particulate matter 10, $PM_{2.5}$=particulate matter 2.5, RR=relative risk, SO=sulfur dioxide, VOC=Volatile organic compound

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3.3 Desk Study 3: Air pollution and respiratory diseases among children in Malaysian cities

Air pollution is a major environmental health concern, posing a serious threat to the population. Children are especially vulnerable to poor air quality because their lungs are still developing, and early exposure to air pollutants can easily alter lung development and function. Few studies on air pollution have been published in Malaysia. Some have linked air pollution to poor population health in urban areas based on respiratory mortality and hospital admission data. However, evidence for a specific association between air pollution and childhood respiratory diseases is limited. Previous epidemiological studies frequently looked at the overall impact of air pollution on respiratory diseases across all populations. It is unknown whether the air pollutants are linked to an increased risk of childhood respiratory diseases. Furthermore, the association's possible modifiers such as age and gender are unknown.

From December 2019 to April 2021, the United Nations Children's Fund (UNICEF) Malaysia, in collaboration with Universiti Kebangsaan Malaysia and Universiti Malaysia Sabah, conducted a project titled 'Analysis of the impacts of climate change and environmental degradation on children in Malaysia, and assessment of the child-sensitivity of current adaptation and mitigation policies.' This project included several studies, one of which aimed to quantify the risk of respiratory diseases among Children in Malaysia due to ambient air pollution.

This study found that:

- Short-term exposure to ambient air pollution increases the risk of respiratory disease up to eight days (seven days lag) after the exposure.
- In Klang Valley, SO_2 and O_3 were significantly associated with increased total admissions for respiratory diseases. The greatest single-lag effect estimation for SO2 was observed at lag 3 with ER 3.33 (95% CI 1.10-5.60), and for O3, the highest ER were observed at lag 2 with ER 0.32 (95% CI 0.05-0.59). The highest ERs for cumulative-lag effect was observed at lags 0–5 with ERs 5.41 (95% CI 2.13-8.79) and lags 0-4 with ERs 0.59 (95% CI 0.14-1.04) for SO_2 and O_3, respectively.
- In Kuching, only PM_{10} was significantly associated with an increase in total respiratory hospital admissions among children. However, all pollutant except O_3 was found to be significantly associated with an increase in respiratory hospital admissions among children aged 5 to 9 years old in Kuching
- Young school-age children (five to nine years) are at a higher risk of developing respiratory diseases due to air pollution than other age groups.
- There was little difference between boys and girls in developing the risk of hospitalisation for respiratory illnesses related to air pollution.

These findings are helpful in the process of making informed decisions for environmental and public health policy improvement.

3.3.1 Introduction

Air pollution, climate change and health effect

The primary focus of air pollution research has been on the effects on human and ecosystem health. Climate change research has concentrated mainly on the impact on the physical climate system, such as temperature, weather, glaciers, and sea-level rise, among other things. Although they appear to be two distinct issues, climate change and air pollution are inextricably linked: both air pollution and climate change have significant negative effects on people's and the environment's health.

The primary sources of air pollution and climate change are the same: the combustion of fossil fuels and solid biomass, including forests and agricultural emissions. Pollutants in the atmosphere also have a significant impact on climate change. Similarly, weather extremes caused by climate change has a substantial effect on health. Furthermore, air pollution and climate change interact with one another in the atmosphere through complex interactions. Increasing levels of greenhouse gases change the energy balance between the atmosphere and the Earth's surface, which can cause temperature changes that alter the atmosphere's chemical composition. As a result, climate change and air pollution management have implications for one another Figure 51.

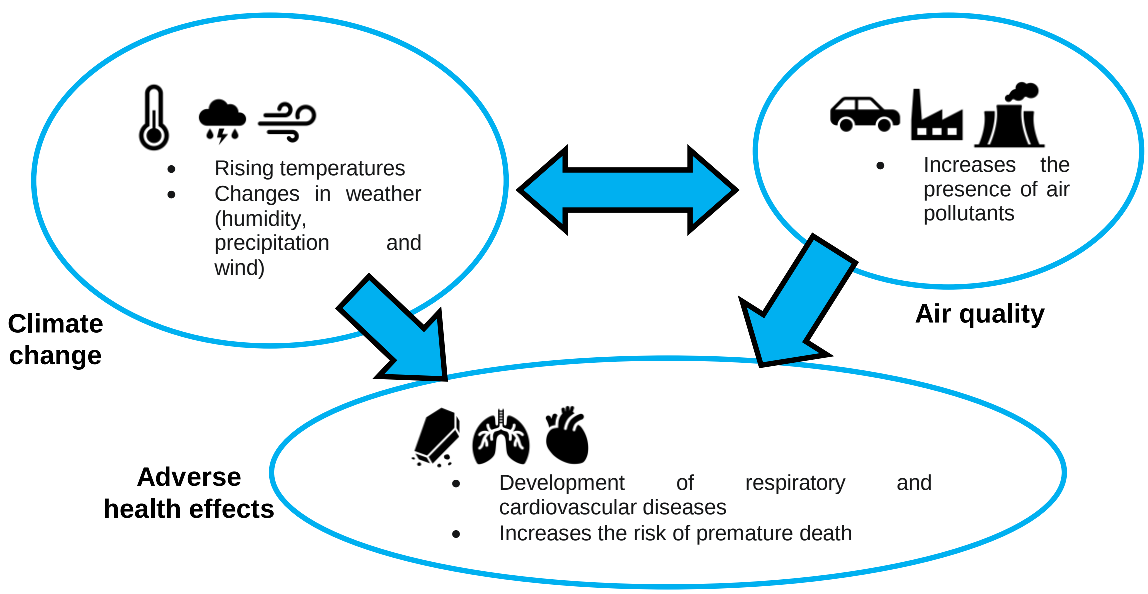

Figure 51: Interaction between climate change, air pollution and health effects

Air pollution and health effects in Malaysia

Air pollution continues to be an issue worldwide, posing a serious threat to the population. Children are especially susceptible to poor air quality because their lungs are still developing, and early exposure to air pollutants can easily alter lung development and function (Stocks et al. 2013). This problem is more severe among children living in low- and middle-income countries due to the lack of resources for maintaining good air quality (Pinder et al. 2019) and the pressure to grow the economy.

It is known that air pollution can increase morbidity and mortality of respiratory diseases, such as chronic obstructive pulmonary disease, asthma, and others. In Malaysia, few studies have been published about air pollution. Some of them linked air pollution to adverse population health in urban areas based on respiratory mortality and hospital admission data. Wan Mahiyuddin et al. (2013) first used time-series analysis to discover the association between air pollution and respiratory mortality in Klang Valley. The findings indicate that high levels of particulate matter less than 10μm (PM_{10}), carbon monoxide (CO), nitrogen dioxide (NO_2), and Ozone (O_3) were significantly associated with respiratory mortality in Klang Valley in 2000-2006. In a similar study undertaken in Kuala Lumpur (Tajudin et al. 2019), significant associations between air pollution and respiratory hospitalizations were observed for carbon monoxide (CO), NO_2 and sulphur dioxide (SO_2). However, evidence for the specific association between air pollution and childhood respiratory is limited. Previous epidemiological studies often explored the total effect of air pollution on respiratory diseases in all populations. It is uncertain whether the air pollutants are associated with elevated risks of childhood respiratory diseases. Furthermore, the possible modifiers in the association are unknown.

3.3.2 Objectives

Main objective

To quantify the risk of respiratory diseases among children attributed to ambient air pollution in Malaysia from 1st January 2010 to 31st December 2018.

Specific objectives

1. To identify the daily trends of respiratory hospital admissions among children and air pollution in Malaysia from 1st January 2010 to 31st December 2018.
2. To determine the relationship of air pollutants (PM_{10}, CO, NO_2, SO_2, O_3), meteorological parameters (humidity, temperature) with respiratory hospital admissions.
3. To estimate the risk of ambient air pollution on hospital admissions for respiratory diseases among children in Malaysia.

Scope

This study will focus only on several variables that contribute to ambient air pollutions. This includes five main parameters of ambient air pollutants: PM_{10}, NO_2, SO_2, CO and O_3, and two metrological parameters: temperature and relative humidity. For the health outcomes attributed to ambient air pollution, this study will only examine hospital admissions for respiratory diseases among children below 18 years old from several public hospitals in Klang Valley and Sarawak from 2010 to 2018. This study applied a time-series model to estimate the excess risk (ER) of respiratory hospital admissions among children attributed to ambient air pollution.

3.3.3 Material and methods

Study areas

Klang Valley is a Malaysian urban area centred on Kuala Lumpur and encompassing cities and towns in the states of Selangor and Putrajaya. With a population of around 8 million people, Klang Valley is Malaysia's industrial and commercial heartland. In comparison, Kuching is the capital and most populous city of Sarawak, a state in East Malaysia. The city is located at the southwest tip of Borneo and has a population of approximately 325,132 people. Figure 52 shows the location of Klang Valley and Kuching.

Figure 52: Location of the study area for Desk Study 3

Malaysia has an equatorial climate, with hot and humid weather throughout the year due to its proximity to the equator. The average annual rainfall is 250 centimetres, and the average temperature is 27 °C. Malaysia is vulnerable to the El Niño phenomenon, which reduces rainfall during the dry season. Malaysia experiences two monsoon seasons: the Southwest Monsoon from late May to September and the Northeast Monsoon from October to March. The Northeast Monsoon, which originates in China and the north Pacific, brings in more rain than the Southwest Monsoon. The southwest monsoon originates in Australia's deserts. The transitional months between the two monsoons are March and October.

Climate change is expected to significantly impact Malaysia, increasing sea levels and rainfall, the risk of flooding, and severe droughts. The major contributors to poor air quality have been identified as transboundary haze, vehicle exhaustion, manufacturing activities, and biomass burning (Awang et al. 2000, Latif et al. 2021).

Study population

This study included children under the age of 18 who lived in Klang Valley and Kuching. Due to privacy concerns, the children's home addresses were not made public. As a result, it is assumed in this study that sick children were transported from their homes to the nearest hospital.

Eligible criteria

Inclusion criteria

1. Admissions to government hospitals located within a 50km radius of the monitoring stations in Klang Valley and Kuching.
2. Individual admitted to the hospital for respiratory disease (10th revision of the International Classification of Diseases [ICD10]):
   a. Lower respiratory infection: J09-J18, J20-J22, J40, J85.1
   b. Upper respiratory infections: J00-J06, J36
   c. Chronic respiratory diseases: J30-J35.9, J37-J39.9, J41-J44.9, J47, J67.9, J68, J82, J84, J90-J91, J94.9, J96, J98
   d. Asthma: J45-J46
3. Individual age below 18 years old

Exclusion criteria

1. Admissions to Hospital Sentosa Sarawak (psychiatric hospital), Hospital Angkatan Tentera Tuanku Mizan (military hospital), Pusat Perubatan Universiti Malaya (teaching hospital), Hospital Pengajar Universiti Putra Malaysia (teaching hospital) and Hospital Shah Alam

3.3.4 Data collection

a. *Ambient air pollution*

Daily ambient air pollution data were provided by DOE Malaysia's Continuous Ambient Air Quality Monitoring Station (CAAQMS), which included measurements of 24-hours PM_{10}, SO_2, NO_2, CO and O_3 between 1st January 2010 and 31st December 2018. Daily air pollutant data were calculated by averaging data from eight monitoring stations in Klang Valley and Kuching. If data were missed for a particular monitoring station on a given day, the daily average values were estimated using multivariate imputation by chained equations. Table 35 shows the CAAQMS used in this study to represent the air quality in Klang Valley and Kuching.

b. *Meteorological data*

Meteorological data for Klang Valley and Kuching during the study period were obtained from the same CAAQMS that measured the air pollutants. Daily measurements of temperature and relative humidity were collected and used in the analysis as covariates.

Table 35: CAAQMS location in Selangor, Kuala Lumpur, Putrajaya and Kuching

State	Site	Site ID	Location
Selangor	Banting	CA22B	Kolej Mara Banting, Bukit Changgang, Selangor
	Pelabuhan Klang	CA21B	SM(P) Raja Zarina, Klang, Selangor
	Petaling Jaya	CA19B	SK Bandar Utama, Petaling Jaya, Selangor
	Shah Alam	CA20B	SK. TTDI Jaya, Shah Alam, Selangor
Federal Territory of Kuala Lumpur	Batu Muda	CA15W	SK. Batu Muda, Batu Muda, Kuala Lumpur
	Cheras	CA16W	S.M.K Seri Permaisuri, Cheras, Kuala Lumpur
Federal Territory of Putrajaya	Putrajaya	CA17W	S.K.Putrajaya 8(2), Jln P8/E2, Presint 8, Putrajaya
Sarawak	Kuching	CA65Q	Kuching Medical Store

c. *Hospital admissions*

Data on children's hospital admissions were obtained from two main sources. The first source is the Malaysian Health Data Warehouse (MyHDW), derived from all MOH hospitals in Malaysia. The second source is from an electronic database of Hospital Canselor Tuanku Mizan, a teaching hospital. A total of 17 hospitals in Klang Valley and Sarawak were included, and data on hospital admissions for respiratory diseases among children were collected from 1st January 2010 to 31st December 2018. These hospitals' diagnoses would be more reliable than those of other community and private clinics. The World Health Organization's International Classification of Diseases, Tenth Edition (ICD-10) encoding was used to categorise medical data. As the outcome in this study, hospitalisation for respiratory diseases (ICD10 J00-99) was chosen. Demographic information (including age and gender) was also obtained from the MyHDW. Table 36 shows the 16 hospitals involved in this study, while Figure 8 shows the included monitoring station and hospital locations in Klang Valley and Kuching, respectively.

Table 36: List of selected hospitals

State	City/Town	Hospital
Selangor	Ampang Jaya	Hospital Ampang
	Banting	Hospital Banting
	Kajang	Hospital Kajang
	Batu Caves	Hospital Selayang
	Kajang	Hospital Serdang
	Shah Alam	Hospital Shah Alam
	Sungai Buluh	Hospital Sungai Buloh
	Klang	Hospital Tengku Ampuan Rahimah, Klang
Federal Territory of Kuala Lumpur	Kuala Lumpur	Hospital Kuala Lumpur
		Institut Perubatan Respiratori
		Hospital Orang Asli Gombak
Federal Territory of Putrajaya	Putrajaya	Hospital Putrajaya
Sarawak	Bau	Hospital Bau
	Kuching	Hospital Umum Kuching
	Serian	Hospital Serian
	Simunjan	Hospital Simunjan

3.3.5 Statistical analysis

Poisson regression in a single- and multiple-pollutant generalized linear model (GLM) with a log function was used in this study to estimate the relationship between pollutants and hospital admissions at various lag days. These were used to regress the dependent variable, the daily number of hospital admissions, on the independent variables (pollutant concentrations). The covariates were the time variable (day), the daily mean temperature, humidity, a holiday indicator, and the day of the week. This Poisson model incorporates natural cubic spline functions to account for long-term seasonality patterns in daily hospital admissions and other time-varying covariates that may confound the relationship between air pollution and hospital admissions. The procedure began with developing the basic core model, which was then adjusted for seasonality, trends, and potential confounders.

A public holiday indicator was captured using coding values 1 or 0. In addition, the week beginning on Sunday was coded as 1 and was included in the core model. Strong confounders of the series that needed to be controlled in the model will be managed by adding terms for meteorology variables such as daily mean temperature and humidity. All these variables were added to the core model to control systematic variations over time, long-term year trends and short-term temporal variations of the day of the week, in addition to adjusting for meteorological variables. Relationships between air pollution and hospital admissions were investigated for both genders (male and female) and age groups (under five years, five to nine years and ten to 17 years). The quasi Akaike Information Criterion (qAIC) was used during the GLM application to determine the number of degrees of freedom to use. For the temporal trends, temperatures, and humidity for all groups, a natural cubic spline of 3 df per year was used.

The Poisson regression estimates the relative risk (RR) as RR = exp(ß), where b is the regression coefficient associated with a unit increase in an air pollutant at different lag structures ranging from lag 0 to lag 7. This study also investigates the overall cumulative effects of a 10-unit (10mg/m3) increase in air pollutants over a 7-day lag period. The outcomes are presented in terms of excess risk (ER). The percentage increase in hospital admissions for standard exposure increments was calculated using RR, where the RR was the relative risk derived from exp (ß). Positive ER values represent the percentage increase (%) in respiratory hospital admissions caused by a 10mg/m3 increase in pollutant concentration. Negative ER values indicate that there is no link between increased air pollution and hospital admissions.

3.3.6 Results and discussion

a. Concentration of air pollution in the study areas

Air pollution concentration in Klang valley

Table 38 demonstrates the daily mean of all air pollutants and meteorological parameters in Klang Valley and Kuching from 2010 to 2018. The daily mean concentrations for PM_{10} in Klang Valley is 58.92 ± 24.49 μg/ m^3, while for all the gas pollutants (SO_2, NO_2, O_3 and CO) were 11.03 ± 3.63 μg/m^3, 72.49 ± 14.45 μg/m^3, 111.05 ± 31.97 μg/m^3 and 1604.80 ± 437.96 μg/m^3 respectively. A high concentration of NO_2 was observed during the study period, and there were several episodes of the PM_{10} concentration level in Klang Valley that had exceeded the Malaysian Ambient Air Quality Standard (MAAQS) of Interim Target1 (IT1) 2015 (Table 37). Incomplete combustion from motor vehicles may cause high NO_2 emissions (Wild et al. 2017). Furthermore, industrial emissions and domestic combustion in Klang Valley can contribute to the high concentration of NO_2. This finding is not surprising in Klang Valley, which has a high volume of traffic per day. The several high concentration episodes of PM_{10} are due to the transboundary haze episodes from Sumatra, Indonesia (Latif et al. 2018a). Figure 53 - Figure 59 show the daily trend of ambient PM_{10}, SO_2, NO_2,

O_3, CO and meteorological parameters (temperature and relative humidity) in Klang Valley from 2010 to 2018.

Table 37: Malaysia Ambient Air Quality Standard and WHO Ambient Air Quality Standard

Pollutants	Averaging Time	Malaysia Ambient Air Quality Standard			WHO Ambient Air Quality Standard ($\mu g/m^3$)
		1997 ($\mu g/m^3$)	Interim Target-1 (2015) ($\mu g/m^3$)	Interim Target-2 (2020) ($\mu g/m^3$)	
PM_{10}	1 year	NA	50	40	20
	24 hour	150	150	100	50
SO_2	1 hour	NA	350	250	NA
	24 hour	105	105	80	20
NO_2	1 hour	320	320	280	200
	24 hour	NA	75	70	40
O3	1 hour	200	200	180	NA
	8 hour	NA	120	100	100
CO	1 hour	NA	35	30	NA
	8 hour	10	10	10	NA

Air pollution in Kuching

In general, the air quality in Kuching (Table 38) is within the MAAQS except for PM_{10}. The daily mean concentrations for PM_{10} in Kuching is 44.29 ± 24.39 µg/ m3, while for SO_2, NO_2, O_3, and CO were 4.13 ± 1.63 $\mu g/m^3$, 28.19 ± 8.81 $\mu g/m^3$, 51.89 ± 18.59 $\mu g/m^3$ and 817.60 ± 413.57 $\mu g/m^3$ respectively. A high level of concentration of PM_{10} was observed in 2015 due to the severe haze episode in 2015 El Niño in Malaysia (Latif et al. 2018b, Miettinen et al. 2017, Samsuddin et al. 2018), Figure 60- Figure 66 demonstrate the daily trend of ambient air pollutants(PM_{10}, SO_2, NO_2, O_3, CO) and the meteorological parameters (temperature and relative humidity) in Kuching from 2010 to 2018.

Table 38: Summary statistics of air pollutant concentrations and meteorological parameters by location from 2010-2018

Characteristics	Mean	SD	Min	P (25)	Median	P (75)	Max
Air pollutant concentrations (μg/m^3)							
Klang Valley							
PM_{10}	58.92	29.49	22.43	44.51	52.57	63.43	403.00
SO_2	11.03	3.63	3.68	8.58	10.21	12.67	46.17
NO_2	72.49	14.45	32.25	61.86	71.83	82.09	131.05
O_3	111.05	31.97	10.93	87.73	109.31	132.01	236.28
CO	1604.80	437.96	562.30	1317.00	1558.50	1831.70	6384.00
Kuching							
PM_{10}	44.29	24.39	16.00	33.50	39.00	46.50	356.00
SO_2	4.13	1.63	2.86	2.86	2.86	5.71	14.28
NO_2	28.19	8.81	4.11	20.52	28.73	30.78	65.67
O_3	51.89	18.59	2.19	37.16	48.10	62.31	159.59
CO	817.60	413.57	140.50	562.00	702.50	983.50	5901.00
Meteorological factors							
Klang Valley							
Temperature (ºC)	33.27	1.51	23.74	32.50	33.46	34.28	37.56
Humidity (%)	91.41	3.50	71.86	89.54	91.71	94.00	97.86
Kuching							
Temperature (ºC)	33.08	2.05	24.00	31.90	33.25	34.50	38.85
Humidity (%)	95.44	2.79	78.50	94.00	96.00	97.50	100.00

