

Scoping Assessment on Climate Change Adaptation in Malaysia

Summary
October 2011



ADAPTATION
KNOWLEDGE
PLATFORM



REGIONAL CLIMATE CHANGE
ADAPTATIONKNOWLEDGEPLATFORM for Asia

Acknowledgements

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CONTENTS

ACRONYMS	<i>i</i>
SUMMARY	<i>iii</i>
<hr/>	
SCOPING ASSESSMENT ON CLIMATE CHANGE ADAPTATION IN MALAYSIA	2
BACKGROUND TO THE STUDY	2
MALAYSIA'S VULNERBILITIES AND ATTITUDES TOWARDS CLIMATE CHANGE	4
INSTITUTIONAL AND ORGANIZATIONAL ARRANGEMENTS IN RESPONSE TO CLIMATE CHANGE IMPACTS	7
Focal National Coordination Bodies and Ministerial Actors	8
Policies and Regulations Addressing Climate Change Related Issues	11
Focal International and National Institutions and Non-Governmental Organizations Involved in Climate Change Adaptation	14
REGIONAL AND NATIONAL CLIMATE CHANGE ADAPTATION EFFORTS	19
Strategic knowledge development and use – vulnerability and planning	19
Strategic Actions for Environmental Sustainability	22
Strategic Actions within the Water Sector	23
Agriculture Production	25
Public Safety and Wellbeing	26
Policy and Governance	28
CLIMATE CHANGE ADAPTATION CAPACITY GAPS: ACTIONS, KNOWLEDGE, AND PRIORITIES	31
Gaps to Achieve Environmental Sustainability	32
Gaps to Effective Water Resource Management	34
Gaps to Sustainable Agriculture Production	34
Gaps to Enhanced Public Safety and Wellbeing	36
Gaps in Policy and Governance Processes to Build Climate Resiliency	39
CLIMATE CHANGE ADAPTATION CAPACITY DEVELOPMENT STRATEGY	41
Environmental Sustainability	41
Strategy for knowledge development	42
Agriculture Production	42
Public Safety and Wellbeing	45
Policy and Governance	49
CONCLUDING OBSERVATIONS AND ADAPTATION KNOWLEDGE GENERATION RECOMMENDATIONS	51
<hr/>	
ANNEX 1 CITED LITERATURE	56
ANNEX 2 PERCEPTION INTERVIEW LISTING	59
ANNEX 3 MULTI-STAKEHOLDER WORKSHOP PARTICIPANT LISTING	60

ACRONYMS

ACT	ARTEMISININ COMBINATION THERAPY
AKP	REGIONAL CLIMATE CHANGE ADAPTATION KNOWLEDGE PLATFORM FOR ASIA
CAN	CLIMATE ACTION NETWORK
CANSEA	CLIMATE ACTION NETWORK SOUTH EAST ASIA
CBD	UNITED NATIONS CONVENTION ON BIOLOGICAL DIVERSITY
CBO	COMMUNITY BASED ORGANIZATIONS
CBNRM	COMMUNITY BASED NATURAL RESOURCE MANAGEMENT
CCD	UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION
CDC	CENTRE FOR COMMUNICABLE DISEASES
CEMD	CONSERVATION AND ENVIRONMENTAL MANAGEMENT DIVISION
CETDEM	CENTER FOR ENVIRONMENT TECHNOLOGY AND DEVELOPMENT MALAYSIA
COMBI	COMMUNICATION FOR BEHAVIORAL IMPACT
CPRC	CRISIS PREPAREDNESS AND RESPONSE CENTRE
CTI	CORAL TRIANGLE INITIATIVE
DANIDA	DANISH INTERNATIONAL DEVELOPMENT AGENCY
DOE	DEPARTMENT OF ENVIRONMENT
DID	DEPARTMENT OF IRRIGATION AND DRAINAGE
DMPM	DEPARTMENT OF MARINE PARKS MALAYSIA
DRR	DISASTER RISK REDUCTION
DSS	DECISION SUPPORT SYSTEM
EAEF	ASSOCIATION FOR SOUTHEAST ASIAN NATIONS ASEAN ENERGY FACILITY
ENSO	EL NIÑO/LA NIÑA-SOUTHERN OSCILLATION
EPSM	ENVIRONMENTAL PROTECTION SOCIETY, MALAYSIA
EPU	ECONOMIC PLANNING UNIT
FOE	FRIENDS OF THE EARTH
FRIM	FOREST RESEARCH INSTITUTE MALAYSIA
GEC	GLOBAL ENVIRONMENT CENTER
GEF	GLOBAL ENVIRONMENT FACILITY
GEF-SGP	SMALL GRANTS PROGRAMME OF THE GLOBAL ENVIRONMENT FACILITY
GHG	GREEN HOUSE GASES
IDP	INTEGRATED DEVELOPMENT PLAN
IGBP	INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME
IKLIM	MALAYSIAN METEOROLOGICAL DEPARTMENT
IPCC	INTERGOVERNMENTAL PANEL FOR CLIMATE CHANGE
ISIS	INSTITUTE OF STRATEGIC AND INTERNATIONAL STUDIES
ISMP	INTEGRATED SHORELINE MANAGEMENT PLANS
IVM	INTEGRATED VECTOR MANAGEMENT
JICA	JAPAN INTERNATIONAL COOPERATION AGENCY
JPSPN	JABATAN PENGURUSAN SISA PEPEJAL NEGARA
JSP	DEPARTMENT OF IRRIGATION AND DRAINAGE

LESTARI	INSTITUTE FOR ENVIRONMENT AND DEVELOPMENT
LITS	LOW INTENSITY TAPPING SYSTEMS
MARDI	MALAYSIAN AGRICULTURAL RESEARCH AND DEVELOPMENT INSTITUTE
MCCG	MALAYSIAN CLIMATE CHANGE GROUP
MENGOS	MALAYSIAN ENVIRONMENTAL NGOS
MHLG	MINISTRY OF HOUSING AND LOCAL GOVERNMENT
MMD	MALAYSIAN METEOROLOGICAL DEPARTMENT
MNS	MALAYSIAN NATURE SOCIETY
MOA	MINISTRY OF AGRICULTURE
MOH	MINISTRY OF HEALTH
MOSTE	MINISTRY OF SCIENCE, TECHNOLOGY AND THE ENVIRONMENT
MOSTI	MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION
MOPIC	MINISTRY OF PLANTATION INDUSTRIES AND COMMODITIES
MYCLIMATE	THE MALAYSIAN NETWORK FOR RESEARCH ON CLIMATE, ENVIRONMENT AND DEVELOPMENT
NAHRIM	NATIONAL HYDRAULIC RESEARCH INSTITUTE MALAYSIA
NCSA	NATIONAL CAPACITY NEEDS SELF-ASSESSMENT FOR GLOBAL ENVIRONMENTAL MANAGEMENT
NC2	SECOND NATIONAL COMMUNICATION
NGO	NON GOVERNMENT ORGANIZATION
NOD	NATIONAL OCEANOGRAPHY DIRECTORATE
NRE	MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT
NSCCC	NATIONAL STEERING COMMITTEE ON CLIMATE CHANGE
PRECIS	PROVIDING REGIONAL CLIMATES FOR IMPACTS STUDIES
PTM	INDUSTRIAL PROCESSES
REAP-CCA	REGION-WIDE EARLY ACTION PLAN FOR CLIMATE CHANGE ADAPTATION
REGHCMPM	REGIONAL HYDRO-CLIMATE MODEL FOR PENINSULAR MALAYSIA
SARCS	SOUTHEAST ASIA REGIONAL COMMITTEE FOR START
SEADPRI	THE SOUTHEAST ASIAN DISASTER PREVENTION RESEARCH INSTITUTE
START	GLOBAL CHANGE SYSTEM FOR ANALYSIS, RESEARCH AND TRAINING
SOP	STANDARD OPERATING PROCEDURE
TCPD	TOWN AND COUNTRY PLANNING DEPARTMENT
TWN	THIRD WORLD NETWORK
UKM	UNIVERSITI KEBANGSAAN MALAYSIA
UM	UNIVERSITY OF MALAYSIA
UNDP	UNITED NATIONS DEVELOPMENT PROGRAM
UNEP	UNITED NATIONS ENVIRONMENT PROGRAMME
UNFCCC	UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE
V&A	VULNERABILITY AND ADAPTATION
WSI	WATER SERVICES INDUSTRY
WUE	WATER USE EFFICIENCY

SUMMARY



The Intergovernmental Panel for Climate Change (IPCC) 2007 report on the “Science of Climate Change” noted small increases in temperature and rainfall through the Southeast Asia Region in the last decade; however, changing behavioral patterns of ocean circulation systems are triggering weather extremes and variability, subsequently influencing patterns of hydro-meteorological and geo-morphological events. This puts the focus of ‘change’, centered on the region’s major river basins respective of flood and drought intensities, haze pollution, slope failures, and the emergence of certain diseases.

Currently Malaysia has been able to absorb climate change impacts to date, given its strong environmental management programmes,

backed by stringent economic policies including effective poverty eradication and food production programs. However, it must be understood that these efforts address only the ‘environmental change threat’ and not specifically the ‘climate change threat’ where in the long term the impact scenario for Malaysia would generally diverge. Climate change could well trigger national and international distributional conflicts in Malaysia, e.g. within its fisheries sector, and intensify problems already hard to manage in the region. Given the aforementioned, there are four areas of concern:

- Climate-induced degradation of forest, marine and freshwater resources;
- Climate-induced increases in certain hydro-meteorological and geo-morphological events;
- Climate-induced decline in food production capacities and other environmentally driven economic systems; and
- Climate change ethical – justice issues such as environmentally induced displacements and migration, the deprivation and sustenance of certain livelihood activities, and the safety and well being of the more marginalized sectors of society.

Malaysia has engaged fully with the climate change community; committing to steep Green House Gas (GHG) reductions, but to a far lesser extent focusing its attention on climate change adaptation needs. Noted in Malaysia’s Second National Communication (NC2) to the United Nations Framework Convention on Climate Change (UNFCCC), climate change adaptation is back in focus with vigor. Supporting this drive forward is the REGIONAL CLIMATE CHANGE ADAPTATION KNOWLEDGE PLATFORM FOR ASIA, also known as the Adaptation Knowledge Platform (AKP). The AKP is a response to the demand for effective mechanisms for sharing information on climate change adaptation, and for developing adaptive capacities in Asian countries. This scoping study is the beginning of the AKP’s engagement with Malaysian stakeholders; developed via 1) a review of current literature, 2) the conduct of perception interviews with key stakeholders across Malaysian society, and 3) a participatory workshop to enhance awareness among stakeholders in relation to climate change adaptation, and importantly, to plan focal actions together in response to Malaysia’s climate change adaptation needs.

Increase in average temperatures as a result of global warming is of concern for Malaysia, but the impact on its economic systems is really a mixed bag – either detrimental or beneficial depending on sector activities and geographic positioning, and then there are the combined impacts of ‘stimuli’ that comes with increases in temperatures, e.g. wind storms and rainfall strength leading to flooding. Studies presented in the NC2 express that a moderate change in average temperature, from 1Co to 2Co, such would be good for some sectors of agriculture production, for most, this would be detrimental, e.g. rice production would drop in the



range of 4.6% to 6.1% (at +1Co change) and 9.6% to 10% (at +2Co change) (Siwar, et. al., 2009). Additionally, given that Malaysia's water supply is not well diversified, fluctuations in water supply during both drought and flooding periods could pose significant challenges to controlling vector-borne and food-and-water-borne diarrheal diseases (Husaini, 2007). In consideration of Malaysia's natural endowments, highly likely is that climate variation will exceed environmental thresholds wherein habitats and ecosystems could not recover to existing equilibrium and stable conditions. Respective of lowland and upland forest habitat; expected is a redistribution of species, a worst-case scenario, significant losses in biodiversity (NRE, 2011).

For Malaysia, 'unknown until known' is seemingly how climate change impact is viewed and acted upon... reactive, rather than proactive. 'What is it that we need to adapt to' is a question often asked. This is a very different stance when considering Malaysia's proactive stance towards climate change mitigation respective of reducing its carbon footprint. However, this perception is changing and there is renewed interest in taking another look at climate change adaptations needs; that beyond flood control and disaster risk reduction in the major population centers within the country. As noted in Malaysia's NC2, based on 'events', the following are proposed adaptation needs in brief:

Drought

- Enhance water supply efficiency;
- Demand management practices to reduce per-capita consumption of potable water by industrial, commercial and residential consumers; and
- Demand management practices to improve the efficiency of irrigation and other water uses that rely on non-potable sources such as rainfall and groundwater.

Flood and erosion

- Review flood management plans and assess integrity of existing structures particularly where failure could result in loss of life;
- Review design standards for flood risk management in all new infrastructure including water control structures, transportation structures and electrical, water and waste amenities to incorporate climate change factors; and
- Complementation of structural approaches with non-structural approaches such as improved rainfall and flood forecasting, disaster warning systems and flood hazard mapping as part of a coordinated disaster prevention and management plan.

Agriculture production losses

- Drainage system improvements to regulate water table depth and prevent floods;
- Further establishment of irrigation facilities (particularly during crop establishment); and
- Cultivar breeding programmes to develop new varieties with high Water Use Efficiency (WUE) traits and drought tolerance.

Health losses

- Strengthening surveillance programmes and detection mechanisms for vector and water born diseases, e.g. rural entomologists at the district level; and
- Community involvement in defense strategies, e.g. environmental management.

Forest and biodiversity losses

- Establishment of conservation and protection corridors between forests; and
- Ensure the protection of genetic resource via the establishment of gene banks, botanic gardens, animal sanctuaries, captive breeding centers and rehabilitation centers for fauna.



Coastal and marine habitat losses

- Retreat approach – the abandonment of land and structures in vulnerable areas and resettlement of inhabitants – human, flora, and fauna;
- Accommodation approach - modification of drainage systems, structural building codes, to allowing changes in land use such as conversion of agriculture land to aquaculture uses, to the protection of ecosystem components; and
- Protection approach – the defense of vulnerable areas, especially population centers, economic activities and natural resources, e.g. engineering responses that involve defensive measures to protect areas against inundation, tidal flooding, and effects of waves on infrastructure, soil erosion and loss of natural resources such as mangroves.

At present, climate change related concerns are addressed through various sectors such as energy; forestry and natural resource management; land-use planning; agriculture; solid waste; and drainage and irrigation. Often, actions taken in the realm of ‘climate change’ are guided by Malaysia’s international obligations and commitments, namely three Conventions: 1) United Nations Framework Convention on Climate Change (UNFCCC), 2) United Nations Convention on Biological Diversity (CBD), and 3) United Nations Convention to Combat Desertification (CCD). Currently, the Secretary General of the Ministry of Natural Resources and the Environment, which also acts as the focal point for the UNFCCC, chairs the National Steering Committee on Climate Change (NSCCC). The Committee consists of representatives from relevant ministries and agencies, the private sector, and NGOs. The role of the National Committee is to formulate and implement climate change policies including adaptation to climate change. Chaired by the Prime Minister of Malaysia, the National Green Technology and Climate Change Council, is tasked to coordinate and facilitate the implementation of the National Policy on Climate Change and the National Green Technology Policy. Several Working Committees support this Council, including one on adaptation, anchored by the Ministry of Natural Resources and Environment with members from multiple agencies to promote the implementation of adaptation programmes at all levels.

For Malaysia, climate change is cross sectoral in nature, involving more than merely environmental issues, but also those affecting economic growth and human well-being (Pereira, J.J. and Subramaniam, M. (Eds.), 2007). For example, the conservation of natural resources and biological diversity is carried out through the implementation of various sectoral laws and regulations such as the Protection of Wildlife Act (1972), Environmental Quality Act (1974), National Forestry Act (1984) and Fisheries Act (1985). The conservation of biodiversity is also addressed in the 5-year Malaysia Plans, as well as policies such as the National Policy on Biological Diversity (1998), National Policy on the Environment (2002), National Wetlands Policy (2004), National Physical Plan (2005), and National Urbanization Plan (2006). These and other sectoral laws and regulations have provided a foundation on which climate change related policies and regulations support sectoral actions (NRE, 2008). Using the aforementioned as the backdrop of solid environment and sustainable development related policies; the National Policy on Climate Change was developed and recently launched into action. (NRE, 2010a). Focus is placed on mitigation: to a far lesser degree on adaptation measures.

Through key government and non-government institutions and organization such as: the United Nations Development Programme, the National Security Council, the Southeast Asia Disaster Prevention Research Institute, the Ministry of Natural Resources and Environment (NRE) - Environmental Management and Climate Change Division, National Hydraulic Research Institute of Malaysia, Malaysian Agricultural Research and Development Institute, The Institute for Environment and Development, The Malaysian Network for Research on Climate, Environment and Development, Environmental Protection Society, Malaysia, The Malaysian Environmental NGOs, Malaysia has taken, perhaps a unique, approach to climate change adaptation; often coined as ‘adaptation through climate change mitigation’, noting that the need for adaptation is unavoidable – but such must be derived in the form of co-benefits from concerted mitigation actions. Nonetheless,

climate change adaptation in Malaysia involves action by affected entities; requiring national, state, local and community level responses. Accordingly, much of Malaysia's adaptation responses come in the form of improved ecosystem management, water resource management, and secured agricultural production – each with a backdrop of doing so to improve productivity, efficiency in resource use, and optimized economic benefit for the State, and to the individual. For this reason, and others, little attention has been given to supporting autonomous climate change adaptation in practice; rather focus is placed on assessments and planned strategies to achieve the aforementioned.