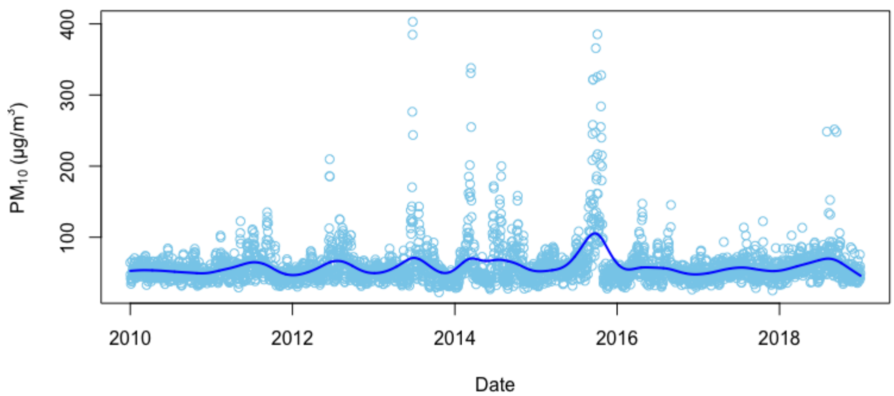

Figure 53: Daily PM_{10} level and smoothed trend in Klang Valley, 2010-2018

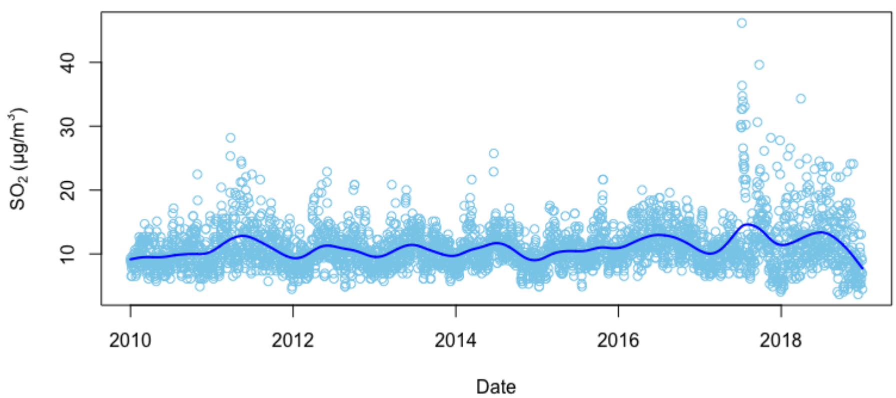

Figure *54*: Daily SO_2 level and smoothed trend in Klang Valley, 2010-2018

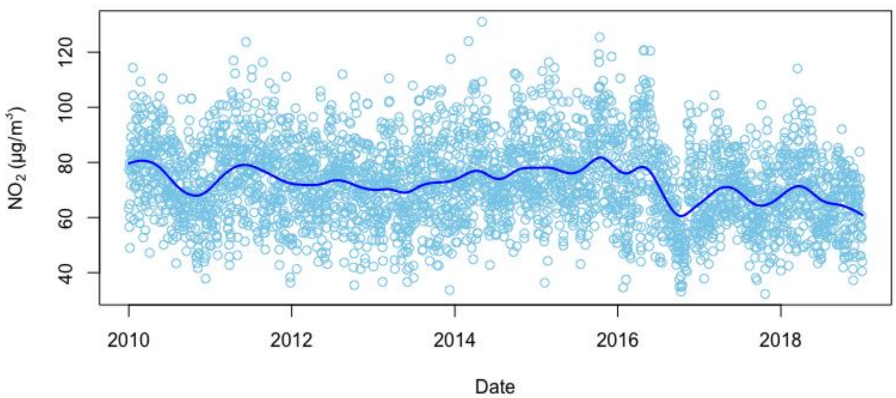

Figure 55: Daily NO_2 level and smoothed trend in Klang Valley, 2010-2018

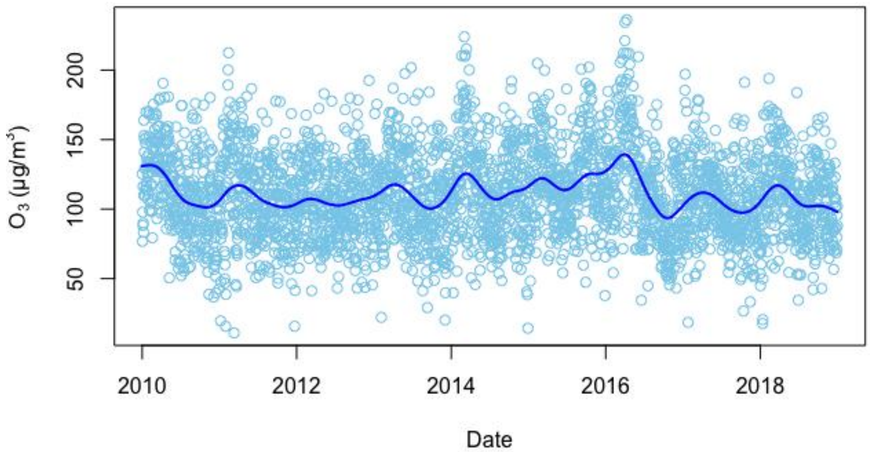

Figure 56: Daily O_3 level and smoothed trend in Klang Valley, 2010-2018

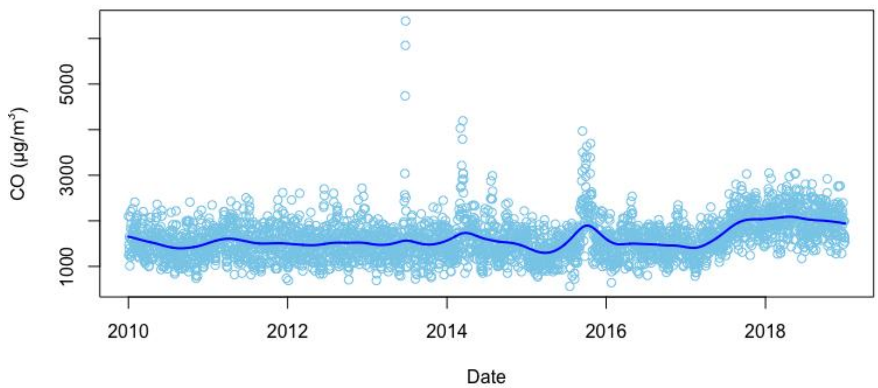

Figure 57: Daily CO level and smoothed trend in Klang Valley, 2010-2018

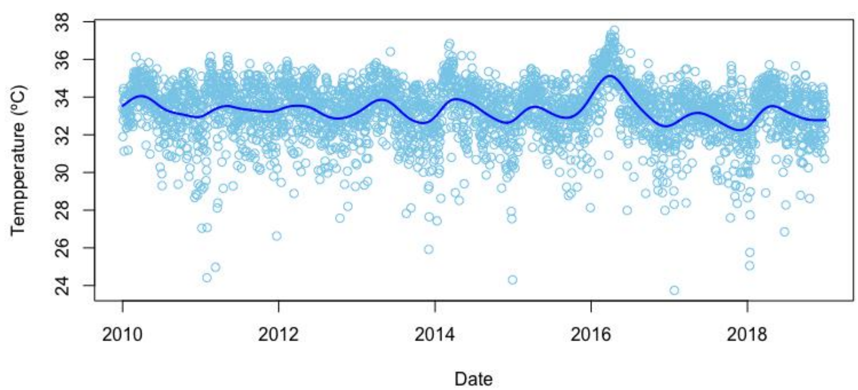

Figure 58: Daily temperature and smoothed trend in Klang Valley, 2010-2018

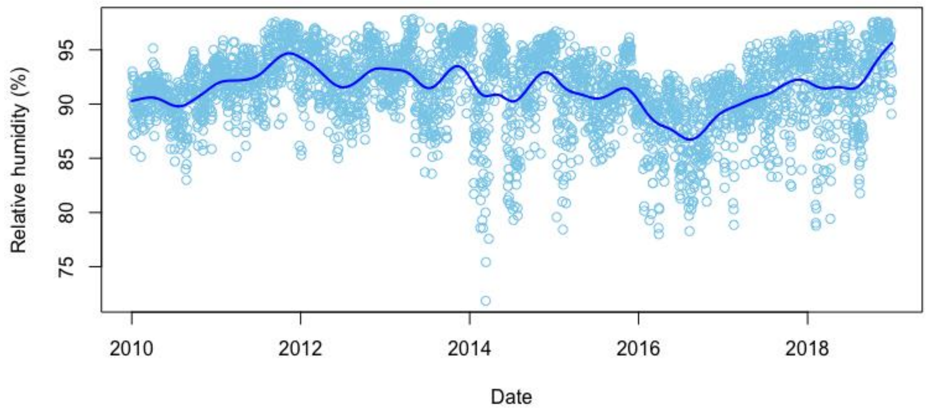

Figure 59: Daily relative humidity and smoothed trend in Klang Valley, 2010-2018

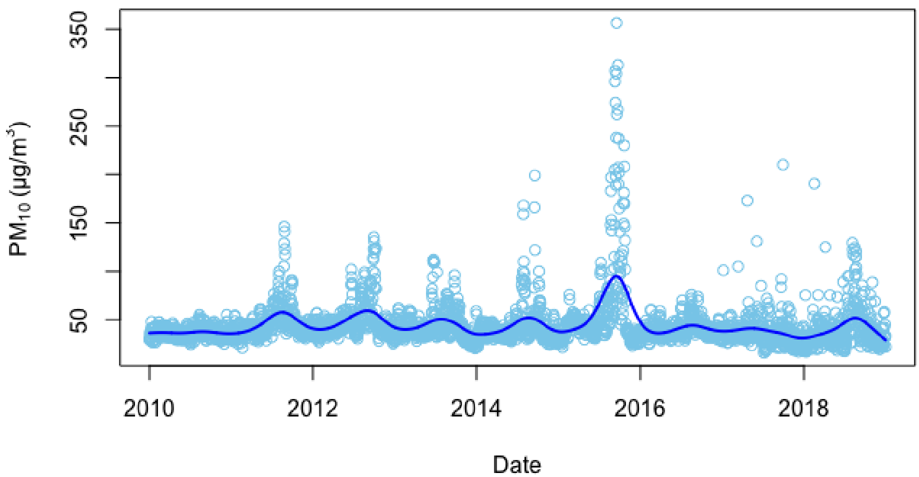

Figure 60: Daily PM_{10} level and smoothed trend in Kuching, 2010-2018

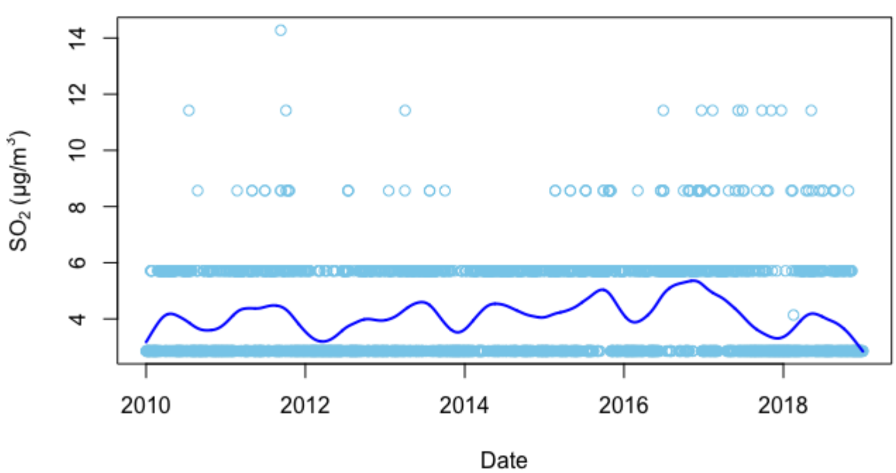

Figure 61: Daily SO_2 level and smoothed trend in Kuching, 2010-2018

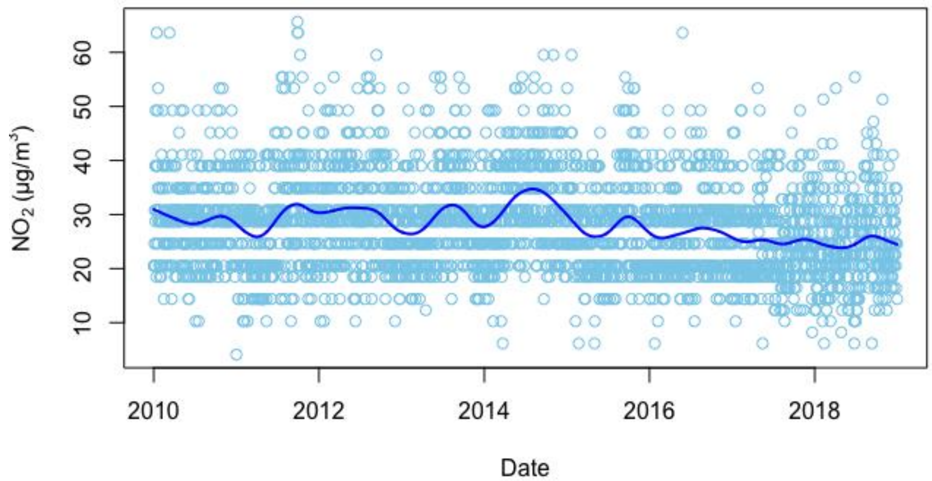

Figure 62: Daily NO_2 level and smoothed trend in Kuching, 2010-2018

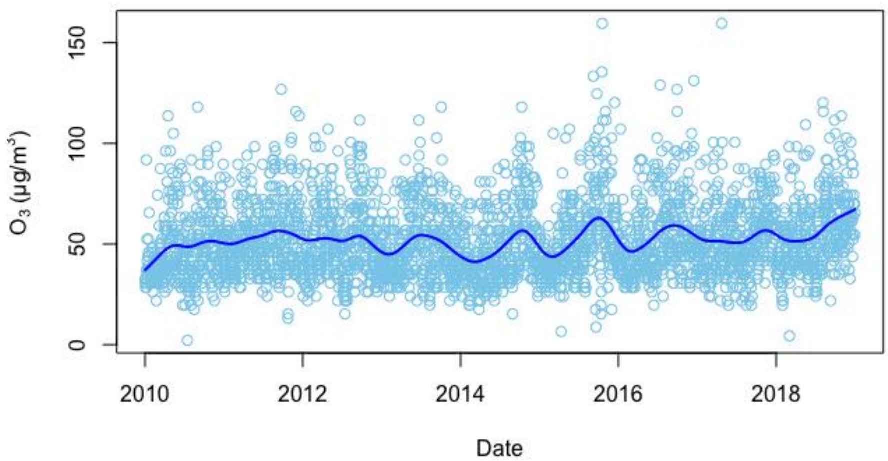

Figure 63: Daily O_3 level and smoothed trend in Kuching, 2010-2018

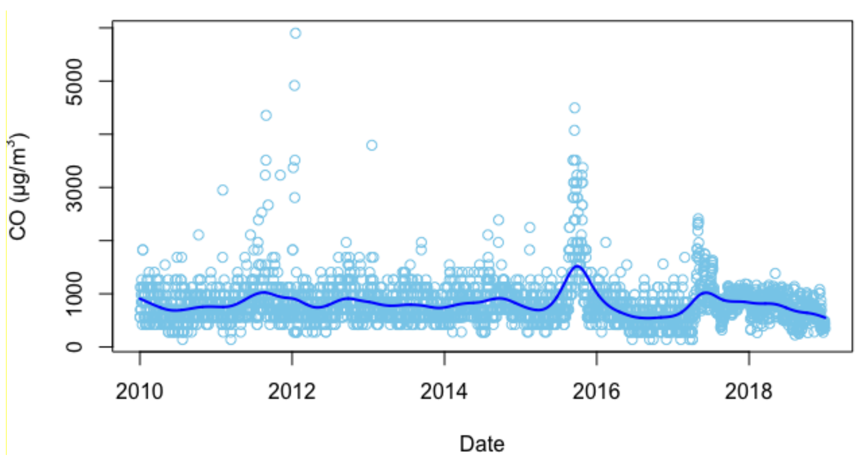

Figure 64: Daily CO level and smoothed trend in Kuching, 2010-2018

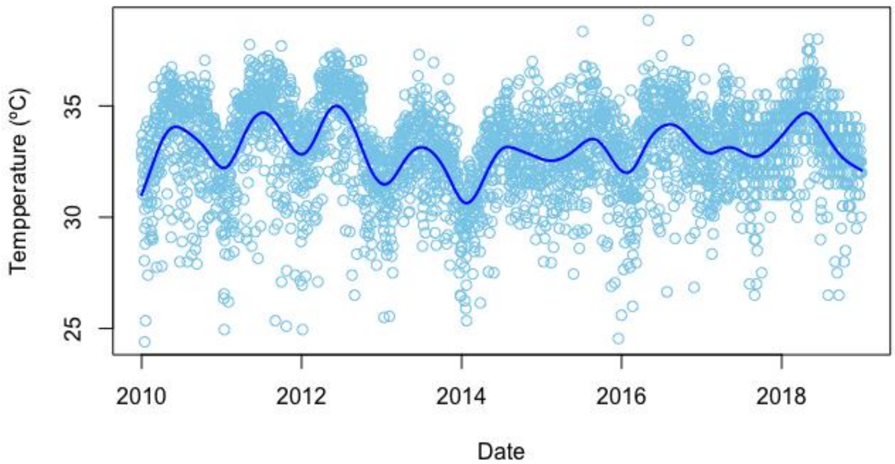

Figure 65: Daily temperature and smoothed trend in Kuching, 2010-2018

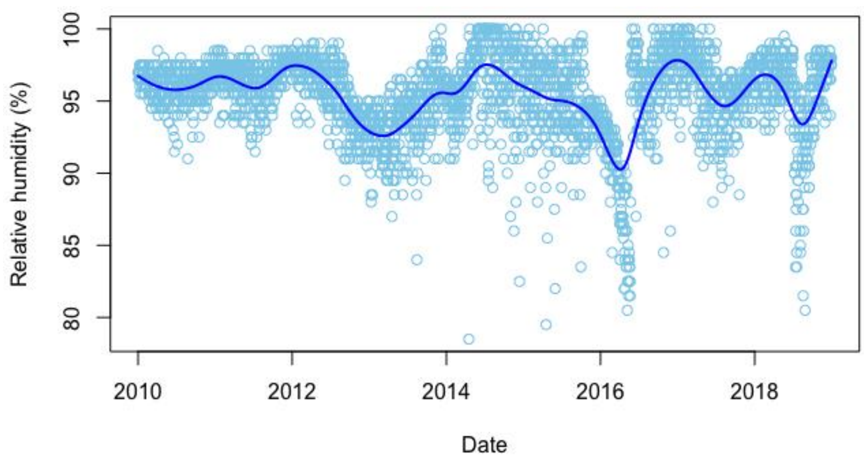

Figure 66: Daily relative humidity and smoothed trend in Kuching, 2010-2018

b. Hospital admissions for respiratory diseases

Hospital admissions in Klang Valley

From 1st January 2010 to 31st December 2018, the total number of hospital admissions for respiratory diseases in Klang Valley was 179,699, of which 139,560 were under five years old, 27,698 were between the age of five to nine years old, and 12,362 were ten to 17 years old. The gender distribution for this group was 103,833 boys and 75,866 girls. Meanwhile, 32,373 children were admitted to hospitals in Kuching for respiratory diseases. There were 26,005 under the age of 4 years old, 4,641 between the ages of five to nine years old, and 1,727 between the ages of ten to 17 years old. There were 19,396 boys and 12,977 girls admitted to the hospital. Table 39 summarized the statistical characteristics for the daily hospital admissions for respiratory diseases in Klang Valley and Kucing from 2010-2018. The trends of daily hospital admissions for respiratory diseases in both Klang Valley and

Kuching showed an increase in respirator admissions throughout the study period (Figure 10).

Table 39: General characteristics of daily hospital admissions for respiratory diseases by location, sex, and age from 2010-2018

Characteristics	Mean	SD	Min	P (25)	Median	P (75)	Max
Daily admission counts							
Klang Valley							
Total	55	23.54	1	37	52	71	131
Boy	32	14.01	1	21	30	41	79
Girl	24	10.68	0	15	22	30	61
<5 years	43	18.80	1	28	40	56	108
5-9 years	9	4.83	0	5	8	11	31
10-17 years	4	2.40	0	2	3	5	14
Kuching							
Total	10	5.99	0	5	9	14	36
Boy	6	3.86	0	3	5	8	21
Girl	4	2.89	0	2	3	6	18
<5 years	8	5.04	0	4	7	11	33
5-9 years	2	1.43	0	0	1	2	10
10-17 years	1	0.78	0	0	0	1	6

c. Correlations between air pollutants

The results of the Pearson correlation test showed that there were significant correlations among most of the pollutants and meteorological factors. The highest significant correlation found in Klang Valley was between O_3 and temperature ($r = 0.63$, $p < 0.01$), followed by PM_{10} and CO ($r = 0.57$, $p < 0.01$). This finding indicates that as the temperature rose, so did the concentration of O_3. Significant negative correlations were also found between PM_{10} and humidity ($r = -0.21$, $p < 0.01$), SO_2 and humidity ($r = -0.18$, $p < 0.01$), and O_3 with humidity ($r = -0.10$, $p < 0.01$). These negative findings suggest that dry weather raises the concentration of air pollutants.

In Kuching, significant correlations were found between the pollutants except those between SO_2 with humidity, and NO_2 with temperature and humidity. The strongest significant correlation found in Kuching was between PM_{10} and CO ($r = 0.54$, $p < 0.01$), followed by O_3 and temperature ($r = 0.32$, $p < 0.01$). Similar to Klang Valley, there were significant negative correlations between PM10 and humidity ($r = -0.16$, $p < 0.01$), O_3 and humidity ($r = -0.05$, $p < 0.01$), and CO with humidity ($r = -0.04$, $p < 0.01$).

Table 40: Pearson correlation coefficients (r) among air pollutants and meteorological variables in Klang Valley

	PM_{10}	SO_2	NO_2	O_3	CO	Temperature	Humidity
PM_{10}	1						
SO_2	0.22**	1					
NO_2	0.28**	0.05**	1				
O_3	0.28**	0.12**	0.50**	1			
CO	0.57**	0.16**	0.38**	0.20**	1		
Temperature	0.11**	0.13**	0.14**	0.63**	-0.05**	1	
Humidity	-0.21**	-0.18**	0.13**	-0.10**	0.13**	-0.31**	1

Table 41: Pearson correlation coefficients (r) among air pollutants and meteorological variables in Kuching

	PM_{10}	SO_2	NO_2	O_3	CO	Temperature	Humidity
PM_{10}	1						
SO_2	0.19**	1					
NO_2	0.26**	0.10**	1				
O_3	0.29**	0.08**	0.16**	1			
CO	0.54**	0.12**	0.31**	0.11**	1		
Temperature	0.20**	0.09**	0.00	0.32**	0.05**	1	
Humidity	-0.16**	-0.02	0.01	-0.05**	-0.04*	-0.03	1

3.3.7 Association between ambient air pollution and childhood respiratory diseases in Klang Valley

a. *Single pollutant model for total and gender-specific hospital admissions in Klang Valley*

The excess risk (ER) estimates and 95% confidence intervals associated with an increase in pollutant concentration of 10mg/m3 were obtained for each pollutant and evaluated for seven lag days effect (lag 0-7 days).

Table 42 summarizes the results of single-pollutant models for the estimates of respiratory hospital admissions for total admissions and gender-specific admissions in Klang Valley. For the total hospital admissions, significant single-lag and average cumulative-lag effects of SO_2 and O_3 were found. The greatest single-lag effect estimation for SO_2 was observed at lag 3 with ER 3.33 (95% CI 1.10-5.60), and for O_3, the highest ER were observed at lag 2 with ER 0.32 (95% CI 0.05-0.59). The highest ERs for cumulative-lag effect was observed at lags 0–5 with ERs 5.41 (95% CI 2.13-8.79) and lags 0-4 with ERs 0.59 (95% CI 0.14-1.04) for SO2 and O3, respectively.

In the single-lag effect for boys, the highest ER was observed for SO2 at lag 2 with ER 3.91 (95% CI 1.42-6.46). The highest ER for girls was observed for O_3 at lag 2 with ER 0.48 (95% CI 0.15-0.81). In cumulative-lag effects for boys, the highest ER was observed at lags 0–5 with ER 6.97 (95% CI 3.28 to 10.78) and at lags 0-4 with ER 0.51 (95% CI 0.01 to 1.02) for SO2 and O3, respectively. Among the girls, the highest ER for O_3 in the cumulative-lag effect was found at lags 0-3 with ER 0.71 (95% CI 0.19-1.24). This study shows that both boys and girls in Klang Valley were susceptible to air pollution.

b. Single pollutant model for age-specific hospital admissions in Klang Valley

Table 43 summarizes the results of the single-pollutant models for estimating the risk of respiratory-related hospital admissions based on age group. There were statistically significant associations found for children aged zero to nine years but not for ten to 17 years. Age was an effect modifier of respiratory hospital admissions, with young children being more susceptible to SO_2. For the single-lag effect, the highest association of pollutants with the respiratory hospital admissions for children under five was observed at lag 3 with ER 2.98 (95% CI 0.70-5.31) and lag 2 with ER 0.36 (95% CI 0.08-0.63) for SO_2 and O_3, respectively. SO2 at lag 5 had the highest single lag effect estimation for children aged five to nine years, with ER 7.09. (95% CI 2.93-11.42). The highest ER was observed in cumulative-lag effects at lags 0–4 days for children aged 0–4 years, with ER 4.65 (95% CI 1.44-7.96) and 0.69 (95% CI 0.22-1.16) for SO_2 and O_3, respectively. Whilst, for children aged five to nine years, the highest ER for SO_2 in the cumulative-lag effect was found at lags 0-7 with ER 12.32 (95% CI 5.56-19.50).

3.3.8 Association between ambient air pollution and childhood respiratory diseases in Kuching

a. Single pollutant model for total and gender-specific hospital admissions in Kuching

Table 44 summarizes the results of single-pollutant models for the estimates of respiratory hospital admissions for total and gender-specific admissions in Kuching. A strong relationship was found between PM_{10} and hospital admissions for respiratory diseases among children in total hospital admissions. Significant single-lag and cumulative-lag effects for PM_{10} were observed at all lags. The greatest single-lag effect estimation for the PM_{10} was found at lag 3 with ER 2.37 (95% CI 1.67-3.07). The highest ER for cumulative-lag effect was observed at lags 0–5 with ER 3.37 (95% CI 2.45-4.29).

Similar to the findings in Klang Valley, both boys and girls in Kuching were vulnerable to air pollution. Only PM_{10} was found to be significantly associated with respiratory admissions in both genders. The highest ER was observed for PM_{10} at lag 3 in the single-lag effect for boys, with ER 2.55. (95% CI 1.74-3.37). PM_{10} had the highest ER for girls at lag 4, with an ER of 2.40. (95% CI 1.50-3.30). The highest ER in cumulative-lag effect for PM_{10} was observed at lags 0–4 with ER 3.50 (95% CI 2.45 to 4.55) and at lags 0-5 with ER 3.19 (95% CI 1.99 to 4.40) for boys and girls, respectively.

b. Single pollutant model for age-specific hospital admissions in Kuching

Table 45 summarizes the findings of the single-pollutant models for estimates of respiratory-related hospital admissions for age-specific admissions in Kuching. Statistically significant associations were discovered for the age groups under five years and five to nine years, but not for ten to 17 years. Children under five years old were susceptible to PM_{10} and SO_2. In the single-lag effect, the highest association of PM_{10} for the children under five was observed at lag 0 (ER 2.31,95% CI 1.56-3.07), and for SO_2 was observed at lag 4 (ER 8.79, 95% CI 0.24-18.07). In cumulative-lag effects for children under five, the highest ER was only found for PM_{10} at lags 0–5 with ER 3.33 (95% CI 2.36-4.31).

For children aged five to nine years, the findings showed that the relative magnitude of risks for an association of the pollutants with respiratory hospital admissions was in the order of SO_2, NO_2, PM_{10} and CO. In the single lag effect, the highest association of each pollutant with hospital admissions was observed with SO_2 at lag 2 (ER 17.41, 95% CI 1.50-35.81), NO_2 at lag 4 (ER 5.09, 95% CI 1.10-9.24), PM_{10} at lag 4 (ER 3.19, 95% CI 1.82-4.58) and CO at lag 4 (ER 0.16, 95% 0.09-0.24). In cumulative-lag effects, the highest ER was observed with PM_{10} at lag 0-4 (ER 4.37, CI 2.54-6.23) and CO at lag 0-5 (ER 0.22, CI 0.11-0.34). These findings show that children aged five to nine years were susceptible to more pollutants than children under five years old.

Table 42: Positive association for RR and ER (%) with 95% CI of daily hospital admissions stratified by gender dissociation with 10µg/m3 increase of pollutant concentrations in Klang Valley (2010-2018)

Group	Pollutant	Lag	RR	Lower CI	Upper CI	ER (%)	Lower CI (%)	Upper CI (%)	p-value
Total	SO_2	1	1.027	1.005	1.050	2.70	0.47	4.98	*
		2	1.032	1.010	1.055	3.18	0.95	5.45	**
		3	1.033	1.011	1.056	3.33	1.10	5.60	**
		4	1.025	1.003	1.048	2.50	0.29	4.76	*
		0-1	1.032	1.006	1.059	3.22	0.64	5.87	*
		0-2	1.042	1.014	1.071	4.22	1.40	7.12	**
		0-3	1.051	1.021	1.082	5.06	2.05	8.15	**
		0-4	1.054	1.023	1.087	5.42	2.27	8.66	**
		0-5	1.054	1.021	1.088	5.41	2.13	8.79	**
		0-6	1.052	1.018	1.087	5.21	1.82	8.70	**
		0-7	1.050	1.015	1.086	5.02	1.53	8.64	**
	O_3	2	1.003	1.001	1.006	0.32	0.05	0.59	*
		0-2	1.005	1.001	1.009	0.46	0.06	0.86	*
		0-3	1.006	1.001	1.010	0.57	0.14	1.00	**
		0-4	1.006	1.001	1.010	0.59	0.14	1.04	*
		0-5	1.006	1.001	1.010	0.56	0.08	1.03	*
		0-6	1.005	1.000	1.010	0.51	0.02	1.01	*
Boys	SO_2	0	1.028	1.003	1.054	2.81	0.31	5.38	*
		1	1.035	1.010	1.061	3.54	1.05	6.10	**
		2	1.039	1.014	1.065	3.91	1.42	6.46	**
		3	1.038	1.013	1.064	3.81	1.33	6.36	**
		4	1.034	1.009	1.059	3.40	0.93	5.94	**
		0-1	1.042	1.013	1.072	4.23	1.33	7.21	**
		0-2	1.054	1.022	1.087	5.41	2.24	8.67	**
		0-3	1.063	1.029	1.098	6.29	2.92	9.78	**
		0-4	1.069	1.033	1.105	6.86	3.32	10.53	**
		0-5	1.070	1.033	1.108	6.97	3.28	10.78	**
		0-6	1.069	1.031	1.109	6.94	3.12	10.89	**
		0-7	1.069	1.030	1.110	6.92	2.98	11.01	**
	O_3	0-4	1.005	1.000	1.010	0.51	0.01	1.02	*
Girls	O_3	0-2	1.006	1.001	1.011	0.64	0.15	1.14	*
		0-3	1.007	1.002	1.012	0.71	0.19	1.24	**
		0-4	1.007	1.001	1.013	0.69	0.14	1.25	*
		0-5	1.007	1.001	1.013	0.68	0.10	1.27	*
		0-6	1.006	1.000	1.012	0.62	0.01	1.23	*

Note: Significant level *<0.05, **<0.01. Values marked in bold indicate values that are significant on the 95% confidence limit.

Table 43: Positive association for RR and ER (%) with 95% CI of daily hospital admissions stratified by age group associated with 10µg/m3 increase of pollutant concentrations in Klang Valley (2010-2018)

Age	Pollutant	Lag	RR	Lower CI	Upper CI	ER (%)	Lower CI (%)	Upper CI (%)	p-value
<5 years	SO_2	1	1.025	1.002	1.049	2.53	0.24	4.87	*
		2	1.029	1.006	1.052	2.86	0.58	5.20	*
		3	1.030	1.007	1.053	2.98	0.70	5.31	*
		0-1	1.028	1.002	1.055	2.80	0.15	5.51	*
		0-2	1.037	1.008	1.067	3.71	0.83	6.68	*
		0-3	1.045	1.014	1.076	4.47	1.40	7.63	**
		0-4	1.046	1.014	1.080	4.65	1.44	7.96	**
		0-5	1.043	1.009	1.077	4.26	0.93	7.70	*
		0-6	1.040	1.006	1.076	4.00	0.56	7.56	*
		0-7	1.036	1.001	1.073	3.62	0.08	7.29	*
	O3	2	1.004	1.001	1.006	0.36	0.08	0.63	*
		3	1.003	1.000	1.006	0.28	0.00	0.55	*
		0-1	1.004	1.000	1.008	0.40	0.02	0.78	*
		0-2	1.006	1.002	1.010	0.58	0.17	0.99	**
		0-3	1.007	1.002	1.011	0.68	0.24	1.12	**
		0-4	1.007	1.002	1.012	0.69	0.22	1.16	**
		0-5	1.007	1.002	1.012	0.68	0.19	1.17	**
		0-6	1.007	1.001	1.012	0.65	0.14	1.17	*
		0-7	1.006	1.001	1.011	0.59	0.07	1.13	*
5-9 years	SO_2	0	1.043	1.001	1.086	4.26	0.11	8.59	*
		2	1.054	1.013	1.097	5.44	1.31	9.73	**
		3	1.050	1.009	1.093	5.03	0.92	9.31	*
		4	1.057	1.015	1.100	5.66	1.54	9.95	**
		5	1.071	1.029	1.114	7.09	2.93	11.42	**
		7	1.048	1.007	1.091	4.84	0.73	9.13	*
		0-1	1.053	1.005	1.103	5.30	0.50	10.33	*
		0-2	1.071	1.018	1.127	7.12	1.84	12.67	**
		0-3	1.083	1.027	1.143	8.33	2.69	14.28	**
		0-4	1.096	1.037	1.159	9.61	3.66	15.90	**
		0-5	1.113	1.051	1.180	11.32	5.06	17.96	**
		0-6	1.115	1.050	1.184	11.51	5.01	18.41	**
		0-7	1.123	1.056	1.195	12.32	5.56	19.50	**

Note: No significant level of RR was observed for air pollution among children aged ten to 17 years old in Klang Valley.
Significant level *<0.05, **<0.01. Values marked in bold indicate values that are significant on the 95% confidence limit.

Table 44: Positive association for RR and ER (%) with 95% CI of daily hospital admissions stratified by gender associated with 10μg/m3 increase of pollutant concentrations in Kuching (2010-2018)

Group	Pollutant	Lag	RR	Lower CI	Upper CI	ER (%)	Lower CI (%)	Upper CI (%)	p-value
Total	PM_{10}	0	1.023	1.015	1.030	2.26	1.54	2.98	**
		1	1.019	1.012	1.026	1.92	1.20	2.65	**
		2	1.019	1.012	1.026	1.91	1.19	2.62	**
		3	1.024	1.017	1.031	2.37	1.67	3.07	**
		4	1.022	1.015	1.029	2.23	1.54	2.93	**
		5	1.016	1.009	1.023	1.59	0.88	2.30	**
		6	1.011	1.003	1.018	1.06	0.33	1.78	**
		7	1.011	1.004	1.018	1.10	0.38	1.83	**
		0-1	1.025	1.017	1.033	2.46	1.68	3.25	**
		0-2	1.027	1.019	1.035	2.68	1.86	3.52	**
		0-3	1.031	1.022	1.039	3.08	2.22	3.95	**
		0-4	1.033	1.025	1.042	3.34	2.45	4.24	**
		0-5	1.034	1.025	1.043	3.37	2.45	4.29	**
		0-6	1.033	1.023	1.042	3.27	2.34	4.22	**
		0-7	1.032	1.023	1.042	3.23	2.27	4.20	**
Boys	PM_{10}	0	1.022	1.014	1.030	2.20	1.36	3.05	**
		1	1.022	1.013	1.030	2.17	1.34	3.02	**
		2	1.021	1.013	1.030	2.12	1.29	2.95	**
		3	1.026	1.017	1.034	2.55	1.74	3.37	**
		4	1.021	1.013	1.029	2.11	1.30	2.94	**
		5	1.016	1.007	1.024	1.57	0.74	2.40	**
		6	1.010	1.001	1.018	0.99	0.14	1.84	*
		7	1.011	1.002	1.019	1.08	0.23	1.93	*
		0-1	1.026	1.017	1.035	2.58	1.67	3.51	**
		0-2	1.029	1.019	1.038	2.87	1.90	3.85	**
		0-3	1.033	1.023	1.043	3.30	2.29	4.32	**
		0-4	1.035	1.025	1.046	3.50	2.45	4.55	**
		0-5	1.035	1.024	1.046	3.50	2.42	4.58	**
		0-6	1.034	1.023	1.045	3.37	2.28	4.48	**
		0-7	1.033	1.022	1.045	3.32	2.20	4.45	**
	SO_2	0-3	1.188	1.004	1.406	18.82	0.42	40.59	*
Girls	PM_{10}	0	1.023	1.014	1.033	2.33	1.40	3.27	**
		1	1.016	1.006	1.025	1.55	0.60	2.51	**
		2	1.016	1.007	1.025	1.60	0.66	2.55	**
		3	1.021	1.012	1.030	2.10	1.19	3.02	**
		4	1.024	1.015	1.033	2.40	1.50	3.30	**
		5	1.016	1.007	1.026	1.62	0.70	2.55	**
		6	1.012	1.002	1.021	1.15	0.21	2.10	*
		7	1.011	1.002	1.021	1.14	0.20	2.09	*

	0-1	1.023	1.013	1.033	2.30	1.27	3.33	**
	0-2	1.024	1.013	1.035	2.42	1.34	3.52	**
	0-3	1.028	1.016	1.039	2.76	1.63	3.91	**
	0-4	1.031	1.020	1.043	3.13	1.96	4.31	**
	0-5	1.032	1.020	1.044	3.19	1.99	4.40	**
	0-6	1.031	1.019	1.044	3.13	1.91	4.37	**
	0-7	1.031	1.019	1.044	3.11	1.86	4.38	**
CO	4	1.001	1.000	1.001	0.06	0.00	0.11	*

Note: Significant level *<0.05, **<0.01. Values marked in bold indicate values that are significant on the 95% confidence limit

Table 45: Positive association for RR and ER (%) with 95% CI of daily hospital admissions stratified by age group associated with 10µg/m3 increase of pollutant concentrations in Kuching (2010-2018)

Age	Pollutant	Lag	RR	Lower CI	Upper CI	ER (%)	Lower CI (%)	Upper CI (%)	p-value
<5 years	PM_{10}	0	1.023	1.016	1.031	2.31	1.56	3.07	**
		1	1.019	1.012	1.027	1.92	1.15	2.68	**
		2	1.019	1.012	1.027	1.91	1.15	2.67	**
		3	1.023	1.016	1.030	2.31	1.57	3.05	**
		4	1.021	1.014	1.028	2.10	1.37	2.85	**
		5	1.016	1.009	1.024	1.60	0.85	2.36	**
		6	1.011	1.003	1.018	1.07	0.30	1.84	**
		7	1.012	1.004	1.020	1.20	0.44	1.97	**
		0-1	1.025	1.017	1.033	2.50	1.67	3.33	**
		0-2	1.027	1.018	1.036	2.71	1.83	3.59	**
		0-3	1.031	1.022	1.040	3.08	2.16	4.00	**
		0-4	1.033	1.024	1.043	3.30	2.35	4.25	**
		0-5	1.033	1.024	1.043	3.33	2.36	4.31	**
		0-6	1.032	1.023	1.042	3.24	2.25	4.25	**
		0-7	1.032	1.022	1.043	3.23	2.21	4.25	**
	SO_2	3	1.088	1.002	1.181	8.79	0.24	18.07	*
5-9 years	PM_{10}	0	1.025	1.011	1.040	2.54	1.07	4.04	**
		1	1.024	1.009	1.039	2.39	0.91	3.89	**
		2	1.025	1.011	1.040	2.53	1.11	3.98	**
		3	1.030	1.016	1.044	3.03	1.64	4.45	**
		4	1.032	1.018	1.046	3.19	1.82	4.58	**
		5	1.016	1.002	1.031	1.62	0.17	3.09	*
		01	1.029	1.013	1.046	2.92	1.31	4.56	**
		02	1.033	1.016	1.051	3.33	1.63	5.07	**
		03	1.039	1.021	1.057	3.88	2.11	5.68	**
		04	1.044	1.025	1.062	4.37	2.54	6.23	**
		05	1.043	1.024	1.062	4.28	2.40	6.19	**
		06	1.040	1.021	1.060	4.03	2.10	6.00	**
		07	1.038	1.018	1.058	3.82	1.84	5.83	**
	SO_2	2	1.174	1.015	1.358	17.41	1.50	35.81	*
	NO_2	2	1.051	1.011	1.092	5.09	1.10	9.24	*
		4	1.041	1.002	1.082	4.09	0.16	8.19	*
	CO	0	1.001	1.000	1.002	0.08	0.00	0.16	*
		1	1.001	1.000	1.002	0.09	0.01	0.17	*
		3	1.002	1.001	1.002	0.16	0.08	0.23	**
		4	1.002	1.001	1.002	0.16	0.09	0.24	**
		0-1	1.001	1.000	1.002	0.11	0.02	0.21	*
		0-2	1.001	1.000	1.002	0.13	0.03	0.23	*
		0-3	1.002	1.001	1.003	0.18	0.07	0.29	**

	0-4	1.002	1.001	1.003	0.22	0.11	0.33	**
	0-5	1.002	1.001	1.003	0.22	0.11	0.34	**
	0-6	1.002	1.001	1.003	0.21	0.09	0.33	**
	0-7	1.002	1.001	1.003	0.21	0.08	0.33	**

Note: No significant level of RR was observed for air pollution among children aged ten to 17 years old in Klang Valley. Significant level *<0.05, **<0.01. Values marked in bold indicate values that are significant on the 95% confidence limit.

3.3.9 Multi-pollutant models for gender- and age-specific hospital admissions in Klang Valley and Kuching

A single-pollutant model was used to estimate the relationship between a single pollutant and a health outcome. On the other hand, the real environment is a mixture of pollutants that affect people synergistically and vary in time and space. In environmental health studies, it has been common practice to use multi-pollutant models that include terms for estimated population exposure to several pollutants to identify the most toxic pollutant or subset of pollutants. The multi-pollutant models are regression models used to estimate population exposure to multiple pollutants responsible for the observed effects (respiratory admissions). In this study, the multi-pollutant models (Table 46) demonstrated that SO_2 were significantly associated with childhood respiratory admissions in Klang Valley, whilst PM_{10} were strongly associated with childhood respiratory admissions in Kuching.

Table 46: Multi-pollutant of daily hospital admissions with 10µg/m3 increase of pollutant concentrations in Klang Valley and Kuching (2010-2018)

Location	Group	Model	Pollutant	Lag	RR	Lower CI	Upper CI	ER (%)	Lower CI (%)	Upper CI (%)	p-value
Klang Valley	All age	1	SO_2	0-5	1.048	1.015	1.082	4.81	1.51	8.23	**
			O_3	0-4	1.005	1.000	1.009	0.47	0.01	0.93	*
	Boys	2	SO_2	0-5	1.065	1.028	1.104	6.51	2.78	10.37	**
			O_3	0-4	1.004	0.998	1.009	0.36	-0.15	0.87	
	<5 years	3	SO_2	0-4	1.039	1.007	1.073	3.93	0.69	7.28	*
			O_3	0-4	1.006	1.001	1.011	0.59	0.11	1.06	*
Kuching	Boys	4	PM_{10}	0-4	1.034	1.024	1.045	3.42	2.35	4.49	**
			SO_2	0-3	1.074	0.905	1.274	7.39	-9.46	27.37	
	Girls	5	PM_{10}	0-5	1.032	1.019	1.046	3.21	1.89	4.55	**
			CO	4	1.000	0.999	1.001	0.00	-0.06	0.06	
	<5 years	6	PM_{10}	0-5	1.033	1.023	1.043	3.30	2.32	4.28	**
			SO_2	3	1.023	0.941	1.112	2.28	-5.89	11.17	
	5-9 years	7	PM_{10}	0-4	1.042	1.024	1.061	4.22	2.37	6.09	**
			SO_2	2	1.131	0.975	1.311	13.10	-2.45	31.13	
		8	PM_{10}	0-4	1.040	1.022	1.060	4.04	2.16	5.95	**
			NO_2	2	1.031	0.991	1.073	3.10	-0.91	7.27	
		9	PM_{10}	0-4	1.034	1.011	1.056	3.36	1.15	5.63	**
			CO	0-4	1.001	1.000	1.002	0.11	-0.03	0.24	
		10	SO_2	2	1.165	1.005	1.351	16.52	0.50	35.10	*
			NO_2	2	1.049	1.009	1.090	4.89	0.90	9.03	*
		11	SO_2	2	1.165	1.005	1.351	16.55	0.53	35.11	*
			CO	0-4	1.002	1.001	1.003	0.22	0.11	0.33	**
		12	NO_2	2	1.034	0.994	1.076	3.43	-0.60	7.62	
			CO	0-4	1.002	1.001	1.003	0.20	0.08	0.31	**

Note: Significant level *<0.05, **<0.01. Values marked in bold indicate values that are significant on the 95% confidence limit.

3.3.10 Discussion

This study found that short-term exposure to ambient air pollution increases the risk of respiratory disease up to eight days (seven days lag) after the exposure. In Klang Valley, SO_2 and O_3 were significantly associated with increased respiratory hospital admissions, whereas in Kuching, only PM_{10} was significantly associated with increased total admissions for respiratory diseases among children. However, all pollutant except O_3 was found to be significantly associated with an increase in respiratory hospital admissions among children aged five to nine years old in Kuching. The non-significant finding of O_3 in Kuching is probably due to the measurement of air quality in Kuching that derived from a station located in the city centre. The concentrations of air pollutants, except for O_3, were generally higher in the cities; O_3 showed its peak in suburban and rural areas. In Klang Valley, SO_2 was the most significantly associated pollutant with respiratory hospital admissions, while PM_{10} was the most significantly associated pollutant in Kuching. This observation was expected due to the urban and dense population of Klang Valey, which lead to a higher level of SO_2, NO_2, CO and O_3 compared to Kuching. The high level of PM_{10} in Kuching is caused by local biomass burning and exacerbated by the annual transboundary haze from Kalimantan, Indonesia (Abdullah et al.2020).

Most research in Asian countries found that SO_2 was linked to increased emergency and outpatient visits for respiratory diseases. In China, for every 10µg/m^3 increasing in concentrations of SO_2 were associated with an increase hospital visit for URTI, pneumonia, and upper and lower respiratory tract infections with ER of 2.92 (95% CI 1.88-3.97) (Y. R. Li et al. 2018), 5.00 (95% CI 1.30-8.80) (D. Li et al. 2018) and 15.17 (95% CI 11.29-19.19) (Zheng et al. 2017), respectively. A similar finding was discovered in an Iranian modelling study, which found a significant association between SO_2 and acute respiratory diseases with an attributed proportion of 3.65 (95% CI 1.30–5.94) (Ghaffari et al. 2017). This study adds to the existing evidence on air pollution and respiratory diseases in children, showing that despite low levels of SO_2 (lower than MAAQS) in Klang Valley, the risk of respiratory hospital admissions with the highest ER for single-lag effect was 3.33 (95 % CI 1.10-5.60) at lag 3 and highest ER for cumulative lag-effect was 5.41 (95 % CI 2.13-8.79) at lag 0-5. The source of SO_2 in Klang Valley was most likely from the industrial activities (Latif et al. 2021, Leh et al. 2020) and power generation (Salleh et al. 2020) from the power plant located around the city.

In Klang Valley, there was a significant relationship between hospital admissions for respiratory diseases and O_3. This is most likely due to the high NO_2 levels in Klang Valley during the study period. NO_2 is a member of the nitrogen oxides group of highly reactive gases (NO_x). Ground-level ozone, also known as tropospheric ozone, is formed by the interaction of sunlight, particularly ultraviolet light, with hydrocarbons and NO_x emitted by automobile tailpipes and industrial smokestacks. High ozone levels are common in urban areas during the warm season due to this chemical reaction (Austin et al. 2015). This study's findings are consistent with those of a previous study conducted in Hanoi, which found that each increase of 10µg/m^3 of O_3 was associated with a 6.2% increase in the risk of admission for respiratory disease among children in the winter and 1.2% in the summer (Luong et al. 2018).

PM_{10} posed a greater risk to children in Kuching. All lag effects showed a positive association for all children admitted to the hospital for respiratory diseases. This study's finding has strengthened the evidence of air pollution and health effect in Malaysia. Previous case-crossover studies have discovered that respiratory mortality was significantly associated with haze events (PM_{10} more than 10µg/m^3) for all ages at lag 0 (OR 1.19, 95% CI 1.02-1.40) (Sahani et al. 2014). A similar positive relationship between haze and mortality in children under the age of five was found in 13 Malaysian districts, with an OR 1.210 (95% CI 1.000-1.464) following two days of exposure to moderate levels of PM_{10} (>75µg/m^3) (Phung et al. 2021). The high concentration of PM_{10} is most likely due to deforestation and transboundary haze episodes that occur regularly in Kuching. Several Southeast Asian countries, most notably Indonesia, Malaysia, Singapore, and Brunei, are frequently affected by haze pollution (Emmanuel, 2000, Odihi, 2001, Othman et al. 2014). Forest fires in Kalimantan, Indonesia, are the primary cause of the haze in Kuching, Malaysia (Tacconi et al. 2008). Many farmers in Indonesia practice shifting agriculture, a traditional farming method that involves clearing forest for agriculture using the slash-and-burn method. This practice has become more common in recent decades as large-scale burning to prepare land for planting commercial crops such as oil palm has increased due to its high efficiency and low cost. Coupled with the El Niño phenomenon, which brings hot and dry weather conditions, the conditions are ideal for igniting forest fires and escalating the forest fire. During the southwest monsoon season (which typically occurs between June and September), strong winds help spread the haze produced by such fires from Kalimantan, Indonesia, to Kuching, Malaysia (Khan et al. 2020).

In gender-specific analysis, boys and girls were both susceptible to air pollutants, and gender was not a significant modifier in this study since no significant difference was observed between them, which was consistent with other epidemiological studies (Bai et al. 2018, Ding et al. 2017, J. Wang et al. 2019). In gender-specific analysis, boys and girls were both susceptible to air pollutants, and gender was not a significant modifier in this study since no significant difference was observed between them. This was consistent with several epidemiological studies (Bai et al. 2018, Ding et al. 2017). However, the sensitivity of gender was inconsistent in published studies on the effects of ambient air pollution and respiratory disease in children. Previous studies found that the risk of ambient air pollution on respiratory disease was higher in boys than that in girls (Al Qerem et al. 2010, Dong et al. 2011, Spencer-Hwang et al. 2016). These results might be attributed to boys spending more time outdoor than girls, which expose them to more air pollution.

In terms of age-specific analysis, the results of this study show that younger children (0-9 years old) were susceptible to air pollution, and children aged five to nine in Kuching were more vulnerable because of effect for SO_2, NO_2, PM_{10}, and CO were greater compared to children under five. Children aged five to nine years old engage in outdoor activities more frequently than younger children. Children less than five years old are only allowed to go outside their house or preschool in the presence of an adult or their caretaker. In Malaysia, children aged seven years old start attending school. They are involved in many outdoor activities such as travelling from home to school, playing sports, and participating in the outdoor school's co-curricular activities. This study did not observe a positive association between children aged ten to 17 years, probably due to low hospital admissions. Lung-function development in children continues until their late adolescence but is slower than in the earlier adolescent period (Wang et al. 1993). Therefore, a better degree of lung function in elder children may decrease the risk of respiratory conditions. This finding, however, was not entirely consistent with those of other studies. Ding et al. (2017) found that the strongest effects of PM_{10}, $PM_{2.5}$, SO_2, NO_2, and CO were in those aged 2-5 years. However, another study in Australia found the strongest effects of PM_{10}, $PM_{2.5}$, SO_2, CO, and O_3 were in those aged five to nine years, while the strongest effects of NO_2 were in those aged 1-4 years (Jalaludin et al. 2008).

3.3.11 Limitations

There are some limitations for the association of air pollution and health in this study that should be highlighted. First, the exposure assessment was performed by averaging the air pollutant concentrations from several fixed monitoring stations across the city to reflect daily city-wide exposure levels. The personal exposure levels of each subject were not evaluated. In addition, the concentrations of air toxins, such as diesel exhaust particles or surrogates, such as black carbon or soot, were not monitored. Second, this study does not measure personal behaviour and socio-economic status, such as child nutrition or time spent outdoors, which may affect the magnitude of the observed associations when compared with other studies with different behaviour profiles. Finally, our assessment is at a city level, and air pollutant concentrations in the study could not be representative of individual exposures. Hence, the results for the association should be interpreted carefully to avoid ecological fallacy.

3.3.12 Conclusion

The findings of this study have important population health implications because they discovered associations between a variation of air pollutants and hospitalization for respiratory diseases among Children in Malaysia. Except for NO_2 in Klang Valley and several spikes of PM_{10} due to transboundary haze episodes in Klang Valley and Kuching, ambient concentrations level of air pollutants are relatively low in Klang Valley and Sarawak. The findings of this study provide evidence that short-term exposure to ambient air pollution increases the risk of hospitalization for respiratory diseases in children. Children's ages have been identified as a moderator of respiratory hospital admissions, with children aged 5 to 9 years being more vulnerable to ambient air pollution. However, it should be noted that many other important risk factors for respiratory diseases, such as viral infections and allergens, may have a greater impact on respiratory diseases than ambient air pollutants. Nonetheless, this study's findings can help address impartiality concerns on air pollution in both reviewers and policymakers, leading to changes in practice within decision-making organizations of evidence-informed policy development and decisions.

3.3.13 References

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3.4 Desk Study 4: Assessing the health effects of wildfire haze among children in Malaysia

3.4.1 Method

In epidemiological studies, exposure assessments of haze events are usually indicated via binary or categorical variables, which are derived from particulate matter (PM) concentration (Sahani et al. 2014), pollutant standard index (Ho et al. 2014), and visibility (Sastry 2002). Some studies also applied haze intensity (Faustini et al. 2015) and duration (Faustini et al. 2015, Kunzli et al. 2006). However, no study examined the association by considering haze duration, intensity, and time lag concurrently. This study aimed to investigate the association between haze and under-five mortality in Malaysia by accounting for three aspects: duration, intensity, and time lag.

Using a generalized additive model, we examined under-five mortality related to haze in Malaysia from 2014 to 2016. Considering districts with over 500,000 population and available monitoring stations for exposure assessment, 12 districts were selected (Figure 11): Kuala Muda, Timur Laut, Kinta, Kuala Lumpur, Klang, Petaling, Melaka Tengah, Johor Bahru, Seremban, Kuantan, Kota Bharu, and Kuching.

Health data was obtained from the Family Health and Development Division, MOH Malaysia. All-natural deaths (hereafter 'all-cause') (International Classification of Disease, 10th Revision (ICD-10: A00-R99)) were included, whereby deaths due to accidental, traumatic, and external causes were excluded (ICD-10: S00-Y98). Air pollutant and weather data were obtained from the Air Quality Division, DOE.

'Haze day' was defined by intensity and duration based on the PM_{10} concentration. Three levels of intensities were defined based on particulate matter (PM) concentration, while three durations were defined if the haze day occurred for 1, 2, and 3 or more successive days. We also examined the lag effects of the association: single lag and moving average lags up to 7 days. All the statistical analyses in this study were performed using the R statistical software (R Core Team 2018). Under-five mortality accounting results for each aspect are reported as an odds ratio (OR) with a 95% confidence interval (95% CI).

3.4.2 Results

No clear association was observed between haze and under-five mortality. From the lag patterns, we observed that when haze occurred for a longer duration and at a higher intensity (i.e. occurring at shorter lags), health effects could be more acute.

The highest odds ratio of under-five mortality was observed at single lag 4 of Intensity-3, though this was not statistically significant (Figure 67). The moving average lag pattern is shown in Figure 68. There was a minimal variation of ORs over the lagged days. The highest OR at Intensity-3 was observed at a moving average lag of 0-1 day. When stratified by PM distribution, the districts with 'low' category (districts with PM concentration below the 95th percentile of the total PM distribution over the study period) showed a positive association at Intensity-2 over >3 days (odds ratio = 1.210 [95% confidence interval: 1.000, 1.464]).

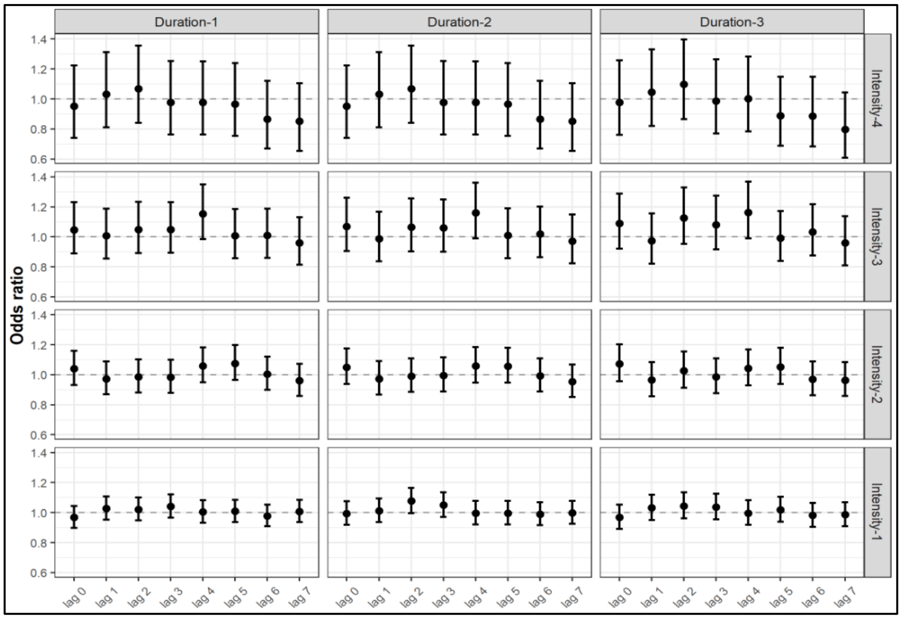

Figure 67: Single lags of ORs of under-five mortality by duration and intensity of the haze

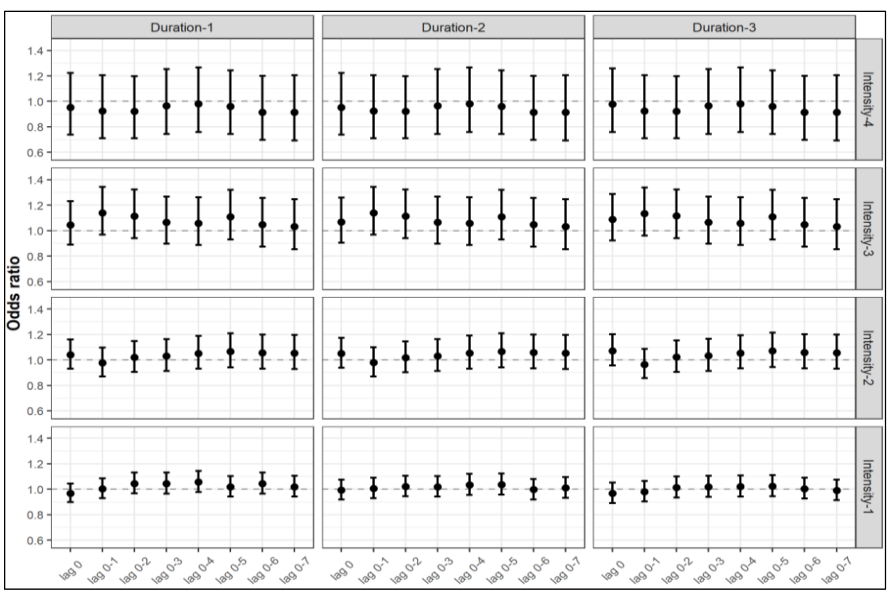

Figure 68: Moving average lags of ORs of under-five by duration and intensity of the haze

3.4.3 Significance of the study

Our study highlights a few important aspects to be considered for future studies. Firstly, we applied time lag, duration, and intensity to define a haze event. This approach incorporates more information about haze events than definitions that focused only on intensity as used in previous studies (Ho et al. 2014, Sahani et al. 2014). The presentation of findings based on these three aspects would elucidate the pathophysiological pathways and facilitate risk communication towards a wider range of stakeholders, policy decision-makers, and the public. Secondly, the target population in this study were children under five.

Evidence of health effects related to air pollution or haze events among this age group is scarce. As the immune system among children under five might differ from older children (Decker et al. 2017), it is necessary to elucidate their health effects separately. Finally, this study adds to the currently limited evidence of health effects related to haze in Southeast Asia. There have been numerous studies in North America and Europe (Reid et al. 2016). However, health effects might be different due to differences in climate conditions, vegetation types, and causes of fires.

An article has been recently published (Phung et al. 2021) titled 'Investigation of association between smoke haze and under-five mortality in Malaysia, accounting for time lag, duration, and intensity' (refer to Appendix 14).

3.4.4 Conclusion

A null association was observed between haze and under-five mortality in Malaysia (2014-2016). However, there were some patterns of higher odds ratios of under-five mortality at certain lags depending on the intensity and duration of haze. Future studies should consider these aspects when examining the health effects of haze on children and youth.

3.4.5 References

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APPENDIX 4 CASE STUDIES

4.1 Details of participants

Table 47: Details of participants for all case studies

Location	
Pulau Gaya, Sabah (6°1.0798'N 116°1.7909'E),	**Questionnaire: Children** SK Pulau Gaya (Primary school) SMK Pulau Gaya (Secondary school) Alternative Learning Centre (ALC), Kampung Lok Urai **IDI: Teachers** Sekolah Kebangsaan (SK) Pulau Gaya (Primary school) Sekolah Menengah Kebangsaan (SMK) Pulau Gaya (Secondary school) ALC, Kampung Lok Urai **FGD: Community** Kampung Kasuapan, Pulau Gaya Kampung Lok Urai, Pulau Gaya
Pos Kuala Mu, Perak (4°50.2499'N 101°20.0445'E)	**Questionnaire: Children** SK Pos Kuala Mu (Primary school) SMK Bawong (Secondary school) **IDI: Teachers** SK Pos Kuala Mu (Primary school) SMK Bawong (Secondary school) **IDI: Community** Kampung Bersah, Pos Kuala mu. **FGD: Community** Kampung Bersah, Pos Kuala mu.
PPR Sungai Bonus, Kuala Lumpur (3°11.1778'N 101°43.3215'E)	**Questionnaire: Children** PPR Sungai Bonus, Kuala Lumpur **IDI: Children** PPR Sungai Bonus, Kuala Lumpur **FGD: Community** PPR Sungai Bonus, Kuala Lumpur

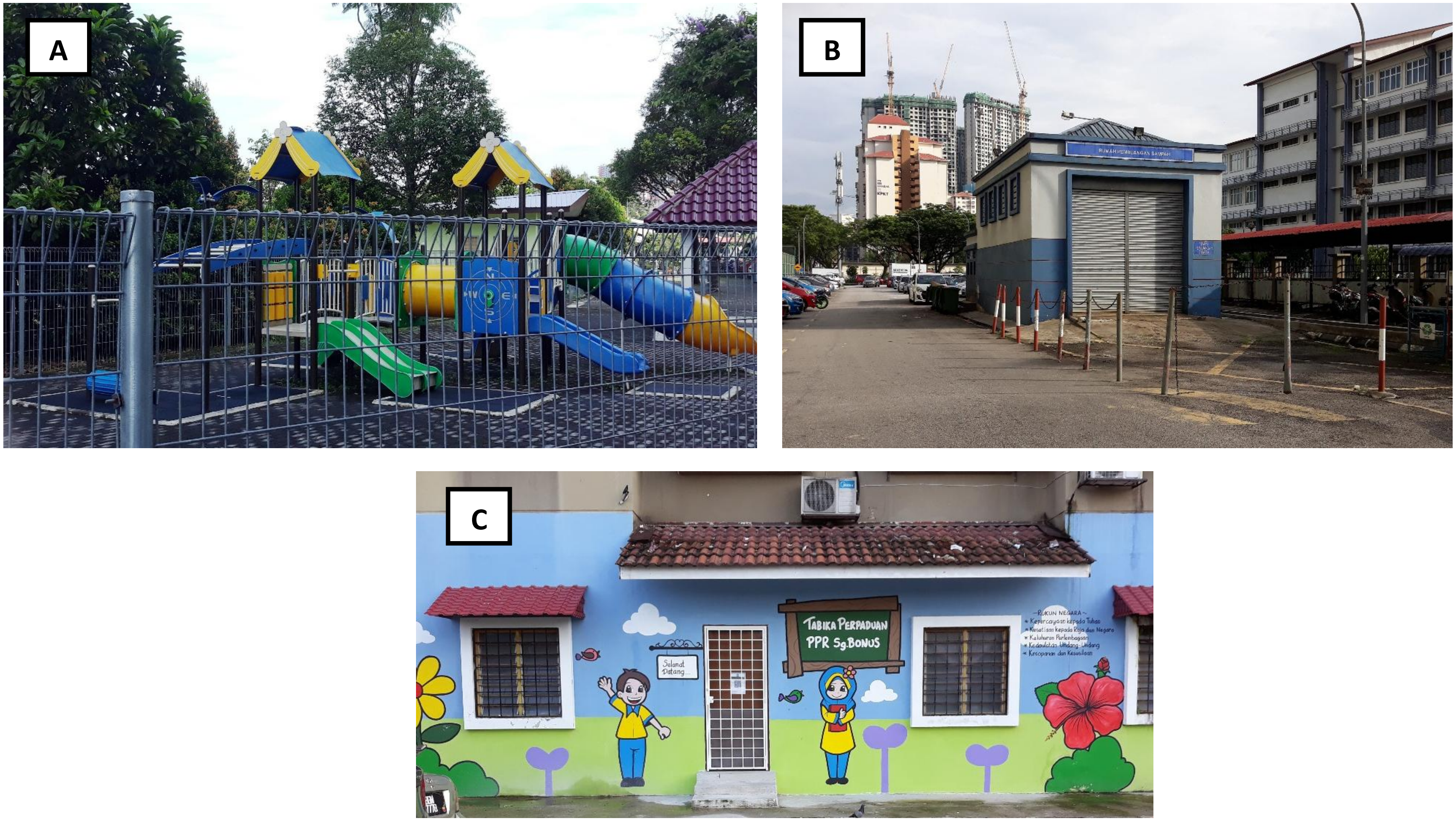

Figure 69: Basic facilities in PPR Sg. Bonus, Kuala Lumpur (A: Playground; B: Garbage house; C: Kindergarten)

4.2 Quantitative study

4.2.1 Data collection

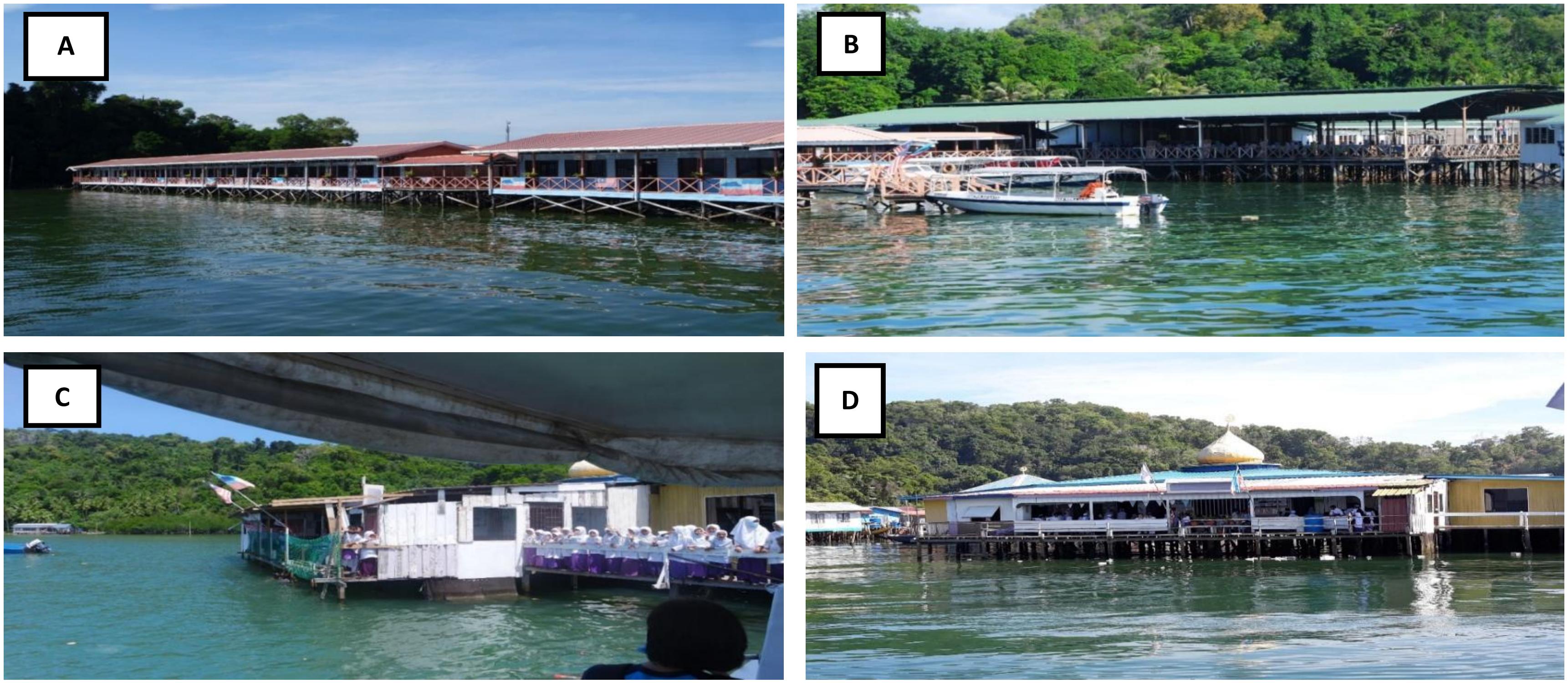

Figure 70 : Schools in Pulau Gaya, Sabah (A: SK Pulau Gaya (Primary school); B: SMK Pulau Gaya (Secondary school); C: ALC, Kampung Lok Urai)

Figure 71: Primary school: SK Pos Kuala Mu in Pos Kuala Mu, Perak

Figure 72 : Secondary school: SMK Bawong in Sungai Siput (U), Perak

Figure 73: Questionnaire data collection at SMK Bawong, Sungai Siput (U), Perak

Figure 74: FGD sessions with the community in Pulau Gaya, Sabah

4.2.2 Demographic and descriptive outcome

Table 48: Demographic characteristics of participants from the quantitative study

	***Pulau Gaya n(%)	***Pos Kuala Mu n(%)	***PPR Sungai Bonus n(%)
Age			
6-9 years old	35 (17.5)		4 (6.5)
10-14 years old	138 (69.0)	136 (69.4)	44 (71.0)
15-18 years old	27 (13.5)	60 (30.6)	13 (21.0)
Gender			
Male	85 (42.5)	72 (36.7)	33 (53.2)
Female	115 (57.5)	124 (63.3)	29 (46.8)
Race/Ethnicity	Suluk : 21 (10.5) Bajau: 159 (79.5) Others: 20 (10.0)	Temiar: 193(98.5) Semai: 2(1.0) Chinese:1(0.5)	Malay: 39 (62.9) Indian: 21 (33.9) Others: 2(3.2)
Guardian			
Parents	162 (81.0)	169 (86.2)	49 (79.0)
Mother	17 (8.5)	17 (8.7)	8 (12.9)
Father	2 (1.0)	5 (2.6)	3 (4.8)
Guardian	19 (9.5)	5 (2.6)	2 (3.2)
Education			
Primary school	24 (12.0)	26 (13.3)	32 (51.6)
Secondary school	76 (38.0)	170 (86.7)	28 (45.2)
Others (ALC/private school)	100 (50.0)		1 (1.6)

***Pulau Gaya, n=200, Pos Kuala Mu, Perak, n=196, PPR Sungai Bonus, Kuala Lumpur, n=62

Table 49: Demographic characteristics of IDI participants

	***Pulau Gaya n(%)	***Pos Kuala Mu n(%)	***PPR Sungai Bonus n(%)
IDI			
Teacher			*n/a
Primary school	6(35.3)	3(21.4)	
Secondary school	6(35.3)	11(78.6)	
Alternative learning Centre	5(29.4)		
Age			
20-60 years old	17(100)	14(100)	
Gender			
Male	11(64.7)	6(42.9)	
Female	6(35.3)	8(57.1)	
Length of service			
less than 1 year	2(11.8)	3(21.4)	
1-5 years	4(23.5)	7(50.0)	
6-10 years	2(11.8)	1(7.1)	
11-15 years	9(52.9)	2(14.3)	
Community			*n/a
Age			
40-70 years old	1(100)	2(100)	
Gender			
Male	1(100)	2(100)	
Female		0(0)	

*n/a (not available): The question was not included in the questionnaire for that particular community

**n/a (not applicable): Irrelevant to that particular community

***Pulau Gaya, n=200, Pos Kuala Mu, Perak, n=196, PPR Sungai Bonus, Kuala

Table 50: Demographic characteristics of FGD participants

	***Pulau Gaya n (%)	***Pos Kuala Mu n (%)	***PPR Sungai Bonus n (%)
FGD			
Community	4 groups	1 group	2 groups
Age			
20-70 years old	20(100)	6(100)	10(100)
Gender			
Male	10(50.0)	0(0)	5(50.0)
Female	10(50.0)	6(100)	5(50.0)
Children	*n/a	*n/a	4 groups
Age			
10-18 years old			23(100)
Gender			
Male			13(56.5)
Female			10(43.5)
Education			
Primary school			9(39.1)
Secondary school			14(60.9)

*n/a (not available): The question was not included in the questionnaire for that particular community
**n/a (not applicable): Irrelevant to that particular community
***Pulau Gaya, n=200, Pos Kuala Mu, Perak, n=196, PPR Sungai Bonus, Kuala Lumpur, n=62

Table 51: Participants' water availability

	***Pulau Gaya, Sabah n(%)	***Pos Kuala Mu, Perak n(%)	***PPR Sungai Bonus, Kuala Lumpur
	Use seawater as a water source	Use river as a water source	*n/a
Yes	56(28.0)	139(70.8)	
No	144 (72.0)	57(29.1)	

*n/a (not available): The question was not included in the questionnaire for that particular community
**n/a (not applicable): Irrelevant to that particular community
***Pulau Gaya, n=200, Pos Kuala Mu, Perak, n=196, PPR Sungai Bonus, Kuala Lumpur, n=62

Table 52: Participants' access to electricity

	***Pulau Gaya n (%)	***Pos Kuala Mu n (%)	***PPR Sungai Bonus
Electricity supply			*n/a
Sabah Electricity Sdn. Bhd. (SESB)	119(59.5)	**n/a	
Tenaga Nasional Berhad (TNB)	**n/a	159(81.1)	
Shared electricity/connect from other places	57(28.5)	37(18.9)	
Own generator	13(6.5)	4(2.0)	
Shared generator	4(2.0)	1(0.5)	
No electricity	7(3.5)	2(1.0)	

*n/a (not available): The question was not included in the questionnaire for that particular community
**n/a (not applicable): Irrelevant to that particular community
***Pulau Gaya, n=200, Pos Kuala Mu, Perak, n=196, PPR Sungai Bonus, Kuala Lumpur, n=62

Table 53: Participants' access to town

	***Pulau Gaya n(%)	***Pos Kuala Mu n(%)	***PPR Sungai Bonus n(%)
Frequency to town/week			*n/a
1 time	101(50.5)	86(43.9)	
2 times	56(28.0)	38(19.4)	
3 times	28(14.0)	11(5.6)	
more than 3 times	15(7.5)	6(3.1)	
Once in a while	0(0)	1(0.5)	
Never	0(0)	11(5.6)	
Don't know		2(1.0)	
Transportation to town			*n/a
Boat	152(76)	**n/a	
Sampan	15(7.5)	**n/a	
Bicycle	3(1.5)	5(2.6)	
Motorcycle	1(0.5)	151(77.0)	
Car	**n/a	137(69.9)	
Others	0(0)	6(3.1)	
Have you been hindered from going to town?			*n/a
Yes	153(76.5)	50(25.5)	
No	47(23.5)	144(73.5)	
Factors preventing you from going to town			*n/a
Weather	92(46.0)	138(70.4)	
Health	34(17.0)	109(55.6)	
Financial	29(14.5)	67(34.2)	
Transportation	5(2.5)	52(26.5)	
Enforcement	33(16.5)	20(10.2)	
Safety	*n/a	50(25.5)	
Others	29(14.5)	6(3.1)	
No hindrance	38(19.0)	27(13.8)	

*n/a (not available): The question was not included in the questionnaire for that particular community
**n/a (not applicable): Irrelevant to that particular community
***Pulau Gaya, n=200, Pos Kuala Mu, Perak, n=196, PPR Sungai Bonus, Kuala Lumpur, n=62

Table 54: Participants' access to health-related information and health facilities

	***Pulau Gaya n (%)	***Pos Kuala Mu n (%)	***PPR Sungai Bonus n (%)
Exposure to health information			
Yes	121(60.5)	159(81.0)	52(83.9)
No	79(39.5)	37(19.0)	10(16.1)
Source of health information			
Parents/guardian	59(29.5)	105(53.6)	44(71.0)
Teacher		93(47.4)	27(43.5)
Television	71(35.5)	138(70.4)	39(62.9)
Radio	6(3.0)	53(27)	17(27.4)
Talks	21(10.5)	33(16.8)	17(27.4)
Health officer	4(2.0)	7(3.6)	5(8.1)
Others	28(14.0)	4(2.0)	0(0.0)
No source	48(24.0)	5(2.6)	2(3.2)
Experience certain types of diseases/feeling unhealthy during a specific season			
No	54(27.0)	116(59.2)	40(64.5)
Hot season (example: cough, fever, headache, flu)	88(44.0)	40(20.4)	6(9.7)
Rainy season (example: cough, fever, headache, flu)	105(52.5)	48(24.5)	15(24.2)
Place to seek medical treatment			
Government clinic/hospital	130(65.0)	164(83.7)	58(93.5)
Private clinic/hospital	58(29.0)	31(15.8)	9(14.5)
Traditional remedy	21(10.5)	81(41.3)	2(3.2)
Self-treatment	48(24.0)	75(38.3)	17(27.4)
Not seeking any treatment	7(3.5)	7(3.6)	4(6.5)
Others	3(1.5)	2(1.0)	1(1.6)

***Pulau Gaya, n=200, Pos Kuala Mu, Perak, n=196, PPR Sungai Bonus, Kuala Lumpur, n=62

4.3 Principal component analysis (PCA)

PCA was employed to analyse the effect of climate change and environmental degradation on children at the selected locations. Based on the analysis from the questionnaire, three main patterns of behaviour emerged related to climate change and environmental degradation among the children living in Pulau Gaya, Pos Kuala Mu, Perak and PPR Sungai Bonus, Kuala Lumpur: vulnerability, resilience, and accessibility. The patterns and principal components for each cases study are as follows (Table 6).