Some of Malaysia's significant climate change adaptation knowledge developed and in use is the 'Regional Hydro-Climate Model for Peninsular Malaysia (RegHCMPPM)' to generate climate and hydrological projections. A similar model for Sabah and Sarawak is said to be nearing completion. Malaysia has also been using another projection model, 'Providing Regional Climates for Impacts Studies (PRECIS)', for understanding and projecting climate change impact and adaptation needs. Other knowledge development embodiments linked to building climate change adaptation knowledge would include the development of a Coastal Vulnerability Index, including field base testing of data collection processes, and the identification of the relationship between the impacts of climate change and vector-borne diseases – each supported by the Ninth Malaysian Plan. MyCLIMATE has also done extensive research in the area of climate change adaptation and disaster risk reduction, e.g. the development of a vulnerability assessment method for risk reduction given climatic hazards such as sea-level rise, flooding and flash floods, as well as hazards associated with other extreme climatic conditions that impact societal well-being. Despite these, and numerous other knowledge-building efforts, numerous adaptation knowledge generations needs have been identified, some aimed at understanding climate change and climate change adaptation, others importantly aimed at developing knowledge bases in support of spurring climate change adaptation actions. For example:

- Promoting the development of courses in ecological economics within existing universities and research profiles;
- Initiating localized research and programmatic extension efforts for and in the development of innovation and the sharing of 'best adaptation practices';
- The development of networks and platforms for knowledge transfer between governance, intermediaries, and community entities – including the private sector;
- The identification of entry points on how to move policy and information sharing within and between sectors and or established platforms towards implementation;
- Conduct of perception surveys on adaptation needs to understand the various barriers to climate change adaptation and to generate ideas to overcome these;
- Understanding how local level adaptation can be supported through stakeholder and community engagement; and
- Policy effectiveness studies, e.g. are vulnerabilities being reduced given an implemented policy, and at what cost?

This scoping study has identified many climate change adaptation knowledge capacity gaps via available literature and of that identified during a two-day multi-stakeholder workshop - Climate Change Adaptation: Awareness building to strategic action planning. Interestingly, of the government and non-government institutions and organization previously mention, these and similar identities can be noted as 'knowledge generators' and 'knowledge users'; with the exception of sustainable agriculture production and more prominently, public safety and wellbeing; communities and local NGO involvement is significant in both roles. In brief, climate change adaptation knowledge needs are:

Environmental sustainability

- Research on storm surges to help establish quantitatively the trends of storm surges and wave patterns therefore facilitating the understanding of long term coastal evolution;
- Research on coastal reforestation to develop optimal planting methods and the creation of robust coastal forests that can strengthen the stability of coastlines and contribute to biodiversity enhancement;
- Environmental economics on payment for environmental services – research to develop the understanding of and associated framework for assessment to be incorporated within vulnerability assessments/ models;

- Limitations of ecological and biological sustainability/ stability under climate change; and
- Ecological resilience and land use studies – identification of costs and benefits to rehabilitation, and or adaptation into other land uses i.e. options vs. resilience gained in holistic terms, e.g. economics, human safety, food security, shoreline stabilization, infrastructure protection etc.

Water Resource Management

- Improved climate impact modeling that would allow for the integration of water resources management with other sector elements, e.g. health vector management, biodiversity, to localized food production; and
- The development of efficient water harvesting techniques for water conservation, e.g. reservoir and distribution efficiency.

Sustainable agriculture production

- Research on the adaptation and mitigation options provided by ecological agriculture, taking into account context and location specificities such as soil types, crop types, management practices and climate conditions;
- Understanding localized research and extension for the development and sharing of ‘best practices’;
- Research in the context of ‘Fair Trade’ to promote ecological agriculture and small rural farm holders; and
- Knowledge management arrangements for the sharing of information and experiences, transfer of and training in good practices that constitute adaptation and mitigation in ecological agriculture, including that through extension services.

Public safety and wellbeing

- Research on integrated malaria control should be enhanced with the intent of developing cost effective malaria control strategies;
- Food sufficiency: stress on food production due to anticipated rise in temperature and prolonged periods of drought;
- Localized information related to climate hazard risk and vulnerability mapping - to include localized climate risk reduction/ vulnerability needs assessments;
- Research on the development and deliver of such assessments for effectively and efficiency by local level researchers/ facilitators; and
- Integrated modeling information that includes factors of climate change, socio-economic implications, biology, ecology, and human health parameters.

Policy and Governance

- Entry points on how to move policy and information sharing within/ between a sector and or established platform towards implementation;
- Perception surveys – adaptation needs; barriers to climate change adaptation and ideas to overcome; local adaptation priorities and strategies employed; what are and how can local level adaptation be supported, i.e. stakeholder and community engagement; and
- Policy effectiveness studies, e.g. are vulnerabilities being reduced given an implemented policy, and at what cost?

Leading from the aforementioned policy and governance knowledge, noted within this study is a ‘complacency towards real actions’ and ‘uncertainties’ vis-à-vis action or inaction. Suggested as a central element to overcome these less than flattering sentiments is the pressing need for a climate change adaptation knowledge platform – one that is free from influence and one that is transparent. This holds relevancy for all sector involvements regarding knowledge generation, to sharing, to climate change adaptation action. Stakeholders have suggested the following roles and responsibilities for such a platform:

- Connecting stakeholders and knowledge together – linking climate change adaptation expertise, technology and human resources;
- Compelling action on climate change adaptation;

- Driving and guiding advocacy – focusing on issues of climate change adaptation and responses equally and constructively;
- Maintenance of a climate change adaptation knowledge bank;
- Forum development aligned to thematic areas and open to all – active forums year round; and
- Noting funding and research opportunities.

There has also been the suggestion that the proposed platform be focused on generating learning value above all - avoid redundancy, and encouraging continuity of action. Additionally, strategic users to casual participants in the proposed platform must benefit by way of gaining a common understanding of climate change adaptation, and by way of being empowered to harness opportunities to engaged in response actions from a shared stance.

Operationally, the platform should work through ‘membership’, be self-sustaining, placed outside of a ministry, and facilitated through focal points within a secretariat. Noted is that government representation should take on a concerted role as focal points along with others from civil society and the private sector. There should also be key areas within the platform that would create points of integration between the Green Technology Council and climate change technical working groups active in Malaysia. To accomplish the aforementioned according to needs and cooperation, the Ministry of Natural Resources and Environment, MyCLIMATE, the Malaysia Climate Change Group, the Junior Council of Investment and Sustainable Development, and the Malaysian Youth Climate and Justice Network are a probable and willing group of actors to take the lead in the formation of the platform. In the Malaysian context, this platform will need to be championed to gain recognition and cooperation among the various sectors and climate change adaptation actors, and for its placement within a permanent structure. Although this is undetermined – the Office of the President has been recommended.

Stakeholders engaged in this scoping study have outlined a three-year Action Plan to fill knowledge gaps and address points of inaction. It should be underscored that the complete action plan has been tentatively budgeted at just over one million United States Dollars; a small investment for such rich gains to spur focused knowledge generation and sharing, and action towards sustained climate change adaptation.

In closing, there is no doubt that Malaysia has the base knowledge and capacity needed to begin mainstreaming climate change adaptation within its development framework. Yet, often reiterated by those involved in this study reflects on how to adapt – its a matter of economic efficiency. Finding the win-win, no regrets scenario, has ingrained complacency towards real and significant adaptation actions on the ground. This could well be Malaysia’s number one challenge in relation to climate change adaptation.



The AKP is a response to the demand for effective mechanisms for sharing information on climate change adaptation, and for developing adaptive capacities in Asian countries.

SCOPING ASSESSMENT ON CLIMATE CHANGE ADAPTATION IN MALAYSIA



BACKGROUND TO THE STUDY

The Intergovernmental Panel for Climate Change (IPCC) 2007 report on the “Science of Climate Change” noted small increases in temperature (~ 0.3oC) and rainfall (~ 3.0%) through the Southeast Asia Region in the last decade, however, in general agreement amongst scientists, changing behavioral patterns of the el-Nino - ENSO, monsoons, and to a certain extent the Indian Dipole Oscillation circulation systems are triggering weather extremes and variability, subsequently influencing changing behavioral patterns of hydro-meteorological and geo-morphological events. This puts the focus of ‘change’, centered on the region’s major river basins respective of flood and drought intensities, haze pollution, slope failures, and the emergence of certain diseases. Also mentioned within the report are the attributes of the South Indian Ocean cyclones and the Pacific – South China Sea Regions’ typhoons contributing to ‘change’, change triggered by warming ocean surface waters due to the global warming.

Currently Malaysia has been able to absorbed climate change impacts given its strong environmental management programmes, backed by stringent economic policies including effective poverty eradication and food production programs. However, it must be understood that these efforts address only the ‘environmental change threat’ and not specifically the ‘climate change threat’ where in the long term the impact scenario for Malaysia would generally diverge, i.e. exceeding environmental thresholds where habitats and ecosystems could not recover to existing equilibrium and stable conditions. Additionally, climate change could well trigger national and international distributional conflicts, e.g. fisheries, and intensify problems already hard to manage in the region. Given the aforementioned, there are four areas of concern:

- Climate-induced degradation of forest, marine and freshwater resources;
- Climate-induced increases in certain hydro-meteorological and geo-morphological events;
- Climate-induced decline in food production capacities and other environmentally driven economic systems; and
- Climate change ethical – justice issues such as environmentally induced displacements and migration, the deprivation and sustenance of certain livelihood activities, and the safety and well being of the more marginalized sectors of society.

Through the 1990s and onward, Malaysia has engaged fully with the 'climate change community'; committing to steep Green House Gas (GHG) reductions, but to a far lesser extent focusing its attention and resources on climate change adaptation needs. 2009 to the present, perhaps spurred on by the development of its Second National Communication (NC2) to the United Nations Framework Convention on Climate Change (UNFCCC), climate change adaptation is back in focus with vigor. Supporting this drive forward, in a small but focused way, is the REGIONAL CLIMATE CHANGE ADAPTATION KNOWLEDGE PLATFORM FOR ASIA, also known as the Adaptation Knowledge Platform (AKP).

The AKP is a response to the demand for effective mechanisms for sharing information on climate change adaptation, and for developing adaptive capacities in Asian countries. The initiative supports research and capacity building, policy-making and information assimilation, generation, management and sharing. It also facilitates climate change adaptation at local, national and regional levels, while working with existing and emerging networks and initiatives. Thirteen countries are identified as focal countries for the Adaptation Knowledge Platform's first three years of operation: Cambodia, China PR, Lao PDR, Myanmar, Thailand, Vietnam, Bangladesh, Bhutan, Indonesia, Nepal, the Philippines, Sri Lanka, and Malaysia, one of the thirteen countries identified as a pilot country targeted in 2011.

This scoping study is the beginning of the AKP's engagement with Malaysian stakeholders; developed via 1) a review of current literature, 2) the conduct of perception interviews with key stakeholders across Malaysian society, and 3) a participatory workshop to enhance awareness among stakeholders in relation to climate change adaptation, and importantly to plan focal actions together in response to Malaysia's climate change adaptation needs.

Beginning with a review of relevant literature, Malaysian's climate change vulnerabilities are briefly laid out in this scoping study, combined with how these vulnerabilities are view and acted upon (Section II). This is followed by an overview of Malaysia's institutional arrangements in response to climate change impacts, e.g. coordinating bodies and Ministries involved, to the involvements of non-government stakeholders, and the country's policy support guiding stakeholder climate change adaptation actions, e.g. those in the fields of environmental sustainability, water resource management, agricultural production, and public safety and wellbeing (Sections III and IV). A review of the aforementioned is also outlined indicatively in terms of identified capacity gaps in reference to knowledge, systems and structures, and policy and governance needs for effective climate change adaptation among the aforementioned sectors of interest (Section V).

Also within this scoping study is a 'Strategic Action Plan' (Section VI); addressing Malaysia's knowledge and action based climate change adaptation capacity development needs. This strategy has been formulated through a participatory process that engaged stakeholders from key Malaysian Ministries, International and National Non-Government Organizations/ Institutions and Networks, the academe and researchers, to key representatives of civil society – together and in the interest of all Malaysians alike. The final Section (VII) brings forth key observations noted within the 'scoping study processes', and recommendations for an institutional mechanism for Malaysia as a basis for the operationalization of the Adaptation Knowledge Platform in Malaysia in subsequent years.



MALAYSIA'S VULNERBILITIES AND ATTITUDES TOWARDS CLIMATE CHANGE

Climate extremes, variability, and anomalies will threaten the bases of many of the country's populace livelihoods and its key economic systems. Most vulnerable are the poor; those living at the threshold of the poverty line, however the safety and well being of all is of equal concern. Traditionally low-income systems, e.g. agriculture and fisheries, are especially vulnerable as their practices, and benefits derived, are dictated and sustained by climate – weather behavioral patterns. Changes to these behavioral patterns, e.g. rain fall distribution, without adaptation measures taken, the potential for adverse effects to a populace, sector, and or country as a whole is real.

Building from Malaysia's 1st National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), to its 2nd communication, vulnerability studies have narrowed the parameters of investigation and concern, e.g. from a temperature variation of +0.03 - +3.4Co (MoSTE, 2000) to a focus of 1.0 – 2.0Co (NRE, 2011). Nonetheless, this has not change the form of climate vulnerability for the country. Of key concern is sea level rise, particularly through Peninsular Malaysia – areas of Tanjung Piai and Pantai Chenang. Equating seal level rise with salt water inundation into fresh water sources, agriculture production, to potable water availability among coastal communities

will produce unfavorable results respective of rural livelihoods, and water and sanitation problems key to maintaining acceptable levels of health and nutrition in these communities. Additionally, equating sea level changes to water salinity in coastal waters; marine and aquatic life, and aquaculture productivity is expected to decline – for the most part a decline that adaptation measures are defenseless against.

Traditionally low-income systems, e.g. agriculture and fisheries, are especially vulnerable as their practices, and benefits derived, are dictated and sustained by climate – weather behavioral patterns.

Increase in average temperatures as a result of global warming is of concern for Malaysia, but the impact on its economic systems is really a mixed bag of impacts – either detrimental or beneficial depending on sector

activities, and the combined impacts of 'stimuli' that comes with increases in temperatures, e.g. wind storms and rainfall strength leading to flooding. Studies presented in the Second National Communication express that a moderate change in average temperature, from 1Co to 2Co, such would be good for fruit and oil palm production, but not for cocoa, rubber, and rice production (NRE, 2011). Considering rice production, temperature increases within the said range would likely result in production losses between 4.6% to 6.1% (at +1Co) and 9.6% to 10% (at +2Co). Although agriculture yields are also dependent on other factors such as the type of cultivar, location, and management practices, higher temperatures are expected to be accompanied by increased storm activity and rainfall intensity; often resulting in flooding which is not favorable for many forms of agriculture production – including those mentioned (Siwar, et. al., 2009).

Regional differences in rainfall increase in some areas, decrease in others is also a major concern to agricultural production, e.g. swings in rain fall equating to variations in flood and drought events. Reported are fluctuations of -5% to +50% for Peninsular Malaysia; to a far lesser degree for the Sabah and Sarawak regions, e.g. -6% to +5%. Given that Malaysia's water supply is not very diversified (most comes from surface water sources with ground water contributing

about 3%), fluctuation are of special interest to the health sector where in health risks, i.e. vector-borne and food-and-water-borne diarrheal diseases (Husaini, 2007). Several of these diseases are still endemic in Malaysia's rural areas. Although outbreaks are usually sporadic and associated with environmental sanitation and water supply, increases in floods and drought could adversely affect Malaysia's fight to control outbreaks; vector-borne diseases, and other water-borne diarrheal disease are expected to increase due to a general deterioration of water quality expected via rainfall variations (Commonwealth Secretariat, 2009).

Although Malaysia's annual rainfall is very high (3,000 mm average) there are large variations both in time and in space, and river flows are prone to large fluctuations as well. Thinking of increased rainfall, flooding, and landslides, such are common incidence in and around Kula Lumpur, and are often dealt with through infrastructure builds. However, there is another dimension to the aforementioned, especially in coastal and low-lying areas; areas highly dependent on ecological process/ ecosystem services that support rural lives and livelihoods. In these areas, increased rainfall could result in waterlogged soils and soil nutrient leaching; inevitability equating to economic losses through losses in ecosystem services reductions. Additionally, expected increases in storm intensity, duration and frequency would also equate to enhanced erosion risks within and around coastal settlements and increased sedimentation of river mouths.

There is also a need to look at Malaysia's vulnerabilities to climate change from perhaps less of an anthropocentric perspective, i.e. a view towards ecosystem function and biodiversity endowments. Previously mentioned in this scoping study was Malaysia's seeming ability to absorbed climate change impacts given its strong environmental management programmes. However, it must be understood that it is highly likely that climate variation will exceed environmental thresholds where habitats and ecosystems could not recover to existing equilibrium and stable conditions. Respective of lowland and upland forest habitat, expected is a redistribution of species; a worst-case scenario, significant losses in biodiversity. For example, reported in the NC2, within Peninsular Malaysia alone 13.5% of amphibians, 5.8% of birds, and 5.4% of a mammals are considered to be highly vulnerable to ecosystem changes brought on by climate change (NRE, 2011). Hence, adaptation of both plants and animals to changing climatic pressures occurs over many generations and possibly hundreds or thousands of years. It would be extremely difficult to ensure the survival of a species should the rate of climate change exceed the species' natural ability to adapt.

For Malaysia, 'unknown until known' is seemingly how climate change impact is viewed and acted upon... reactive, rather than proactive. What is it that we need to adapt to, is a question often asked. This is a very different stance when considering Malaysia's proactive stance towards climate change mitigation respective of reducing its carbon footprint. However, this perception is changing and there is renewed interest in taking another look at climate change adaptations needs; that beyond flood control and disaster risk reduction in the major population centers within the country.

Noted through perception interviews is that climate change adaptation has been taken in the light of addressing the results of vulnerability, e.g. structural damage, displacements, and supply deficiencies, rather than in the light of adaptation needs, i.e. support for planned adjustments to climate stimuli

across sectors and society. Pointed out by representatives of the Southeast Asian Disaster Prevention Research Institute (SEADPRI), Malaysia is looking for ‘no regret options’, yet in the same frame of mind, asking what is it ‘we’ are adapting to; climate change itself - the impacts of climate change - the known causes of change - adapting as an aspect of the impacts of political, environmental, and economic development? Underscoring the perceptions of Malaysian stakeholders interviewed for this scoping study (refer to listing in Annex 1), climate change adaptation and mitigation do not mean the same thing to everyone. This is also exemplified by differences between Malaysia’s Initial and Second report to the UNFCCC, the later clearly showing detailed progress in its attempts to clearly understanding adaptation needs – although still mostly in terms of improving economic efficiency and growth (see Table 1). Perhaps this is also a reflection of Malaysia’s stance on climate change, exemplified in the Ninth Malaysia Plan (2006 – 2010) as expressed by the Ministry of Natural Resources and Environment and the Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (NRE and LESTARI, 2010):

- Mainstreaming of measures to address climate change challenges through strengthened economic competitiveness, wise management of resources, environmental conservation and enhanced quality of life for sustainable development; and
- Integration of responses into national policies, plans, and programmes to strengthen the resilience of development from arising and potential impacts of climate change.

Table1 Overview of Malaysia proposed climate change adaptation needs to address key climate induced events, losses, and threats as expressed in the NC2.

EVENT	PROPOSED CLIMATE CHANGE ADAPTATION NEEDS
Drought	Enhance water supply efficiency. This includes improving storage efficiency by removing sediment from reservoirs and dams and eliminating losses from leakage and water theft; Promote demand management practices to reduce per-capita consumption of potable water by industrial, commercial and residential consumers. This includes reducing wastage through behavioral changes and encouraging water harvesting for non-potable uses; and Promote demand management practices to improve the efficiency of irrigation and other water uses that rely on non-potable sources such as rainfall and groundwater.
Flood and Erosion	Review flood management plans and assess integrity of existing structures particularly where failure could result in loss of life (e.g. dams and large barrages); Review design standards for flood risk management in all new infrastructure including water control structures, transportation structures and electrical, water and waste amenities to incorporate climate change factors; and Complement structural approaches with non-structural approaches such as improved rainfall and flood forecasting, disaster warning systems and flood hazard mapping as part of a coordinated disaster prevention and management plan.

LOSSES	
Agriculture	<p>Drainage system improvements to regulate water table depth and prevent floods;</p> <p>For water stressed regions – establish sufficient irrigation facilities (particularly during crop establishment);</p> <p>Establish cultivar breeding programmes to develop new varieties with high Water Use Efficiency (WUE) traits and drought tolerance; and</p> <p>Enhancing Low Intensity Tapping Systems (LITS) for the rubber sector - Technology is available, yet additional resources will be required to disperse the technology and capacitate workers.</p>
THREATS	
Health	<p>Strengthening surveillance programmes and detection mechanisms for vector and water born diseases, e.g. rural entomologists at the district level; and</p> <p>Community involvement in defense strategies, e.g. environmental management.</p>
Forest and Biodiversity	<p>Establishment of conservation and protection corridors between forests; and</p> <p>Ensure the protection of genetic resource via the establishment of gene banks, botanic gardens, animal sanctuaries, captive breeding centers and rehabilitation centers for fauna.</p>
Coastal and Marine Habitat	<p>Retreat approach - abandonment of land and structures in vulnerable areas and resettlement of inhabitants; the prevention of development near coastal areas through the imposition of more stringent setback limits, land acquisition, land use restriction and prohibition of reconstruction in areas damaged by storms; and taking measures to enable wetlands to migrate inland (assisted flora migration);</p> <p>Accommodation approach - continued occupancy and use of vulnerable areas. This constitutes a compromise between retreat and protection. This would entail modification of drainage systems, specifications of minimum floor elevation and piling depth as well structural bracing for building code; allowing changes in land use such as conversion of agriculture land to aquaculture uses; prohibiting filling of wetlands, damming of rivers, and mining of coral and beach sands; and allowing natural resources, such as mangroves and coral reefs to be left to their natural processes to cope with sea level rise; and</p> <p>Protection approach - defense of vulnerable areas, especially population centers, economic activities and natural resources. These include engineering responses that involve defensive measures to protect areas against inundation, tidal flooding, and effects of waves on infrastructure, soil erosion and loss of natural resources such as mangroves. Consequently, hard measures such as sea-walls and groynes and soft measures such as beach nourishment and wetlands/mangroves creation are possible adaptation measures.</p>



INSTITUTIONAL AND ORGANIZATIONAL ARRANGEMENTS IN RESPONSE TO CLIMATE CHANGE IMPACTS

Malaysia became a Non-Annex I Party to the UNFCCC when it signed the UNFCCC in 1993. As a Non-Annex I Party, it has no obligations towards reducing emissions of green house gases (GHGs) under the Kyoto Protocol. Following the ratification of the Convention in 1994, efforts have been strengthened to address climate change in Malaysia. Currently, Malaysia

Malaysia adopts a “precautionary principle” and “no regret” policy, which could be taken to mitigate or adapt to climate change, even though there are still scientific uncertainties.

adopts a “precautionary principle” and “no regret” policy, which action, justified in their right, could be taken to mitigate or adapt to climate change, even though there are still scientific uncertainties.

Focal National Coordination Bodies and Ministerial Actors

At present, climate change related concerns are addressed through various sectors such as energy; forestry and natural resource management; land-use planning; agriculture; solid waste; and drainage and irrigation. Often, actions taken in the realm of ‘climate change’ are guided by Malaysia’s international obligations and commitments, namely three Conventions: 1) United Nations Framework Convention on Climate Change (UNFCCC), 2) United Nations Convention on Biological Diversity (CBD), and 3) United Nations Convention to Combat Desertification (CCD). In 1994, the National Steering Committee on Climate Change (NSCCC) was established under the Ministry of Science, Technology and the Environment (MoSTE). Subsequently, the Ministry of Natural Resources and Environment (NRE) was established on March 27, 2004, following the formation of a new cabinet by the Prime Minister. Note that the Secretary General of the NRE chairs the NSCCC (see Box 1), which also acts as the focal point for the UNFCCC. The Committee consists of representatives from relevant ministries and agencies, the private sector and NGOs (see Box 1).

BOX_1 Membership of National Steering Committee on Climate Change.

Secretary General, Ministry of Natural Resources and Environment (NRE) - Chairman
 Conservation and Environmental Management Division, NRE - Secretariat
 Malaysian Meteorological Service
 Ministry of Energy, Water and Communications
 Ministry of Plantation Industries and Commodities
 Ministry of Finance
 Ministry of Education
 Ministry of International Trade and Industry
 Ministry of Agriculture
 Ministry of Foreign Affairs
 Economic Planning Unit
 Attorney General’s Office
 Others as and when required

The role of the National Committee is to formulate and implement climate change policies including mitigation of GHG emissions and adaptation to climate change by:

- Formulating national policy, strategy and action plan to address and adapt to climate change;
- Formulating and coordinating a national implementation plan related to climate change;
- Formulating and coordinating national action plans to meet commitments as agreed upon in the UNFCCC;
- Serving as the national focal point for external financial and technical assistance for climate change programmes; and

- Discussing and recommending Malaysia’s position on issues related to climate change in international fora.

In 2010, the government established the National Green Technology and Climate Change Council, chaired by the Prime Minister of Malaysia, to coordinate and facilitate the implementation of the National Policy on Climate Change and National Green Technology Policy. Several Working Committees support the Council: including one on adaptation. The Working Committee on Adaptation is anchored by the Ministry of Natural Resources and Environment with members from multiple agencies to promote implementation of adaptation programmes at all levels.

As noted in Box 1, there is a wealth of coordination and sectoral involvement with climate change issues and response actions. Literature and information gathered in interviews with various Ministerial actors; Table 2 is a composite view of roles and responsibilities of State actors addressing climate change adaptation in rural Malaysia, and Table 3 represents relevant Malaysian implementing agencies of the UNFCCC

Table 2 Composite view of roles and responsibilities of State actors addressing climate change adaptation in rural Malaysia

CONTENT	IMPLEMENTING AGENCIES
Adaptation Service Providers	Ministry of Natural Resources and Environment; Ministry of Land and Co-operative Development; Forestry Department Peninsular Malaysia; Forest Research Institute Malaysia; Department of Environment; Department of Wildlife & National Parks Peninsular Malaysia; Department of Irrigation and Drainage; and the National Hydraulic Research Institute of Malaysia Ministry of Energy, Water and Communication; Ministry of Agriculture and Agro-Based Industries; Ministry of Plantation Industries & Commodities; Ministry of Health; Ministry of Education; and the Malaysian Meteorological Department.
Adaptation Knowledge Generation and Management	Department of Statistics; Ministry of Science, Technology & Innovation; and the Ministry of Higher Learning; LESTARI, University Kebangsaan Malaysia; University Malaya Climate Change Centre; University Sains Malaysia; and the University Putra Malaysia.
Adaptation Planning and Coordination	Sabah State Economic Planning Unit; Sarawak State Planning Unit; and the Economic Planning Unit, Prime Minister Department
Multiple Purpose	Ministry of Transport; Ministry of Housing and Local Government; and the Ministry of International Trade and Industry.
Reference: pers com. collective response	



For Malaysia, climate change is cross sectoral in nature, involving more than merely environmental issues, but also affecting economic growth and human well-being

Table 3 Relevant Malaysian implementing agencies of the United Nations Framework Convention on Climate Change (UNFCCC) respective of climate change adaptation actions (non-exhaustive).

CONTENT	IMPLEMENTING AGENCIES
National Policy and Strategy	Ministry of Natural Resources and Environment (NRE); and Economic Planning Unit (EPU).
Forestry Sector	Forestry Development Division (NRE); State Forestry Departments; and Forest Research Institute Malaysia (FRIM).
Plantations Sector	Ministry of Plantation Industries and Commodities (MPIC);
Multiple Purpose	Ministry of Transport; Ministry of Housing and Local Government; and the Ministry of International Trade and Industry.
VULNERABILITY AND ADAPTATION	
Urbanization / Land Use Planning	Ministry of Agriculture (MOA); Ministry of Housing and Local Government (MHLG); Town and Country Planning Department (TCPD); and State Governments.
Climatic Change Projection	Ministry of Science, Technology & Innovation (MOSTI); Malaysian Meteorological Department (MMD); National Hydraulic Research Institute Malaysia (NAHRIM); Institute for Environment and Development (LESTARI); and University of Malaysia (UM).
Coastal and Water Resources	State Governments; Department of Irrigation and Drainage (DID); and National Hydraulic Research Institute Malaysia (NAHRIM).
Health	Ministry of Health (MoH); and Institute for Medical Research
Agriculture	Ministry of Agriculture (MOA); and Malaysian Agricultural Research and Development Institute (MARDI).
Fisheries	Ministry of Agriculture (MOA).
Tourism	Ministry of Tourism
Biodiversity	Ministry of Natural of Resources and Environment (NRE); Forest Research Institute Malaysia (FRIM); Forestry Department of Peninsular Malaysia; Department of Marine Parks Malaysia (DMPM); and National Oceanography Directorate (NOD).
NRE (2008) Report on national Capacity Needs Self-Assessment for Global Environmental Management and National Capacity Action Plan. Government of Malaysia, ministry of Natural Resources and Environment, Malaysia.	

Policies and Regulations Addressing Climate Change Related Issues

For Malaysia, climate change is cross sectoral in nature, involving more than merely environmental issues, but also affecting economic growth and human well-being (Pereira, J.J. and Subramaniam, M. (Eds.), 2007). For example, the conservation of natural resources and biological diversity is carried out through the implementation of various sectoral laws and regulations such as the Protection of Wildlife Act (1972), Environmental Quality Act (1974),

National Forestry Act (1984) and Fisheries Act (1985). The conservation of biodiversity is also addressed in the 5-year Malaysia Plans, as well as policies such as the National Policy on Biological Diversity (1998), National Policy on the Environment (2002), National Wetlands Policy (2004), National Physical Plan (2005), and National Urbanization Plan (2006). These and other sectoral laws and regulations have provided a foundation on which climate change related policies and regulations could support sectoral actions (see Table 4) (NRE, 2008).

Table 4 Policies, Laws and Regulations that Indirectly Address Climate Change (non-exhaustive).

CONTENT	POLICIES, LAWS AND REGULATIONS
National Policies	Malaysia Third Outline Perspective Plan (2001 – 2010); Ninth Malaysia Plan (2006-2010); National Policy on the Environment (2001); National Physical Plan (2005); and National Urbanization Policy (2006).
Sectoral Policies	National Agriculture Policy (1998-2010); National Biofuel Policy (2006); and National Forestry Policy (1978, revised 1992).
Laws and Regulations	Environmental Quality Act, (1974) (amended in 1985 and 1995); Environmental Quality Clean Air Regulation (1978); Environmental Quality Prescribed Activities Regulation (EIA Order) (1987); and National Forestry Act (1984). Sabah Environment Protection Enactment (2002); and Forest Enactment (1968). Sarawak Natural Resources and Environment Ordinance (1993); and Forest Ordinance (1958).
NRE (2008) Report on national Capacity Needs Self-Assessment for Global Environmental Management and National Capacity Action Plan. Government of Malaysia, Ministry of Natural Resources and Environment, Malaysia.	

Using the backdrop of solid environment and sustainable development related policies, and extensive consultation workshops; the National Policy on Climate Change was developed and recently launched into action. Outlined within five (5) principles, ten (10) strategic thrusts, and forty-three (43) key actions (see Section 4.5 for actions), focus is placed on both mitigation and adaptation measures (NRE, 2010a).

Objectives of the National Policy on Climate Change

- Mainstreaming climate change through wise management of resources and enhanced environmental conservation resulting in strengthened economic competitiveness and improved quality of life;
- Integration of responses into national policies, plans and programmes to strengthen the resilience of development from arising and potential impacts of climate change; and
- Strengthening of institutional and implementation capacity to better harness opportunities to reduce negative impacts of climate change.

Principles (P) of the National Policy on Climate Change

- P1** *Development on a Sustainable Path:* Integrate climate change responses into national development plans to fulfill the country's aspiration for sustainable development;
- P2** *Conservation of Environment and Natural Resources:* Strengthen implementation of climate change actions that contribute to environmental conservation and sustainable use of natural resources;
- P3** *Coordinated Implementation:* Incorporate climate change considerations into implementation of development programmes at all levels;
- P4** *Effective Participation:* Improve participation of stakeholders and major groups for effective implementation of climate change responses; and
- P5** *Common but Differentiated Responsibilities and Respective Capabilities:* International involvement on climate change will be based on the principle of common but differentiated responsibilities and respective capabilities.

Strategic Thrusts (ST) of the National Policy on Climate Change

- ST1-P1** Facilitate the harmonization of existing policies to address climate change adaptation and mitigation in a balanced manner;
- ST2-P1** Institute measures to make development climate-resilient through low carbon economy to enhance global competitiveness and attain environmentally sustainable socio-economic growth;
- ST3-P1** Support climate-resilient development and investment including industrial development in pursuit of sustainable socio-economic growth;
- ST4-P2** Adopt balanced adaptation and mitigation measures to strengthen environmental conservation and promote sustainability of natural resources;
- ST5-P2** Consolidate the energy policy incorporating management practices that enhances renewable energy and energy efficiency;
- ST6-P3** Institutionalize measures to integrate crosscutting issues in policies, plans, programmes and projects in order to increase resilience to climate change;
- ST7-P3** Support knowledge-based decision-making through intensive climate related research and development and capacity building of human resources;
- ST8-P4** Improve collaboration through efficient communication and coordination among all stakeholders for effective implementation of climate change responses;
- ST9-P4** Increase awareness and community participation to promote behavioral responses to climate change; and
- ST10-P5** Strengthen involvement in international programmes on climate change based on the principle of common but differentiated responsibilities and respective capabilities.

Overall, the approach of policy and regulation, and subsequent climate change resilience building in Malaysia is to respond strategically by mainstreaming climate change

Overall, the approach of policy and regulation, and subsequent climate change resilience building in Malaysia is to respond strategically by mainstreaming climate change throughout its economic development initiatives; instituting an integrations of balanced adaptation and mitigation responses; and the enhancement of institutional and implementation capacity through coherent coordination of policy responses – not specifically developing new ones.

Focal International and National Institutions and Non-Governmental Organizations Involved in Climate Change Adaptation¹

International involvement in climate change adaptation is steered through the Environmental and Climate Change Management Division of the Ministry of Natural Resources and Environment (NRE). This would include bilateral and

multilateral cooperation, capacity building activities, information sharing and networking at both national and international levels. Noting the aforementioned, supporting Development Partners are the United Nations Development Program (UNDP) with funding from the Global Environment Facility (GEF); the World Bank; the Asian Development Bank; the European Communities – Association for Southeast Asian Nations ASEAN Energy Facility (EAEF); the DANIDA and Japan International Cooperation Agency (JICA), New Energy and Industrial Technology Development Organization of Ministry of Energy, Trade and Industry, Japan. These and other prominent actors directly involved in climate change issues and adaptation initiatives are:

.....

International involvement is steered through the Ministry of Natural Resources and Environment; and includes bilateral and multilateral cooperation, capacity building activities, information sharing and networking at all levels of government.

.....

Development Partner

- The *United Nations Development Programme's (UNDP)* work in Malaysia is the development of a National Capacity Needs Self-Assessment for Global Environmental Management (NCSA), the goal of which is to identify country level priorities and needs for capacity building and enhancement to address environmental issues through the fulfillment of international obligations and commitments, in biological diversity, climate change, and land degradation. UNDP also provides strategic and innovative policy advice on climate change and works with relevant government ministries and their agencies to strengthen their capacities to address the challenges faced by the country, especially as they relate to the needs of the poor and disadvantaged.

Disaster Risk Reduction

- *National Security Council* of the Prime Minister's Department is the national focal point for disaster management in the country. Through the Directive No. 20 on "Policy and Mechanism on National Disaster and Relief Management", the Council is responsible for coordinating activities that are implemented by the Disaster Management and Relief Committee at federal, state and local levels that comprises various agencies. Disaster risk reduction is a priority for the Malaysian Government in view of the severity of its potential impact on lives and livelihood as well as development of the nation.
- *Southeast Asia Disaster Prevention Research Institute (SEADPRI)* hosted at the Universiti Kebangsaan Malaysia (UKM) was founded on 1 June 2008 as a research institution under the structural governance of Universiti Kebangsaan Malaysia. SEADPRI-UKM oversees holistic research activities related to disasters covering a global regional scope in helping the government to come to decisions with regards to establishing policies on climate disasters, geological disasters and technological disasters and growing the human capital as well as the ability of work force at the local, state, national and international levels, especially in South East Asia.