4.3.1 Principal component analysis for children living in an island environment

The island environment setting is represented here by Pulau Gaya of Sabah. The large positive associations between climate change and environmental degradation with vulnerability, resilience, and accessibility significantly distribute to the children's behavioural patterns. Figure 75 shows the PCA, which illustrates the associated effects of climate change and environmental degradation on the children in an island environment. Each of the patterns is discussed based on the major components.

a. Vulnerability

Children living in Pulau Gaya perceived themselves as vulnerable on four indicators. These are socializing ability, citizenship status, support system, and perceived degree of literacy. Sociability is referring to the children's perceived social ability. This research found that children who went to ALC are perceived to be more sociable than children who went to the government schools in Pulau Gaya. The next indicator of perceived vulnerability among children in Pulau Gaya is the availability of a support system. The support system here is defined as the provision of support by parents. In this study, we found that girls are perceived to receive better support than boys. There are no clear differences of support between the three categories of age.

Another indicator in measuring the children perceived vulnerability is the degree of literacy. Obviously, the lower the degree of literacy, the more vulnerable the children are. In this study, it was shown that girls have a better degree of literacy compared to boys. Another interesting observation is that number of individuals in the household will determine the degree of literacy among the children. Children from smaller household sizes (less than five) are perceived to have better literacy levels than children from bigger-sized households.

Another interesting observation is that children who studied at the ALC perceived that their degree of literacy was much lower than their friends who went to government schools. Thus, children in Pulau Gaya who tend to have low sociable skills, low support system, insecurity about their citizenship, and low degree of literacy would be categorized as vulnerable. This vulnerability is manifested in how the children deal with extreme weather, as indicated in the IDIs with the teachers at Pulau Gaya. Through the teachers' observations, these children are particularly vulnerable to extreme weather because of their dependence on adults to ensure their safety and well-being. Children are also vulnerable to climate change because of their potentially greater exposures, greater sensitivity to certain exposures, and dependence on caregivers for appropriate preparedness and response. According to respondents, the most common illnesses for children in Pulau Gaya are fever, heat-related illnesses, water-borne diseases such as diarrhoea, and vector-borne diseases like malaria.

b. Resilience

The next observed pattern of behaviour among the children in Pulau Gaya is the degree of resilience. Children's perceived resilience is measured based on how the children adapt to climatic challenges, sea-related extremes, heat extremes, and rain extremes. This perceived behaviour pattern is an essential indicator of how children would face climate change and environmental degradation. Sea-related extremes refer to any extreme changes to the sea, such as big tides and waves. Heat extremes refer to increases in temperature and prolonged dry seasons. Rain extremes refer to prolonged rainy seasons and increases in rain volume.

This study found that boys are perceived as more resilient towards sea-related extremes but are perceived as less resilient to heat and rain extremes. On the other hand, girls are perceived as less resilient towards sea-related extremes but are more resilient towards heat and rain extremes. Children from families that earn less than RM1,500 per month are perceived to have less resilience towards sea-related extremes, heat, and rain extremes than children from families that earned more than RM1,500 per month. In other words, families with better income could provide better protection to their children, hence the high perceived resilience.

c. Accessibility

Children living in Pulau Gaya were also asked about their perceived accessibility towards several indicators such as medical services, living conditions, education, clean water, and adequate food. Access to all these necessities are essential indicators to further understand the impact of climate change and environmental degradation on children. In an ideal world, children should have limitless access to medical services, good living conditions, education, clean water, and food. Findings from the research show that in terms of gender, girls are perceived to have better access to food, water, and medical services than boys. Boys perceived that they are not as lucky as the girls in access to these three indicators. The boys perceived that they only have more access to education.

From the context of income, children from families who earn less than RM1500 a month perceived that they already have access to water and food but not education, unlike children from families that earn more than RM1500 a month. These children perceived that they have access to education but no access to water and food. Access to clean water in Pulau Gaya is still troublesome. Only certain villages receive clean water from the mainland, while others depend on rainwater and buy water from the mainland through a middleman. As for access to medical services, no medical facilities are available in Pulau Gaya. The islanders would need to go to the mainland to get medical attention if necessary. However, children from both categories of family income perceived that they do have access to medical services.

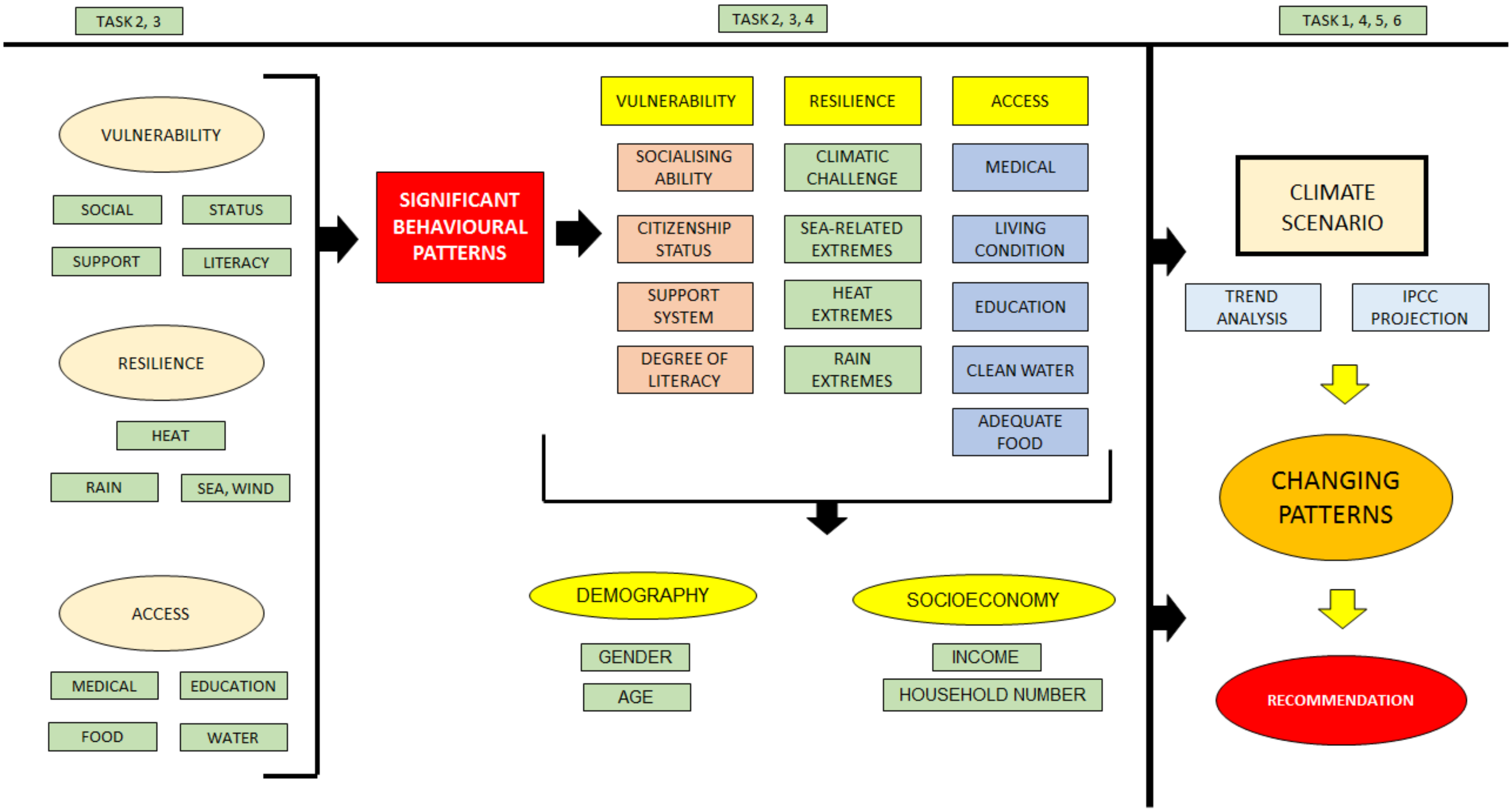

Figure 75: Overview of tasks for the case study in Pulau Gaya, Sabah

Task1 - To establish and map the ecological sensitivity of Pulau Gaya, Task 2 - To investigate the level of resilience of the children of Pulau Gaya against climate change, Task 3 - To evaluate the degree of vulnerability of the children, Task 4 - To identify all the critical needs for strategic intervention (especially in healthcare and education), Task 5 - To understand the existing policies and governance framework (state level) of the related issues, Task 6 - To make and communicate recommendations to the relevant authority.

4.3.2 Principal component analysis for children living in a mountainous environment

The mountainous environment is represented here by Pos Kuala Mu in Sungai Siput, Perak. Some slightly different associations between climate change and environmental degradation with vulnerability, resilience and accessibility were observed. Figure 76 below shows the PCA, which illustrates the associated effects of climate change and environmental degradation on children in a mountainous environment. Each of the patterns is discussed based on the major components.

a. Vulnerability

Children from the Orang Asli community in Pos Kuala Mu, Perak, perceived themselves as vulnerable based on several indicators. Girls and older children aged more than 14 years old from families with estimated monthly incomes of less than RM1,500 are more attentive to their health and hygiene regardless of their household size. Personal hygiene is important as its acts as both the first and last defence against diseases and infections. Thus, how the children perceive their health and hygiene is crucial in determining their vulnerability to climate change impacts. Studies have shown that primary measures for disease prevention include the improvement of water, sanitation, and hygiene (WASH) (WHO 2014, WHO 2016). For example, improving WASH can prevent 57% of diarrheal deaths and becomes the first line of defence against cholera (WHO 2014, WHO 2015, WHO 2016).

The Orang Asli children are satisfied with their current living conditions regardless of family income or household size. For the Orang Asli community, some houses are provided by JAKOA. Living conditions are another factor that can influence the vulnerability of children. Children with good living conditions, especially in terms of their house condition and comfort, can grow healthily and have sufficient support against climate change impacts. Good living conditions provide a stable environment for children's development. According to Clair (2019), homes are an important component of the children's environment. Housing is one of the components investigated in some studies related to children's well-being, such as Bradshaw and Richardson (2009). How the children perceived their living conditions is important because it is a part of the children's rights, as an adequate standard of living is included in the UNCRC in Article 27.

As a gender equity indicator, boys aged ten to 14 years old, from households with estimated household incomes of less than RM1,500 and household sizes of five or more, perceived that they do more house chores than their siblings. Other than that, they perceived that they could get along with those of a different gender. Their attitude towards the environment is important as it can bring a harmful effect to the environment.

Older boys aged more than 14 years old, from families with estimated household incomes of less than RM1,500, and household sizes of five and above perceived themselves as someone with a lack of an attitude towards the environment. Children from families with estimated household incomes of more than RM1,500 and family members of five and more perceived that they had received sufficient social support in terms of food supply and access to school (can go to school easily). These children also perceived that their families had good resources in terms of access to alternative health facilities and financial sources. In terms of supporting their family, girls aged ten to 14 years old, coming from families with estimated household incomes of more than RM1,500, and regardless of household size, prefer to earn a living instead of going to school. Among the reasons for this could be the lack of awareness about the importance of education and motivation or support from parents.

Poverty can further exacerbate the impact of climate change. Poverty deprived the children of their right to education and to grow healthily. The researcher found that children from families with estimated household incomes of less than RM1500 and family members of five or more perceived that they do not have sufficient food supply and cannot go to school easily. Large family sizes will add another burden to low-income families as household needs increase when there is more family member (Department for Work and Pensions 2014). Furthermore, due to their slightly better conditions, children from families with estimated household incomes of more than RM1500 and family members of five or more perceived that their family has good resources in terms of access to alternative health facilities such as private clinics and alternative financial sources. Lack of financial and educational resources with little access to social and cultural capital was associated with low socio-economic status families. These may adversely affect children's well-being (Bradley and Corwyn 2002, Claro et al. 2016, Watkins and Howard 2015).

b. Resilience

Climate resilience refers to the ability to prepare for, recover from, and adapt to climate change impacts (Center for Climate and Energy Solutions 2019). The study found that boys aged between ten to 14 years old, from families with less than RM 1,500 estimated household incomes per month, and more than five family members perceived themselves as resilient to heat and rain extremes. In terms of vaccination, older boys and those from families with more than RM 1,500 estimated household incomes and more than five family members perceived vaccination as a means to protect themselves from diseases.

c. *Accessibility*

In terms of accessibility, boys aged between ten to 14 years old and children from households with more than five family members with estimated household incomes of more than RM1,500 perceived that the rainy season did not hinder them from going to school and their fathers to work.

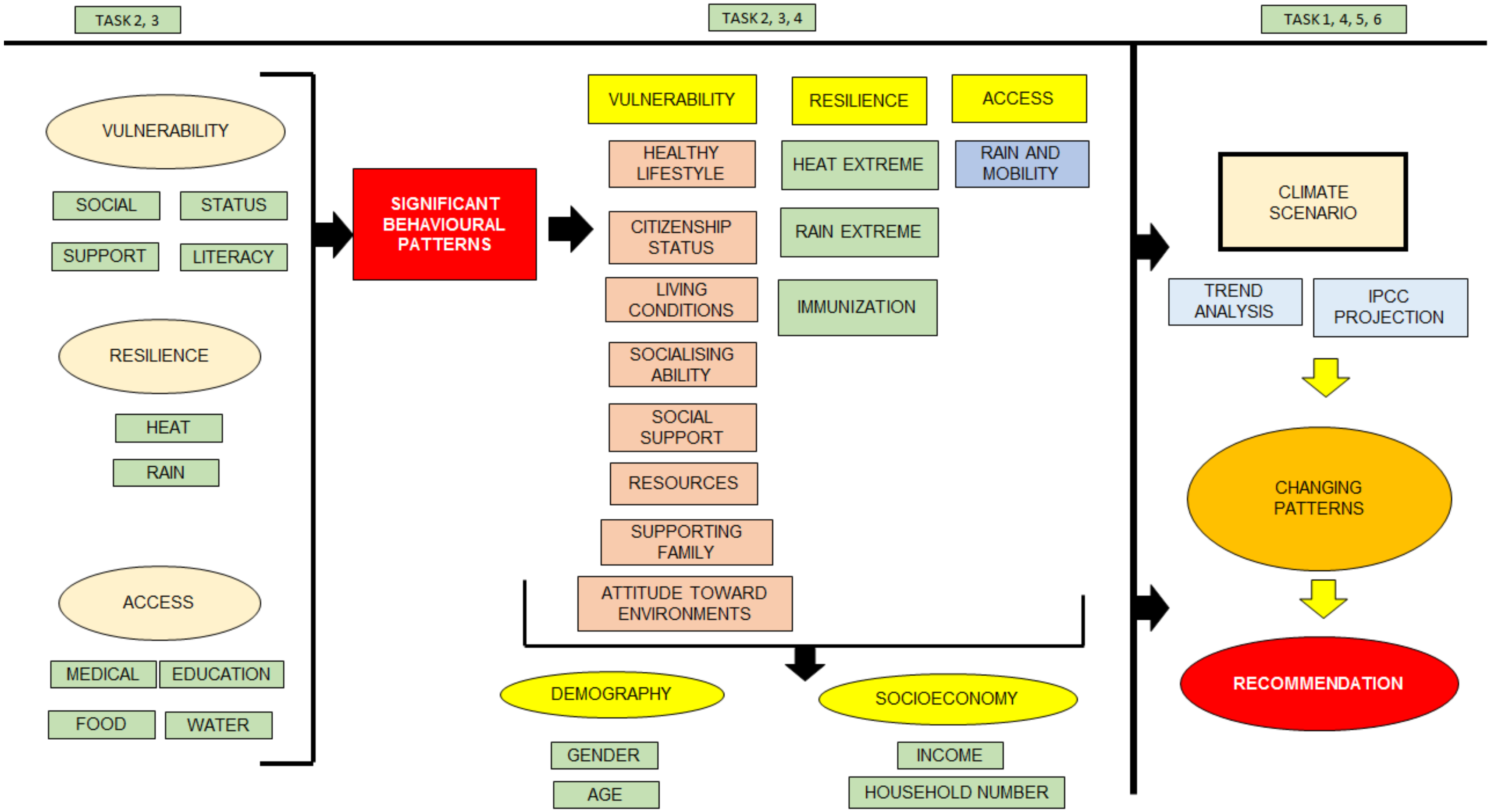

Figure 76: Overview of tasks for the case study in Pos Kuala Mu, Perak

Task1- To establish and map the ecological sensitivity of Pos Kuala Mu, Task 2- To investigate the level of resilience of the children of Pos Kuala Mu against climate change, Task 3- To evaluate the degree of vulnerability of the children, Task 4- To identify all the critical needs for strategic intervention (especially in healthcare and education), Task 5- To understand the existing policies and governance framework (state level) of the related issues, Task 6- To make and communicate recommendations to the relevant authority

4.3.3 Principal component analysis for children living in an urban environment

The urban environment is represented here by a PPR situated in Setapak, Kuala Lumpur, known as PPR Sungai Bonus. Some slightly different associations between climate change and environmental degradation with vulnerability, resilience and accessibility were observed. Figure 77 below shows the PCA illustrating the associated effects of climate change and environmental degradation on children in an urban environment. Each of the patterns is discussed based on the major components.

a. Vulnerability

In terms of healthcare support, children in PPR Sungai Bonus from families with estimated household incomes of more than RM1,500 and more than five family members perceived that they received good healthcare support. Other than that, they are also perceived to have received sufficient social support in terms of food supply.

For living conditions, children from families with estimated household incomes of more than RM1,500 and less than five family members perceived that their house was comfortable for their whole family. The PPR type of house with three bedrooms and two bathrooms with a rental of RM124 per month will be affordable and comfortable for families with an average family size of five persons. In terms of safety indicators, children, regardless of their family's estimated household income, perceived that their houses as the safest place during bad weather. Boys aged ten to 14 years old prefer to support their families by working instead of going to school.

Boys aged ten to 14 years old and children with less than five family members prefer to support their family by working instead of going to school. However, based on estimated household income, the children in PPR Sungai Bonus preferred going to school instead of supporting their families. Awareness about the importance of education and parents' or guardians' perception toward education might be why they preferred to go to school. Children's perceptions towards education and their school performance can be influenced by their family's socio-economic background and parent's involvement and attitude towards education (MOE, 2018). Education will become less important for families with economic and social difficulties (DOSM, 2018).

Girls aged more than 14 years old and children from families with estimated household incomes of more than RM1,500 and household size of more than five perceived themselves as someone with a lack of an attitude towards the environment. As for gender equity, girls aged less than ten and more than 14 and children from families with estimated household incomes of more than RM1,500 and more than five family members perceived that gender is not a problem for them in school.

b. Resilience

In terms of resilience, boys aged ten to 14 years old and children from families with estimated household incomes of more than RM1,500 perceived themselves as resilient towards heat and rain extreme. Other than that, children, regardless of their families' estimated household incomes, are resilient toward rain extremes.

Studies show that the urban heat island phenomenon exposed the urban populations to higher and more frequent heat than the non-urban populations, thus makes them more susceptible to heat waves (Hajat and Kosatky 2010, Gabriel and Endlicher 2011, Tan et al. 2010). It was found that children from households with estimated incomes of more than RM 1,500 and less than five family members are perceived as resilient towards heat extremes than children from the opposite family conditions. Their household conditions may enhance their ability to cope with heat extremes.

c. Accessibility

This study found that young girls aged between six to nine years old and children from families with estimated household incomes of more than RM1,500 with more than five family members are perceived to have access to health facilities, including non-government ones. Their families also have alternative financial sources. For rain and mobility indicators, children, regardless of their family income, perceived that during rainy weather, their father could not go to work, and it is difficult to get food supplies.

In terms of accessibility to education, girls aged less than 14 years old and children with more than five family members perceived that it is easy for them to go to school. However, children, regardless of their family income, perceived that it is difficult for them to go to school. The reason might be due to COVID-19 since the data was collected during the COVID-19 pandemic, and the school was closed.

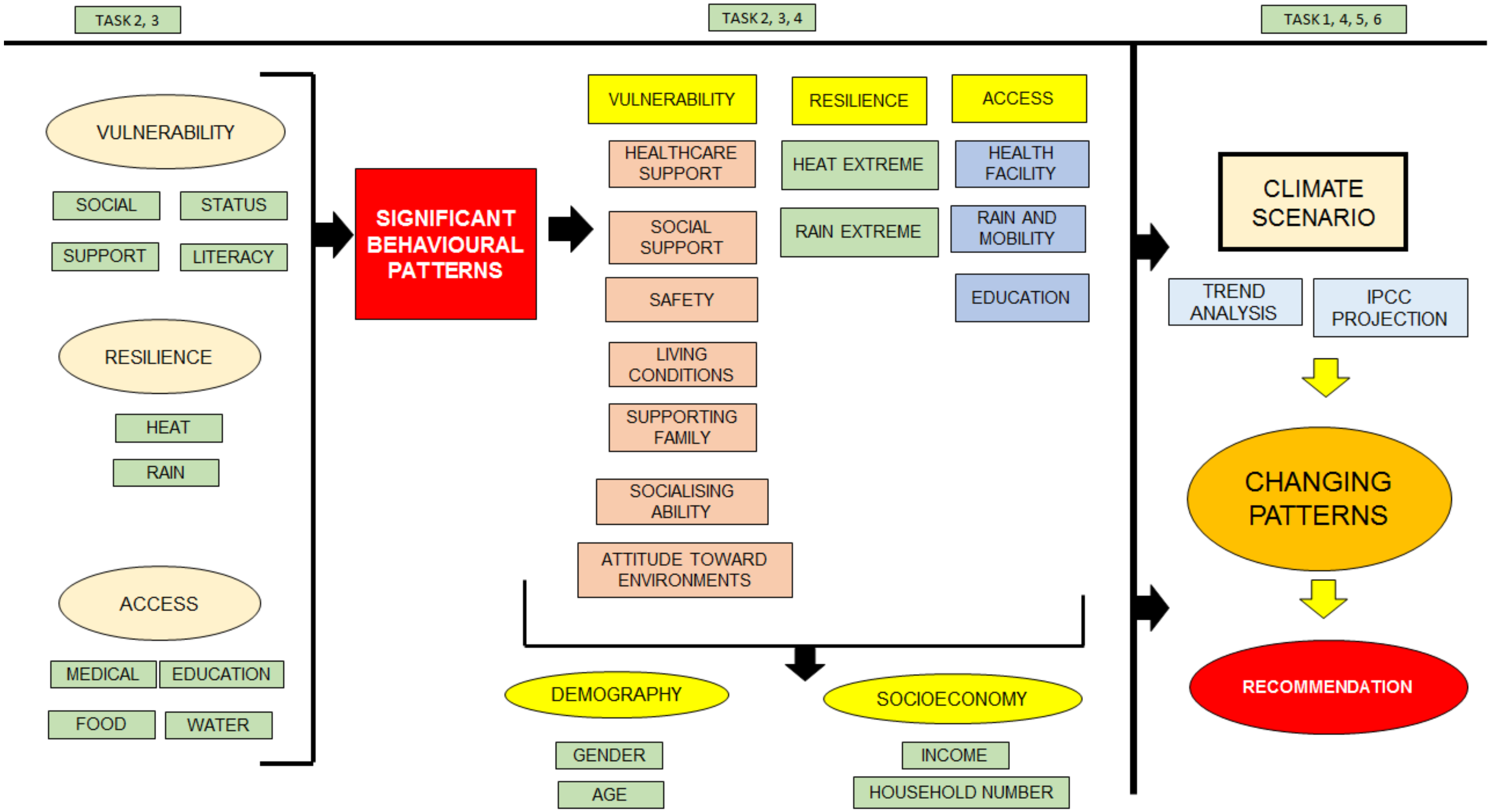

Figure 77: Overview of tasks for the case study in PPR Sungai Bonus, Kuala Lumpur
Task 1 - To establish and map the ecological sensitivity of PPR Sungai Bonus, Task 2 - To investigate the level of resilience of the children of PPR Sungai Bonus against climate change, Task 3 - To evaluate the degree of vulnerability of the children, Task 4 - To identify all the critical needs for strategic intervention (especially in healthcare and education), Task 5 - To understand the existing policies and governance framework (state level) of the related issues, Task 6 - To make and communicate recommendations to the relevant authority

4.4 Qualitative study: in-depth interview (IDI) and focus group discussion (FGD)

4.4.1 Themes and Subthemes

The qualitative approach was used to explore the perceptions of the community in Pulau Gaya, Sabah, Pos Kuala Mu, Perak and PPR Sungai Bonus, Kuala Lumpur about changes related to climate and environmental degradation that occur around the community and the potential impact of climate variability to their livelihood and their children's well-being. The themes and subthemes that emerged from the qualitative studies are as follows (Table 55):

Table 55: Themes and subthemes from qualitative studies in Pulau Gaya, Sabah, Pos Kuala Mu, Perak and PPR Sungai Bonus, Kuala Lumpur

Core themes	Subthemes		
Vulnerability	Local environmental and geographical conditions	Source of income	Prevalence of climate-sensitive diseases
Resilience	Education		
Accessibility	Water and food availability	Availability and accessibility of basic social services	

a. *Vulnerability*

Local environmental and geographical *conditions*

Among the factors that determine the vulnerability of communities towards climate change and environmental degradation impact are their local environmental and geographical conditions. From this study, the communities living in Pulau Gaya, Sabah, Pos Kuala Mu, Perak and PPR Sungai Bonus, Kuala Lumpur, may experience different impacts of climate change due to their difference in local environmental and geographical conditions. In terms of geographical locations, communities in Pulau Gaya and Pos Kuala Mu, Perak are especially vulnerable to climate change due to their susceptibility to climate-related disasters such as hurricanes and landslides.

In Pulau Gaya, Sabah, a hurricane occurrence may affect the safety of the islanders, especially children, as it can cause roofs to be blown away, houses to collapse, and bridges that connect one house to another to break.

> *'…Last year (2019), in October, a hurricane occurred, the roof (made of zinc) at the ALC school was blown away by the strong wind, children could not go to school for weeks...'*

'…Once we had experienced… our house being blown away by strong wind… strong winds also blew off the roof of the school and surau ...'

Communities in Pos Kuala Mu, Perak are exposed to landslide risk, especially during the rainy season. One of the participants said that when it is raining, a landslide can occur and cut off the road towards the Orang Asli pos or villages on the mountain area, as the road is near the hillside.

'Recently, a landslide occurred on the road towards Pos Yob (one of the Orang Asli village in the area), so the road was cut off…the road is near the hillside so when it's raining, the land will slip, and the road will be cut off.'

Other than that, local environmental conditions, i.e. environmental pollution and logging or land clearing activities in the surrounding area, may contribute to the community's vulnerabilities towards climate change impacts. Environmental pollution due to garbage is the main concern of the communities in Pulau Gaya and PPR Sungai Bonus, Kuala Lumpur. The littering habit of the communities is the main cause of environmental pollution in both areas. The improper garbage disposal may become breeding habitats for climate-sensitive diseases vectors, making the communities vulnerable to climate change impacts, especially children. Not only that, but the littering habit may also affect the safety of the communities. For example, some of the residents in PPR Sungai Bonus habitually throw garbage from the upper floor to the ground floor. This habit may affect the safety of other residents, especially the children.

'Sometimes when I walk around the flat area, there will be people throwing their rubbish from upstairs, soy sauce bottle or glass.'

'The garbage house is there, but maybe they feel that this flat is too high, then they just throw the garbage out of the window.'

Logging and land-clearing activities are the main environmental degradation found in the surrounding area of communities in Pos Kuala Mu, Perak.

'When I first came here, all the area was still green. Now it has been explored...even up there. Before this, the air was fresh. But maybe because a lot of trees had been cut down, the air is not the same as before.'

'Deforestation can be found here because the forest was cut down for clearing (land clearing)… yes. (the land is for agriculture)...palm oil, rubber, cocoa...'

These logging and land clearing activities may cause landslides to occur in the area during the rainy season.

> *'Maybe the trees….the villagers…when they want to make a farm they will need to clear the area. Maybe when the trees are no longer there, the roots can no longer hold the ground, thus, it is easy for the landslide to occur when it is raining.'*

Source of income

The rainy season may affect the communities' sources of income, especially communities in Pulau Gaya and Pos Kuala Mu, Perak. Many of them depend on climate-sensitive economic activities for their livelihood, and rainy seasons will hinder them from going out to work.

> *'My husband works as a contract worker (in the mainland). During the rainy season, he can't go to work.' (participant from Pulau Gaya, Sabah)*

> *'Like this year, starting July if I'm not mistaken, July, August, September...it always rains...we can't do anything. Can't go rubber tapping, we can't enter the forest to find herbs…to find 'Tongkat Ali'...to dig 'Tongkat Ali'...to sell 'Tongkat Ali', we can't do it because of rain' (participant from Pos Kuala Mu, Perak)*

> 'I work as a Grab driver, so during heavy rain with the storm, lightning…who wants to go out? Who wants to take the risk? This will affect our income' *(participant from PPR Sungai Bonus, Kuala Lumpur)*

The situation has now worsened as many people lost their jobs due to the COVID-19 pandemic.

> '..no…I don't have a job for two years. Before that, I tried to work as a Grab driver but Grab also now is getting worse (due to the COVID-19 pandemic) *(participant from PPR Sungai Bonus, Kuala Lumpur)*

Meanwhile, children with disabilities are provided with financial assistance from the Department of Social Welfare (JKM) Malaysia, which can help lessen the burden of families with children with disabilities.

> *'Registered…she gets it (financial assistance) from JKM…around RM400' (participant from PPR Sungai Bonus, Kuala Lumpur)*

This may contribute to the vulnerabilities of the children, as their families' financial problems may affect the availability and accessibility of basic necessities and social services such as food and healthcare. Other than that, socio-economic problems may lead to social issues such as drugs and petty theft. These have occurred in the PPR Sungai Bonus, Kuala Lumpur community, where several cases related to drugs and theft had been reported.

> *'It's easy to get pocket money by selling drugs. Once they start to sell it, they will start using it.'*

> *'Theft cases (isolated cases) are among teenagers.'*

Prevalence of climate-sensitive diseases

The existence of climate-sensitive diseases in the community will make the community vulnerable to climate change impacts. From this study, all three communities are exposed to the risk of climate-sensitive diseases, i.e. dengue and malaria.

> '*It occurs here (malaria)' (Participant from Pulau Gaya, Sabah)*

> *'At the moment, this village has no malaria cases. Recently in Pos Yum (another Orang Asli village in the area)…but not many get malaria, only about two cases.' (Participant from Pos Kuala Mu, Perak)*

> *'There is are a lot of dengue cases here.' (Participant from PPR Sungai Bonus, Kuala Lumpur)*

b. Resilience

Education

Children's education can be considered a part of the children's adaptive capacity against the impending impact of climate change and environmental degradation. This is because education may provide children with adequate knowledge and skills to cope with climate change and environmental degradation. Climate variability may affect children's education in terms of transportation and access. Rainy seasons may prevent children in Pulau Gaya, Sabah and Pos Kuala Mu, Perak, from going to school due to transportation issues. This may affect the children's education, and climate change will aggravate the situation as frequent rainfall will continuously prevent the children from going to school if the issue is not addressed. In Pulau Gaya, Sabah, one participant noticed that students would become less focused in lessons during hot weather. There is also a decline in school attendance during the rainy season. Other than that, not many boats are available during the rainy season due to strong winds.

'...If it's raining in the morning, they don't come to school the whole day...'

Parents in Pulau Gaya, Sabah, are also concerned about their children's safety. Thus, they did not allow their kids to go to school during rainy weather.

'…when it's raining, we didn't allow our children to go to school...but if it's only cloudy, we still send them to school.'

Meanwhile, one of Pos Kuala Mu's participants said that it is difficult to send his children to school during heavy rain, but he will find an alternative.

'If the rain is heavy, then need to postpone it (not attending school)… (his child) can't go to school….it happens sometimes, but we will try to send them to school…using an umbrella or raincoat…'

One of the reasons why the rainy season may affect children's access to education is transportation. According to a participant in Pos Kuala Mu, Perak:

'Maybe in terms of transportation to school because most of the Orang Asli, they only have a motorcycle, they don't have a car. So when it rains, they can't send their children...and those who live far from school are staying at the hostel, but problems still arise if they go back during the weekend and come back on Sunday...if it's raining heavily on Sunday, they will not be many students on Monday. They either come back to the hostel on Monday afternoon or the next day if it's still raining on Monday.'

Children who live in PPR Sungai Bonus, Kuala Lumpur, can still go to school despite the rainy weather, as various modes of transportation are available for them. Children's perceptions towards education and their school performance can be influenced by their families' socio-economic background and parents' involvement and attitude towards education (MOE, 2018). Education will become less important for families with economic and social difficulties (DOSM, 2018). Thus, a family's lack of income due to climate variability may affect the children's education as their parents or guardian might regard education as unimportant for their family's survival.

c. Accessibility

Water and food availability

Climate variability, especially rainy seasons, may affect the community's food and water availability. This is the case for communities in Pulau Gaya and Pos Kuala Mu, Perak. For Pulau Gaya communities, the rainy season may hinder them from getting food supply from the mainland.

'… *the food supply is not sufficient during rainy season… and strong winds and strong waves prevented us from going fishing… difficult for us to go to the market (Pasar Besar) also in Kota Kinabalu*…'

Meanwhile, according to one of the participants from Pos Kuala Mu, Perak, the lack of income sources is the main cause of their lack of food availability.