1 Information obtained from the mentioned entity's web site – current as of August 9, 2011.

- The *World Youth Foundation* as an NGO with Special Consultative Status with the Economic and Social Council of the United Nations, and Civil Society Status from United Nations Environment Programme (UNEP), is an international non-profitable organization established in 1994 with its headquarters in Melaka. The aim of the Foundation is to organize programs that are beneficial and promote healthy development of youth in Malaysia and elsewhere in the world. Many projects have been successfully accomplished by organizing various for youth on areas such as environment, sustainable development, and disaster risk reduction.
- The *Force of Nature Aid Foundation*, using the back drop of Disaster Risk Reduction engages in coastal protection and through its networks, facilitates the formation of community groups for consultation and education on environmental awareness, and information-sharing activities with the aim to mitigate the effects of future disasters on coastal communities.
- *Mercy Malaysia* plays an active role in building capacity on Disaster Risk Reduction (DRR). Activities are aimed at protecting communities from hazards and minimizing their vulnerability to disaster risks. Mercy Malaysia moves beyond the traditional disaster management approach of simply focusing on response, rehabilitation and rebuilding after a disaster event, noting that for DRR projects to achieve meaningful and sustainable reduction in disaster risk, the whole community needs to be involved – government, academic institutions, private sector, civil society and community-based organizations, the general public- especially those most at risk.

Environmental Management

- *Ministry of Natural Resources and Environment (NRE) - Environmental Management and Climate Change Division* has had the primary responsibility to develop the 2nd National Communication to the UNFCCC under the stewardship of the Ministry of Natural Resources and Environment (NRE) which chairs both the Project Management Group and the Project Steering Committee, assisted by a secretariat established under the project. The NRE's main course of climate resilience building activities is focused on environmental management/ protection, which is the mainstay of Malaysia's approach to adaptation.
- *National Hydraulic Research Institute of Malaysia (NAHRIM): Regional Water Knowledge Hub for Water and Climate Change Adaptation in Southeast Asia* - established by the Government of Malaysia in response to the country's increasing number of water-related challenges, including floods, drought events, deteriorating water quality in rivers and coastal bodies, competing users, erosion, accretion, sedimentation, and not least, the impending anticipated impacts of climate change on water. Operating under the direction of NAHRIM's Research Centre for Water Resources, the regional water knowledge hub for water and climate change adaptation in Southeast Asia has building capacity in areas of water management impacted by climate change due to global warming as its goal.
- The *WorldFish Center* is a non-profit organization that focuses on alleviating poverty and hunger by improving fisheries and aquaculture in developing countries. The Center produces new syntheses and insights

that integrate ecological, social, economic, and policy perspectives. These analyses are the basis for key policy advice and agenda setting at the national and regional geopolitical levels. The Center also develops new information, tools, networks, and capacity building mechanisms in developing countries.


- The *Global Environment Center (GEC)* is a non-profit NGO, established in 1998 to address key environmental issues. In Malaysia, focus is on bringing together all parties—individuals, communities, corporations and other like-minded organizations—to help foster lasting change for environmental benefits through its programmes on Forest and Biodiversity, Peatlands, River Care, and its Outreach and Partnership Programme.

Knowledge Generation and Academic Research

- *Malaysian Agricultural Research and Development Institute (MARDI)* offers advisory services and consultancy to entrepreneurs and investors in areas relating to agricultural techniques, technology, and management. Efforts related to climate change are focused on lowering GHG emissions from agricultural practices, and impact research on production outputs given climate and weather extremes.
- *Forest Research Institute Malaysia (FIRM)* functions include planning and implementing research for the development of the forestry sector and conservation of forest resources and ecosystem functions key to providing assets needed in climate change adaptation and resilience building; obtaining and disseminating research information to enhance forest management and the use of forest products; and establishing joint research and joint forest development with other bodies within and outside Malaysia.
- *Institute of Strategic and International Studies (ISIS)* is an autonomous and non-profit organization in Malaysia engaged in a wide range of activities focusing on objective and independent policy research and fostering dialogue and debate between the public sector, the private sector and academia. In general, its programmes are directed towards five central areas of national interest, e.g. national and international economic affairs, strategies for nation-building and national unity, policies on energy and natural resources, and science, technology and industry. ISIS was also actively involved in the preparation of Initial National Communication to the UNFCCC.

Multidisciplinary Action and Networks

- *The Institute for Environment and Development (LESTARI)* was established on 1st October 1994 as a multidisciplinary institute within the structure of Universiti Kebangsaan Malaysia. LESTARI was also established to serve as a reference center capable of dealing with environment and development issues, assisting government in formulating policies based on research of a holistic and balanced kind. The development function is directed towards enhancing human resource capacity through skill development and training, for both government and private sectors. As a focal point, conducting multi-disciplinary and integrated research in balancing trade-offs between environment and development. LESTARI also hosts the Secretariat of MyCLIMATE.



Much of Malaysia's adaptation responses come in the form of improved ecosystem management, water resource management, and secured agricultural production

- The *Malaysian Network for Research on Climate, Environment and Development (MyCLIMATE)*, providing research support to the National Focal Point for the UNFCCC and the Cabinet Committee on Climate Change in climate change research activities at national, state and local levels. MyCLIMATE is also a network of individuals and organizations from various universities, government agencies and institutions interested in climate change issues to support sustainable development. The Secretariat of MyCLIMATE is hosted by LESTARI, UKM.
- *Environmental Protection Society, Malaysia (EPSM)* is a Non-Profit Environmental Organization. EPSM was founded at a public meeting held at the University of Malaya in Kuala Lumpur on 11 January 1974 by a group of Malaysians concerned about protecting the environment. It is a membership-based national organization, run by an elected Executive Committee on an entirely voluntary, non-profit basis. EPSM objective include the prevention of environmental deterioration as a result of human activities; control human activities that contribute towards deterioration of our environment; initiate measures for the improvement of our environment; and to increase public awareness about the state of our environment. EPSM is also The Climate Action Network (CAN) is a worldwide network of over 700 Non-Governmental Organizations (NGOs) working to promote government and individual action to limit human-induced climate change to ecologically sustainable levels. As a brief activity profile:

 - Holding of public for a on Malaysia's response to climate change;
 - Ecological Foot-printing and Sustainable Living in Malaysia, including: workshops and for a on the concept an 'Ecological Footprint'; National Conference and Public Forum for Earth Hour, Public Talks at school, orphanages, and pubs; Public Talk - Uniting to Combat Climate Change; and
 - Rainwater harvesting project being implemented in an orphanage (Pure Life Society) with 140 residents.
- *CETDEM (Center for Environment Technology and Development Malaysia)* together with the *Environmental Protection Society of Malaysia (EPSM)* and the *Malaysian Nature Society (MNS)* formed an alliance, the Malaysian Climate Change Group (MCCG) – a non-governmental body in Malaysia that actively addresses climate change issues. This network of people and resources have been working both behind the scenes and on the frontlines and are active in attending international conferences, organizing public talks and fora, creating informative materials, to try to mobilize as many sectors of Malaysian society as possible to address the problems of climate, both local and global. CETDEM also play an active role in the Climate Action Network South East Asia (CANSEA).
- The *Malaysian Environmental NGOs (MENGOs)* through its Community Based Natural Resource Management (CBNRM) Facility has played a key role in the Biodiversity Component under the Malaysian-Danish Environmental Cooperation Programme; provide grants in support of field-based initiatives/projects that addresses a combination of biodiversity/natural resources, indigenous peoples and gender related issues. Common activities of MENGOs are:

- Kelab Pencinta Alam / Nature Lover's Club in schools to promote a conservation culture and bring climate change awareness to students;
 - Development of Environmental textbooks funded by ExxonMobil, published in 2007
 - Studies on GHG emissions (g CO₂ per passenger km) for buses in Klang Valley in 2007 – funded through the NRE and DANIDA
 - National Workshops on climate change projections in Malaysia, to highlight and sensitize civil society on the sectoral impacts of climate change; and
 - Ongoing conservation studies, projects and campaigns.
- Friends of the Earth (FoE), Malaysia is the first environmental NGO in Malaysia involved in community mobilization to combat climate change, and is now making progress in building a grassroots movement. Through its work on mangrove rehabilitation and other initiatives, FoE builds local awareness on climate change mitigation and adaptation, i.e. making climate change relevant to villagers, farmers and fisherfolk.
 - Third World Network (TWN) is an independent non-profit international network of organizations and individuals involved in issues relating to development, and 'Third World and North- South issues'. Its objectives are to conduct research on economic, social and environmental issues pertaining to the South; to publish books and magazines; to organize and participate in seminars – including those on climate change adaptation; and to provide a platform representing broadly Southern interests and perspectives at international fora.



REGIONAL AND NATIONAL CLIMATE CHANGE ADAPTATION EFFORTS

Malaysia has taken, perhaps a unique, approach to climate change adaptation; often coined as 'adaptation through climate change mitigation', noting that the need for adaptation is unavoidable – but such must be derived in the form of co-benefits from concerted mitigation actions. Nonetheless, climate change adaptation in Malaysia involves action by affected entities; requiring national, state, local and community level responses. Accordingly, much of Malaysia's adaptation responses come in the form of improved ecosystem management, water resource management, and secured agricultural production – each with a backdrop of doing so to improve productivity, efficiency in resource use, and optimized economic benefit for the State, to the individual. For this reason, and others, little attention has been given to autonomous climate change adaptation in practice; rather focus is placed on assessments and planned strategies to achieve the aforementioned. Exemplified in this context, Section 4.0 is organized around six (6) thematic areas exemplified within the literature and Malaysia's Second National Communication to the UNFCCC (NRE, 2011): 1) Knowledge development and use, 2) Environmental Sustainability, 3) Water Resources, 4) Agriculture Production, 5) Public Safety and Wellbeing, and 6) Policy and Governance.

Strategic knowledge development and use – vulnerability and planning

Taking a brief step back, various agencies in Malaysia have been involved in compiling GHG inventories and studying possibilities in mitigation and

adaptation measures (CEMD NRE, 2005). Naturally felt was to institute a comprehensive research and systematic observation mechanism involving relevant institutions such as NAHRIM and Malaysian scientists from the: International Geosphere-Biosphere Programme (IGBP); Global Change SysTem for Analysis, Research and Training (START); and the Southeast Asia Regional Committee for START (SARCS) regional programs on climate change (Salmah, Z, Jamalluddin, A., and Y. Chan, 2007). Efforts have led to climate change adaptation knowledge developing simultaneously amongst sectors; each spurred by efforts in relation to conducting vulnerability, impact and adaptation assessments in areas of health, natural disasters and extreme events, environmental security, water scarcity, spatial planning responses; to livability assessments at the local level, including community and livelihood resilience studies. Naturally, the aforementioned studies have utilized support and efforts done in preparation for the NC2, e.g. the downscaling of climate projections to enhance spatial details in quantitative vulnerability and adaptation assessments.

One of Malaysia's significant achievements has been the development of the 'Regional Hydro-Climate Model for Peninsular Malaysia (RegHCMPM)' to generate climate and hydrological projections.

One of Malaysia's significant achievements has been the development of the 'Regional Hydro-Climate Model for Peninsular Malaysia (RegHCMPM)' to generate climate and hydrological projections. A similar model for Sabah and Sarawak is said to be nearing completion. Malaysia has also been using another projection model, 'Providing Regional Climates for Impacts Studies (PRECIS)', for understanding and projecting climate change impact and adaptation needs. This model was developed by the Hadley Centre for Climate Prediction and Research, United Kingdom Meteorological Office. The difference in the two models is that the PRECIS model has only been able to provide vital information at the scale of 50 km resolution, whereas the RegHCMPM is capable of doing so at the scale of 9 km in resolution. However, each has been able to provide Malaysia with detailed quantitative climate change impact and vulnerability assessments towards developing and selecting more appropriate adaptation options (NRE, 2011). The importance of such should be underscored, for much of Malaysia's efforts in building climate change adaptation knowledge is centered on learning 'what it is we are adapting to', i.e. the condition, whereas how to adapt has for the most part taken second stage.

Other knowledge development embodiments linked to building climate change adaptation knowledge would include the development of a Coastal Vulnerability Index, including field base testing of data collection processes; and the identification of the relationship between the impacts of climate change and vector-borne diseases – each supported by the Ninth Malaysian Plan. Additionally, MyCLIMATE has done extensive research in the area of climate change adaptation and disaster risk reduction, e.g. the development of a vulnerability assessment method for disaster risk reduction due to climatic hazards such as sea-level rise, flooding and flash floods, as well as hazards associated with other extreme climatic conditions that impact societal well-being. MyCLIMATE knowledge generation efforts also extend to others sectors such as health, and research content guidance for higher education needs. Perhaps its most concerted work has been linked to 'Climate Change Policy and National Security', wherein MyCLIMATE has provided key inputs into monitoring and documentation of international developments on global

climate regimes for formulating strategic national positions and responses; mainstreaming climate change into development, specifically in reference to balancing adaptation and mitigation; and in assessing the economics of climate change adaptation and mitigation for selected sectors.²

MYCLIMATE AND LESTARI-UKM

On Going and Future Knowledge Building Actions

- Development of a Directory of 'Who's Who in Climate Research' encompassing researchers and experts in government agencies, universities, community based organizations, non-government organizations, academia and the private sector, in accordance to key sectors and elements of climate change (LESTARI);
- Development of national climate strategies for long term implementation and in facing the future climate regime (post-2012) (LESTARI);
- Research on adaptation to climate change through spatial planning tools(LESTARI);
- Localized Climate Modeling and Projection (IKLIM/ Faculty of Science & Technology); and
- Inventory for adaptation (Faculty of Science and Technology; Faculty of Social Sciences and Humanities).

For more information see <http://www.ukm.my/myc>

The National Hydraulic Research Institute of Malaysia (NAHRIM) is also a key 'knowledge player' in the region within the water sector. NAHRIM is the Regional Water Knowledge Hub for Water and Climate Change Adaptation in Southeast Asia. Established by the Government of Malaysia in response to the country's increasing number of water-related challenges, including floods, drought events, deteriorating water quality in rivers and coastal bodies, competing users, erosion, accretion, sedimentation, and the impending/ anticipated impacts of climate change on water resources. NAHRIM provides knowledge-based services such as training courses and programs to the region that are relevant and self-sustaining. NAHRIM is also active in the following:³

- Assessing the impacts of global climate change and land use change on water balances and water quality in Southeast Asia through regional interactive climate, hydrology, and water quality models, such as NAHRIM's Regional Environmental Hydroclimate Model (RegEHCM);
- Training technical personnel from interested agencies around the region in the use of state-of-the-art data and technology from regional environmental Hydro-Climat models and water resources systems models designed to assist in assessing the impact of climate change in the region;
- Developing awareness of water related issues in agricultural, coastal resource, biodiversity, forestry, public health, energy, and socio-economic planning, drawing on the expertise of regional and international teaching personnel;
- Creating feasible policies for the optimal management of the region's water resources and the mitigation of the potential impacts of climate change against a variety of likely future water demand and land use scenarios;
- Developing simulation model for water resources systems at the regional, country, and watershed scales that will include both water balances and water quality conditions (water temperature, dissolved oxygen, turbidity, nutrient loads, etc.) under global climate change and future urban-industrial-agricultural water demand and land use scenarios; and
- Predicting possible scenarios of land use change and urban-industrial-agricultural water demands in Southeast Asia in the 21st century at

2 Information extracted from <http://www.ukm.my/myc>; current as of August 16, 2011

3 Information extracted from www.nahrim.gov.my; current as of August 16, 2011

a fine space (grid resolution ~3 kilometers) and time (hourly/daily) resolution.

The Malaysian Agricultural Research and Development Institute (MARDI) along with various Malaysian universities are currently focused on determining what the Malaysian agricultural sector will have to adapt to in a 'climate change' context. For example, the University of Malaya - focused on climate-related vulnerability rather than adaptations phases, recently conducted multi-disciplinary research. This particular study, Policy Challenges Towards Potential Climate Change Impacts: In search of agro-climate stability, investigates the major Malaysian agricultural sectors such as food crops (rice) and cash or industrial crops (palm oil and rubber) under a climatic and economic perspective, quantifying the merits of the projected simulation and presenting an insight into the nature of the overall subject of suitability of adaptation options (Al-Amin, A.Q., et., al., 2010). Other key researches, and there are many, deal with areas of governance, socio-economic impacts, food security and poverty. As part of this variety of research, the following are indicative examples:

- Al-Amin A.Q., Jaafar A.H., Azam M.N., Kari F., and O.S., Syed (2010). Climate change issues and Malaysian initiatives, in Climate Change Governance, Walter Leal Filho and Jörg Knieling eds, Springer, Netherlands (2010: In Press).
- Baharuddin M.K., (2007). Climate Change: Its effects on the agricultural sector in Malaysia, in National Seminar on Socio-Economic Impacts of Extreme Weather and Climate Change, 21–22 June, Malaysia.
- Chamhuri S., Alam M., Murad W, A.Q., Al-Amin (2009). Climate Change, Agricultural Sustainability, Food Security and Poverty in Malaysia. IRBRP, 5(6): 309-321.

Strategic Actions for Environmental Sustainability

On a regional scale Malaysia is active in pursuing climate change adaptation needs within the marine environment through its participation in the Coral Triangle Initiative (CTI). This is in recognition that global marine and coastal ecosystems capture and store more than 30% of the human caused carbon emissions from the atmosphere, e.g. through mangrove forests, salt marshes, and sea grass beds; each particularly efficient at capturing and storing carbon. Destruction and degradation of these ecosystems has been noted to degrade the adaptive capacity of local users to climate related impacts. Malaysia, as a whole, has developed agreements with the CTI on 1) finalizing its objectives, approaches, financing, timelines and actions toward developing the CTI Region-wide Early Action Plan for Climate Change Adaptation (REAP-CCA), and 2) collaborating on a 'climate change adaptation sharing policy' and capacity building toward finding common ground where the CTI can stand together on policy issues in regional and global forums, and work toward shared solutions (USAID, 2010).

Efforts are also being taken to ensure sustainable development and management of coastal areas especially to cope with impacts of climate variability and change, including sea level rise

Efforts are also being taken to ensure sustainable development and management of coastal areas especially to cope with impacts of climate variability and change, including sea level rise. The implementation of the Integrated Shoreline Management Plans (ISMP) by local authorities has already started in selected coastal areas of the country (NRE, 2011). Additions to the list of strategic efforts: the Conserving Marine

Biodiversity through Enhanced Marine Park Management and Inclusive Sustainable Island Development by Marine Parks Unit, implemented through the NRE; and the Integrated River Basin Management in Peninsular Malaysia implemented through the NRE - Department of Irrigation and Drainage.

The Small Grants Programme of the Global Environment Facility (GEF SGP) has also supported environmental sustainability efforts, e.g. conserving biodiversity, reducing the risks of climate change, stopping land degradation and reducing water pollution, among others. In conjunction with its partners, GEF has committed substantial funding to national Non Government Organizations (NGOs) and Community Based Organizations (CBOs); supporting them in addressing global environmental problems by raising public awareness, building partnerships and promoting policy dialogue to address global environmental problems and promote sustainable development; and to ensure that conservation and sustainable development strategies and projects that protect the global environment are understood and practiced by communities and other key stakeholders, i.e. the backbone of Malaysia's position and action on climate change adaptation needs (UNDP, 2008).

Respective of the forestry sector, measures to enhance the National Seed Bank collections have been undertaken to ensure the survival of genetic stocks. Additionally, protected forest areas and forest state parks have been expanded which is expected to enhance natural adaptation processes of forests. There are also several hallmark 'forestry management' efforts in Malaysia that through process do build local resilience to climate change impacts. For example: the Deramakot Forest Reserve Project, implemented under the premise of 'multiple functions and uses', with strong emphasis on future productivity, environmental impact, and the economics of forest operations, and the Kelawat Forest Reserve, a joint forest management project in forest restoration and management. This project particularly exemplifies the stance of the Malaysian government; climate change adaptation and resilience building through mitigation. The aforementioned forestry efforts have planted more than 20,000 trees comprising mixed indigenous species, and silvicultural measures carried out to encourage the new forest growth, and to protect the naturally regenerating trees and medicinal plants that are competing against lianas and shrubs. Many varieties of fruit trees have also been planted in various cropping patterns, including durian, terap, rambutan, cempedak, coconut, langsung, and mango. In addition to woody perennials; other food crops planted included bananas, pineapples, and vegetables such as sweet potatoes. Hence, common climate change adaptation measure in forest communities often consist of slope stabilization initiatives to deal with increased landslide activity, and do so in a way to improve livelihood diversity and food security in time of climate variability. The Mangkuwagu Forest Reserve Project should also be highlighted. The project has been implemented jointly through the UNDP and the Sabah Forestry Department (also known as the Promoting Sustainable Use and Conservation of Forest Resources in Mangkuwagu Forest Reserve through Capacity Building and Community Forestry project)(UNDP, 2008).

Strategic Actions within the Water Sector

Within the water sector, perhaps where the majority of Malaysia's climate change adaptation activity and emphasis has been, is to incorporate integrated approaches to water management through the introduction of Integrated Water Resources Management (IWRM) plans. Implementation of the IWRM

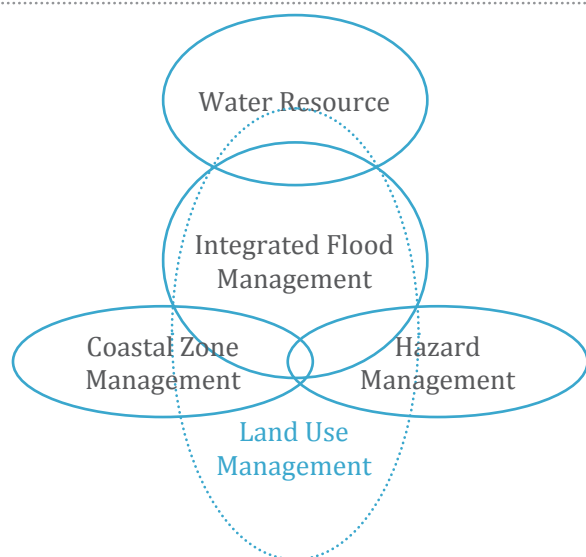
plans, reported to the UNFCCC, is that efforts have strengthened Malaysia's ability to deal with floods and droughts. In addition, Malaysia has also taken adaptive measures to strengthen its infrastructure, e.g. the 'Storm Water Management and Road Tunnel' (SMART), which has helped in addressing urban flooding in Kuala Lumpur city, and the structural upgrade of the Timah Tasoh Dam in the state of Perlis, i.e. strengthening water storage capacities to alleviate water shortages during periods of low rainfall and drought (NRE, 2011). Other measure would include enlarging the reservoir capacity throughout the country, improving hydrological forecasting, promoting the widespread use of groundwater, rainwater harvesting, and demand side management of water resources.

The aforementioned are important measure to undertake, even prioritize, because Malaysia derives much of its water resources/ supply side in the forms of rivers, lakes, and groundwater. Streams and or rivers contribute about 99% of the raw water; the remaining 1% of raw water comes from groundwater sources. With population growth, urbanization, industrialization and the expansion of irrigated agriculture, such is imposing rapidly growing demands and pressures on water resources. Water management is becoming increasingly comprehensive and complicated due to large concentrations of population, commercial activities and industries around the cities and towns, increasing water consumption, increasing water pollution, increasing land use conflicts and micro-climate changes. As a response, Malaysia has developed a Water Quality Index (WQI) as a basis for assessment of a watercourse in relation to the designation of classes of beneficial uses as stipulated in the National Water Quality Standards for Malaysia. In some ways this has spurred the reorganization of how Malaysia would handle its water resources in future climate change contexts.

Restructuring among ministries in March 2004, the Ministry of Natural Resources & Environment (NRE) was established, and with a combination of departments from four (4) other ministries. The purpose of doing so was to ensure the integration of water resources management. Hence, water resource management is a shared responsibility among the ministries, e.g. water services monitoring and supervision – the Ministry of Water, Energy and Communication; monitoring and safeguarding of water resources and natural resources – the Ministry of Natural Resources and Environment; water research and development – the Ministry Science, Technology and Innovation, drinking water quality – the Ministry of Health, and water resource planning and development, done by Local Governments (Sharifuddin, 2010). The following are important commissions and Acts guiding the integration process:

- The National Water Services Industry Commission Bill and Water Services Industry Act (WISA) amended by Malaysian Parliament in 2006, placing water resources under State jurisdiction, and control of all water services in thirteen (13) States of Malaysia under the Federal Government to ensure quality and reliability where water supplies are concerned; and
- National Water Services Industry Commission (SPAN) established under the provision of the Water Services Commission Act and employs the WSIA as regulatory tools to regulate water services industry in term of licensing, supervision and monitoring. This means that State Governments have to corporatize their state water authorities and that the Commission would serve as the central regulatory body.

FIGURE_1 Concept of 'Integrated Flood Management' for Pahang and Muar River Basin in Peninsular Malaysia



More recent 'governance' efforts in the water sector related to climate change adaptation are workshops organized to reflect and possibly update existing guidelines, action plans and strategies related to IWRM in March of 2009 in Kuala Lumpur. The Workshop was conducted to prepare for the development of the ASEAN IWRM Country Strategy Guidelines. The workshop agreed on six (6) key water related issues in the region: 1) water supply; 2) irrigation; 3) storm water management; 4) flood management; 5) water pollution management; and 6) sanitation management. Additionally, the implementation of the Integrated River Basin Management (IRBM) plan, which takes into account integrated management of water resources, land resources, ecosystems and socio-economic needs, will enable a more comprehensive approach towards reducing the vulnerability of this sector to climate change. In support, Laws like the National Water Services Commission Act, 2006 (NWSC Act) and the Water Services Industry Act 2006 (WSI Act) are in place to promote sustainable water use and better water management; crucial in adapting to climate change (NRE, 2011). The following are key water management programs in Malaysia related to climate change adaptation needs (Mohdzaki, M., Amin, 2009):

- CLIMATE CHANGE PROJECTION PROGRAM including: the 'Study of the Impact of Climate Change On the Hydrologic Regime and Water Resources in Sabah and Sarawak (2007-2010)'; the development of the Hydro-Climate Projection Downscaling For Malaysia Using Hadley Centre PRECIS Model (2009-2010); and the extension of research on the Impact of Climate Change on the Malaysian Water Resources (2011-2015);
 - WATER RESOURCES PROGRAM including:
 - Integrated Flood Management Program for Pahang and Muar River Basin in Peninsular Malaysia (Figure 1);
 - Updating the Integrated Development Plan (IDP) relationship to maintain design standards;
 - Integrated rainfall and flood forecasting, warning and response system for Johor, Pahang, & Kelantan River Basin which aims to increase lead time forecast to 72-hrs & reduce any severe flood impact;
 - The formulation of the climate change impact on design flood;
 - Development of a National Water Resources Policy and Law in Malaysia; and the
 - Sarawak Integrated Water Resources Master Plan (mid-2010)

Agriculture Production

Agriculture production and climate change adaptation are closely linked in Malaysia's Framework for climate change, agricultural impacts, vulnerability and livelihoods (Figure 2), underscoring the focus of adaptation efforts on the development of drought tolerant varieties of rice, rubber, oil palm and cocoa... as well as concerted efforts to develop rice strains that consumes less water (NRE, 2011). Naturally the aforementioned 'adaptation' efforts aim to reduce the negative effects of climatic variability, e.g. changing the cropping

calendar to take advantage of the wet period and to avoid extreme weather events during the growing season. Notably, as research on agricultural adaptation needs include variety development, much of the application/field adaptation efforts are still under investigation.

Respective of ‘climate change actors’, three key questions are commonly being asked:

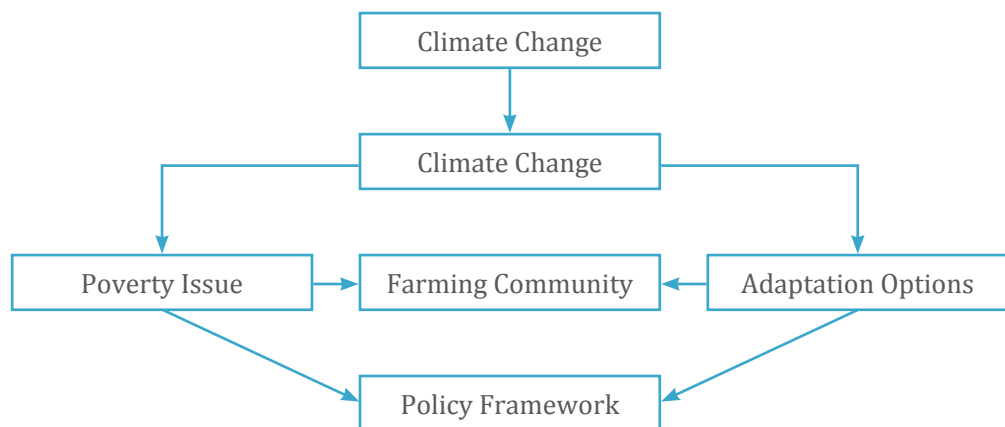
1. Issue - Are planning strategies for agricultural resources in Malaysia supported by the climate record;
2. Impact - What additional pressures will be placed on agriculture as a result of projected climatic variability and change; and
3. Policy - What practical strategies (adaptation options) can be engaged to reduce vulnerability and enhance livelihood outcomes?

Until these questions are answered definitively, the application of climate change adaptation methodologies may be slow to come; conversely, finding the answers is aggressively supported via Malaysia’s water sector advancements.

Public Safety and Wellbeing

In terms of public safety and Disaster Risk Reduction (DRR), strategic Malaysia’s efforts go back into the 1990s wherein the National Security Council of the Prime Minister’s Department issued Directive No. 20 on “Policy and Mechanism on National Disaster and Relief Management” on 11 May 1997, to guide relevant management activities according to the level of, and complexity of a disaster. The Council is responsible for coordinating activities that are implemented by the Disaster Management and Relief Committee at federal, state and local levels that comprises various agencies. Government agencies are responsible for different aspects of disaster risk reduction while maintaining their core responsibilities.

FIGURE_2 Malaysia’s Framework for climate change, agricultural impacts, vulnerability and livelihoods (Siwar, C., and A., Q., Al-Amin, 2009).



Aside from the activities of the Southeast Asia Disaster Prevention Research Institute (SEADPRI), the World Youth Foundation; the Force of Nature Aid Foundation; and Mercy Malaysia’s efforts mentioned in the previous Section;

public safety and DRR efforts in Malaysia are mainly focused on creating awareness and information sharing... stopping short of instituting significant community actions based on DRR principles and local participation. Yet, it should be noted that risks and hazards are local in context... requiring local responses and actions to build resilience to potentially hazardous events, e.g. climate change impacts. From those interviewed for this study, clear is that DRR in Malaysia emphasizes post hazard responses. This is not to say that public safety is not taken in the fold of prevention, mitigation, and preparation context; rather these principles are combined to a series of Ministry and sector programs and projects outside of the more traditional fold of DRR, e.g. the Water Resource Management Program to the Storm Water Management and Road Tunnel project. Additionally, local organizations working in concert with others, e.g. the Force of Nature Aid Foundation, and Ministries, such as the Ministry of Natural Resources and Environment (NRE), each are active in establishing coastal protection measures through rehabilitation and enhancement efforts.

Crucial, but often deferred in the past are school based DRR efforts; however this has begun to change. MERCY Malaysia has established a School Preparedness Programme. The programme is designed to raise awareness amongst students of the hazards they face and to help schools to minimize the risks posed by natural disasters, such as the seasonal floods experienced in many parts of Malaysia. Additionally, through their School Watching Workshop program, concepts like 'Community-Based Hazard Mapping' are taught and utilized by participants to help school communities identify hazards and risks in and around schools. Most recently, an ASEAN Knowledge Sharing Workshop on Mainstreaming Disaster Risk Reduction in Education was held in Malacca, Malaysia, 18-19 February 2011. The theme of the workshop was based on achieving disaster resilience through youth participation via mainstreaming DRR in school curriculums (ASEAN, 2011).

Akin to the aforementioned activities, the government of Malaysia has launched its 'One Million Safe Schools and Hospitals and Making Resilient Cities Campaign' in February 2011. This event was done in connection with its National Disaster Awareness Day, and the ASEAN Regional Workshop for Mainstreaming Disaster Risk Reduction in Education. The event focused on issues related to disaster risk reduction and climate change adaptation in Malaysia, such as a review of the national disaster management policy and mechanisms, implementation of the Hyogo Framework of Action, to the integration of DRR as part of a climate change adaptation package in national physical planning and township policy development.⁴

Moving towards Malaysia's activities in relation to regional and international participation, Malaysia is an active partner in the Disaster Risk Reduction Platform; the focal Point to the Hyogo Framework Action (2005-2015) - Building the Resilience of Nations and Communities to Disasters. For example, Malaysia hosted the Third Asian Ministerial Conference on Disaster Risk Reduction. Note that the Asian Ministerial Conference on Disaster Risk Reduction is entrusted with the task of ensuring that member countries remained committed towards the goals of the Hyogo Framework for Action in building the resilience of nations and communities to disasters.⁵

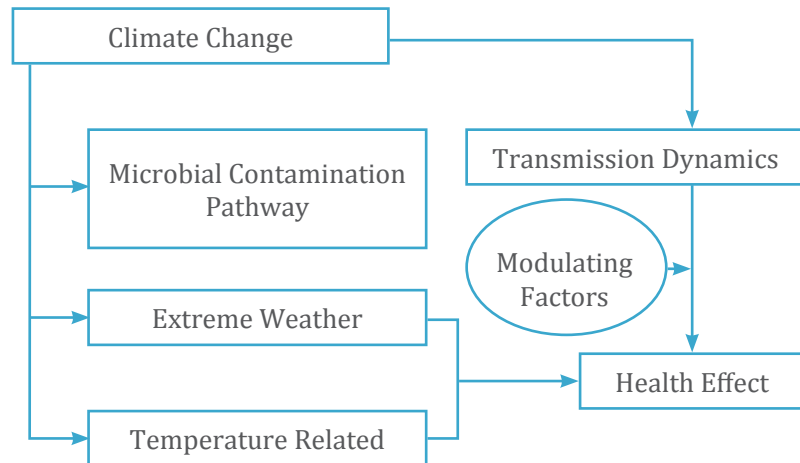
For Malaysia, the health sector also figures prominently into the 'Climate Change' discourse. Focus is on larval and insecticide controls; already in place as part of the Health Ministry's Vector-borne Diseases Control Programme.

4 Information retrieved from http://www.safe-schools-hospitals.net/en/NewsandEvents/ViewNewsandEvents/tabid/91/articleid/166/Default.aspx?dnnprintmode=true&mid=486&SkinSrc=%5BG%5DSkins%2F_default%2FNo+Skin&ContainerSrc=%5BG%5DContainers%2F_default%2FNo+Container. Current as of August 16, 2011.

5 Information retrieved from <http://www.pmo.gov>. Current as of August 16, 2011.

Standard Operating Procedures for emergency and disaster management are also incorporated at all levels of the national health infrastructure. Again, it is not currently clear in Malaysia if these actions are adaptive in nature, or reactive to current situations. Figure 3 is a snap shot view of how the health sector views 'its' connection to climate change impacts.

FIGURE_3 Perception of climate change connection to health related pathways, dynamics, and modulation in Malaysia.