'*Sometimes I don't have enough money to go to grocery store…sometimes it comes to the point where I make an agreement with the store owner…let say his name is Hamid… 'Mid, please help me, I want to borrow a few things (buy and pay later), later when I have money I will pay you back'...'*

Climate variability can also affect water quality and accessibility, especially for communities in Pulau Gaya, Sabah and Pos Kuala Mu, Perak, as they lack access to clean water. Most of them depend on nature for water sources as river water. The hot and rainy season will affect the Pulau Gaya community's access to clean water. The rainy season affects the availability of clean water because the boat that sells water cannot come to the island, so they need to depend on rainwater. Meanwhile, it is difficult to get water during the hot weather as water becomes expensive, and the people who sell water seldom come to the island. There is no systematic water supply for daily use in Pulau Gaya, so the community has to buy water at RM5 to RM7 a drum. One of the participants From Pulau Gaya stated that:

'… *the villages in Pulau Gaya lack water supply because the main pipes/taps are not connected to our homes...we have to buy clean water from our neighbours who have the main pipe. We get water supply from rain*…*and we buy water from the mainland (Kota Kinabalu)…*'

As for Pos Kuala Mu, Perak, the rainy season will affect the community's water quality as they depend on the river as the main source of water supply.

'The rainy season (affects water quality) because the water is murky.'

The community that lives in PPR Sungai Bonus, Kuala Lumpur, might not experience this lack of food and clean water supply as climate variability may not hinder access to these resources.

Availability and accessibility of basic social services

Communities in Pulau Gaya, Sabah and Pos Kuala Mu, Perak may experience a lack of access to basic social services, i.e. health facilities during the rainy season, as it may have hindered their mobility. One of the participants from Pulau Gaya, Sabah, said that:

> *'…our child is sick…want to take him to Likas Hospital…we go knock on our neighbour's door…asking anyone who has a boat. Depending on the weather as well, if the rain is not heavy…we can go to hospital…* if the rain is heavy*, there is a storm and strong waves, we can't go to the hospital…we are afraid that the boat will overturn… even if your child is really...really sick, you just need to wait…'*

For communities in Pos Kuala Mu, Perak, the health facility is located far from the village. The closest health facility for villagers in Pos Kuala Mu is the Lintang health clinic, Sungai Siput, more than 40km away. The rainy season will affect their access to the health facility as rainy weather will hinder their mobility. The road that winds up the mountain is narrow and may only fit one large vehicle at a time. Thus, travelling during the rainy weather may affect their safety.

> *'There is no specialist to come to the village (for health check-ups). They need to refer to the big Hospital. So, the parents, when the doctor asks them to go to the hospital (for their child's treatment) …at the beginning they will go...but later on, they will stop going…(because) it's far.'*

The community that lives in PPR Sungai Bonus, Kuala Lumpur, have easy access to basic social services as they are sufficient in the urban areas and within their reach

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APPENDIX 5 FINAL REPORT OF THE CASE STUDY IN PULAU GAYA

5.1 Introduction

The impacts of climate change and environmental pollution and degradation are increasingly felt in Malaysia. As surface mean temperatures continue to rise, the country is expected to experience increasingly volatile weather systems. Challenges associated with land use and land cover changes, urbanization, environment, and air quality degradation are also expected to increasingly impact agriculture and food security, safe water supplies, public health, and the delivery of essential social services.

Despite the many ways climate change impacts children, children are consistently overlooked in the design and content of climate policies and related processes (Pegram and Colon 2019). In addition, insufficient attention has been directed to increase community understanding of the impacts of climate change and environmental degradation on the lives of families and children – particularly in vulnerable communities – and encouraging environment-friendly values and practices among children and young people. In vulnerable communities, climate and environment-related risks are further exacerbated by poverty, illiteracy and limited access to information. UNICEF has set out to examine current national climate policies/plans to ascertain how child-sensitive they are and provide recommendations on strengthening the focus on children's rights, including actionable and measurable results for children.

Legislative, enforcement, and other measures to prevent children from being exposed to environmental health risks are often inadequate or missing. Tuncak (2015) noted, for example, that while the child's best interests should be at the heart of all decisions affecting the child, today 'laws and policies around the world essentially permit children to be exposed to hazardous substances. Strong laws and policies, with good implementation, play a crucial role in ensuring children's rights and best interests are upheld and protected. While Malaysia has put serious effort within its law and policies to deal with environmental issues and address the effects of climate change, children's issues have not been well recognized or addressed within the existing national climate change and environmental framework. On the other hand, law and policies relating to children or public health does not address climate change and environmental harms. Therefore, efforts should be undertaken to review the current framework holistically.

NDCs outline the post-2020 climate actions that countries intend to take to reduce national emissions in line with the Paris Agreement's goal of limiting warming to under 2°C. While their focus is on mitigation, Parties are invited to include a more comprehensive view of national climate policies, strategies, and action plans, including adaptation and means of implementation (UNFCCC, 2014). Given this comprehensive coverage and the role of NDCs in setting out State Parties' national commitments on climate change, these provide a useful indication of national priorities and the degree to which these are child-sensitive. Moreover, National Adaptation Plans (NAPs) identify countries' medium- and long-term adaptation needs and strategies/programmes to address them. Since NAPs represent countries' strategic approach to adaptation and address issues that are fundamental to children's rights in developing countries, the degree to which they are child-sensitive provides an important insight into whether governments understand, recognize and prioritize the specific needs and capacities of children and youth.

Overall, the major challenges faced in mobilizing more effective action on climate change and environmental degradation concerns in Malaysia include:

5. Inadequate evidence to guide policies and plans on the likely impacts of climate change and environmental pollution and degradation on the healthy growth, development, and socialization of children
6. Inadequate legislative and policy protection for children from environmental and climate risks, particularly in marginalised communities
7. Lack of clarity about the extent to which current national policies, laws, and budgets are climate change responsive and the extent to which broad climate change adaptation and mitigation measures are child friendly
8. Low levels of community consciousness of these impacts and adaptation measures required at individual, family, and societal levels

5.2 Objectives

Based on the above background, Pulau Gaya has been chosen as a case study to demonstrate the above-listed challenges in mobilizing effective action on climate change and environmental degradation in Malaysia. From the climatology perspective, as an island, Pulau Gaya is relatively more vulnerable to climate change. Therefore, a case study has been conducted to achieve the following objectives:

- Profiling the climate patterns and trends (for seasonal variability and long-term change) and environmental degradation
- Profiling the children's demographic and socio-economic backgrounds, including their mobility
- Analysing the degree of vulnerability by correlating both the climate/environment and the children's profiles
- Engaging with relevant stakeholders (local/state authorities and NGOs) to map the existing policies and initiatives related to the issue (children's vulnerability under the multiple climatic and environmental factors)
- Recommending a strategic framework and proposed interventions to address the issue

5.2.1 Tasks

To achieve the above objectives, five tasks have been identified as follows.

i. To establish and map the ecological sensitivity of Pulau Gaya
ii. To investigate the level of resilience of the children of Pulau Gaya against climate change
iii. To evaluate the degree of vulnerability
iv. To identify all the critical needs for strategic intervention (especially in healthcare and education)
v. To understand the existing policies and governance framework (state level) of the related issues
vi. To make and communicate recommendations to the relevant authority

5.3 Methods of study

Desk study	• climate change patterns
Survey	• with children at Pulau Gaya
FGDs	• with parents
IDIs	• with teachers at SK/SMK Pulau Gaya and Lok Urai ALC
Stakeholder engagement	• for data validation and feedback
Analysis of data	• data analysis from desk study, survey and IDI, FGD and engagement workshop

5.4 Findings

5.4.1 Demographic Profile

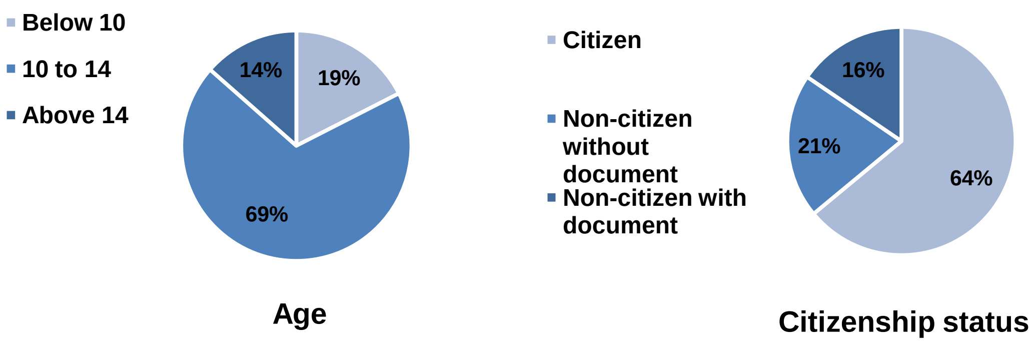


Figure 78: Age and citizenship status of respondents

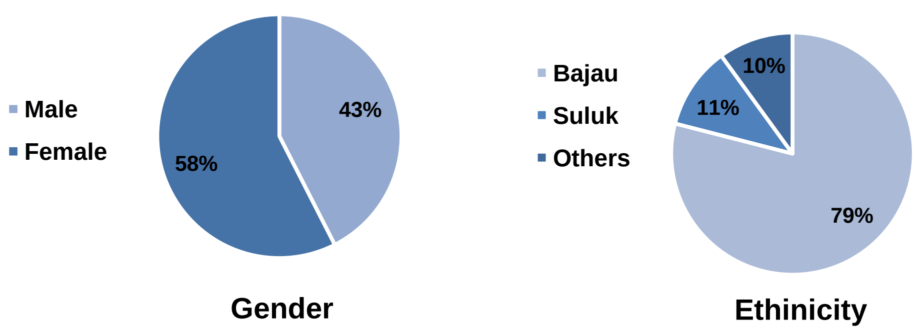


Figure 79: Gender and ethnicity of respondents

Figure 78 and Figure 79 shows the demographic distribution of respondents. Overall, 200 respondents agreed to be interviewed. 69% are from the age group of ten to 14 years old, with 54% citizens, 20.5% undocumented non-citizens, and 15% non-citizens with documents. 57% are female, while the remaining 42.5% are male. Bajau is the ethnic majority (79%).

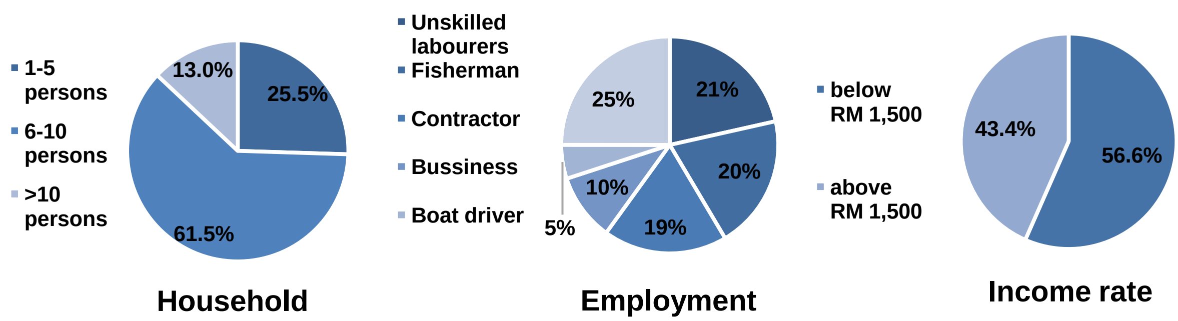


Figure 80: Parents' socio-economic income

Figure 80 shows the children's parents' socio-economic income. Most children in Pulau Gaya live in a household with six to ten others (61.5%), and 56% of their families earned below RM1,500 per month. Most of their parents work as unskilled labour, followed by fishermen.

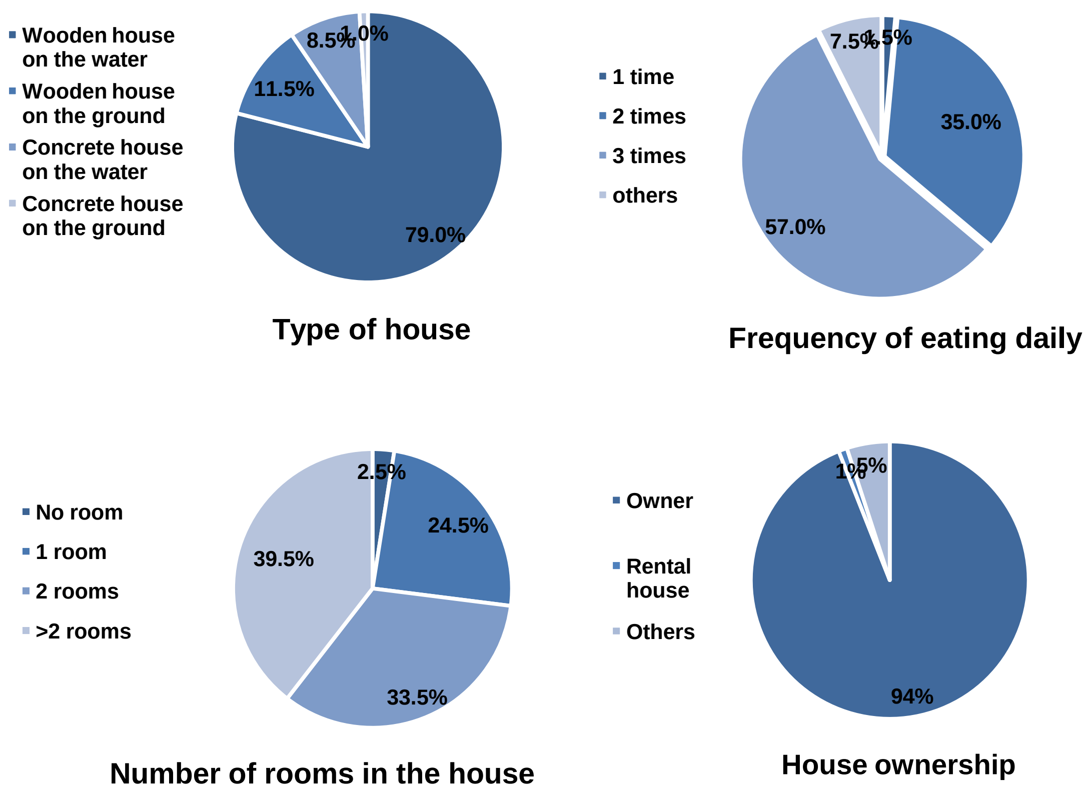


Figure 81: Living conditions

Figure 81 above represents the living conditions of the respondents in Pulau Gaya. 79% of respondents live in wooden houses on the water. However, only 39.5% have more than two rooms in their house. 94% claimed that they are living in their own house. Only 57% of the respondents reported that they have at least three meals a day.

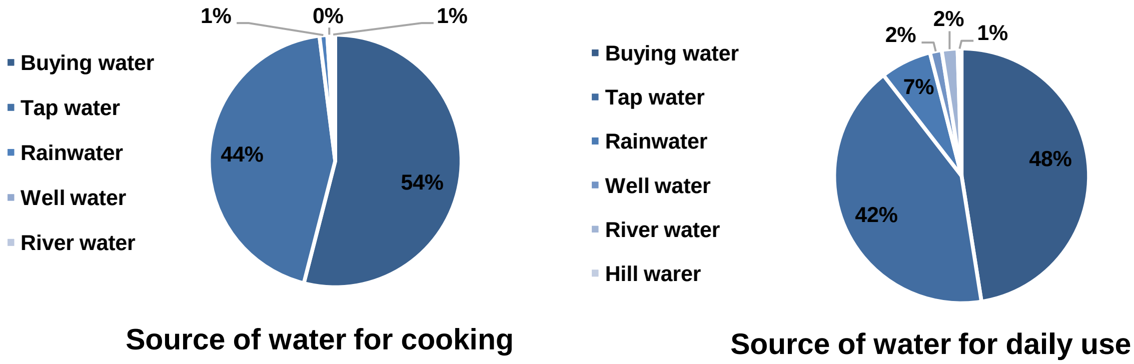


Figure 82: Living conditions - access to water

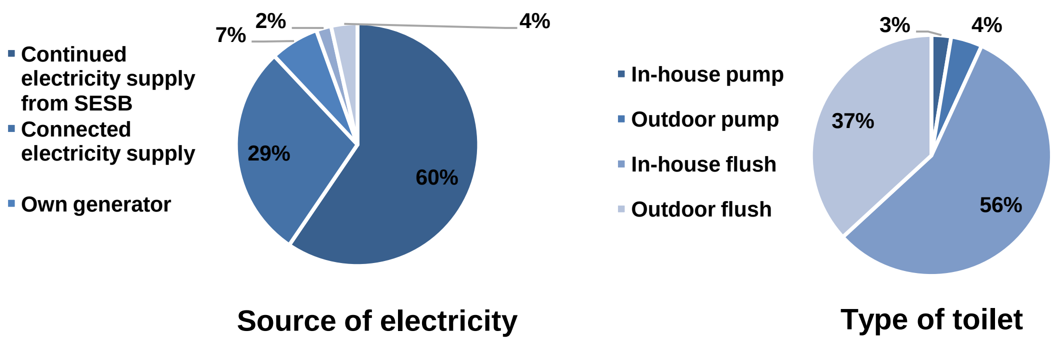
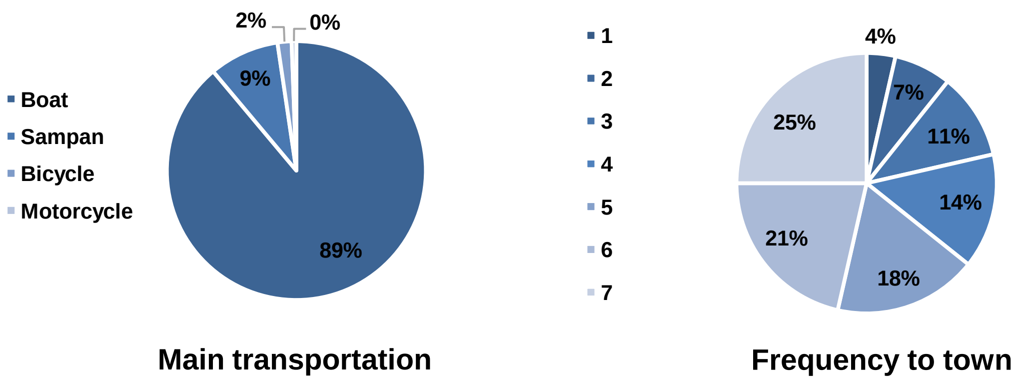
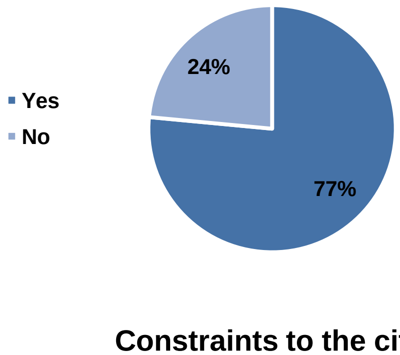


Figure 83: Living conditions - access to electricity and toilet sanitation

More than half of the respondents still rely on water bought from the mainland as the main source of clean water for cooking (Figure 82). Only 44% have access to tap water. 59% enjoy electrical supply from SESB (Figure 83). For sanitation, 53.5% of respondents claimed to have an in-house flush toilet (Figure 83).





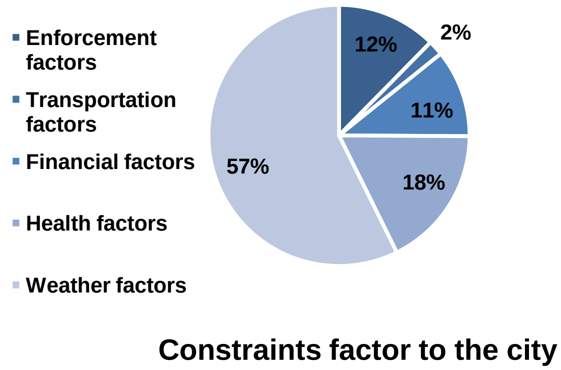


Figure 84: Mobility

The above Figure 84 represents the mobility of the children within or from the island to the mainland. 76% are relying on boats as the main transportation. 50% claimed that they would go to the mainland at least once a week. However, 76.5% claimed that the weather is the main constraint for them to go to the mainland or commute within the island.

5.4.2 Trend analysis and IPCC projection

An analysis using the regional circulation model has been conducted to investigate climate change in Pulau Gaya by taking the Kota Kinabalu meteorological station as the reference point. There are three main observations that are relevant to this study:

- Heat extremes are increasing in terms of number, length, and intensity
- Rainfall is less likely to change, either in terms of the number of wet days or the length of dry spell days
- Storms and sea-related extremes are likely to increase

5.4.3 Climate and environment-related behavioural patterns

Based on the analysis from the survey, the research team has observed three main patterns of behaviour related to climate change and environmental degradation among the children living in Pulau Gaya. These patterns explain the issues of Vulnerability, Resilience and Accessibility.

a. Vulnerability

Children living in Pulau Gaya perceived themselves as vulnerable on four indicators. These are socializing ability, citizenship status, support system, and perceived degree of literacy. Sociability is referring to the children's perceived social ability. This research found that children who went to ALC are perceived to be more sociable than children who went to the government schools in Pulau Gaya. The next indicator of perceived vulnerability among children in Pulau Gaya is the availability of a support system. The support system here is defined as the provision of support by parents. In this study, we found that girls are perceived to receive better support than boys. There are no clear differences of support between the three categories of age.

Another indicator in measuring the children perceived vulnerability is the degree of literacy. Obviously, the lower the degree of literacy, the more vulnerable the children are. In this study, it was shown that girls have a better degree of literacy compared to boys. Another interesting observation is that number of individuals in the household will determine the degree of literacy among the children. Children from smaller household sizes (less than five) are perceived to have better literacy levels than children from bigger-sized households.

Another interesting observation is that children who studied at the ALC perceived that their degree of literacy was much lower than their friends who went to government schools. Thus, children in Pulau Gaya who tend to have low sociable skills, low support system, insecurity about their citizenship, and low degree of literacy would be categorized as vulnerable. This vulnerability is manifested in how the children deal with extreme weather, as indicated in the IDIs with the teachers at Pulau Gaya. Through the teachers' observations, these children are particularly vulnerable to extreme weather because of their dependence on adults to ensure their safety and well-being. Children are also vulnerable to climate change because of their potentially greater exposures, greater sensitivity to certain exposures, and dependence on caregivers for appropriate preparedness and response. According to respondents, the most common illnesses for children in Pulau Gaya are fever, heat-related illnesses, water-borne diseases such as diarrhoea, and vector-borne diseases like malaria.

b. Resilience

The next observed pattern of behaviour among the children in Pulau Gaya is the degree of resilience. Children's perceived resilience is measured based on how the children adapt to climatic challenges, sea-related extremes, heat extremes, and rain extremes. This perceived behaviour pattern is an essential indicator of how children would face climate change and environmental degradation. Sea-related extremes refer to any extreme changes to the sea, such as big tides and waves. Heat extremes refer to increases in temperature and prolonged dry seasons. Rain extremes refer to prolonged rainy seasons and increases in rain volume.

This study found that boys are perceived as more resilient towards sea-related extremes but less resilient to heat and rain extremes. On the other hand, girls are perceived as less resilient towards sea-related extremes but are more resilient towards heat and rain extremes. Children from families that earn less than RM1,500 per month are perceived to have less resilience towards sea-related extremes, heat, and rain extremes than children from families that earned more than RM1,500 per month. In other words, families with better income could provide better protection to their children, hence the high perceived resilience.

This finding is consistent with the finding from the IDI conducted with the teachers from the government school and the ALC. During extreme weather, the teachers noticed a lack of focus on studying due to heat. Furthermore, there was a decline in school attendance during the rainy season. Not many boats are available during the rainy season, and there will also be strong winds, and parents are concerned about their children safety. Heavy rain will sometimes cause the rise of sea levels and strong winds. One of the teachers stated:

> *'...if it's raining in the morning, they don't come to school the whole day ...'*
> (Cikgu A, Interviewed on 2nd September 2020)

c. Accessibility

Children living in Pulau Gaya were also asked about their perceived accessibility towards several indicators such as medical services, living conditions, education, clean water, and adequate food. Access to all these necessities are essential indicators to further understand the impact of climate change and environmental degradation on children. In an ideal world, children should have limitless access to medical services, good living conditions, education, clean water, and food.

Findings from the research show that in terms of gender, girls are perceived to have better access to food, water, and medical services than boys. Boys perceived that they are not as lucky as the girls in access to these three indicators. The boys perceived that they only have more access to education compared to girls.

From the context of income, children from families who earn less than RM1,500 a month perceived that they already have access to water and food but not education, unlike children from families that earn more than RM1,500 a month. These children perceived that they have access to education but no access to water and food. Access to clean water in Pulau Gaya is still troublesome. Only certain villages receive clean water from the mainland, while others depend on rainwater and buy water from the mainland through a middleman.

As for access to medical services, no medical facilities are available in Pulau Gaya. The islanders would need to go to the mainland to get medical attention if necessary. However, children from both categories of family income perceived that they do have access to medical services. From the FGD, it was found that access to medical services is very much dependent on the weather and the availability of transportation from the island to the mainland. In that context, participants addressed the challenges of accessing and getting healthy food, clean water, and health services during extreme weather (i.e. the rainy and windy season). As one participant (a mother) stated:

> *'…our child is sick…want to take him to Likas Hospital…we go knock on our neighbour's door…asking anyone who has a boat. Depending on the weather as well, if the rain is not heavy…we can go to hospital…* if the rain is heavy,

there is a storm and strong waves, we can't go to the hospital…we are afraid that the boat will overturn… even if your child is really...really sick, you just need to wait…'

From the above explanation, the following are the main points that should be considered for further deliberation, particularly in drafting policy related to climate change and children.

1. Boys are perceived to be more resilient to climate issues and have better access to education
2. Girls are perceived to be more vulnerable to climate issues and have better access to medical facilities
3. Climate extremes – boys are perceived to be able to adapt better to storm, girls are perceived to be able to adapt better to heat and rain
4. The older the children (>14 years old), the higher the awareness of health issues – but they are more vulnerable to climate challenges and have lower access to quality of life
5. The younger the children are (below 10), the less exposure to climate challenges, but the more prone to marginalization
6. The lower the income, the better the support system. The higher the income, the more resilient and less vulnerable
7. The ideal household number is five and below, where vulnerability is significantly lower, and resilience is higher
8. Government (more systematic) education significantly enhances resilience quality of life. However, alternative schools provide much better access to education

5.4.4 Observed finding from the FGD and IDI

a. Introduction

The qualitative data reports provide in-depth information on parents' and teachers' perceptions in Pulau Gaya on climate change and environmental degradation. Qualitative data in this case study can be used as supporting evidence to deeply understand the community-level perspectives on climate change and environmental degradation. 17 teachers from government schools (primary and secondary schools) and the ALC were interviewed from the 2nd of September until the 4th of September 2020. FGD sessions with communities in Pulau Gaya was carried out in Kampung Kasuapan and Kampung Lok Urai. Each IDI and FGD session were completed within 30 minutes to 1 hour and 30 minutes. Each focus group was moderated by a researcher who followed an approved set of questions. Participants were given an informed consent form to review and sign before participating in the FGD and IDI.

Both IDI and FGD sessions were audio-taped with permission, and the audio was later transcribed into written text. The transcripts were then analysed using thematic analysis, coded and categorized into several themes. Thematic analysis is used to identify patterns and themes, and these themes are used to address the key findings of this research. As with any study, several important limitations are considered during the review and interpretation of key findings. FGD and IDI are designed to gather in-depth information from a small number of participants/respondents but are not intended to be broadly representative of all islanders' perspectives. Despite this limitation, qualitative data analysis sheds light on parents' and teachers' perspectives on climate change and environmental degradation in relation to their livelihood and children's well-being. There are also suggestions on coping, adapting, and mitigating the effects of climate change and environmental degradation on the island.

Questions for IDI and FDG were developed by UKM and UMS team through several discussion sessions. The questions started with the introduction or 'ice breaking' questions to allow the participants to feel relaxed and comfortable before further discussion. The questions were developed to ensure consistency in response aligned with the objectives of the study. The questions were also designed and modified based on target participants (Pulau Gaya communities and teachers in Pulau Gaya Schools), and it is generally and culturally compatible with participants. Any sensitive issues, especially those related to the Pulau Gaya community, were not asked during the IDI and FGD sessions. The qualitative data analysis process is summarized in Figure 85.

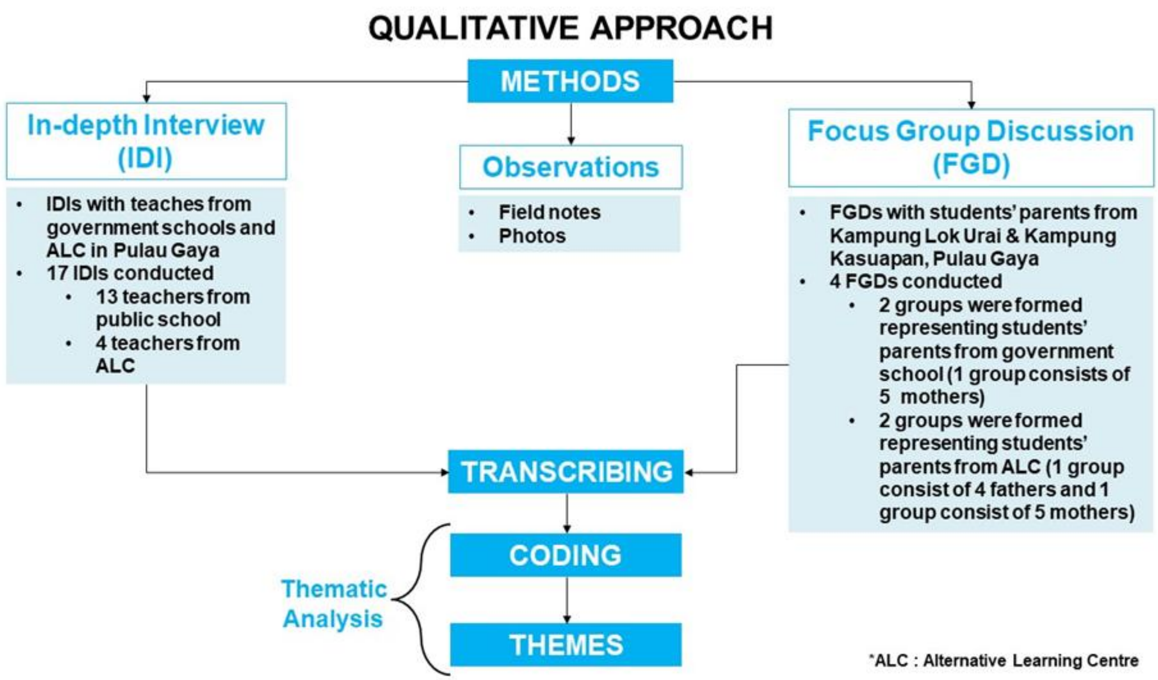


Figure 85: Data analysis framework

b. Demographic profile

A total of 17 teachers were interviewed in this study. The figures below indicated basic demographic information of the teachers who participated in this case study. These figures indicate the ethnicity, level of education, subjects they taught in the schools, and length of their service in the schools.