The Vector-borne Disease Control Programme is currently in the process of revising the control programme into an elimination programme. Among the key approaches being undertaken include strengthening and improving current strategies, changing the drug regimen to a more effective Artemisinin Combination Therapy (ACT) as suggested by the World Health Organization to address the problem of viruses becoming drug resistant, strengthening the surveillance programme particularly in malaria free but prone areas to prevent re-introduction of the infection and occurrence of out-breaks, and improving the case detection mechanism and approaches, including screening of migrant workers. Current and expected programmes and activities for adaptation to both current and projected climate-related health burdens involve the following (NRE, 2011):

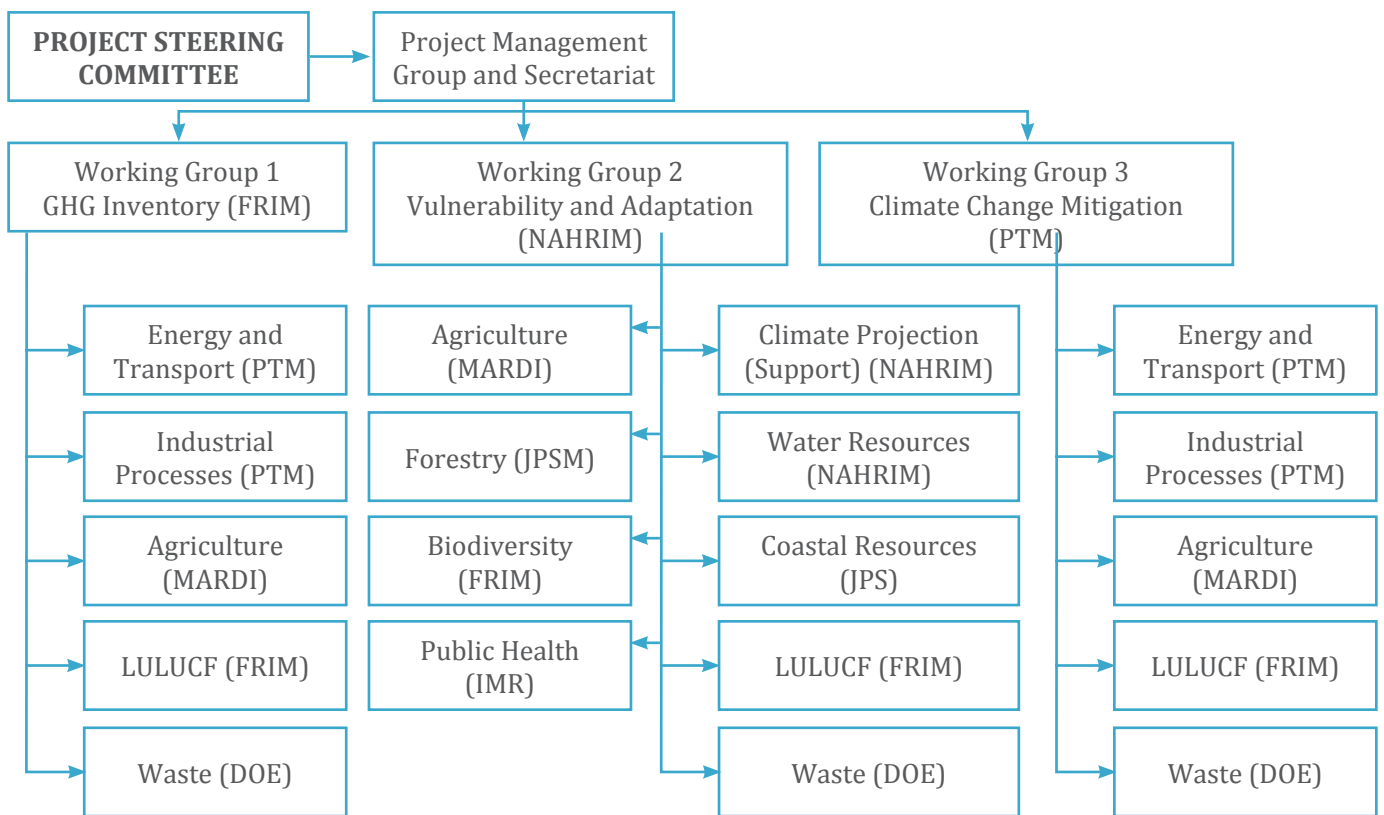
- Emphasis to be placed on entomological surveillance with the recruitment of entomologists at the district level;
- Established a Rapid Response Command Centre, and incorporated the Centre for Disease Control and Prevention in the 9th Malaysian Plan;
- Continued investment in health infrastructures, human resources, and research;
- Network of public health laboratories and continued vigilance on infectious diseases; and
- Strengthening surveillance system and disaster preparedness and response.

Policy and Governance

Malaysia, and other countries around the globe have ratified the UNFCCC and the Kyoto Protocol. These countries, along with Malaysia, have also established national focal points for climate change. For Malaysia it is the Ministry of Natural Resources and Environment. Noted through the literature

is criticism over having an environmental agency as the national focal point to climate change, for it is said to often result in a failure to promote the integration of climate change strategies into development planning. However, emerging in Malaysia is a potential policy framework to address this shortcoming. For example, Malaysia has established a high level multi-ministerial – multi-stakeholder governmental body with responsibility for the development and implementation of policies, plans, and measures to address climate change issues at the national level. As a clear reflection of this is the level of cooperation noted in the development of the NC2 (see figure 4).

FIGURE_4 Malaysia Second National Communication (NC2) to the United Nations Framework Convention on Climate Change – Organizational Framework (NRE, 2011).



From the NC2 framework, climate change adaptation related activity is seemingly emphasized, but in reality this is not the case, impart because ‘adaptation’ is heavily dependent upon external assistance, and in many cases, building adaptive capacities involves programmatic uncertainties which would have strong implications on both national and local level policy development and governance (Lian, K. K., and L. Bhullar, 2010). For this, and other reasons, the Ministry of Natural Resources and Environment Malaysia has worked extensively in collaboration with the Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia; conducting a Policy Study on Climate Change, with a view to formulating a national policy to ensure concerted holistic responses to climate change challenges. The study adopted broad stakeholder participation and consultative processes. Stakeholder viewpoints were gathered in overlapping phases at national and regional meetings, interviews and peer-review sessions provided

Table 5 Key policy and governance action elements of the National Policy on Climate Change in support of climate change adaptation/ impact resilience building (NRE, 2010b).

Key Action # - Strategic Thrust #	
KA1 – ST1	Conduct systematic reviews and harmonize existing legislation, policies and plans, taking into account and proposing relevant balanced adaptation and mitigation measures.
KA2 – ST1	Incorporate climate change as a priority area in the national Development Planning Council.
KA3 – ST1	Establish an inter-ministerial and cross-sectoral committee to enable the implementation of climate change measures.
KA5 – ST2	Incorporate and facilitate implementation of climate friendly measures and technologies by strengthening: 1) Laws and regulations and enforcement, 2) Human resource development, 3) Finance and incentives, 4) Research and development, 5) Transfer of technology, and 6) Outreach to relevant stakeholders.
KA7 – ST2	Integrate balance adaptation and mitigation measures into development plans.
KA12 – ST4	Integrate balanced adaptation and mitigation measures into policies and plans on environment and natural resources.
KA13 – ST4	Incorporate measures, including mobilizing financing and technical assistance into... agriculture and food security, natural resources and the environment, public health, land use and land use change, and disaster risk reduction.
KA18 – ST4	Develop multiple national climate change and hydro-climate projection models for identifying vulnerabilities and assessing potential impacts of climate change.
KA28 – ST7	Establish and implement a national research and development agenda on climate change.
KA29 – ST7	Strengthen national data repository through periodic national inventory by, e.g. reviewing the role of the Department of Statistic as the central depository for environmental information, to establishing a database inventory on natural disasters and extreme weather events.
KA35 – ST8	Strengthen legislative provisions for participatory planning and decision making
KA28 – ST9	Adopt systematic and targeted formal and informal education and awareness raising on climate change.

crucial inputs to refining the study's recommendations for the formulating of a National Policy on Climate Change for the country. A concise overview of this was given in Section 3.2 - Policies and Regulations Addressing Climate Change Related Issues; Table 5 depicts key policy and governance action elements stipulate in the National Policy on Climate Change (NRE, 2010b).

For Malaysia, climate change adaptation policy and governance engagements have not stopped at its borders. Considering the Coral Triangle Initiative (CTI), and that coastal ecosystems capture and store more than 30% of the human caused carbon emissions from the atmosphere, Malaysia has been actively pursuing the building of common objectives, approaches, financing, timelines and actions toward developing the CTI Region-wide through an Early Action Plan for Climate Change Adaptation. Key areas of cooperation are:

- Climate change risk assessment
- Improving livelihoods and food security;
- Infrastructure protection and the protection of coastal and marine ecosystems;
- Governance and management opportunities; and
- Preparation for disasters.

Despite all the actions mentioned in Section 4.0, Malaysia is still far behind on adaptation programs and activities, in particular on measures to protect

land, water and coastal resources. This is critical, as the first cost of climate change is often born through floods, droughts, extreme weather events, and of course sea level rise among many other impacts. In part, the reasons for inadequate adaptation measures often result from the lack of awareness, insufficient information and knowledge on the detail of the impact of climate change and uncoordinated and unilateral management of the individual sub-sectors. Yet, positive action has begun, e.g. the development of the National Framework on Water Resources Management and the accompanying action plan, and the National Policy on Climate Change, which are assertive actions.

The question now to ask is what is missing in terms of generalities, many of which will be addressed in further detail in the following section on Climate Change Adaptation Capacity Gaps: Actions, Knowledge, and Priorities:

- Assumption free data to planning and implementation... present development, social planning objectives and implementation programmes of the country are based on assumptions quantified with uncertain data on climate change impacts;
- Formal vulnerability and adaptive capacity development analysis for all sectors; including financial, economic and social fields of analysis;
- An integrated vulnerability and adaptive capacity development programme based on a regional or eco-system based approach... including data collection, information integration, and analysis;
- Knowledge management systems to meet the needs of, and participation of professionals and the public, e.g. guidelines for vulnerability and adaptive capacity assessments, to programmes aimed to assist the public in selecting options for adaptation to climate change;
- Recent review of laws, rules, regulations, policies and plans relevant to all sectors to strengthen efforts to address climate change issues and encourage adaptation measures;
- Localize risk reduction studies; studies highlighting autonomous and planned adaptation actions in play and how these can be fortified through institutional and policy support; and
- Affirmative climate change adaptation programmes, and that of integration for all sectors at multiple levels of concern (National to household) with a multitude of perspectives, e.g. climate induced hazards and changes that impact, e.g. food security to economic and environmental stability and integrity, to that of household needs, and human safety.



CLIMATE CHANGE ADAPTATION CAPACITY GAPS: ACTIONS, KNOWLEDGE, AND PRIORITIES

There is no doubt that Malaysia has the base knowledge and capacity needed to adapt to climate change, perhaps it is a matter of understanding the economic efficiency of choices to be made before action is undertaken. Among the key questions that need to be addressed in Malaysia, and through the Economics of Climate Change in Malaysia project would be to determine the expected cost of climate change in the absence of adaptation measures, the economic cost of alternative adaptation measures, the economic benefit of alternative adaptation measures, and addressing questions on can adaptation measures offer the largest economic returns or the best benefit – cost ratio. Currently, little data is available on local cost and benefits of adaptation measures

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Among the key questions that need to be addressed in Malaysia would be to determine the expected cost of climate change in the absence of adaptation measures, the economic cost of alternative adaptation measures, the economic benefit of alternative adaptation measures, and addressing questions on can adaptation measures offer the largest economic returns or the best benefit – cost ratio.

.....

by sectors e.g. coastal, agriculture etc. (ADB-INDP, 2011). The importance of these studies is, perhaps in some way, is underscored by many of the perception interviews conducted for this study, i.e. once an impact is felt, just mobilize the resources needed to mitigate.

There is much room for building knowledge on exactly what options are currently available, and where generation and innovation is needed. Important to note is that knowledge building must take 1) a multi disciplinary approach, i.e. studying an issue from the perspective of several disciplines; and 2) an inter-trans disciplinary approach, allowing for the simultaneous integration of knowledge from various disciplines, perspectives, involving various stakeholders, researchers and practitioners (Pereira, J.J., and I, Komoo, Undated).

Gaps to Achieve Environmental Sustainability

Beginning with Malaysia's key regional actions within the Coral Triangle Initiative (CTI), cited action related gaps prioritize are to move from a 'Framework for the Early Action on Climate Change' state towards action on the ground in 2012. However key knowledge gaps and supportive constraints towards action must be overcome (USAID, 2010):

- Support for capacity-building, particularly in relation to the gathering and analysis of scientific and traditional knowledge and development of policy and governance to enable effective adaptation to climate change;
- Understanding of the vulnerability of the people residing in the Coral Triangle in order to improve their capacity to make effective ecosystem and structural adaptation plans - at the local, national and regional level;
- Improvements in spatial planning, especially in implementing networks of resilient marine protected areas; and the
- Development of frameworks to provide early warning of disaster and climate change impacts, and strategies to reduce risk and improve management.

Moving towards national level interests, the sustainability of Malaysia's forestry and biodiversity in a climate change context is also of concern. Known is that components of biodiversity, namely plant and animal species, ecosystem and genetic materials should be, and are better conserved through the establishment of conservation corridors between forests. Yet, gaps in adaptation actions, if they persist, may call for genetic resources to be conserved through the establishment of gene banks, seed centers and botanic gardens for flora and, animal sanctuaries, captive breeding centers and rehabilitation centers for fauna. However, noted is that achieving the aforementioned areas of priority actions could be constrained by:

- Insufficient funds and funding mechanisms to support research on biodiversity as well as building capacity through training and workshops;
- A lack of taxonomist for both flora and fauna, which are crucial for ecosystem inventory and also taxonomic work for plant identification; and

- Laps in enforcement and monitoring environmental related projects, and in cooperation between federal and state management of biodiversity and ecosystems respective of handling issues related to climate change and land degradation (NRE, 2008).

For coastal and marine ecosystems, noted in the NC2 is the need to enhance Integrated Shoreline Management Plan efforts to reduce the impacts of sea level rise and more frequent storm surges caused by climate change (NRE, 2011). Seen as adaptation options to sea level rise are three choices, Retreat, Accommodation, and Protection:

Retreat - abandonment of land and structures in vulnerable areas and resettlement of inhabitants; the prevention of development near coastal areas through the imposition of more stringent setback limits, land acquisition, land use restriction and prohibition of reconstruction in areas damaged by storms; and taking measures to enable wetlands to migrate inland.

Accommodation - continued occupancy and use of vulnerable areas. This constitutes a compromise between retreat and protection. This would entail modification of drainage systems, specifications of minimum floor elevation and piling depth as well structural bracing for building code; allowing changes in land use such as conversion of agriculture land to aquaculture uses; prohibiting filling of wetlands, damming of rivers, and mining of coral and beach sands; and allowing natural resources, such as mangroves and coral reefs to be left to their natural processes to cope with sea level rise.

Protection - defense of vulnerable areas, especially population centers, economic activities and natural resources. These include engineering responses that involve defensive measures to protect areas against inundation, tidal flooding, and effects of waves on infrastructure, soil erosion and loss of natural resources such as mangroves. Consequently, hard measures such as sea-walls and groynes and soft measures such as beach nourishment and wetlands/mangroves creation are possible adaptation measures.

Climate change adaptation in the coastal zone also means attaining an in depth understanding of storm patterns, intensity, duration and frequency. Identified measures to adapt would firstly involve obtaining a better understanding of storm patterns and potential responses through research. This would include:

- Research on storm surges to help establish quantitatively the trends of storm surges and wave patterns therefore facilitating the understanding of long term coastal evolution; and
- Research on coastal reforestation to develop optimal planting methods and the creation of robust coastal forests that can strengthen the stability of coastlines and contribute to biodiversity enhancement.

Additionally the wider usage of soft engineering should be promoted and widely applied as it is less damaging to the environment and can enhance coastal ecosystems. Soft engineering applies both structural and biological concepts in the solving of erosion and reduction of erosive forces.

It has been pointed out in the literature, and in this scoping study, that much of the enabling policy frameworks needed to achieve environmental sustainability in a climate change context is in place in Malaysia. Still, Malaysia's

commitments to the global community and to itself – as attested by the various Malaysia Plans, by legislation and policies for environmental and resource management, green energy, physical planning and climate change, such needs to be followed up to ensure much better implementation, coordination, monitoring and evaluation, and the development and implementation of forthcoming recommendations. Recommended by a recent United Nations scoping study is that Malaysia should also develop appropriate incentives for States and the private sector to implement initiatives and to comply with national policies and objectives on environmental sustainability in a climate change context (UN, 2011).

Gaps to Effective Water Resource Management

Much of what is stated in the literature covers Malaysia's need to manage its water resource from a view of conservation, containment, and efficiency in distribution as climate change adaptation measures. Pointed out is Malaysia exemplary commitment and success in the provision of safe water and improved sanitation for its people; achieving its target of halving the proportion of people without access. Yet, also noted is that too many people in the States of Kelantan, Terengganu, Sabah and Sarawak remain without access to either or both (UN, 2011).

Primarily under the guidance NAHRIM, reported in the Second National Communication to the UNFCCC is an emphasis on knowledge building respective of the further development of Hydro-Climate Projection Models. Also noted is the importance of these models; providing clear parameters and guidance to needed extension research on the impact of climate change on Malaysian water resources, urban and rural drainage systems, catchments management, highway drainage, dam and reservoir safety and integrity, water supply allocation and distribution, irrigation water demand and efficiency and hydrology analysis and synthesis for flood risks, i.e. improved modeling that would allow for the integration of water resources management systems, decision making, and action (Amin, M. M., 2009). Once achieved, management of information use and flow will present key challenges. Yet to be realized fully is Malaysia's planned hydro-climate change projection database; said to be based on five (5) main parameters i.e. Precipitation, Evapotranspiration, Soil Water Storage, Surface Temperature and Stream flow with data sets of simulated past data and future data (ADB-UNDP, 2011). Further areas to address gaps in adaptation needs within the water sector are in water supply, irrigation, and flood and erosion control; outlined in Table 6.

Gaps to Sustainable Agriculture Production

Perhaps within the agriculture sector is where significant challenges to climate change adaptation are, 1) due to the biological nature of the 'product', 2) the complexity of technical innovation needed (both on and off farm), and 3) the needed integration of other sectors to support agricultural production, e.g. water and natural resources. Table 7 demonstrates these challenges in the context of need knowledge to fill adaptation knowledge gaps to meet sustainable agriculture production in a climate change context.

Noted in the Oil Palm sub-sector, efficient drainage systems are required to regulate water table depth and prevent floods. In water stressed regions, there should be sufficient irrigation facilities, particularly during crop establishment. In addition, breeding programmes are needed to develop new varieties with high Water Use Efficiency (WUE) traits and drought tolerance,

Table 6 Priority action areas to address gaps in adaptation needs and capacities within the water sector to achieve effective water resource management in a climate change context (NRE, 2011).

Priority Areas	Priority Adaptation Needs
Water Supply	<p>The development of efficient water harvesting techniques for water conservation, e.g. increase reservoir capacity/ storage and distribution efficiency, e.g. removal of sediment from reservoirs and dams and eliminating losses from leakage;</p> <p>Promote demand management practices to reduce per-capita consumption of potable water by industrial, commercial and residential consumers, e.g. awareness raising, reducing wastage through behavioral changes and encouraging water harvesting for non-potable uses;</p> <p>Promotion of demand management practices to improve the efficiency of irrigation and other water uses that rely on non-potable sources such as rainfall and groundwater.</p> <p>Improving management of water resources by incorporating weather forecasting data into a Decision Support System (DSS).</p>
Irrigation Efficiency	<p>To develop good water harvesting techniques for the projected low rainfall periods especially during main seasons (increase irrigation supply capacity and storages); and</p> <p>Rainwater harvesting, soil-water management and drainage improvement should be strengthened.</p>
Flood and Erosion	<p>Update of historical records and the incorporation future hydro-climate projections in flood management and design;</p> <p>Review flood management plans and assess integrity of existing structures particularly where failure could result in loss of life (e.g. dams and large barrages).</p> <p>Review design standards for flood risk management in all new infrastructure including water control structures, e.g. drainage systems, transportation structures and electrical, water and waste amenities to incorporate climate change factors and</p> <p>The complement structural approaches with non-structural approaches such as improved rainfall and flood forecasting, disaster warning systems and flood hazard mapping as part of a coordinated disaster prevention and management plan.</p>

Table 7 Knowledge to fill adaptation knowledge gaps to meets sustainable agriculture production in a climate change context (Quasem A.A., and C., Siwar, 2009).