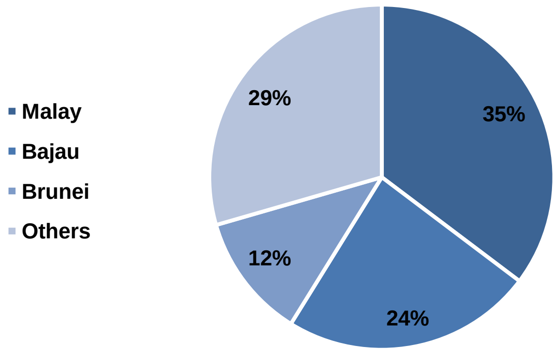


Figure 86: Teachers' ethnicity (Others: Sungai, Jawa and Ida'an)

c. Key Findings

Discussion of qualitative data (IDI) findings is based on three issues as shown in Figure 90:

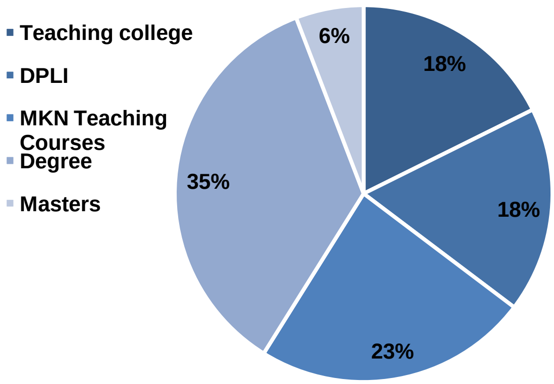


Figure 87: Level of education

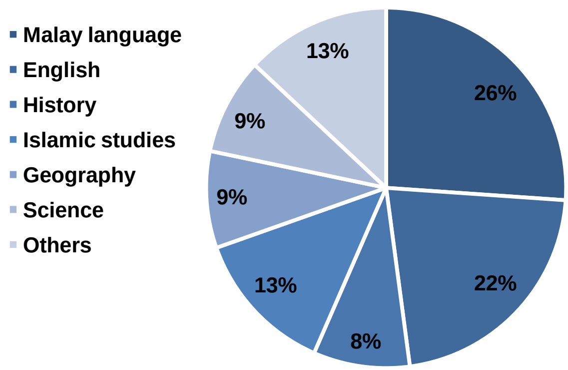


Figure 88: Subjects taught in schools (Others: Mathematics, Visual Arts and Counselling)

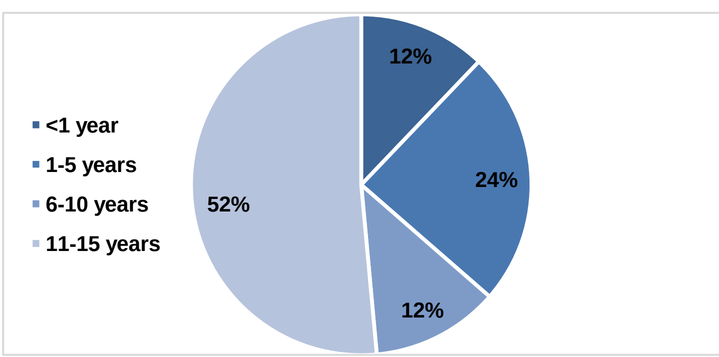


Figure 89: Period of service

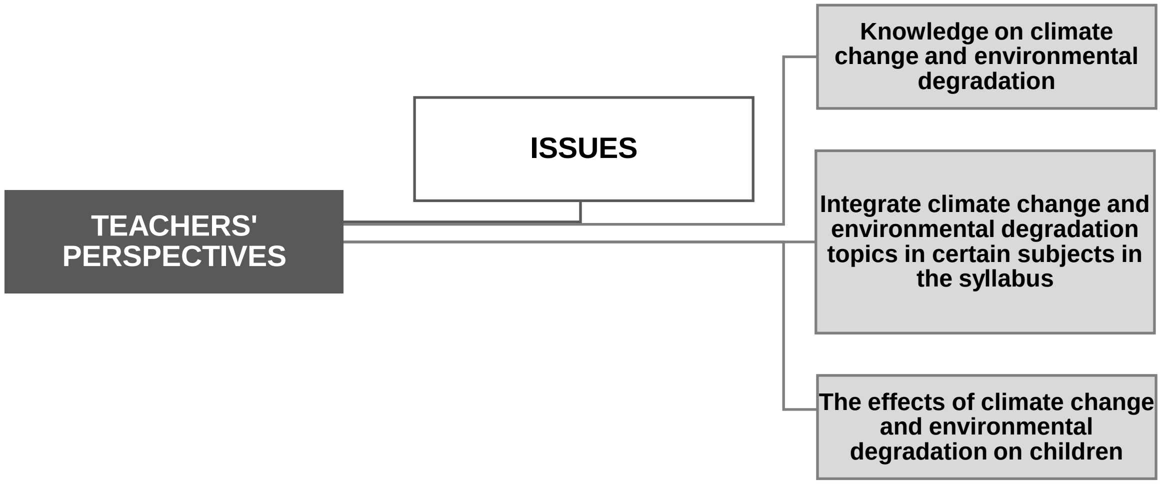


Figure 90: Teachers' perspectives on climate change and environmental degradation

Knowledge on climate change and environmental degradation

To understand the respondents' level of knowledge about climate change, they were asked to share their views and familiarity with the term's climate change and environmental degradation**.** Respondents (teachers) drew upon their own experiences and observations concerning their knowledge of climate change. In general, respondents perceived extreme weather to be evidence of climate change. Respondents overwhelmingly associated severe weather, including strong wind, flooding, rising temperature, rising sea levels, and strong waves with climate change. Respondents also referenced their experiential knowledge and reasons for being concerned about it. Most respondents stated that they know about climate change or are somewhat knowledgeable about climate change and environmental degradation. They are also aware of the environmental degradation in Pulau Gaya, especially ocean pollution. It is important for teachers to have basic knowledge about climate change and extreme weather for them to educate their students. Cikgu Normina, one of the teachers at ALC located at Kampung Lok Urai, opined that teachers must know the reality of weather changes. Being an islander living in Pulau Gaya for many years, she has first-hand experiences with unpredictable weather changes. She stated:

> *'… living on the island for many years, we are very sensitive to the weather changes, hot weather, strong waves, rising sea levels…and that are the challenges… so automatically we understand that….'*
>
> (Cikgu N, interviewed on 2nd September 2020**)**

Regarding environmental degradation, most respondents associated it with ocean pollution. Respondents remarked on the role of ocean pollution and its impact on environmental degradation and briefly noted the current effects of pollution on clean water and health.

However, ocean pollution at Pulau Gaya should not be blamed entirely on the island's communities. As one of the teachers at ALC (Kampung Lok Urai) contended:

> '…*ocean pollution is a serious problem...but communities from the mainland (Kota Kinabalu) and surrounding areas, including tourists, are all contributing to the ocean pollution around Pulau Gaya*…*rubbish/garbage at Kampung Lok Urai, might not originate from here, it could have washed up from other places*….'

Figure 91: Rubbish and plastic on the ocean near Kampung Lok Urai

Figure 92: Plastic and other rubbish in front of the ALC

The effects of climate change and environmental degradation on children

Children in Pulau Gaya are most likely to be affected by ocean pollution, water-borne diseases, and vector-borne diseases. The vulnerability of the children in Pulau Gaya is related to poverty, social inequality, citizenship status, lack of public health infrastructure, lack of provision of medical care, and limited access to adequate nutrition and clean water.

Children are particularly vulnerable to extreme weather because of their dependence on adults to ensure their safety and well-being. Children are also vulnerable to climate change because of their potentially greater exposures, greater sensitivity to certain exposures, and dependence on caregivers for appropriate preparedness and response. According to respondents, the most common illnesses among the children in Pulau Gaya are fever, heat-related illnesses, water-borne diseases such as diarrhoea, and vector-borne diseases such as malaria.

Other issues that the teachers noticed during extreme weather are a lack of focus in studying due to heat and declining school attendance during the rainy season. Not many boats are available during the rainy season due to strong winds, so parents are concerned about their children's safety. Heavy rain will sometimes cause the rise of sea levels and strong winds. One of the teachers stated:

> *'… If it's raining in the morning, they don't come to school the whole day ...'*
> (Cikgu A, interviewed on 2nd September 2020)

Integrate climate change and environmental degradation topics in the syllabus

Climate change is a global problem that threatens the survival of the planet. Since young people are the future decision-making citizens and leaders of society, it is important to include them in societal strivings to combat this problem. Hence, it is a task of the educational system at various levels to promote education about climate change (Ojala, 2012:537). In this process, it is important to determine if students are learning the right facts about the causes, societal impacts, and potential solutions to climate change. In that sense, schools should equip children with the necessary skills and develop their capacities to cope with climate change. Also, schools should educate, empower, and engage all students in activities related to adapting to the changing environment. Certain subjects in schools should address the specific needs, knowledge, and skills to educate children in adapting to climate change (Rocha 2020). Incorporating relevant topics in the syllabus, such as disaster risk reduction, will teach the children to think critically about the effects of climate change. Therefore, reorienting the existing curriculum is probably one of the most innovative and relevant steps towards enhancing the quality of education. In this context, quality education should aim to make children more resilient to the impacts of climate change. Quality education will provide an adaptive capacity, the knowledge and skills needed to adapt lives and livelihoods to the realities of a changing environment.

With regards to the current syllabus, according to teachers at ALC and government schools in Pulau Gaya, issues about climate change and the environment are discussed in general in the subjects of English, Malay Language and Islamic Studies subjects. The impacts of climate change are discussed deeply in Science and Geography. Issues on the environment and climate change are taught from Year 1 until Form 5 (primary and secondary). For education to be transformative, teachers must be qualified. Therefore, in-service training is important to enhance teaching skills. However, out of 17 respondents in this case study, only one teacher had experience participating in a course related to the environment organized by State Environmental Department. Due to the lack of in-service training specifically on climate change and the environment, teachers utilize other alternatives to enhance their knowledge. They used Google, YouTube and other internet sources to enhance their knowledge. The schools' effort is most effective when it starts in primary school, continues throughout the child's life cycle, and leads to lifelong learning in adulthood. Participatory learning in the teaching processes is important. As Cikgu Azlan and Cikgu Ekzanul (government schoolteachers) stated, engaging students in activities is important, as well as raising their awareness about the effects of climate change:

> *'…there is a discussion on environmental awareness in the Malay Language subject...so we created an activity… like a writing competition on the environment…to increase students' awareness…'*
>
> (Cikgu A, interviewed on 2nd September 2020)

> *'…in the Malay Language subject…there are discussions on the effects of throwing rubbish everywhere, like plastic...and explaining what the consequences are...'*
>
> (Cikgu E, interviewed on 2nd September 2020)

While children are among the most vulnerable to climate change, they need not be considered passive or helpless victims. Through education, projects and action, children can contribute to every aspect of climate change policymaking. Children are powerful agents of change, and when empowered and educated on climate change (Walker, 2012), children can reduce the vulnerability of themselves and their communities. Hence, educating children is one of the best ways of strengthening community adaptation to climate change. Children can be extraordinarily adaptable in the face of significant challenges, and their knowledge and capacities are invaluable in developing realistic and practicable adaptation plans.

Regarding the learning process, Cikgu A recommends recycling exhibitions to be held regularly so that students can keep learning about how it works and its benefits for the environment:

> *'So… after coming here… we did an exhibition on how to recycle all the plastic, right? That plastic can be used as a blanket… socks…'*
>
> (Cikgu A, interviewed on 2nd September 2020)

Meanwhile, Cikgu Ay, a teacher at the government school, said that talks on the environment from NGOs are actually good, and the teachers will gladly welcome them. He added that it is good for teachers to be knowledgeable about the environment:

> *'…although teachers are busy and now being burdened with clerical works and not being able to focus on students totally…but…we still welcome any talks from NGOs regarding the environment and other relevant topics…'*
>
> (Cikgu Ay, interviewed on 2nd September 2020)

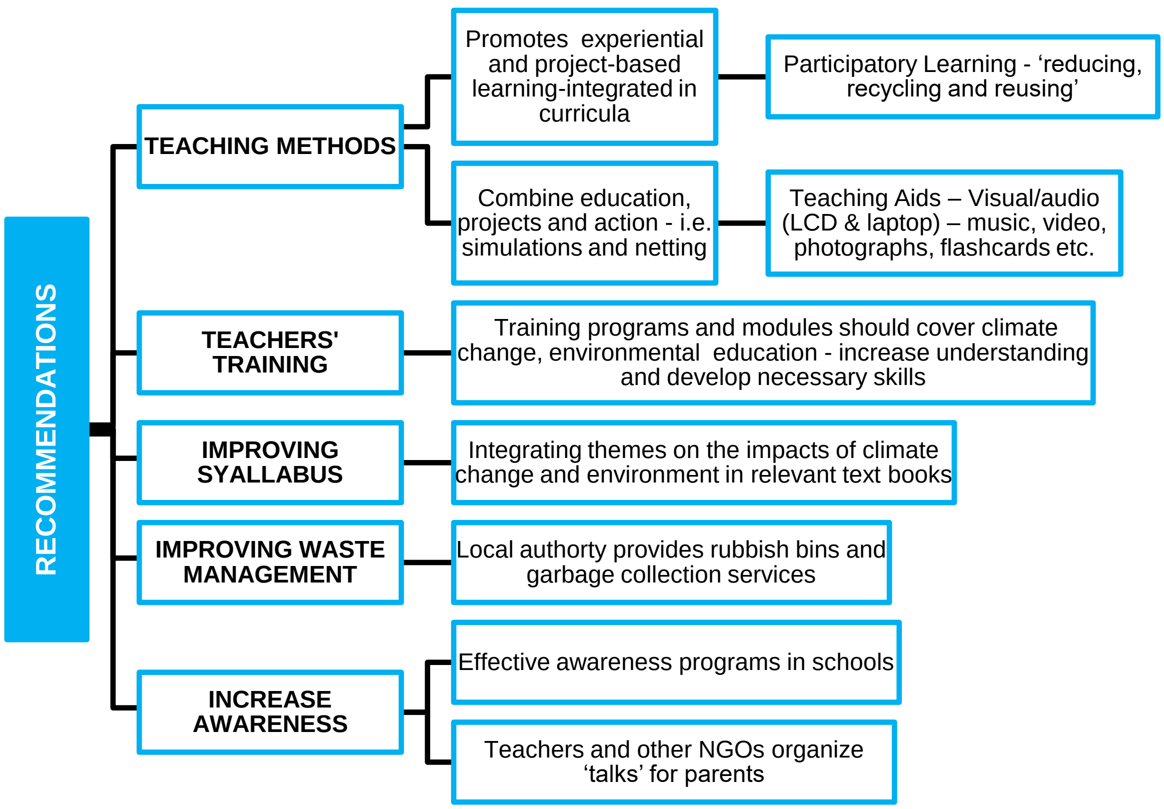


Figure 93: Recommendations by the teachers

d. Recommendations

Based on the IDIs, Figure 93 summarized the main recommendations of the teachers from ALC and government schools (primary and secondary schools).

5.4.5 Focus group discussion

Knowledge related to climate change and environmental degradation

Impacts of climate change and environment degradation

Strategies to adapt and minimize the impacts of climate change and environment degradation

Figure 94: Community perspectives on climate change and environmental degradation

a. Demographics background

There were 20 participants in four focus groups from Kampung Lok Urai and Kampung Kasuapan. FGD participants were between 20 and 60 years of age, as shown in Figure 95. Respondents identified as female (50%) and male (50%) and were from the main ethnic group in Pulau Gaya, Bajau. Most female participants were not employed (housewives), and the majority of male participants were fishermen.

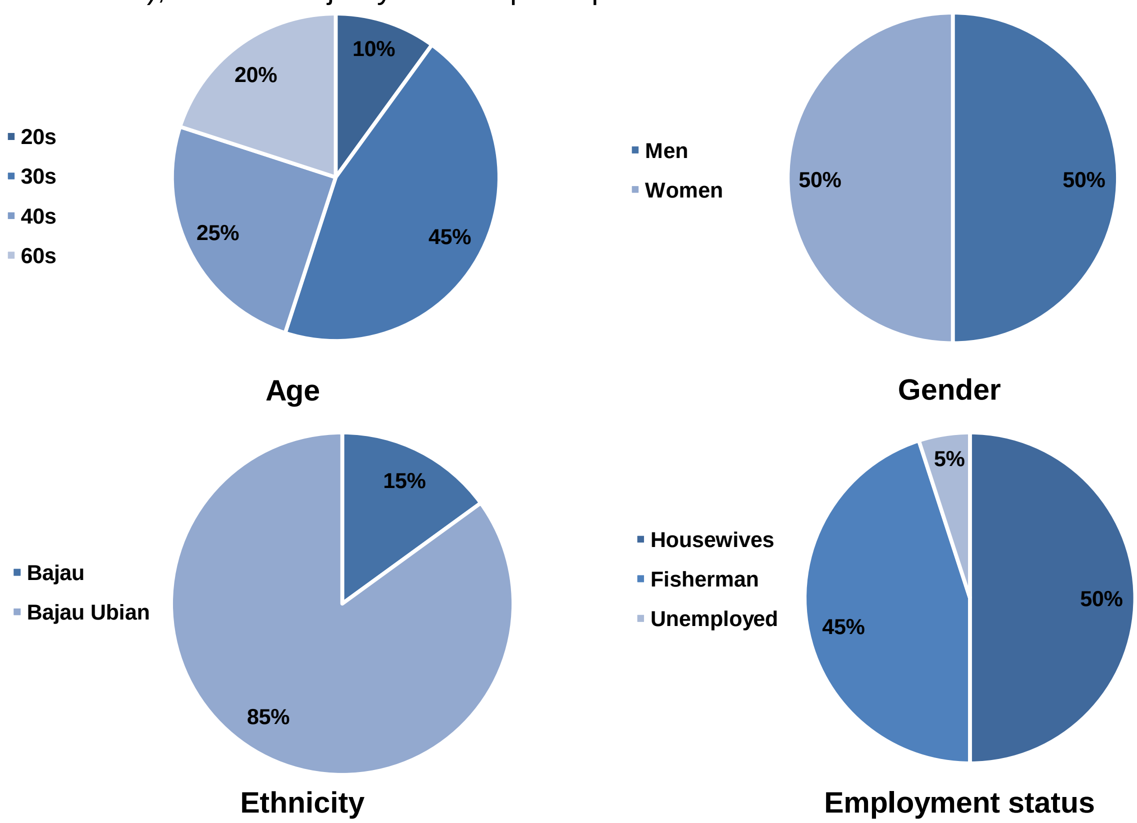


Figure 95: Demographic profile of FGD participants

This section presents the themes that emerged in the FGDs. Unless otherwise noted, the themes identified and quotes provided as examples are drawn broadly from those four FGDs.

b. Knowledge related to climate change and environmental degradation

Personal knowledge and experiences shaped how FGD participants explained their understanding of climate change, weather changes, and environmental degradation. Based on their firsthand experiences, participants shared their views and expressed their concerns about ocean pollution. In general, they associated ocean pollution with climate change and weather changes. Given that the objective of FGDs in this study is to explore lay people's understanding of climate change rather than assessing the accuracy of their understandings, some relevant cited quotations are included in this report. Participants drew upon their experiential knowledge as they shared their perceptions about climate change. Below are some quotations from parents in Kampung Lok Urai:

> *'…The weather is very different now…the weather and wind are uncertain and erratic…in the past, normally in December, it is the rainy season, and we don't go fishing….now it's very unpredictable…other months also (not only in December)…there are storms, strong waves and heavy rain….'*

> *'…we're now even more likely to see strange (patterns) in the weather….It used to be possible to go fishing anytime if it is not in the rainy season… now we cannot go fishing anytime as we wish…we fear unexpected storms (since the weather is unpredictable)…If the wind is strong, the waves are rough, sometimes we stay at home up to one month…'.*

With regards to pollution, participants shared their experiences and observations:

> *'…in the past…lots of lobster, big crabs, shrimps, now no more…because the environment has changed and the ocean is polluted…'*

> ***'…****The increase in population and settlements on the island… has led to an increase of garbage disposal at sea and on land****…'***

> **' …***we have built…there was a 'fence' to hold the garbage in, but it has been destroyed due to big waves and excessive garbage (it lasted less than 1 year)…'*

c. Impacts of climate change and environmental degradation

One of the aims of the FGDs is to better understand how parents perceived climate-related risks, how their livelihoods are being affected, and how they prepare for, adapt, or respond to these risks. In that context, participants addressed the challenges of accessing and getting healthy food, clean water, and health services during extreme weather (i.e. the rainy and windy season). As one participant (a mother) stated:

> *'…our child is sick… want to take him to Likas Hospital…we go knock on our neighbour's door…asking anyone who has a boat. Depending on the weather as well, if it is not heavy rain…we can go to the hospital… if it's heavy rain, if there is a storm and strong waves, we can't go to the hospital…we fear that the boat might overturn…then if your child is really…really sick, you just have to wait…'*

A few participants who are fishermen were concerned about their livelihoods. They perceived extreme weather as a threat to their food supply (i.e. seafood). Participants of the FGDs were also concerned about power supply (i.e. electricity), the safety of their houses, access to health services (in Kota Kinabalu), and their ability to go to sea as fishermen. Their mobility during the windy and rainy season are also affected.

> *'…in the past…during severe weather (heavy rainfalls with storms)… the electricity supply was cut off for up to one week or so… because people who fix the electricity came from Kota Kinabalu (could not come because of the storms and heavy rain)...can't do anything…refrigerator stop working…all food in the refrigerator was damaged*. '

> '...*in the past, the house's structure was low…when the sea level rises… the house became like a pool…water came in…you could literally swim inside the house….we then rebuilt and elevated the structure of the house…to withstand severe weather*... '

Children are particularly vulnerable to the impacts of climate change. Climate change affects children's health through increased air pollution, weather-related disasters, frequent and intense heat waves, decreased water quality and quantity, food shortage and greater exposure to toxicants. Consequently, children experience a greater risk of malnutrition, infectious diseases, allergic diseases, and respiratory diseases (Zhiwei Xu et al. 2012). As for the children's health in Pulau Gaya, according to their parents who participated in FGDs, the most prevalent illness that they endured are fever, infections, asthma and other water-borne diseases such as diarrhoea.

There were some minor injuries among their children during the rainy season, given that some of their houses are connected with dilapidated wooden bridges. Their children also often play outdoors. The rainy season also affected the children's school attendance due to safety reasons. The quotations below reflect some experiences shared by the participants:

> *'…In 1998, I was in third grade, I ran to the mosque, the sea level rose, many houses collapsed…'*

> *'…Last year (2019), in October, a hurricane occurred, the roof (made of zinc) at the ALC school was blown away by the strong wind, children could not go to school for weeks...'*

> *'…Once we had experienced… our house being blown away by strong winds… strong winds also blew off the roof of the school and surau ...'*

> '…*If it rains heavily in the morning, the children stop studying for a while, then the rain stops, and they resume studying at 1 or 2pm*…'

There is no systematic water supply for daily use in Pulau Gaya, so islanders have to buy water at the cost of RM5 to RM7 a drum. With regard to water supply and getting clean water on the island, one participant stated:

> '…*the villages in Pulau Gaya lack water supply because the main pipes/taps are not connected to our homes...we have to buy clean water from our neighbours who have the main pipe, and we get water supply from rain*…*and buy water from the mainland (Kota Kinabalu)…*'

As for the fishermen in the focus groups, their major concerns about weather changes were strong winds, strong waves, and sea-level conditions. Understandably, these threats could disrupt their daily socio-economic routines, whether directly or indirectly. Seafood brings the villagers their main source of income and is also a staple in their daily diet. Another male participant (fishermen) stated:

> '… *the food supply is not sufficient during rainy season…and strong winds and strong waves prevented us from going fishing… difficult for us to go to the market (Pasar Besar) also in Kota Kinabalu*…'

d. Strategies to minimize the impacts of climate change and environmental degradation

The third key finding is related to strategies to adapt and minimize the effects of climate change and environmental degradation. FGD participants voiced out their strategies on how to adapt to climate change. Quotations below reflect some participants' views:

> '…*we (fishermen), if we really can't go to the sea to catch fish due to severe weather, there is a 'jala/pukat' we set outside our house to get fish… '*

'…if the weather is not good, we fish outside the house only for daily consumption…and to survive…'

'…if the fisherman is unemployed and is at home only, we will find a part-time job…a contract worker/job anywhere….'

'…Only people with documents will get assistance (financial) from the government...fishermen without documents can't get any loan or assisstance…'

Figure 96 summarises the mitigation and adaptation strategies as suggested by the parents in Pulau Gaya:

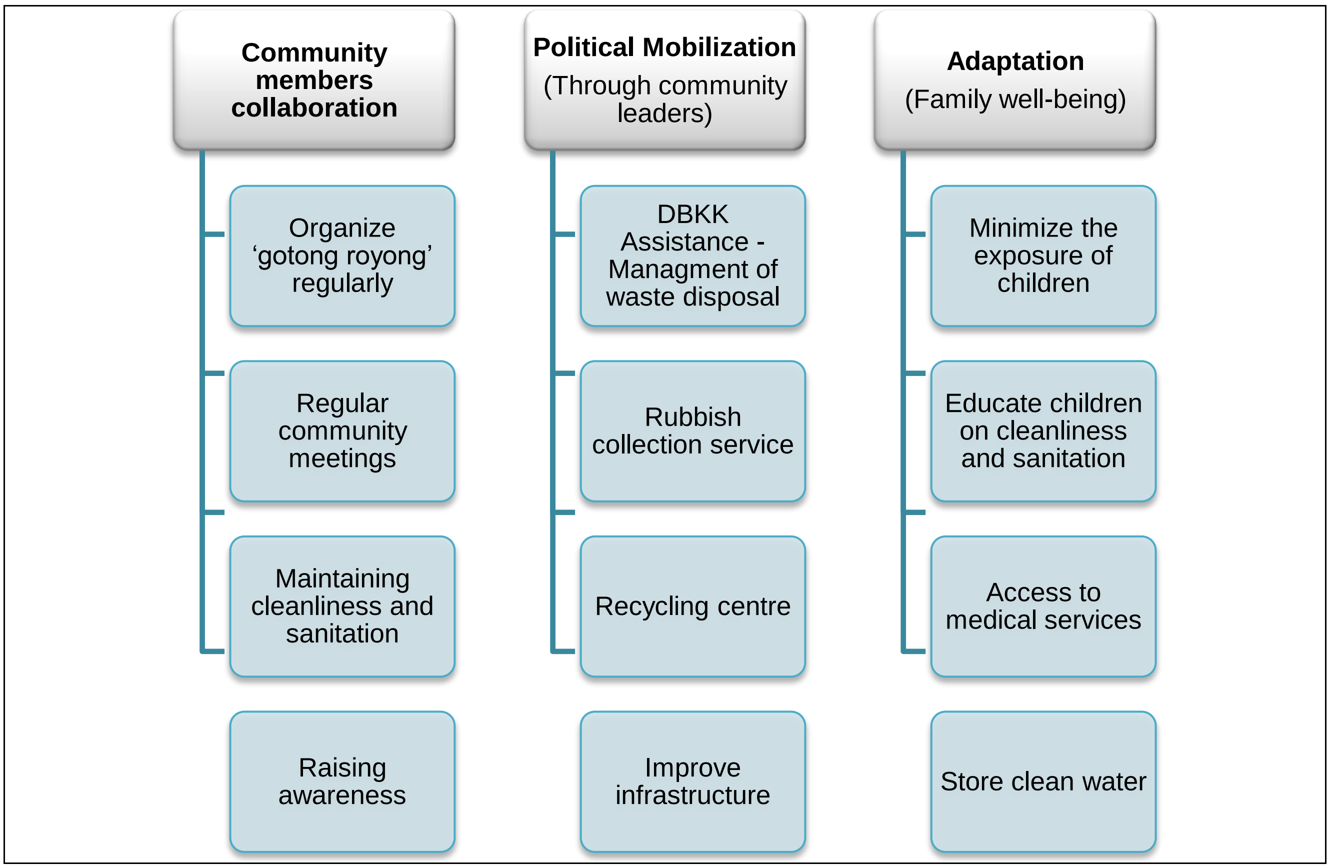


Figure 96: Strategies to adapt and minimize the impacts of climate change and environmental degradation on children

APPENDIX 6 POLICY ASSESSMENT - KEYWORDS

a. Climate change

		Keywords	Malay	Total (CC)	Percentage (%)	National Policy on Climate Change (2009)	National energy policy 1979	National Energy Efficiency Action Plan	National Renewable Energy Policy	National Biofuel Policy	National Green Technology Policy 2009	Green-Technology-Master-Plan-Malaysia-2017-2030	Low Carbon City Framework	National Transport Policy 2019-2030	National Policy on Industry 4	National Agro-Food Policy (2011-2020)	Policy and Mechanism on National Disaster and Relief Manageme	Intended Nationally Determined Contribution of The Government Of Malaysia	TNC-BUR2	BUR3 2020
1	climate	climate change	iklim, cuaca	703	9.02%	100	0	1	10	1	3	24	43	1	5	2	0	10	351	152
2		extreme events	ekstrim	1	0.01%	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
3		natural disaster	bencana	15	0.19%	3	0	0	0	0	0	1	0	0	0	0	2	2	4	3
4		flood	banjir	339	4.35%	0	0	0	0	0	0	7	11	0	0	0	8	10	290	13
5		heat wave	(gelombang) panas	3	0.04%	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
6		temperature	suhu	175	2.25%	0	0	0	1	0	0	2	5	0	0	0	0	5	111	51
7		storm	ribut	37	0.47%	0	0	0	0	0	0	6	7	0	0	0	2	0	18	4
8		landslide	tanah runtuh	6	0.08%	1	0	0	0	0	0	0	0	0	0	0	3	0	2	0
9		emission	pelepasan/penghas	2439	31.31%	7	0	12	29	5	3	136	249	15	0	0	0	17	1198	768
10		mitigation	mitigasi	394	5.06%	18	0	1	9	0	0	7	6	0	2	0	0	5	283	63
11		adaptation	adaptasi	216	2.77%	16	0	2	0	0	0	5	1	0	3	0	0	6	169	14
12		resilience	ketahanan/berdaya	68	0.87%	11	0	0	1	0	0	5	4	2	4	0	0	6	34	1
		Total		4396	56.43%	156		16	50	6	6									
13	environment	environmental degr	pencemaran persek	34	0.44%	0	1	0	2	0	0	0	0	0	23	6	0	0	1	1
14		pollution	pencemaran	79	1.01%	0	0	1	11	0	1	10	14	19	0	6	2	0	15	0
15		air pollution	pencemaran udara	17	0.22%	0	0	0	0	0	0	2	3	1	0	0	0	0	11	0
16		water pollution	pencemaran air	3	0.04%	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0
17		water quality	kualiti air	19	0.24%	0	0	0	0	0	1	4	4	0	0	0	0	0	10	0
18		hazardous	bahaya	17	0.22%	0	0	0	0	0	0	5	0	2	1	2	2	0	2	3
19		toxic	toksik, racun	11	0.14%	0	0	0	0	0	0	0	0	0	0	6	1	2	2	0
20		waste	sampah, sisa	1589	20.40%	4	0	6	46	0	4	375	65	11	0	7	1	3	630	437
		Total		1769	22.71%															
21	children	children	kanak-kanak	14	0.18%	1	0	1	0	1	0	3	1	1	0	1	0	0	5	0
22		student	pelajar	35	0.45%	0	0	0	4	0	3	8	1	1	4	5	0	0	9	0
23		vulnerable	dedah	26	0.33%	1	0	0	0	0	0	0	0	4	0	0	0	1	20	0
		Total		75	0.96%															
24	education	education	pendidikan	176	2.26%	1	0	5	15	0	4	52	1	7	19	2	5	0	63	2
25		awareness	kesedaran	278	3.57%	3	0	23	24	2	5	91	17	17	11	13	0	0	67	5
26		school	sekolah	79	1.01%	0	0	4	1	0	0	12	11	1	0	9	0	0	41	0
		Total		533	6.84%															
27	health	respiratory disease	penyakit pernafasa	0	0.00%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28		disease	penyakit	119	1.53%	0	0	0	0	0	0	2	1	0	0	35	1	2	75	3
29		health	sihat/kesihatan	223	2.86%	6	0	0	4	0	3	11	5	4	2	20	8	4	148	8
30		health risk	risiko kesihatan	1	0.01%	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
31		nutrition	nutrisi/makanan	377	4.84%	0	0	0	0	0	0	0	0	0	3	372	0	0	2	0
		Total		720	9.24%															
32	well being	rights	hak	12	0.15%	0	0	0	6	0	1	2	1	0	0	2	0	0	0	0
33		protection	perlindungan	90	1.16%	1	0	0	7	0	0	1	3	4	3	2	0	0	45	24
34		poverty	miskin ("kemampua	4	0.05%	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0
35		well-being	kesejahteraan	20	0.26%	3	0	0	0	2	0	3	2	5	1	1	0	0	3	0
36		access	akses/ boleh dicapa	171	2.20%	1	0	2	54	0	0	28	11	30	20	4	0	0	16	5
		Total		297	3.81%															

b. Environment

		Keywords	Malay	Total (Environment)	Percentage (%)	National Policy on the Environment	Environmental Impact assessment guidelines 2016	Guidance Document on Health Impact Assessment (HIA) In Environment	National Water Resources Policy	National Policy on Biological Diversity 2016-2025	National Forestry Policy	National Solid Waste Management Policy (2016)	National Cleanliness Policy	Malaysia's Roadmap Towards Zero Single-Use Plastics 2018-2030
1	climate	climate change	iklim, cuaca	41	2.29%	1	4	0	10	25	0	0	0	1
2		extreme events	ekstrim	0	0.00%	0	0	0	0	0	0	0	0	0
3		natural disaster	bencana	2	0.11%	1	0	1	0	0	0	0	0	0
4		flood	banjir	15	0.84%	0	5	0	4	5	1	0	0	0
5		heat wave	(gelombang) panas	0	0.00%	0	0	0	0	0	0	0	0	0
6		temperature	suhu	5	0.28%	0	1	0	0	4	0	0	0	0
7		storm	ribut	16	0.89%	0	15	0	0	1	0	0	0	0
8		landslide	tanah runtuh	1	0.06%	0	0	1	0	0	0	0	0	0
9		emission	pelepasan/penghas	13	0.73%	1	8	1	0	1	0	1	1	0
10		mitigation	mitigasi	133	7.43%	1	105	18	2	7	0	0	0	0
11		adaptation	adaptasi	11	0.61%	0	0	0	4	6	0	0	1	0
12		resilience	ketahanan/berdaya	10	0.56%	0	0	0	3	7	0	0	0	0
		Total		247	13.79%									
13	environment	environmental deg	pencemaran persek	6	0.34%	4	0	0	0	0	2	0	0	0
14		pollution	pencemaran	181	10.11%	13	112	15	7	7	0	1	5	21
15		air pollution	pencemaran udara	20	1.12%	1	14	5	0	0	0	0	0	0
16		water pollution	pencemaran air	10	0.56%	1	5	2	1	1	0	0	0	0
17		water quality	kualiti air	25	1.40%	0	16	6	1	2	0	0	0	0
18		hazardous	bahaya	82	4.58%	2	5	72	0	3	0	0	0	0
19		toxic	toksik, racun	43	2.40%	2	0	41	0	0	0	0	0	0
20		waste	sampah, sisa	268	14.96%	4	49	24	5	6	0	94	70	16
		Total		635	35.46%									
21	children	children	kanak-kanak	5	0.28%	0	0	2	0	3	0	0	0	0
22		student	pelajar	0	0.00%	0	0	0	0	0	0	0	0	0
23		vulnerable	dedah	33	1.84%	0	0	1	3	29	0	0	0	0
		Total		38	2.12%									
24	education	education	pendidikan	53	2.96%	8	2	1	4	17	4	2	8	7
25		awareness	kesedaran	92	5.14%	4	0	0	13	43	1	4	21	6
26		school	sekolah	6	0.34%	1	0	0	0	3	0	0	1	1
		Total		151	8.43%									
27	health	respiratory disease	penyakit pernafasa	12	0.67%	0	0	12	0	0	0	0	0	0
28		disease	penyakit	49	2.74%	0	3	38	0	2	0	0	6	0
29		health	sihat/kesihatan	333	18.59%	2	4	283	4	27	0	4	4	5
30		health risk	risiko kesihatan	175	9.77%	0	0	175	0	0	0	0	0	0
31		nutrition	nutrisi/makanan	0	0.00%	0	0	0	0	0	0	0	0	0
		Total		569	31.77%			508						
32	well being	rights	hak	13	0.73%	0	5	2	1	5	0	0	0	0
33		protection	perlindungan	50	2.79%	10	0	2	9	25	2	0	0	2
34		poverty	miskin ("kemampua	1	0.06%	0	0	1	0	0	0	0	0	0
35		well-being	kesejahteraan	18	1.01%	0	1	6	1	9	0	0	1	0
36		access	akses/ boleh dicapa	69	3.85%	1	37	6	2	23	0	0	0	0
		Total		151	8.43%									

c. Children

		Keywords	Malay	Total (child)	%	1 Child policy 2009	2 Child protection policy 2009	3 National family policy 2010	4 National social policy 2003	5 National Action Plan of Disabled Person 2016-2022	6 National Community Policy	7 National Reproductive and Social Health Education Policy (2009)	8 National Strategy Plan in Handling The Causes Of Child Marriage
1	climate	climate change	iklim, cuaca	0	0.00%	0	0	0	0	0	0	0	0
2		extreme events	ekstrim	0	0.00%	0	0	0	0	0	0	0	0
3		natural disaster	bencana	28	2.35%	3	0	0	0	25	0	0	0
4		flood	banjir	0	0.00%	0	0	0	0	0	0	0	0
5		heat wave	(gelombang) panas	0	0.00%	0	0	0	0	0	0	0	0
6		temperature	suhu	0	0.00%	0	0	0	0	0	0	0	0
7		storm	ribut	0	0.00%	0	0	0	0	0	0	0	0
8		landslide	tanah runtuh	0	0.00%	0	0	0	0	0	0	0	0
9		emission	pelepasan/penghas	0	0.00%	0	0	0	0	0	0	0	0
10		mitigation	mitigasi	0	0.00%	0	0	0	0	0	0	0	0
11		adaptation	adaptasi	0	0.00%	0	0	0	0	0	0	0	0
12		resilience	ketahanan/berdaya	4	0.34%	0	0	2	2	0	0	0	0
		Total		32	2.69%								
13	environment	environmental degr	pencemaran persek	1	0.08%	0	0	1	0	0	0	0	0
14		pollution	pencemaran	0	0.00%	0	0	0	0	0	0	0	0
15		air pollution	pencemaran udara	0	0.00%	0	0	0	0	0	0	0	0
16		water pollution	pencemaran air	0	0.00%	0	0	0	0	0	0	0	0
17		water quality	kualiti air	0	0.00%	0	0	0	0	0	0	0	0
18		hazardous	bahaya	8	0.67%	7	1	0	0	0	0	0	0
19		toxic	toksik, racun	0	0.00%	0	0	0	0	0	0	0	0
20		waste	sampah, sisa	1	0.08%	0	0	0	0	0	1	0	0
		Total		10	0.84%								
21	children	children	kanak-kanak	354	29.72%	244	51	4	3	11	10	0	31
22		student	pelajar	19	1.60%	2	0	0	1	9	1	5	1
23		vulnerable	dedah	7	0.59%	3	1	2	0	0	1	0	0
		Total		380	31.91%								
24	education	education	pendidikan	179	15.03%	34	1	4	5	63	11	22	39
25		awareness	kesedaran	57	4.79%	22	3	1	0	18	8	1	4
26		school	sekolah	63	5.29%	13	0	0	2	25	1	5	17
		Total		299	25.10%								
27	health	respiratory disease	penyakit pernafasa	0	0.00%	0	0	0	0	0	0	0	0
28		disease	penyakit	3	0.25%	0	0	0	0	0	3	0	0
29		health	sihat/kesihatan	110	9.24%	23	4	4	6	29	10	22	12
30		health risk	risiko kesihatan	0	0.00%	0	0	0	0	0	0	0	0
31		nutrition	nutrisi/makanan	5	0.42%	3	1	0	1	0	0	0	0
		Total		118	9.91%								
32	well being	rights	hak	78	6.55%	27	5	5	6	27	1	0	7
33		protection	perlindungan	90	7.56%	47	19	7	3	9	0	0	5
34		poverty	miskin ("kemampua	9	0.76%	5	0	2	0	0	0	0	2
35		well-being	kesejahteraan	45	3.78%	9	1	14	3	18	0	0	0
36		access	akses/ boleh dicapa	130	10.92%	10	0	2	1	101	1	1	14
		Total		352	29.55%								
				1191	100.00%								

d. Health

						1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Keywords	Malay	Total (Health)	Percentage (Health)	MOH strategic plan	MOH action plan	Malaysian Strategy for Emerging Diseases and Public Health	NEHAP	MOH Disaster Mgt Plan	Flood	Haze	Heat- clinical	Typhoid	Scabies	Dengue	Malaria	Leptospirosis	Nutrition
1	climate	climate change	iklim, cuaca	24	0.33%	0	0	4	7	1	2	2	2	1	0	3	0	1	1
2		extreme events	ekstrim	4	0.06%	0	0	0	0	0	0	0	3	0	0	0	0	1	0
3		natural disaster	bencana	129	1.78%	0	0	4	1	42	53	28	0	0	0	0	0	1	0
4		flood	banjir	551	7.61%	0	0	4	1	45	497	0	0	0	0	0	0	4	0
5		heat wave	(gelombang) panas	98	1.35%	0	0	0	1	1	0	1	93	0	1	1	0	0	0
6		temperature	suhu	38	0.52%	0	0	0	1	0	0	0	20	16	1	0	0	0	0
7		storm	ribut	26	0.36%	0	0	0	0	26	0	0	0	0	0	0	0	0	0
8		landslide	tanah runtuh	4	0.06%	0	0	0	0	4	0	0	0	0	0	0	0	0	0
9		emission	pelepasan/penghas	1	0.01%	0	0	0	0	0	0	1	0	0	0	0	0	0	0
10		mitigation	mitigasi	8	0.11%	0	0	1	1	6	0	0	0	0	0	0	0	0	0
11		adaptation	adaptasi	2	0.03%	0	0	0	0	0	0	0	1	1	0	0	0	0	0
12		resilience	ketahanan/berdaya	2	0.03%	1	0		0	0	0	1	0	0	0	0	0	0	0
		Total		887	12.25%														
13	environment	environmental degr	pencemaran persek	21	0.29%	0	0	0	2	0	1	0	0	0	0	0	0	18	0
14		pollution	pencemaran	57	0.79%	0	0		3	4	5	40	0	5	0	0	0	0	0
15		air pollution	pencemaran udara	35	0.48%	0	0	0	3	4	0	28	0	0	0	0	0	0	0
16		water pollution	pencemaran air	1	0.01%	0	0	0	0	0	0	0	0	1	0	0	0	0	0
17		water quality	kualiti air	3	0.04%	0	0	0	0	2	1	0	0	0	0	0	0	0	0
18		hazardous	bahaya	48	0.66%	0	0	1	16	12	0	12	0	1	0	0	0	6	0
19		toxic	toksik, racun	68	0.94%	1	7	1	2	14	11	3	0	5	4	15	5	0	0
20		waste	sampah, sisa	28	0.39%	0	1	0	7	0	5	0	0	5	0	9	0	1	0
		Total		261	3.61%														
21	children	children	kanak-kanak	283	3.91%	5	7	0	3	7	10	3	4	12	18	0	26	1	187
22		student	pelajar	16	0.22%	4	2		0	0	0	0	0	0	0	1	0	0	9
23		vulnerable	dedah	21	0.29%	0	0		2	0	1	5	0	6	1	0	0	1	5
		Total		320	4.42%														
24	education	education	pendidikan	236	3.26%	9	12	16	12	27	54	16	2	5	2	17	1	3	60
25		awareness	kesedaran	48	0.66%	2	8		1	8	0	0	0	0	0	9	2	4	14
26		school	sekolah	215	2.97%	12	36		0	4	0	7	0	0	7	11	0	1	137
		Total		499	6.89%														
27	health	respiratory disease	penyakit pernafasa	23	0.32%	0	0	0	4	4	0	1	4	2	0	0	6	2	0
28		disease	penyakit	698	9.64%	60	10		28	158	96	92	19	46	4	34	50	56	45
29		health	sihat/kesihatan	3153	43.56%	310	219	469	304	460	409	226	14	56	3	100	87	57	439
30		health risk	risiko kesihatan	145	2.00%	3	0	4	32	2	17	6	6	7	3	10	33	22	0
31		nutrition	nutrisi/makanan	1125	15.54%	13	33	0	6	26	156	2	0	0	0	0	1	0	888
		Total		5144	71.06%														
32	well being	rights	hak	8	0.11%	1	1	1	2	0	0	0	0	0	0	0	0	0	3
33		protection	perlindungan	42	0.58%	1	2	0	9	11	3	8	1	1	0	2	1	2	1
34		poverty	miskin ("kemampua	5	0.07%	0	0	0	0	0	0	0	0	1	1	0	0	0	3
35		well-being	kesejahteraan	24	0.33%	2	0	0	3	0	0	0	0	0	0	4	0	0	15
36		access	akses/ boleh dicapa	49	0.68%	18	3		5	2	0	0	2	0	0	0	5	0	14
		Total		128	1.77%														
				7239	100.00%														

e. Education and development plans

		Keywords	Malay	Total (Edu)	Percentage (Edu)	Education Policy	Education Blueprint 2013-2025	11th Malaysia Plan	National Physical Plan 3	Total	Percent
						1	2	1	2		
1	climate	climate change	iklim, cuaca	0	0.00%	0	0	3	116	119	3.75%
2		extreme events	ekstrim	0	0.00%	0	0	0	0	0	0.00%
3		natural disaster	bencana	18	0.27%	18	0	22	195	217	6.84%
4		flood	banjir	1	0.01%	1	0	13	202	215	6.78%
5		heatwave	(gelombang) panas	0	0.00%	0	0	0	3	3	0.09%
6		temperature	suhu	0	0.00%	0	0	1	6	7	0.22%
7		storm	ribut	0	0.00%	0	0	1	4	5	0.16%
8		landslide	tanah runtuh	1	0.01%	1	0	2	36	38	1.20%
9		emission	pelepasan/penghas	0	0.00%	0	0	49	32	81	2.55%
10		mitigation	mitigasi	0	0.00%	0	0	44	12	56	1.77%
11		adaptation	adaptasi	0	0.00%	0	0	23	8	31	0.98%
12		resilience	ketahanan/berdaya	6	0.09%	1	5	87	104	191	6.02%
		Total		26	0.38%			245	718	963	30.36%
13	environment	environmental degr	pencemaran persek	1	0.01%	0	1	2	4	6	0.19%
14		pollution	pencemaran	0	0.00%	0	0	17	35	52	1.64%
15		air pollution	pencemaran udara	0	0.00%	0	0	3	4	7	0.22%
16		water pollution	pencemaran air	0	0.00%	0	0	0	5	5	0.16%
17		water quality	kualiti air	0	0.00%	0	0	9	7	16	0.50%
18		hazardous	bahaya	0	0.00%	0	0	2	6	8	0.25%
19		toxic	toksik, racun	0	0.00%	0	0	0	0	0	0.00%
20		waste	sampah, sisa	0	0.00%	0	0	74	130	204	6.43%
		Total		1	0.01%			107	191	298	9.39%
21	children	children	kanak-kanak	68	1.00%	37	31	47	9	56	1.77%
22		student	pelajar	1576	23.28%	39	1537	98	11	109	3.44%
23		vulnerable	dedah	0	0.00%	0	0	13	24	37	1.17%
		Total		1644	24.28%			158	44	202	6.37%
24	education	education	pendidikan	1210	17.87%	1017	193	225	77	302	9.52%
25		awareness	kesedaran	62	0.92%	17	45	51	21	72	2.27%
26		school	sekolah	3558	52.55%	1015	2543	118	23	141	4.45%
		Total		4830	71.33%			394	121	515	16.24%
27	health	respiratory disease	penyakit pernafasa	0	0.00%	0	0	0	0	0	0.00%
28		disease	penyakit	0	0.00%	0	0	17	5	22	0.69%
29		health	sihat/kesihatan	14	0.21%	14	0	179	98	277	8.73%
30		health risk	risiko kesihatan	1	0.01%	1	0	0	0	0	0.00%
31		nutrition	nutrisi/makanan	23	0.34%	23	0	1	0	1	0.03%
		Total		38	0.56%			197	103	300	9.46%
32	well being	rights	hak	7	0.10%	3	4	20	56	76	2.40%
33		protection	perlindungan	1	0.01%	1	0	38	243	281	8.86%
34		poverty	miskin ("kemampu	15	0.22%	15	0	35	16	51	1.61%
35		well-being	kesejahteraan	6	0.09%	6	0	0	122	122	3.85%
36		access	akses/ boleh dicapa	203	3.00%	20	183	242	122	364	11.48%
		Total		232	3.43%			335	559	894	28.18%
				6771	100.00%			1436	1736	3172	100.00%

APPENDIX 7 LEGAL ASSESSMENT - INTERVIEWS

Topics	Key Points
The scope of the Child Act (R1: an advocate and solicitor)	➢ Law plays an important role in protecting children against the harms associated with environmental and climate change impacts. ➢ However, the scope of children's protection in the Child Act is confined only to abuse, neglect, or violence. There has not been any provision under the Child Act or other legislation on protecting children from environmental and climate change harm. ➢ Existing environmental law and child law needs to be reviewed to determine if these laws reflect the nation's obligations under the UNCRC and account for how children are more susceptible to environmental harm.
The concept of children's best interest (R2: a senior advocate and solicitor, and a committee member of the Bar Council)	➢ The concept of 'children's best interest' is derived from Article 3 of the UNCRC. The article states that 'in all actions concerning children, whether undertaken by public or private social welfare institutions, courts of law, administrative authorities or legislative bodies, the best interests of the child shall be a primary consideration.' ➢ This Principal could be found within the law on children's custody in the case of divorce. The Law Reform (Divorce and Marriages) Act 1976 (LRA) for non-Muslims and the Islamic family law such as the Islamic Family (Federal Territories) Act 1984 for Muslims uphold the principle of children's best interest when deciding in whose custody a child should be placed, whereby the paramount consideration is the welfare of the child. ➢ At present, the definition of the best interest principle and procedures above have only been established in situations related to custody in divorce cases. ➢ The most common interpretation of the concept `best interest' relates to 'care, comfort, attention, well-being and happiness of the child'. The broader scope of the principle has very rarely been implemented within other laws. ➢ It is proposed that legal and institutional bodies apply the best interest principle by considering how children's rights and interests can be affected by their decisions and actions, including in the areas of environment and climate change.
The importance of the EQA (R3: an advocate and solicitor)	➢ Children's best interest has not been an important factor for consideration within the EQA's environmental protection strategies. ➢ EQA has to be supported with a dedicated institutional framework and efficient enforcement of the relevant laws. ➢ For effective law enforcement concerning children's welfare, various agencies' roles and responsibilities must be clearly defined and allocated. ➢ Interagency linkages at the national and local levels and strong data sharing systems could help public authorities to make informed policy decisions at the intersection of law and science. ➢ Data sharing systems could help tackle the multi-dimensional challenges of children's protection issues through coordinated approaches within the related policy, law, and agencies.

Topics	Key Points
The role of the judiciary (R4: a retired judge with experience presiding over cases at the court for children and environmental court)	➢ Children's cases presented stricter procedures to adjudicators both in the nature of the cases and how such cases were presented to the court. ➢ There are special procedures for arrest, bail or remand, trial, and sentencing of children and defining the roles and responsibilities of police, probation officers, and the Court for Children in handling the child, either as a victim or witness or offender. ➢ R4 agreed that environmental issues are closely linked to how children experience their quality of life. Children as a marginalised group are more likely to suffer from health problems caused by environmental issues such as access to water and sanitation. ➢ Judges can play an important role in children's protection from environmental harm because they can interpret the law and have the discretionary power to impose strict sentencing in cases involving public interest, such as that involving children.
Children's protection under Tort Law (R5: an advocate and solicitor)	➢ Principally, the law of tort arises when a person has a duty of care towards another person. The victim or the injured person will be entitled to damages if they can prove that an individual owes him a duty and has breached that duty. ➢ The law of tort gives protection to children in general coverage but does not have specific rules that apply specifically to protect the children. ➢ As the law recognises every individual's right to safety, a child can also establish his right and protection under the law regardless of their age category. ➢ Case of *McHale v Watson:*[19] the court stated that the age factor must be considered in determining a duty of care against children. ➢ Case of *Phipps v Rochester Corporation:*[20] The parent is responsible for protecting the child based on a certain degree of care expected for parents to exercise.
Law of Tort and environmental harm (R5: an advocate and solicitor)	➢ The law of tort can be applied to environmental degradation on the ground of negligence. ➢ The Halsbury's Laws of England[21] defines negligence as a specific tort, and in any given circumstances is the failure to exercise that care which the circumstances demand. ➢ What amounts to negligence depends on the facts of each particular case. It may consist of omitting to do something that ought to be done or doing something that ought to be done either differently or not at all. ➢ The plaintiff must be able to demonstrate: – that a duty of care is owed to him by the defendant, – that the duty has been breached, – that the damage of which he complains was caused by that breach of duty (causation), and

[19] McHale v Watson [1996] ALR 513
[20] Phipps v Rochester Corporation [1955] 1 QB 450
[21] Halsbury's Laws of England 3rd Ed. Vol. 28 pages 1 and 2 under the sub-heading ‘meaning of negligence’

Topics	Key Points
	– that damage of that kind was a reasonably foreseeable consequence of the breach of duty. ➢ The child victim who opts to claim damages under the law of tort needs to fulfil four elements: duty of care, breach of duty, damage suffered, and causation. ➢ For cases related to environmental torts, the court specifically requires the claimant to satisfy three conditions to bring an action in negligence against a polluting act: (i) it has to be proven that the plaintiff suffered some damages due to the polluting act of the defendant, (ii) it has to be established that there was a duty not to pollute, and there was a breach of the duty, and (iii) it has to be proven that statutory authority, if any, in the form of a license or otherwise, does not exonerate the defendant from the liability ➢ Who should be responsible: – The child victim needs to identify and prove who should be responsible for climate change and environmental degradation. The duty relating to this issue also should be defined clearly to avoid any ambiguous claims before the court. In most cases, the government is one of the responsible parties. However, it will later be argued whether the government is to be wholly responsible and the children are the right party to sue for the damages. ➢ The case of toxic pollution at Sungai Kim Kim, Pasir Gudang: – It was reported that about 171 individuals had filed summonses against 12 parties, including the Government of Malaysia. However, it is difficult to fully blame the Government of Malaysia for what was happened to the individuals affected by the pollution based on the tort law. ➢ Damage suffered by children and the causation involved: – In practice, the difficult part for the judge is to link between the extent of the breach of the duty and the worth of the damage suffered by the victim. – The judge is more inclined to award the damages based on physical injury and not mental injury suffered due to stress, trauma and other physiological states. – The burden of proof for mental injury is much heavier than physical injury. ➢ In most scenarios, pollution cases will be investigated and charged under criminal offence or the EQA, not civil law.
Rights of children to claim damages	➢ Does civil law give the children the right to claim damages resulting from climate change and environmental degradation? – In general, the protection given to the children allows them to claim damages for any harm or loss suffered, including harm resulting from climate change and environmental degradation, which lies in the law of negligence and occupier's liability. ➢ In most cases, the parent or legal guardian may be the complainant or petitioner, speaking on behalf of the children. ➢ The category of child, either young or very young, has been decided in several tort claims.

Topics	Key points
(R6: senior law lecturer specialising in human rights law)	– Example: occupier's liability issue where the duty to protect children owned by the occupiers to a young and very young person. This would include protection available to children where the parent has a duty to ensure their child is in a safe environment, such as in the U.K. case of *Phillips v Rochester Corporation*. To stress his point, R6 gave several more examples of decided cases, such as *Mohd Safuan Wasidin v Mohd Ridhuan Ahmad*, where the court held that the issue related to the degree of care would depend on the proportionate age of the child. Whereas in the case of *Abraham v Choo Jit Fung,*[22] the Federal Court further explained that the duty of care for children must not be the same as adults and shall not be blamed in an accident case. ➢ The court has the power of judicial review that could be exercised to protect the children. – Judicial review is an inherent right of the courts to review the decision-making process of a public body provided under Order 53 Rules of Court 2012. The courts can also review the decision and analyse the decision's merits and replace the administration body's decision. However, it is not applicable in all cases. Under judicial review, the Courts can only grant public law remedies under paragraph 1 of the Schedule to the Court of Judicature Act 1964 and Chapter VIII of Part 2 of the Specific Relief Act 1950. ➢ Civil suits – Civil suits by individuals against polluters is common, and there are instances where the plaintiffs were compensated. – Nevertheless, alleging losses caused by pollution other than oil spills or other human-made disasters by fishers is almost unlikely in Malaysia. As it stands today, the regulation is not compassionate enough for the victims of the environment. Maybe, like other victims, this is one of the major obstacles children face in bringing legal suits. – R6 agreed with the view that judicial delineation of tortuous remedies has utterly failed to control environmental pollution and to bring justice to the doorstep of the indigent and poor people. This is because the plaintiff, including children, needs to show that special injury was suffered over and above the injury common to others. ➢ Property rights – Where a property is public, the law does not allow a person to seek compensation on his own unless he successfully proves that the losses are above the general public. No one else is entitled to act on behalf of others because of the strict adherence to the doctrine of *locus standi*. – There is the primary concern in the court of law whether a plaintiff has the right to sue for public property damages. – For example, in *Ketua Pengarah Jabatan Alam Sekitar and Anor v. Kajing Tubek and Ors*, the court took a more restricted view. It denied the native residents' *locus standi* to raise this matter in the court for the following reasons, *inter alia*, the respondents suffered no special injury over and above the injury common to others. ➢ This can hinder children from suing for their environmental rights relating to public property damages unless they can prove that they suffered from a special injury over and above that of others.

[22] Abraham v Choo Jit Fung [1966] 1 MLJ 97

APPENDIX 8 SDG 13 MONITORING FRAMEWORK

Below is the SDG governance structure in Malaysia and the SDGs incorporated across the pillars in the 11MP.

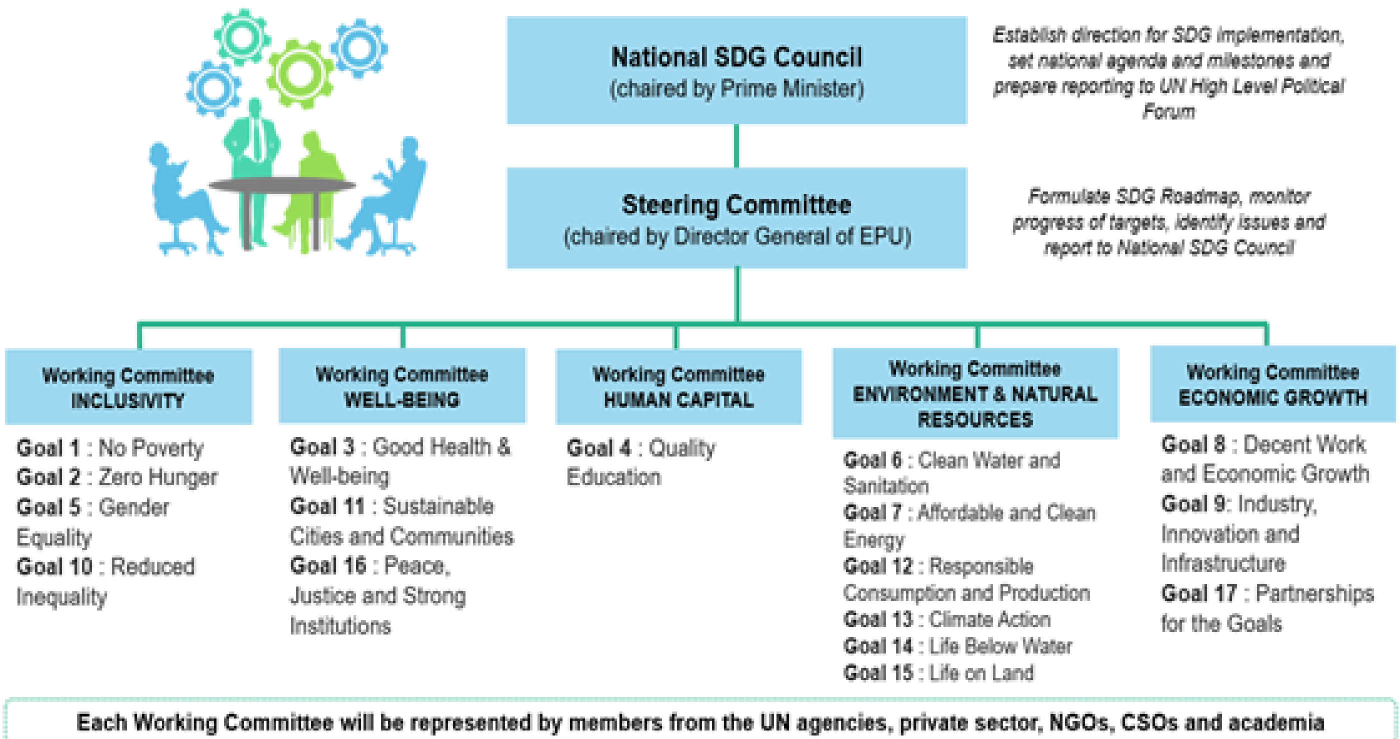


Figure 97: SDG governance structure in Malaysia

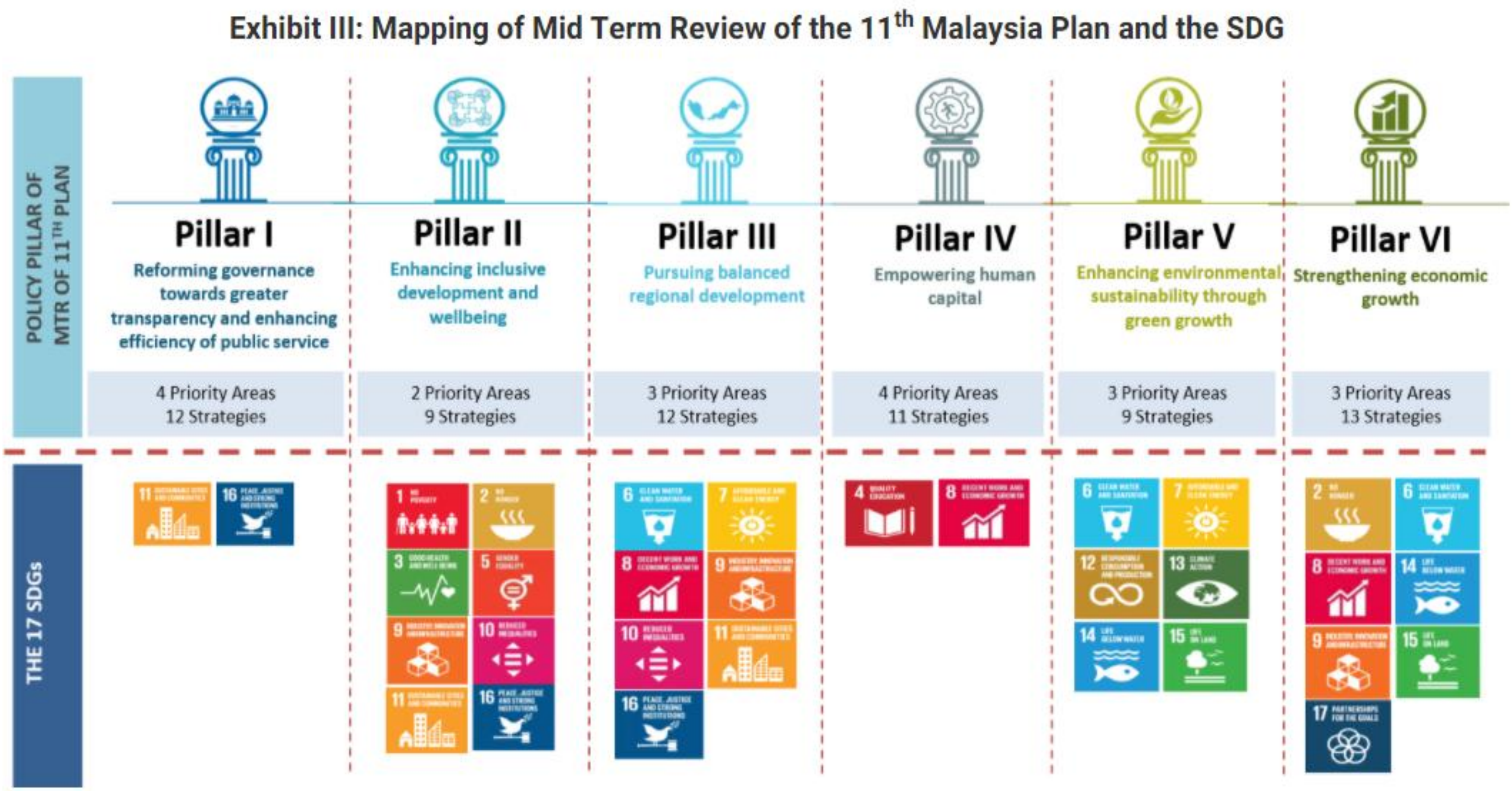


Figure 98: Mapping of the 11th Malaysia Plan and the SDGs

a. SDG 13 Climate Action

SDG Targets	Indicators	Malaysia Monitoring	Source
13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	Indicator 13.1.1: Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	In 2019, there were 10,529 people affected by disasters, nine deaths and 5,906 people injured or ill due to disasters, 4,414 people with damaged dwellings due to disasters, and 209 people with disrupted or destroyed livelihoods due to disasters. (UNStats) **0 deaths and missing persons attributed to disasters per 100,000 population, 32.3 people affected by disasters per 100,000 population (DOSM website)**	
	Indicator 13.1.2: Number of countries that adopt and implement **national disaster risk reduction strategies** in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	*Sendai Framework priorities: i) understand risks, ii) disaster risk governance, iii) investing for resilience, iv) disaster preparedness* **Malaysia placed green emphasis to reduce disaster risks in the Mid-Term Review of the Eleventh Malaysia Plan (2016-2020)** Under Chap 6, 11MP: Pursuing green growth for sustainability and resilience Achievements under 10th MP: -**34 flood hazard maps developed** **-implementation of 194 flood mitigation projects has shielded nearly one million people from floods. In total, 1 million people are protected from flood mitigation projects.** **-24.4km of coastal areas in Johor, Kelantan, Pulau Pinang, Sabah, Sarawak, Selangor, and Terengganu were rehabilitated from risks of erosion** **-New aerobic paddy variant (MRIA1) launched in 2013, a paddy variant resistant to heat and able to be planted in areas with poor water supply** - 11MP under Focus Area D: Strengthening resilience against climate change and natural disasters Workshop on Monitoring of Sendai Framework (NADMA strategic plan 2019-2023)	Malaysia Disaster Management Reference Handbook 2019 11MP NADMA strategic plan 2019-2023

SDG Targets	Indicators	Malaysia Monitoring	Source
	Indicator 13.1.3: Proportion of **local governments** that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies	The proportion of local governments that adopt and implement local disaster risk reduction (DRR) strategies in line with national DRR strategies was 100% in 2019. (UNStats website) All states in Malaysia have adopted and implemented local DRR strategies. Moving forward, it will be extended to local governments (SDG2018) -Integration of DRR in urban development plans - National Physical Plan, State Structure Plan, Local Plan, Malaysia Plan (Rani et al. 2020)	https://country-profiles.unstatshub.org/mys#goal-13 Rani et al. 2020
13.2 Integrate climate change measures into national policies, strategies and planning	Indicator 13.2.1: Number of countries that have **communicated** the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production (including a national adaptation plan, nationally determined contribution, national communication, biennial update report or other)	Malaysia has submitted its national communication and biennial update report to the UNFCCC	

SDG Targets	Indicators	Malaysia Monitoring	Source
13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	Indicator 13.3.1: Number of countries that have integrated **mitigation, adaptation, impact reduction and early warning** into primary, secondary and tertiary **curricula**	Digital Educational Learning Initiative Malaysia (DELIMa) - Global Citizenship Education	
	Indicator 13.3.2: Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions	Malaysia implements adaptation, mitigation and technology transfer, and development actions (SDG2018)	

b. SDG 3 Good Health and Well-Being

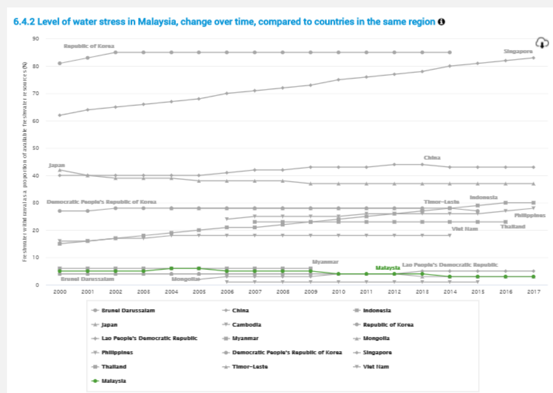
SDG Targets	Indicators	Malaysia Monitoring	Source
3.3 By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.	Indicator 3.3.1: Number of new HIV infections per 1,000 uninfected population, by sex, age and key populations Indicator 3.3.2: Tuberculosis incidence per 100,000 population Indicator 3.3.3: Malaria incidence per 1,000 population Indicator 3.3.4: Hepatitis B incidence per 100,000 population Indicator 3.3.5: Number of people requiring interventions against neglected tropical diseases	-7.6 per 100,000 population in malaria incidence rate (2015) compared to 54.6 per 1,000 in 2000 (SDGReview2017) - 0.1 malaria incidence per 1,000 population from 2015-2017 (SDG2018) -328 per 100,00 population in dengue incidence rates (2016), showing a slight decline despite rates doubling between 2009–2014 (SDGReview2017) -79.45 per 100,000 population in tuberculosis incidence rates (2015), showing a decline compared to the increasing trends observed between 2010–2014 (SDGReview2017) - 80.8 tuberculosis incidence per 100,000 population from 79.5 in 2015 and 81.3 in 2016 (SDG2018) -In 2018, the incidence of tuberculosis was 92.0 per 100,000 population (UNStats) -15.4 hepatitis B incidence per 100,000 population in 2017 from 12.7 in 2015, 12.3 in 2016 (SDG2018) - 0.1 malaria incidence per 1,000 population from 2015-2017 (SDG2018) -In 2018, the incidence of malaria was 0 per 1,000 population (UNStat) -The number of people requiring interventions against neglected tropical diseases was 80,797 in 2018 (UNStats) -Malaysia reduced water-borne diseases by more than 8% between 1990 and 2012 through improved treated water and sanitation facilities (SDGReview2017)	SDGReview2017 SDG2018 UNStats