Priority Areas	Integrated Priority Adaptation Needs
Agriculture Technological Developments	<p>Resource management innovations, e.g. e.g. water management innovation, irrigation, and farm level resource management to address risk of moisture deficiency;</p> <p>Crop development of varieties tolerant to changing climatic conditions; and</p> <p>Weather and climate information systems, e.g. early warning system, daily and seasonal weather forecasts.</p>
Government programming	<p>Agricultural subsidy and support programs, e.g. modified subsidies and insurance programs related to climate related loss of crop yields;</p> <p>Resource management programs, e.g. water resource use and management strategies responsive and adaptive in nature to changing climatic conditions.</p>
Farm production practice	<p>Development of innovative farm production practices, i.e. diversification of crop types and varieties, land use pattern, and irrigation etc., constituting changes in farm operational practices</p> <p>Development of crop type and varieties to suit/ tolerate climatic variation, e.g. rainfall and storm intensity variations;</p> <p>Land use adaptation, e.g. changing of farm locations to match production needs and or risk reduction factors to sustain production levels;</p> <p>Irrigation practices and technology to address moisture deficiencies; and</p> <p>Adaptation in the timing of farm operations to address changing durations/seasons.</p>
Farm financial management	<p>Framer farm financial adaptations, e.g. crop insurance, crop shares and futures, income stabilization programs, and household income;</p> <p>Private and government supported farm financial adaptations, e.g. incentive programs to influence farm financial management decisions that focus on climate change adaptation needs, and or adaptation needs through climate change mitigation strategies, e.g. no-till practices that reduce GHG emissions and aid in the recharge of localized ground water levels.</p>

i.e. a significant and questionable biological challenge. This also holds true for the Rice sub-sector wherein current rice varieties such as MR219 and MR232 can only be cultivated under moderate conditions. Research is needed to develop additional rice varieties that, again, are tolerant to floods, droughts and extreme temperatures. Given the Rubber sub-sector, biologically the plant can handle expected climate change impacts within the range of +1Co to +2 Co , however, lengthy rainfall periods could hamper rubber tapping; instituting the need to enhance the use of Low Intensity Tapping Systems (LITS) and the use of rain-gutters country wide. Considering the Cocoa sub-sector, again, like oil palm and rice, breeding programmes are needed to develop drought, flood and disease tolerant clones (NRE, 2011).

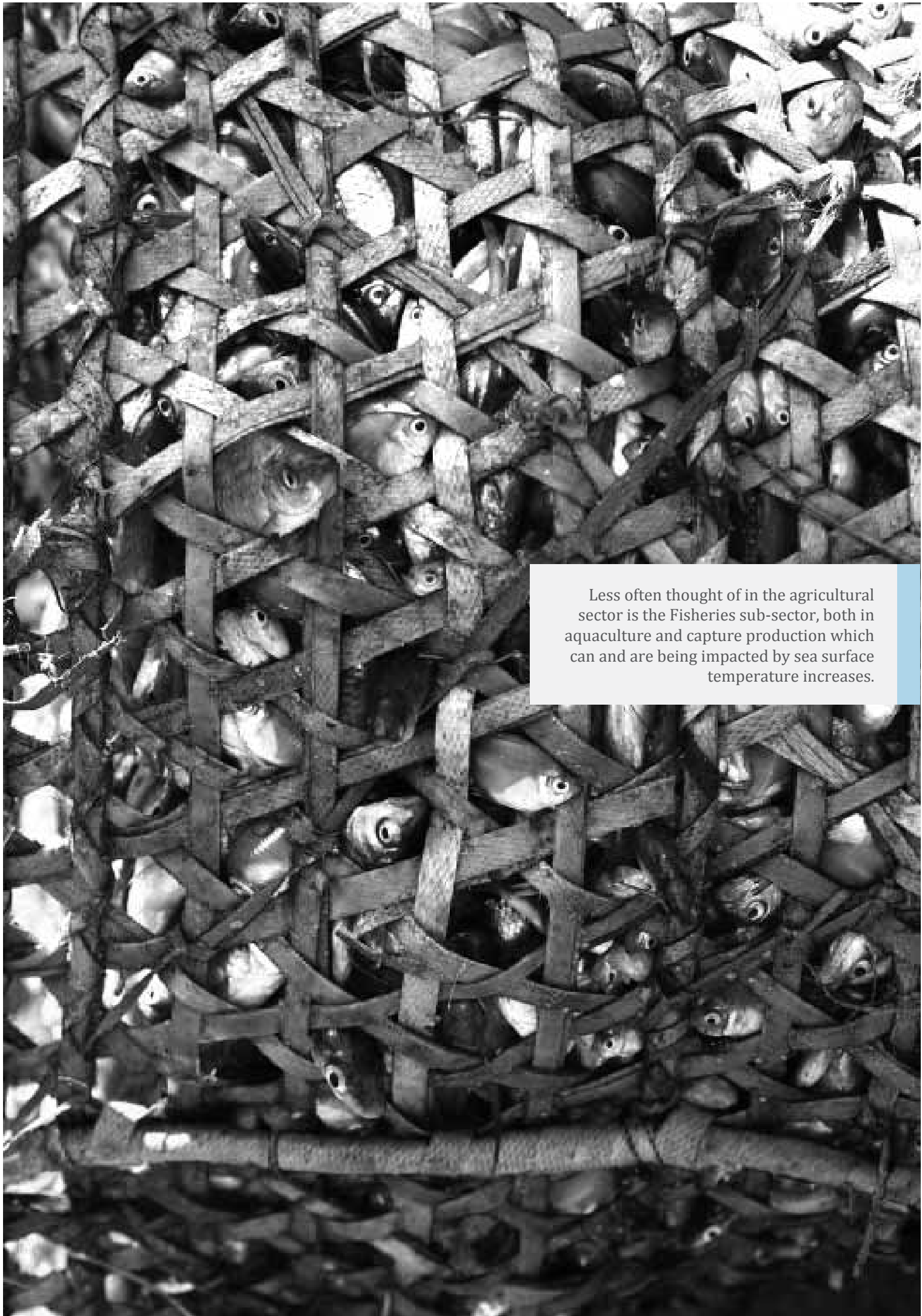
Less often thought of in the agricultural sector is the Fisheries sub-sector, both in aquaculture and capture production which can and are being impacted by sea surface temperature increases. Noted within Malaysia's Second National Communication to the UNFCCC, research is required on adaptation and recovery mechanisms of coral beds to enable appropriate measures to be undertaken. Although artificial reef creation can be considered as a response measure, strongly noted is that such should be studied in greater detail and resorted to only as a last resort to maintaining and rehabilitating natural coral beds. This follows on to knowledge and action related capacity gap recommendations noted by the Third World Network, Malaysia, respective of 'ecological responsible agriculture' and climate change mitigation and adaptation:

- Research on the adaptation and mitigation options provided by ecological agriculture⁶, taking into account context and location specificities such as soil types, crop types, management practices and climate conditions;
- Knowledge management arrangements for the sharing of information and experiences, transfer of and training in good practices that constitute adaptation and mitigation in ecological agriculture, including that through extension services;
- Development and implementation of adaptation and mitigation action plans for agriculture, focusing in particular on ecological agriculture; and
- Institutionalization of financing assistance for adaptation and mitigation measures in the agriculture sector, especially if the 'chosen action' incorporates ecological agriculture practices (TWN, 2011).

Gaps to Enhanced Public Safety and Wellbeing

Public safety and wellbeing is often equated with Disaster Risk Reduction (DRR), actions to reduce peoples' vulnerability to climate change impacts, either by taking adaptive actions to prevention the impact - avoid, to mitigation of the impact - lessen, and or preparedness - being ready to deal with pending losses from the impact. Subsequently, this brings forth a Kaleidoscope of questions, e.g. what is the status of critical infrastructure in Malaysia; how vulnerable are roads, railways, dams, ports, airports, water supplies, and wastewater treatment; how will changes in precipitation alter groundwater levels and pore-pressure conditions, can stability be expected to deteriorate in sloping weak rock terrain, and where would the deterioration be substantial? (Pereira, J.J., and I., Komoo, Undated). Under any circumstance, this list would seem very limited, yet these and others need to be known, the answers found, and needed actions incorporated and acted upon in a national adaptation action plan. One key challenge to this,

6 Ecological Agriculture: Incorporates a process foundation based on natural sciences with an emphasis on the application of ecological principles to the production of horticultural or agronomic crops, e.g. soils, plant pathology, entomology, and integrated farm management systems.



Less often thought of in the agricultural sector is the Fisheries sub-sector, both in aquaculture and capture production which can and are being impacted by sea surface temperature increases.

as reported, is a lack of political-will and buy-in at the highest executive level (ADB-UNDP, 2011). Noted by Mercy Malaysia, an NGO involved in the building of capacity on Disaster Risk Reduction, several challenges, if not barriers to progress to the realization of the Hyogo Framework for Action in Malaysia is as follows:

- Lack of awareness among policy makers about climate change impacts and their economic and social implications in each sector;
- Institutional fragmentation and resulting communication barriers among the many ministries involved in vulnerability and adaptation assessment, disaster risk management, urban and rural development, poverty alleviation, and land-use regulation; and the
- Lack of “ownership” of an adaptive approach to future risks (Izumi, T., 2010).

Additionally, from various forms of literature, a common set of practical actions to reduce vulnerability to natural hazards and adapt to climate change can be noted and of issue is the bringing of actions to scale across Malaysia:

- Promoting a culture of climate change impact prevention and resilience building;
- Identifying local level risks through participatory risk mapping and hazard and vulnerability assessments;
- Develop of multi-facet early warning systems to local contexts;
- Building of hazard-resistant structures, prioritizing critical infrastructure such as schools and hospitals;
- Protection and enhancement of natural hazard buffers, e.g. barrier forests, reefs, mangroves ecological systems; and the
- Integration within local governance and development planning improve prevention, mitigation, and preparedness response, and the development of pre-disaster recovery plans.

In line with public safety and wellbeing, community health in a climate change context brings ‘disease’ to the forefront of discourse, e.g. efficient communicable disease outbreak investigation and management. Noted in a previous section, Malaysia’s Crisis Preparedness and Response Centre (CPRC) was established to monitor outbreaks and to initiate and coordinate responses. Additionally, the establishment of the Centre for Communicable Diseases (CDC) further enhances Malaysia’s disease surveillance and epidemiological investigation capacities and provides the much-needed advanced laboratory support for efficient and effective communicable disease outbreak investigation and management. Yet, as with most Southeast Asian countries, increasing incidences of Malaria is of grave concern to many as climate variations and extremes become more prevalent. Given the current status of Malaria in Malaysia, ‘climate change adaptation’ should give way for an increased emphasis on entomological surveillance with the recruitment of entomologists at the district level.

The absence of relevant research in Malaysia was identified in 2009 by the Commonwealth Secretariat, as a challenge to responding effectively to climate change and health related issues; as simple as the need to conduct risk assessments, to the collection of baseline data and information on the possible impacts of climate change on health, to the monitor the impacts of climate change on health. Each of the aforementioned is important to

providing scientific evidence to guide policy development in the sector. From the Commonwealth Secretariat, the following recommendations to fill capacity gaps have been made (Commonwealth Secretariat, 2009).

- Climate change must be included as an important driver of malaria;
- Vulnerability mapping should be carried out to identify areas that malaria is likely to invade as the climate changes;
- Climate data should be used in identifying vulnerable areas;
- Entomological and parasitological surveillance should be undertaken in vulnerable areas;
- Research on integrated malaria control should be enhanced with the intent of developing cost effective malaria control strategies;
- New entomological studies on the effects of climate change on malaria vectors should be initiated; and
- Early interventions in newly malaria-colonized areas should be encouraged.

Further recommendations to address adaptation gaps to enhanced public safety and wellbeing from an integrated perspective are offered by stakeholders involved in the development of Malaysia's Second National Communication to the UNFCCC (NRE, 2011):

- Modeling climate change: capacity to better adapt, develop and run a climate model to generate relevant and localized scenarios;
- Food sufficiency: stress on food production due to anticipated rise in temperature and prolonged periods of drought;
- Data availability and quality, e.g. currently dengue data is available only for 1997 to 2004, as well missing data, double entry and wrong zoning of dengue cases has been noted;
- Knowledge of the differences in diagnostic methods and reporting systems, e.g. meteorological knowledge vs. disease transmission dynamics; and
- A need for further data and research on potential health impacts of climate Change.

Gaps in Policy and Governance Processes to Build Climate Resiliency

In previous sections within this scoping study, policy and governance gaps has been itemized in context, and for the most part addressed most recently in the National Policy on Climate Change. It would not be fair, nor appropriate at this point to say 'gaps' lay within the implementation of adaptation policies for the largest and most evident gap is the absence of a climate change adaptation strategy wherein policies developed and those under refinement/ development are further expressed and move towards actions. Noted is that the multi-stakeholder participatory workshop associated with this scoping study, was used to outline a plausible 'Climate Change Adaptation Capacity Development Strategy' to be considered in the official development of Malaysia's climate change adaptation strategy (see Section 6.0). Conversely, perception interviews have also highlighted the nature of applicable policies developed and being developed... 'Not much different than past policy development efforts... the same emphasis on GHG emissions reduction... the addition in spelling of climate change adaptation inserted.'

With criticisms aside, peripheral capacity gaps do exist, many of which stem from gaps in policy and governance processes on the ground. For example,

adherence to best practices to minimize environmental degradation and natural resources exploitation as strategized in the objectives of the 9th Malaysia Plan and the National Environmental Policy. Respective of the agriculture sector, the Third National Agricultural Policy makes no references to climate change threats and to the necessity of adaptation. Regarding rice crops, drought and flood resistant varieties need to be introduced; yet the state of policy and governance support for this remains unclear... clear is the need to generate crop varieties with improved water-use efficiency suited to production with reduced water inputs. Noted in 2008, there were uncertainties raised around extent of climate change, for example the magnitude of the change, and concerns over the technology available to adapted, e.g. crop and pest responses, to more general questions such as what the adaptation measures are/ should be, to a lack of supporting policies and methods of assessment to base such on (Abdullah, M. Y., (2008). This is still valid today.

Linking to the aforementioned, the convergence of disaster and climate change management still lacks mainstreaming into national policies, programmes and plans as both cross-sectoral issues and climate change adaptation needs to be address. Although the institutional capacity in the country is capable of managing disasters, there is still much room for improvement. The existing mechanism for stakeholder consultation is said to be insufficient and requires enhancement, as it is both the responsibility of government and the community in dealing with issues pertaining to disasters.

In relation to governance, noted is that in order to be effective, national policies must be adopted and implemented by the state authorities without amendments, i.e. sound planning can still fail in the absence of enforcement at the operational level. Thus, plans made at the national level need to be implemented effectively at the local level without any political interference. Furthermore, the roles and responsibilities of all stakeholders should be clarified and participation of industry players in addressing climate change should be enhanced (AIT-UNEP, 2010). Perception interviews have also expressed the aforementioned as a significant challenge to overcome within the states of Sabah and Sarawak. This challenge is underlined in part by the lack of insufficient technical expertise and financial limitations of local authorities.

Processes to build climate resiliency in many ways is a matter of how well cross sector adaptation occurs.

Processes to build climate resiliency in many ways is a matter of how well cross sector adaptation occurs. Each sector has some degree of dependency on other sectors. All sectors, for example, are dependent on water resources; therefore processes to adaptation policies and governance options cannot be limited to just within sector initiatives, e.g. increased irrigation

water efficiency as a policy and governance issue in the agriculture sector should also allow for more available water for domestic use. This may be a simple win-win example, yet, as Malaysia takes the stance of seeing climate change adaptation as a co-benefit to climate change mitigation, and that of the development of 'no-regret scenarios', action on the ground could slow, if not stall, particularly towards selecting and implementing appropriate adaptation measures and reducing current climate change vulnerabilities. The following recommendations have been culled from previous sections in the scoping study and should be considered a matter of urgency to support ongoing policy and governance processes aimed at building climate resiliency:

- Development of a formal vulnerability and adaptation (V&A) capacity building programme implemented immediately for all sectors and including financial, economic and social fields;
- An integrated V&A programme for all sectors based on a regional and or eco-system based approach. This programme should also include an integration of data and information collected for sharing between all sectors;
- Within sector V&A initiatives, public participation emphasized in Disaster Risk Reduction and management initiatives;
- Strategic review of relevant laws, rules, regulations, policies and plans, a) to strengthen efforts to address climate change issues, and b) to encourage adaptation measures; and
- Affirmative climate change adaptation programmes - all sectors - and integrated into each sectors the five-year development plans.



CLIMATE CHANGE ADAPTATION CAPACITY DEVELOPMENT STRATEGY

Building from the identified knowledge and action capacity gaps in the previous section; this section brings forward priority capacity development climate change adaptation needs, defined through the collective efforts of a multitude of stakeholders. Prioritized are four (4) thematic areas: Environmental stability, Agriculture production, Public safety and wellbeing – split into sub-areas of Disaster Risk Reduction and health, and lastly, Policy and governance. Note that the water resource management sector has been left out, i.e. noting its advanced development on adaptation knowledge and action, the other sectors mentioned were prioritized for further clarification, investigation, and action planning.