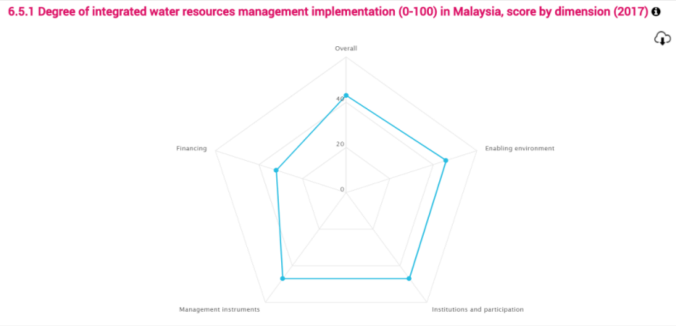
SDG Targets	Indicators	Malaysia Monitoring	Source
3.9 By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.	Indicator 3.9.1: Mortality rate attributed to household and ambient air pollution Indicator 3.9.2: Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services) Indicator 3.9.3: Mortality rate attributed to unintentional poisoning	Mortality rate attributed to household and ambient air pollution, age-standardized (per 100,000 population) was 47.4 in Malaysia - not available in Malaysia (WorldBank website) The mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene was 0.4 deaths per 1,000 population in 2016 (UNStats)	UNStats WorldBank website

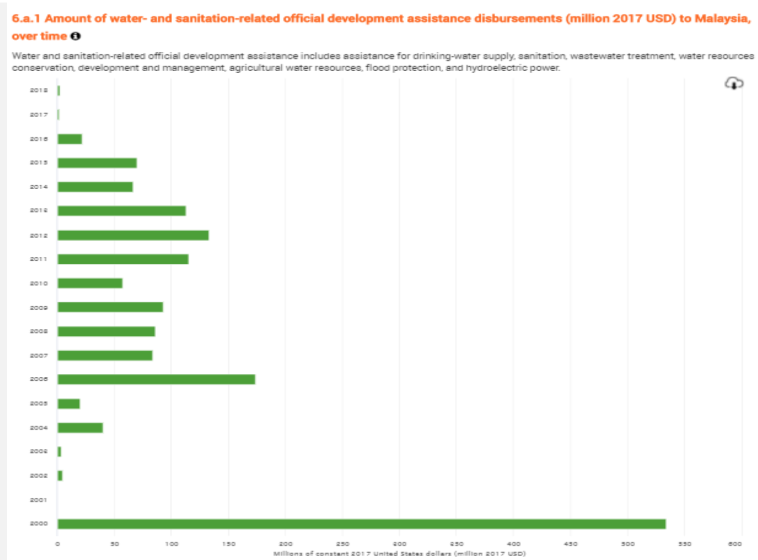
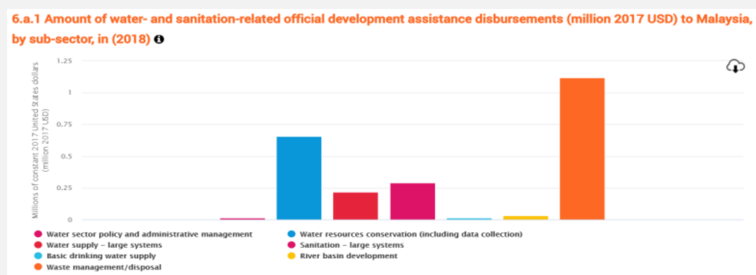
c. SDG 6 Clean Water and Sanitation

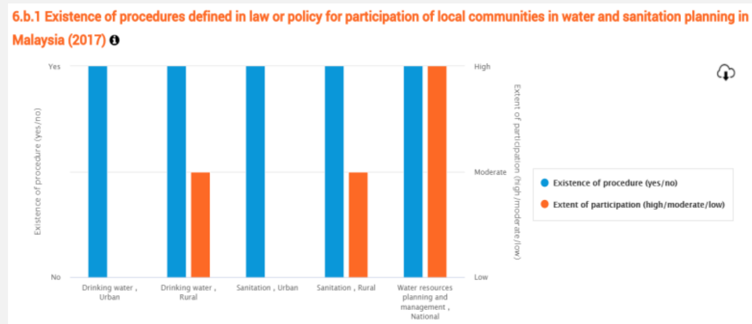
SDG Targets	Indicators	Malaysia Monitoring	Source
6.1. By 2030, achieve universal and equitable access to safe and affordable drinking water for all	Indicator 6.1.1: Proportion of population using safely managed drinking water services	95.5% coverage for treated water and sanitation facilities	SDGReview2017 SDG2018
6.2. By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	Indicator 6.2.1: Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water	99.7% in 2016 (SDG2018)	SDG2018
6.3. By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated waste water and substantially increasing recycling and safe reuse globally	Indicator 6.3.1: Proportion of wastewater safely treated Indicator 6.3.2: Proportion of bodies of water with good ambient water quality	The proportion of wastewater safely treated was 72% in 2015 – (sdg6data) **River water**: 56% clean (all clean water in Sarawak) (EQR2018) **Groundwater quality** (agriculture land use): 16.7% excellent, 83.3% good (urban and suburban land use): 18.1% excellent, 63.6% good, 18.1% moderate (industrial sites land use): 5.6% excellent, 77.8% good, 16.7% moderate (solid waste landfill land use): 52.2% good, 47.8% moderate (golf course): 1 station excellent, 4 station good, 1 station moderate (rural areas land use): 2 st good, 1 moderate (ex-mining areas): 3 st good (municipal water supply): 4 good, 2 moderate (animal burial areas) (aquaculture farms) (radioactive landfill) (resorts): Coastal **marine water quality:** 66% excellent, 20%good, 14% moderate Island marine water: 86% excellent, 8% good, 5% moderate Estuary marine water: 21% excellent, 25% good, 48% moderate, 6% poor	

SDG Targets	Indicators	Malaysia Monitoring	Source
6.4. By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	Indicator 6.4.1: Change in water-use efficiency over time Indicator 6.4.2: Level of water stress: freshwater withdrawal as a proportion of available freshwater resource	6.4.1 - NA (latest in 2005) (sdg6data) 6.4.2 level of water stress - refer to the graph below Water withdrawal by sector in Malaysia, as a percentage of total water withdrawal (2005)- 35% service sector, 43% mining, quarrying, manufacturing, constructions, energy, 22% agriculture, forestry, fishing Renewable water resources: 18,341 m3 per capita (2017) Water withdrawal: 421 m3 per capita (2005) Environmental flow requirements: 66 % of the renewable water resources (2017) (sdg6data)	https://www.sdg6data.org/country-or-area/Malaysia



6.5. By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate	Indicator 6.5.1: Degree of integrated water resources management implementation (0- 100) Indicator 6.5.2: Proportion of transboundary basin area with an operational arrangement for water cooperation	6.5.1- refer graph below 3.4% of transboundary basin area with an operational arrangement for water cooperation in 2017 (Based on the area covered under Memorandum of Agreement (MoA) Malaysia-Thailand On The Golok River Mouth Improvement Project) (SDG2018) 13% (sdg6data)  	SDG2018 https://www.sdg6data.org/country-or-area/Malaysia
SDG Targets	**Indicators**	**Malaysia Monitoring**	**Source**
6.6. By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1: Change in the extent of water-related ecosystems over time	Baseline (2001-2005): 3,531km2 Latest five year period (2011-2015): 3,907km2 Change in extent compared to baseline: gain of 11% (sdg6data) (earth observation data)	https://www.sdg6data.org/country-or-area/Malaysia

6.a. By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies	6.a.1: Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan (sdg6data)	 	https://www.sdg6data.org/country-or-area/Malaysia
SDG Targets	**Indicators**	**Malaysia Monitoring**	**Source**

6.b. Support and strengthen the participation of local communities in improving water and sanitation management	6.b.1: Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management – (sdg6data)		https://www.sdg6data.org/country-or-area/Malaysia

d. SDG 4 Quality Education

SDG 4 Targets	Indicators	Malaysia Monitoring	Source
4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes	4.1.1 Proportion of children and young people: (a) in grades 2/3, (b) at the end of primary, and (c) at the end of lower secondary achieving at least a minimum proficiency level in (i)reading and (ii) mathematics, by sex	The proportion of children and young people at the end of lower secondary achieving at least a minimum proficiency level in reading is 79.5 (2016) to 78.3 (2018), and in mathematics is 47.1 (2016) to 42.3 (2018) in Malaysia.	SDG2018
Target 4.2. By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education	Indicator 4.2.1: Proportion of children under five years of age who are developmentally on track in health, learning and psychosocial well-being, by sex	Increased enrolment for children aged 4+ to 5+ from 72.4% in 2010 to 90.7% in 2014	11MP
	Indicator 4.2.2: Participation rate in organized learning (one year before the official primary entry age), by sex		
Target 4.3. By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university	*Indicator 4.3.1: Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex*	Primary education enrolment rate increased from 95.7% In 2010 to 97.9% in 2014, while the gap in enrolment rates between boys and girls has been reduced from 1% to 0%, at the secondary level, the enrolment rate increased from 88.1% in 2010 to 90% in 2014	11MP
Target 4.4. By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	Indicator 4.4.1: Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill		
Target 4.5. By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations	Indicator 4.5.1: Parity indices (female/male, rural/urban, bottom/top wealth quintile and others such as disability status, indigenous peoples and conflict-affected, as data become available) for all education indicators on this list that can be disaggregated		

SDG 4 Targets	Indicators	Malaysia Monitoring	Source
Target 4.6. By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy	*Indicator 4.6.1: Proportion of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills, by sex*	Between 2010 and 2012, the Literacy and Numeracy Screening (LINUS) programme increased Bahasa Melayu literacy from 84.9% to 99.8% and numeracy skills from 90.9% to 99.9%. In 2013, LINUS was expanded to include English literacy, improving Year One students' English literacy from 50% to 63% within four months	RMK11
Target 4.7. By 2030, ensure that all learners acquire the knowledge and skills needed to promote **sustainable development**, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development	Indicator 4.7.1: Extent to which (i) global citizenship education and (ii) education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in: (a) national education policies, (b) curricula, (c) teacher education and (d) student assessment	In RMK11, Chap 6: SCP in education: Integrating SCP in the formal syllabi to instil sustainable behaviour among students. The SCP curriculum was drafted in collaboration with the MOE, containing training along eight themes, including energy, water, waste, food consumption and production, transport and sustainable buildings. -Environmental education (EE) has been integrated within the existing K-12 primary and secondary curriculum, particularly in subjects such as science and geography. There are curriculum specifications, lesson plans, and syllabi to guide teachers in incorporating environmental education into their teaching. Most public and private universities integrate EE within their academic programmes, courses and co-curricular activities -Sekolah Lestari, Sekolah Rakan Alam Sekitar (SERASI), Green Schools, Wira Alam. - DRR in National Education policy -Climate Change Education (CCE) - SEW	https://thegeep.org/learn/countries/malaysia
Target 4.a. Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all	Indicator 4.a.1: Proportion of schools with access to (a) electricity, (b) the Internet for pedagogical purposes, (c.) computers for pedagogical purposes, (d) adapted infrastructure and materials for students with disabilities, (e) basic drinking water,(f) single-sex basic sanitation facilities, (g) basic handwashing facilities (as per the WASH indicator definitions)		

SDG 4 Targets	Indicators	Malaysia Monitoring	Source
Target 4.b. By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrollment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries	Indicator 4.b.1: Volume of official development assistance flows for scholarships by sector and type of study		
Target 4.c. By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States	Indicator 4.c.1: Percentage of teachers in: (a) pre-primary, (b) primary, (c.) lower secondary, and (d) upper secondary education who have received at least the minimum organized teacher training (i.e. pedagogical training) pre-service or in-service required for teaching at the relevant level in a given country		

APPENDIX 9 STAKEHOLDER ENGAGEMENT WORKSHOP - SUMMARY OF FINDINGS

Stakeholder Organization	Issues	Agency	Activities / Programmes	Comments	Future Plans/Strategy
Yayasan Hasanah	· Protecting natural ecosystems (forest, rivers, marine, and coast) · Ensuring a clean environment (tackling waste, especially plastic pollution)	· Government (forestry department, DID, parks) · NGO (WWF, MNS, YKPM) · Local councils · Local community · Youth leaders · Private sectors	· Government-activation of local communities, stakeholder’s environment and conservation · Building awareness on the role of the natural ecosystem · Advocate for long term solutions to protect the environment · Local councils - Awareness campaigns · Local community-Actionable progress · Youth leaders-Competitions · Work and private sectors	· Not many are aware of the roles of natural ecosystem benefits, e.g. water supply · State government needs to do more for long-term solutions to protect the environment · Lack of awareness · Sustainability of activities · Actionable programmes	· Targeted word spread through social media
UPNM	· Disaster events	· Malaysian Armed Forces (MAF) · HADR centre PNM · NADMA · MOA · JKM	· Humanitarian assistance and disaster relief (HADR)	· HADR workshops and simulation exercises · Military-civilian coordination	· To continue collaboration with local and international agencies

		· FRD · NGO · International agencies			
UPNM	· Safe water supply	· MAF · MOH · JAKOA	· SAFE WHERE (Safe Water Everywhere) Project	· Post-flood-hit areas, e.g. Kelantan, Orang Asli settlements	· Depends on need assessment
UPNM	· Refugee/ population displacement	· MAF · MOH · NGOs · International agencies	· Malaysian field hospital in Cox's Bazaar	· Temporary stop operations due to COVID-19	· Subject to Malaysian government decision whether to resume or to stop for good
Dr Norlen, MOH	· Air quality and health · Healthcare · Extreme health events	· DOE · MOH · MOT · Local authority	· Air quality monitoring · Awareness · HIA · enforcement	·	·
Dr Norlen, MOH	· Water quality and health	· SPAN · MOH · State government	· Drinking water quality monitoring and surveillance	·	·
Dr Norlen, MOH	· Hygiene and environmental sanitation and cleanliness	· KPKT · MOH · MOE · Local councils	· Cleanliness · Waste management · Vector-borne control · Sanitation	·	·
Dr Norlen, MOH	· Healthy lifestyles and co-benefits	· MOH · KPKT · Local authority · PLAN	· Campaign · Creating more places for children	·	·
Dr Norlen, MOH	· Child health programme	· MOH · Local authority	· Child health programme	·	·

Pn. Aznie, KASA	· Funding and better approach to do vulnerability and adaptation assessment · Budget constraints · Lack of data and expertise · Research are too fundamental	· NAHRIM · MET · Sector leads · MOF · EPU	· NAP · Reporting to UNFCCC	·	· Mainstreaming in other priorities · Budget tagging ·
Dr Gary, MGTC	· Awareness and education (parents and children) · Poverty and economic hardship · Global/international systems/standards and norms (for transboundary movement of GMO products)	·	·	· Inadequate messaging and information systems to disseminate information on the far-reaching impacts of climate change · Inability to access information to make informed choices, afford informed choices · Standards for food and nutrition and import standards	· Proposal to develop climate change resource centre at MGTC
Dr Zaini, FSSK	· CBR (community-based rehabilitation centre) · Home help · PBK	· JKM	· Center for PWK	·	·

	· CSO				
Suka Society	· Access to clean water in Orang Asli villages	· Global Peace	· Implementation of clean water resources for Orang Asli villages	-	-
Suka Society	· Lack of green spaces and trees	· Free Tree Society	· Free plant giveaways · Public education and awareness on plant propagation	· This programme reaches all ages. They open workshops every week for the public to raise awareness	-
KPKT	· Waste management (separation of source - SAS)	· JPSPN	· 3R (reduce, reuse, recycle) · ZeComm (Initiative Komuniti Sifar Sisa)	· Improving recycling rate among community · However, limiting factors include lack of awareness in SAS practice although it was gazetted by the government (w.e.f 1st September 2015)	· Increase recycling rate to 40% by 2025 · Introduce EPR · Circular economy
MYD	· Lack of coordination · Low participation from youths and the marginalised · Awareness	-	-	-	· Clear and comprehensive strategy/roadmap on climate change · Youth participation in policymaking and empowerment · Youth education and school empowerment

Ministry of Education	· Physical preparedness plan for schools in natural disaster-prone areas and supported by various agencies (varies between locations).	· Training module for:
	· Topics related to climate change has been embedded in the curriculum (textbooks) and delivered thematically in selected subjects.	i. climate change science,
	· Training of the teachers on climate change-related topics and training of methods to deliver these topics.	ii. delivery method,
	· Community empowerment for adaptation on climate change	iii. health and well-being link to climate change iv. climate change adaptation
Ministry of Rural Development	· Awareness programme in Maktab Rendah Sains Mara (MRSM) schools by MARA. Activities conducted via Kelab Pencinta Alam and Science Club to raise awareness on environmental issues among students.	· Environmental conservation programme

	· Community-based programme on proper waste management by Lembaga Kemajuan Wilayah.	· Waste management	
	· Waste Management Courses targeted to train the community leaders (Jawatankuasa Pembangunan dan Keselamatan Kampung) towards proper waste management at the point source. This programme is conducted by the Institute of Rural Development (INFRA).	· Evaluation of project effectiveness? Indicators	
	· Awareness in early childhood care and education programme focusing on proper waste management and 3R programmes by Jabatan Kemajuan Masyarakat (KEMAS) and SWCorp. This programme is aimed to raise awareness through the implementation programme guided by SWCorp among Tadika KEMAS teachers and students.	· Value added	

	Malaysian Meteorological Department	· Community empowerment for adaptation to climate change	· Early warning system for climate change adaptation	
	Lestari Alam	· Urban/community farming (in collaboration with KPKT and DBKL)	· How to sustain community mobilization for environmental protection	
		· Recycle programme in PPR Kepong. The programme targeted the students living in the area where they have to run their own recycling centre. The industry provides incentives to help them run the recycling centres. Participation among the communities is good because of the incentives provided.	· Enhance education from preschool level (early education), parents' education	

APPENDIX 10 STAKEHOLDER CONSULTATION WORKSHOP - SUMMARY OF FINDINGS

Health

Stakeholder Organization	Issues	Agency	Activities / Programmes	Comments
MOH Ministry of Higher Education	Policy documents	Some of the important documents are not included	● To add more documents on clinical practising guidelines on climate-related diseases, e.g. asthma, water-borne diseases, COVID-19 ● To update the flood management guideline ● To update the Plan of Action for haze ● To compare with international policies documents	MOH UN agencies (e.g. UNDP/UNHCR), neighbouring countries
MOH Ministry of Higher Education	Key players for monitoring and implementing the policies	Some key actors were not included	● To include PBT (local governments)/ Majlis Keselamatan Makanan Negara	Local governments
MOH Ministry of Higher Education	Keywords are not clearly defined	Keywords (vulnerability, resilience, accessibility) are not clearly defined in some of the documents	● To define main keywords clearly ● To identify potential collaborators to address the underlying issues of vulnerability (e.g. poverty/statelessness)	MWFD MFA Local governments
MOH Ministry of Higher Education	Coordinate bodies	No specific agency to address issues on climate change	● To identify the key players in coordinating issues on climate change	

Environmental education and community engagement

Stakeholder Organization	Issues	Agency	Activities / Programmes
Pusat Kepimpinan Wanita Tun Fatimah	1.Children are addressed as the public as a whole. However, children are not just a smaller group of the public. 2. Vulnerability needs a clear definition. 3. Implementing policies need to engage NGOs 4. Children health risks need to be more objective and properly addressed 5. How can the impacts on urban poor children be differentiated from the impact of climate change? Was it actually due to social contributions rather than climate change? 6. Rectification of the study	1.There are many more current policies for sector 5 [Health] that address public health, including children's health. -e.g. under-five mortality is specifically defined 2.Vulnerable children do not necessarily fall under marginalised categories -it can also be ' at risk of vulnerability' Children who are already impacted by climate change and children at risk of the impacts need to be identified separately. So that focus can be given to the latter group to prevent them from being affected 3. Outcomes of the findings may take some time to reach the government agencies for policy development or amendment 4. The elements of children health status cannot be seen as no specific measurement or health screening has been conducted. -If it relates to the rainy season (climate change), what health component is being measured? It has to be specific	• Look into SDG components involving children • Public health includes children • Need to do correction on Table 1 • Children's vulnerability definition must be clear. • Some content that addresses children at risk and children who are vulnerable is in policies but was not mentioned in Children under Table 1 • Researchers can proceed first with educating the community for immediate changes with the help of NGOs and government agencies. • Issues on climate change impact on children health status/risk can be addressed by collaboration between MOH and Kementerian Pembangunan Wanita, Keluarga dan Masyarakat • Engage with Kementerian Kesihatan Malaysia or a reputable agency to go through the assessment of the children's health risk

Stakeholder Organization	**Issues**	**Agency**	**Activities / Programmes**
		5. Among the urban poor, social risk is the main issue, not climate change. Health risk among the urban poor is more related to sex-related cases and trauma. -No risk assessment data on health such as skin disease, diarrhoea, and flu have been presented. This data is important 6. Not clear how climate change and environmental degradation has impacted children in Pulau Gaya.	● To include health risk assessment such as specific nutritional screening tool (children's BMI) and water-borne diseases assessment to relate to climate change (rainy season). ● A medical team should be included to assess the children's health and at the same time educate the children about the diseases. ● To include and relate with data on water-borne diseases, diarrhoea, flu or skin infections that can be correlated with the impact of the rainy season. ● Focus on climate change on islands and the forest. ● Break down the diseases from the findings. Do analysis such as correlation or multivariate analysis to make it more believable. ● Present the weight and depth of the problem, then why this child is at risk. In health, do not only be interested in children with problems but also children at risk. ● What measures have already

			been taken by the government, the suggestions, and how can they be rectified.
Stakeholder Organization	**Issues**	**Agency**	**Activities / Programmes**
Institut Pendidikan Guru (IPG)	1. Sabah issue is quite complicated. Issues with undocumented children not being mentioned in National Education Policy 2017.	1. Undocumented children did not go to the government school in Pulau Gaya. -Children in Sepanggar Bay do receive education but not the formal MOE curriculum. -the children are observed to be the ones that are educating the parents.	• The term 'marginalised' group was carefully addressed and not too focused but fairly discussing undocumented children's issues and bringing up issues on citizens children.
Kementerian Pendidikan Malaysia (MOE)	1.MOE Education policy prioritized education for the citizens 2. Teacher readiness to adapt in current situations, convey and teach students on environment-related topics as in curriculum. 3. High cost to train all the teachers. Almost impossible to train almost half a million teachers nationwide. 4. In need of outside help/support to help teachers in school. E.g. NGOs.	1. Basic education for the marginalised (non-citizens) was also given by the MOE but required fees. - In Pulau Gaya, education for non-citizens is mainly given by the NGO. There are no obstacles from KPM; KPM will always provide support to the NGO. This NGO did not fully use the curriculum by KPM and may also focus on skills. 2. There is a specific division to train teachers. A 'non-option' teacher might teach environmental topics because of teacher shortage in school. This may become one of the factors of unreadiness. -Teacher needs to take the initiative to explore new knowledge.	Suggest NGOs enhance the vocational training and skill-based training for the non-citizen children's survival and future livelihood. • Require help from other agencies. • Professional certificates have their own merit to teachers. Therefore, a professional certificate programme related to environmental education can be done but needs to be through KPM. • Teachers need to make extra effort to learn new knowledge. • Teachers need to be familiar with the SDGs and climate change. • Those who want to collaborate to establish co-curricular activities with the school can contact the Arts and

			Curriculum Division of KPM.
Stakeholder Organization	**Issues**	**Agency**	**Activities / Programmes**
		3. Institut Pendidikan Guru Malaysia (IPGM) trains based on the available budget given by the government. 4. The school already has an Environmental Club. -Schools that work with, e.g. NGOs (WWF, GCE), have a high awareness of climate change issues. -Schools in East Malaysia are more exposed to the environment compared to Peninsular due to support from the state government and local NGOs	● Clubs/organizations in schools need to go through the MOE and be registered and approved at the school level/PPD/JPN. Thus, it will be able to be used as a merit for school students and security purposes.
SUHAKAM	1. The environment issue is not fully explored yet in SUHAKAM 2. How far are the implementation and the effectiveness of the current policies 3. Low awareness of climate change among the community	1. Understand that children also belong to the general public (public health), but the question is whether children are really considered when forming policies. Because the assessment for health among children and adults is different as children are more vulnerable and sensitive 2. Whether the existing policies have been implemented properly 3. The level of awareness among the	● Climate change in relation to children's rights will be addressed. ● There is a clause under the UNCRC to provide access to clean water and a healthy environment. ● Article 24- best healthcare possible ● To include more children participation in obtaining inputs on how climate change is/may affect them. ● To create more awareness

		community is very low regarding climate change	campaigns
Stakeholder Organization	**Issues**	**Agency**	**Activities / Programmes**
UNICEF	1. What is the main problem to execute? 2. No module for school children to form a club for the environment and climate change 3. The gap between children and youth with policymaker	1. How to create interest among the school children in clubs related to environmental education. 2. What are the procedures to develop this club/reinforce the existing environmental club in schools 3. Children voices have not been heard	• If the issues are due to a lack of resources and political will, UNICEF will be able to help in addressing the issue and engage with the community, especially among children and families • Volunteer-based community engagement, especially in environmental and climate change education • Embark on an environment and climate change module in order to empower the existing environmental club and also a module for teachers as guidance and references • To develop a climate coalition/platform for young people together with the Climate Change and Environment Section under UNICEF so decision-makers (at the local or federal government level) will hear their voice and concerns • To collaborate with IPG or other relevant parties in implementing environmental education not just via formal education but other alternative forms of education to reach out to children and to train teachers • Children and community outreach

			programmes, having clubs at schools/communities. Like Kelab Dr Muda

Climate and environment

Stakeholder Organization	Issues	Agency	Activities / Programmes	Comments
NADMA	Data sharing Awareness and Public Education (MKN Directive 20)	Data Conundrum Translating policy into action	NRR – National Risk Register (1st phase study completed) Disaster risk map (on-going) DRR Act (in progress) CBDRM-Community Based Disaster Risk Management	Ministries (14) / Agencies (20) NGO / Schools / Universities
MOH	Public health – the most vulnerable group (including children) Add on: Food Act -1983 DDBIA -1975 Kualiti Air Minum (coming soon) *Comparable to WHO standard*	Data representative for prediction purposes Urban landscaping and planning have been associated with climate change that affects mental and physical health Housing conditions for children's health	Adaptation/mitigation i.e. Green Hospital (in mainstreaming of climate change)	University researcher
UNICEF		Evidence generation Data fragmentation Public awareness and education Limited coordination of different agencies.	Coordination of data sharing among organizations	

Stakeholder Organization	Issues	Agency	Activities / Programmes	Comments
DOE	EQA 1974 – no direct mention about children - Being reviewed by ASM Schedule Waste Regulations 2005 – Provision on household waste (electrical/electronic) National Water Quality Standard National Environmental Policy (under review)	API /IPU data accessible to all (APIMS) Data Monitoring Station need to be applied from DOE EQC involvement of children		Rakan Alam Sekitar - as a public participation platform KASA

APPENDIX 11 SABAH STAKEHOLDER ENGAGEMENT WORKSHOP - SUMMARY OF FINDINGS

Overall, all the participants in this workshop welcomed the finding of the case study in Pulau Gaya. The Sabah EPU and the State Ministry of Science, Technology and Innovation admit that there is yet a focus on climate change at the ministry level. However, based on the presentation of findings in Pulau Gaya, they will bring the issue to the attention of the MOSTI Minister and the Director of State EPU. The Sabah State Education Department representative raised concerns about the focus of the study on Pulau Gaya because there has been numerous research going through her office, especially from teachers who are pursuing their post-graduate studies. Apart from this concern, she did believe that the finding from this study could help as a starting block for the discussion on climate change in Sabah.

NGOs, particularly Blue Hope and Trash Hero, welcome the findings and are open to future collaboration with UMS to mainstream the climate change issue in Sabah. Blue Hope, for instance, has several community engagement projects in Pulau Gaya and can validate the finding of the study. While welcoming the finding from the study, the welfare department representative admits that their capacity is very much limited to provide protection for children. Therefore, looking into the impact of climate change and environmental degradation on children seems improbable at the moment. However, in the context of children from Pulau Gaya, the welfare department, with the help of UNICEF Malaysia, has embarked on a pilot study to provide a protection centre and daycare centre for children who were found on the streets of Kota Kinabalu, who mostly comes from Pulau Gaya.

Recommendations

Climate change and environmental degradation is a real issue. Rainfall affects mobility and income; heat affects health and water sources. Less than 5% are getting water from natural sources, while almost 50% buy water. If these are left unattended, it will affect the already vulnerable community, the children. Therefore, there is a strong need to consider the following points:

i) Empowering the education sector to play a significant role in educating the children to mitigate vulnerability.

ii) Establishment of Climate Change Centre at the state level

iii) Specific State Action Plan on Climate Change (adaptation, mitigation, and capacity building) – impacts on vulnerable groups must be included. In the past, Sabah has had various state action plans on specific animals threatened with extinction. The time is now right for a specific action plan on the impacts of climate change.

iv) Specific enactment on Climate Change – Sabah Climate Change Enactment

APPENDIX 12 DISCUSSION NOTES FROM STRATEGIC MEETINGS WITH KEY MINISTRIES

No.	Ministry	Date	Key Points
1.	Ministry of Education	15th February 2021	i. Climate change and environmental education are incorporated across subjects ii. Various programmes have been organized by other agencies such as KeTHHA, MOSTI, KASA in collaboration with MOE. iii. There is a difficulty in assessing the effectiveness of all these cross-agency programmes iv. The most recent initiative is the Digital Educational Learning Initiative Malaysia (DELIMa), which is a Global Citizenship Education programme on the 17 SDGs v. There is a need for teachers' training programmes through professional certification in environmental education. The UKM research team has agreed to be the focal point for training on climate change, environmental education and children well-being. Teachers training modules for this topic will be prepared together with MOE and IPG.
2.	Economic Planning Unit	12th March 2021	i. EPU is the focal point for SDGs, i.e. as the secretariat for the SDG council in Malaysia. ii. EPU coordinates the budget and planning for all the ministries in achieving the 17 SDGs. This planning is consistent with the government priority areas, e.g. special education on climate change adaptation and action to mitigate climate change impacts on children's well-being. iii. EPU will share its SDG voluntary review in June this year, following the last one in 2017.
3.	Ministry of Women, Family and Community Development	18th March 2021	i. Currently, all the policies and acts are under review and the points raised will be considered. ii. There are currently no programmes on climate change and the environment for children. iii. Children need to be included in all policies.
4.	Ministry of Environment and Water	31st March 2021	i. Will consider including children in the NDC, which is currently under review. ii. It is difficult to incorporate more stringent environmental laws (to include children) due to economic factors, but this can be considered in policy and guideline standards, which are under review.

APPENDIX 13 LIST OF PROJECT CONTRIBUTORS

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APPENDIX 14 LIST OF PUBLICATIONS

1. Vera Ling Hui Phung, Kayo Ueda, Mazrura Sahani, Xerxes Tesoro Seposo, Wan Rozita Wan Mahiyuddin, Akiko Honda, Hirohisa Takano (2021). Investigation of association between smoke haze and under-five mortality in Malaysia, accounting for time lag, duration, and intensity. *International Journal of Epidemiology.*

2. Mohd Faiz Ibrahim, Rozita Hod, Mazrura Sahani, Azmawati Mohammed Nawi, Idayu Badilla Idris, Hanizah Mohd Yusoff and Haidar Rizal Toha (2021). The Impacts of Illegal Toxic Waste Dumping on Children's Health: A Review and Case Study from Pasir Gudang, Malaysia. *Int. J. Environ. Res. Public Health* 2021, *18*, 2221. https://doi.org/10.3390/ijerph18052221

3. Mohd Faiz Ibrahim, Rozita Hod, Mazrura Sahani, Azmawati Mohammed Nawi. The effect of ambient air pollution on childhood respiratory diseases in low- and middle-income Asian countries: A systematic review. *Atmospheric Environment*, Volume 256, 1 July 2021, 118422

4. Mustafa, M., Ab Hamid, Z., Kwan, S.C., Mamood, S.N.H., Sahani, M. Analysis of children's health protection under the framework of environmental law and child law. In, Zawawi, M. et al. (eds.) (2021) Family law in Malaysia and beyond: Towards sustainable family institutions

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