Environmental Sustainability

Two specific knowledge building priorities have been identified, 1) building capacity on assessing and evaluating climate vulnerabilities for climate change adaptation responses; and 2) defining the economics of climate change adaptation to support, if not promote, climate change adaptation actions. As a backdrop to the aforementioned, the NC2, and a preparatory workshop and investigative project both entitled the 'Economics of Climate Change in Malaysia' has been initiated by the United Nations Development Programme, Malaysia. Yet to be addressed are the following knowledge development/ capacity needs:

- Environmental economics on payment for environmental services – research to develop the understanding of and associated framework for assessment to be incorporated within vulnerability assessments/ models;
- Limitations of ecological and biological sustainability/ stability under climate change
- Climatology: Enhancements on micro and macro scales to improve the understanding of climate vulnerabilities and impacts, and on how assessments should reflect these 'new' understandings;
- Research on sectors vulnerable to climate change (water, transport, agriculture) and energy (dam-catchment areas) – and the identification of adaptation needs;

- Cost-benefit analysis (Benefit: economic evaluation of ecosystems and services) vis-à-vis vulnerabilities and costs associated with losses expected; and
- Ecological resilience and land use studies – identification of costs and benefits to rehabilitation, and or adaptation into other land uses i.e. options vs. resilience gained in holistic terms, e.g. economics, human safety, food security, shoreline stabilization, infrastructure protection etc.

Noted as those identified to develop the aforementioned knowledge bases are the ‘usual suspects’, e.g. academia, consultants, government and financial agencies and institutions, but with the addition of the NGO sector which may pose challenges associated with acceptance and relevance of the research/ knowledge developed given that Malaysia has the tendency to prioritize academic derived research over experiential learning in which the NGO sector strengths and valued contributions emanate from. Also identified within the given set of the users of the knowledge to be developed are the generators themselves, with the addition of the private sector and communities; both needing and wanting to take advantage of the opportunities that adaptation knowledge and actions can bring forward. Challenges, if not barriers, to the development an use of the given knowledge lies with how the knowledge is to be developed and presented, i.e. given the stakeholder spread and multiple use needs, often noted within the various components of this study are the differences in perceptions and language used – one not being akin to the other.

Strategy for knowledge development

The strategy needed for knowledge priorities listed is NOT to spur one-off research papers given that what has been outlined in research suggested, many parameter are to be assessed/ researched. Thus, under recommendation is to set the foundation of ‘applied research’ by:

- a. Promoting the development of courses in ecological economics within existing universities/ research profiles; and;
- b. Setting up a school of ecological economics.

The aforementioned can be facilitated through the National Professors Council, and the Higher Education Ministry. In support of these ‘actions’ and pending research outputs, recommended is the development of an information sharing & dissemination platform (both physical & virtual). A virtual data base will require that stakeholders and users have free access to data and government reports – thus, such will need the support of relevant ministries to populate the ‘one-stop-shop’. Noted is that My Climate, the MOSTI, and the NRE Ministry could champion this effort together – including physical/ annual public stakeholder reviews. Additionally, to support research and knowledge sharing needs, to be establish/ broadened is a National Register on biodiversity in which data can be held within the proposed ‘platform’.

Agriculture Production

The key knowledge gap to be addressed in reference to the agriculture sector in Malaysia is in support of appropriate ecological agricultural planning and implementation. Noteworthy, the aforementioned is to be done in concert with GHG emission reduction actions as the leading thrust, i.e. adaptation is seen as a co-benefit to implementing GHG reduction technologies within

the sector. If referencing the IPCC report of 2007, the agricultural sector is generally responsible for 13.5% of the global GHG emissions. Hence, the sector has good potential for GHG reductions as well as great adaptation needs (IPCC, 2007), yet little has been done in the sector by way of supporting climate change adaptation needs other than informal and ad-hoc initiatives by individuals, NGOs, and farmers, i.e. noting limited governmental support to introduce and mainstream ecological agricultural practices from the Department of Agriculture. To bring and support together the development of climate change adaptation action and implementation initiatives in the sector, the following has been recommended:

- Localized research and programmatic extension efforts for and in the development of innovation and the sharing of 'best practices';
- Research in the context of 'Fair Trade' to promote ecological agriculture and small rural farm holders; and
- The development of networks and platforms for knowledge transfer between governance, intermediaries, and community entities – including the private sector.

Identified is a wide range of actors to be involved in developing the appropriate knowledge to promote effective ecological agriculture aligned to climate change adaptation: e.g. Local communities; Academics – particularly UPM, MARDI, and the Department of Agriculture; the private sector and NGOs... each as knowledge developers and users. To support knowledge development and use efforts, recommended is the development of an 'ecological agriculture' stakeholders' directory to compensate for challenges in finding/ connecting to needed expertise.

Strategy for knowledge development

The thrust of the strategy put forth in the multi-stakeholder workshop recommended strongly to harness a bottom up approach to creating awareness and fundamental research to advocate, and gain support and acceptance from linked sectors, e.g. health, food security and safety, natural resource management, to rural economic development, and a harness a top down approach to garner policy and financial support for:

- a) Increasing awareness:
 - Developing an alternative mindset/ approach to food production;
 - Education – formal & informal approaches and practices to ecological agriculture – multi-level (to be backed by research noted below); and
 - Movements – stimulated through video screening.
 - Increasing economic viability:
 - Action research on the benefits and profitability of ecological agriculture;
 - Research on market entry points and profitability of using alternative commercial farm spaces for ecological agriculture; and
- b) Policy & financial support (top to bottom approach):
 - Research on governance incentives (possibly a tiered certification system) and disincentives; and
 - Action Point: Reprioritization within the National Agriculture Policy, possibly leading to reprioritization as elements of ecology, sustainability, and climate change are integrated.

Table 8 Proposed action plan for climate change adaptation actions in consideration of environmental sustainability.

Indicative 1 – 3 Year Time Table for Action	Indicative Costing	Barriers to Progress
Year 1 (a): Promote courses in ecological economics within existing universities/ research profiles;	Profile design and promotion workshops – 3 of at 10,000USD each.	Financial and human resource availability; Changing the culture of academic research to a more practical and experiential mode, i.e. financial institutions, ecologists, and academics often do not speak the same language; Agreements in access and transparency of inter-government data; and Data gaps early on within the data based may hinder the perceived value of the effort.
Year 1 (c): Establishment of the platform and database;	Platform establishment workshops – 2 of at 7,000USD each; platform database establishment – initial 35,000 + 8,000USD/ year for maintain operations and population of the database.	
Year 1 (d): National Register; and	Bio-diversity fairs in relevant zones throughout the country – 15 of at 6,000USD each = 75,000USD (Note that the register can be incorporated in the ‘virtual’ database as part of the platform.	
Year 1-3 (b).	Unknown cost but such should be provided through academic/ university expansion funds.	

Table 9 Proposed action plan for climate change adaptation actions in consideration of agriculture production.

Indicative 1 – 3 Year Time Table for Action	Indicative Costing	Barriers to Progress
Year 1: Increasing awareness: a) Education – formal & informal approaches and practices to ecological agriculture – multi-level (to be backed by research noted below); b) Developing an alternative mindset/ approach to food production; and c) Movements – stimulated through video screening.	Preparation of ecological modules to be incorporated into school learning materials: Piloting – 25,000USD (10 schools – school counter part for testing) Advocacy campaign (B and C): 20,000USD	- Resistance to change (fear); - Funding priorities; and - Knowledge transfer.
Year 1: Increasing economic viability: d) Action research on the benefits and profitability of ecological agriculture; and e) Research on market entry points and profitability of using alternative commercial farm spaces for ecological agriculture.	Demonstration: 2,000USD/ farm group Research: 10,000USD	
Year 2-3: Policy & financial support: f) Research on governance incentives (possibly a tiered certification system) and disincentives; and g) Action Point: Redesigning of the National Agriculture Policy (reprioritization) to include integrated elements: ecology, sustainability, and climate change.	Research: 10,000USD Public study and consultation for possibilities: 65,000USD – for redesigning scoping study, 3 regional public consultative workshops, and 1 internal planning workshop.	
To Do: Electronic stakeholder directory	Initial: 10,000USD/ 1-2 year period	

Public Safety and Wellbeing

In relation to public safety and wellbeing, a Disaster Risk Reduction framework is used in light of climate change adaptation. Of priority, knowledge building needs are two-fold; the first dealing with localized public safety vulnerability and disaster risk reduction identification, and the second; health risk and vulnerability Identification. Currently, seasonal weather and climate related calendars have been developed, and risk/hazard, vulnerability assessments, and risk reduction assessments; all done at the national level primarily within areas where disasters have been experienced. And, to a far lesser extent, some Disaster Risk Reduction studies have been conducted respective of people living with visible disability.

Localized public safety

Despite the aforementioned efforts, of priority are knowledge based needs to further identify public safety vulnerabilities, i.e. assessment backstopping needs and delivery processes locally:

- Localized information related to climate hazard risks and associated vulnerability mapping;
- Research on the development (needed parameters), and deliver of vulnerability assessments (including facilitation knowledge) by local level researchers/ facilitators; and
- An understanding of local government (top-down) process and procedures for cross sector and vertical collaboration for the delivery of risk reduction responses.

Strategy for knowledge development

Although information/ knowledge capacities are in place to conduct localized assessments, noted are still 'nuances' to these that need to be considered, e.g. cross sector integration. Thus, a participatory feedback and review process will need to be developed to standardize given assessments, e.g. from field trails to consultation workshops. In parallel, awareness raising and sensitization efforts for national to local government actors, to community level participants will be needed to ensure that assessments are contextualized, understood and eventually moved towards the acceptance of a Standard Operational Procedure (SOP). Noted have been four probable steps to the participatory building of a UNIFIED SOP:

1. Comprehensive awareness building campaign;
2. Knowledge development and framework assessment workshop;
3. Field testing and feedback processes; and
4. Mainstreaming / institutionalization of the participatory assessment and planning process at the provincial level as a SOP.

For a UNIFIED SOP to be realized, required are researchers, from universities to institutes, to facilitate the needed integration purpose of assessments appropriately. Subsequently, these actors would be required to work with/ consult relevant civil society actors to ensure that any assessment designed can be delivered by local facilitators and health officials with integrity. The aforementioned process should be underlined, given that the primary uses of the 'knowledge' developed are stakeholders with varied skill levels, e.g. State to local government units to local civil society based organization, self-help groups, and communities. Derived information must also be understandable to development bilaterals, and international and national non-government organizations supporting actions related to the proposed UNIFIED SOP.

Table 10 Proposed Action plan for climate change adaptation action in consideration of localized public safety.

Indicative 1 – 3 Year Time Table for Action	Indicative Costing	Barriers to Progress
Year 1: Comprehensive awareness building campaign – CBDRR (Key State and local government levels);	State level – 15,000USD/ event Local government – 6,000USD/ event School and community – 3,000USD/ event	Participation by relevant actors and acceptance of local level participatory processes – from investigation to belief in the relevance of data to be used for action planning and the investment of resources into participatory action plan implementations.
Year 1: Knowledge development and framework assessment development workshop;	Workshops – 10,000USD	
Year 2: Field testing and feedback processes (schools to vulnerable / marginalized communities; and	Multiple testing – 6x = 15,000USD plus event costing	
Year 3: Mainstreaming / institutionalization of the participatory assessment and planning process at the level of 'province' – continuous assessment and action.	Undetermined	

Table 11 Proposed Action plan for integrating Disaster Risk Reduction in Local Governance & Development and Planning.

Indicative 1 – 3 Year Time Table for Action	Indicative Costing	Barriers to Progress
Pilot interventions: Year 1: Local awareness raising on proactive DRR - prevention, mitigation and preparedness processes and responses/ climate change adaptation;	Based on 6 high vulnerability locations: Development and delivery – 15,000USD	None perceived other than funding availability.
Year 2: Development of localized platforms for discussing and sharing of DRR knowledge/ experiences (Note that it is highly plausible that this action could suffice as a mechanism for the full scope of DRR collaboration between CSOs and relevant government entities; and	Facilitation: 10,000USD, with in-kind contributions from each pilot areas, e.g. venue, human resources etc.	
Year 2-3: Depending on hazard experiences, a study amongst pilot sites on the economics of DRR and rural development.	Evaluation study – 15,000USD	

Also identified in this sub-section as an ACTION POINT in reference to the integration of DRR and climate change adaptation - the UNIFIED SOP - within Local Governance & Development and Planning; required are empirical studies on the economics of Disaster Risk Reduction and rural development to gather support, investment, and institutionalization of the 'newly' developed SOP. To realize in complete form such empirical studies, required will be a field of actors to insure integration and practicality, e.g. from researches to NGOs such as Mercy Malaysia, to Local Development Councils, to pioneers and experts on integrated programming, and importantly the involvement of Malaysia's National Security Council to outline and build the framework for identified studies.

Additional ACTIONS required are identified as:

- Local awareness raising on proactive DRR - prevention, mitigation and preparedness processes and responses/ climate change adaptation;
- Development of localized platforms for discussing and sharing of DRR knowledge/ experiences; and
- The development of a mechanism for full collaboration between civil society and relevant government entities.

Strategy to deliver knowledge-based ACTION capacities

The process must start with the sensitization of communities and local governance entities to the full spectrum of DRR processes. This should be followed by the acceptance and integration of DRR action responses within development planning frameworks – from design to institutionalization. Through piloting, evidence must be brought forwards and publically evaluated as to the costs and benefits of proactive DRR response planning and delivery, i.e. the economics and community wellbeing.

Health risk and vulnerability identification

In consideration of human health directly, noted is room for improvement on the identification of risks and vulnerabilities. For example, yet to be developed is an integrated model health risk and vulnerability model that includes a broader complement of parameters taken in the context of climate change, e.g. socio-economic to ecological implications. This would complement current knowledge building efforts related to impact studies on dengue, malaria, and on food and water-borne diseases on society, and to a lesser extent, efforts made to develop vector models.

Strategy for knowledge development

The key is to create synergistic collaboration across all sectors, beginning with the identification of vulnerability risk reduction needs in 'hot zones' via participatory hazard and vulnerability mapping at the local level. This should be coordinated with awareness building/ training for health, water, and natural resource management professionals, and for policy makers, i.e. creation a solid foundation for an encompassing Integrated River Basin Management, i.e. including health parameters in planning and intervention responses. Noted for all knowledge development needs expressed in this subsection, a 'health – climate change' database will be required to ensure knowledge access and to promote knowledge sharing in a cross sector format. Universities and research institutions, in conjunction with the Ministry of health are said to take the lead in knowledge development. Additionally, communities have been identified as key providers of local knowledge, and NGOs as mediators, e.g. collection and coordinating, given that they are not only knowledge developers, but also the users of such.

Leading from the aforementioned, an ACTION POINT prioritized is the furthering of Malaysia's Integrated Vector Management (IVM) attempts. To date, vector management options in priority areas have been identified, as well as supporting policies and guidelines for vector management; yet to be done for 'full integration are the following:

- Integrating climate change in to IVM as a driver to vector transmission;
- Training and development to increase the quality of current medical staff respective of climate change drivers within the sector;
- Awareness raising to sensitize and enhance stakeholder/ community involvement, e.g. lateral replication of applying Communication for

Table 12 Proposed action plan for climate change adaptation action in consideration of health risk and vulnerability identification.

Indicative 1 – 3 Year Time Table for Action	Indicative Costing	Barriers to Progress
Year 1: Preparation of multipurpose education modules, e.g. school level, to sectoral and ministerial levels:	Development costs: 125,000USD	Resistance to changing the status quo, and funding priorities; and Effectiveness of the knowledge transfer process
Year 1: Strategic review of policy and incentives/ disincentives considered/ integrated into risk reduction assessments as barriers to progress; and	Encompassing multi-level research: 45,000USD	
Year 2-3: Development of assessment framework and 'hot zone' implementations – including data base support.	Framework and implementation: 60,000USD/ year running cost; and data base support	

Table 13 Proposed action plan for climate change adaptation action in consideration of Integrated Vector Management (IVM).

Indicative 1 – 3 Year Time Table for Action	Indicative Costing	Barriers to Progress
Year 1: Research: Linkages between vector transmitted diseases and climate change;	Research: Unknown costs or duration and scope of the research – should be deferred to world health organizations.	Quality of data will have an impact on 1) cost of duration of research, and 2) lack of knowledge base to define linkages – all may lead to a de-prioritization of the key knowledge building activity; Institutional fragmentation within the sector; and Funding availability given other government priorities, i.e. impact may not justify the cost.
Year 1-2: (A) Pilot programme development - Integration of a 'climate change' lens into health sector staff and facilitators;	(A) Pilot programme: 50,000USD to 75,000USD+ depending on the depth and scope of the program; and	
(B) Stakeholder/ community sensitization initiative to lead to the lateral expansion of a COMBI like initiative on a wider scale; and	(B) Pilot programme by province: 25,000USD to 40,000USD+ depending on the depth and scope of the program; and	
Year 3: Enhancement of surveillance/ early warning needs.	Surveillance: To be absorbed within institutional funding for improvements and coverage areas accordingly.	

Behavioral Impact (COMBI) like community surveillance and action programs; and

- Enhancement of surveillance/ early warning needs.

Again, supporting knowledge to the aforementioned 'action' recommendations is ultimately knowing the linkages between vector transmitted diseases and climate change – the how and of possible prevention methods. Identified, the key knowledge developers are relevant universities & research institutions, and the Centers for Disease Control and Prevention. Noted, the use of the knowledge developed goes far beyond that of the Centers for Disease Control and Prevention. Local governance and rural development planning councils, schools, NGOs and community-based organizations to local village based groups and facilitators are said to be the ones to take the knowledge forward and use this to devise and implement vulnerability reduction responses.

Strategy to deliver knowledge-based ACTION capacities

The foundation of the strategy would be based on knowing how vector born diseases are linked to climate change – rather than just knowing

there is a correlation. Hence, any awareness building/ training for health professionals, to policy makers must be based on understanding well the linkage and possible mitigation/ adaptation responses and needs to reduce health vulnerabilities. Ultimately, intervention designs would be based on the cost effectiveness of the needed responses. Also required would be collaboration between research institutions and networks, 1) to complete the needed research and 2) fully understand the cost and effectiveness of interventions. Noted is that such a study and follow on action will require enhanced access to current data and the management of data into the future for surveillance and early warning purposes.

Policy and Governance

As noted in previous sections of this paper, much work has been done respective of climate change policy and governance, particularly in the environment sector, e.g. the development of a National Policy on Climate Change and the National Energy Policy, to various governance initiatives such as Integrated Water Resource Management, and elements of the National Physical Plan. Yet, climate change adaptation does not fully come into these initiatives as an equal attempt in comparison to climate change mitigation efforts. Hence, the noted challenge for the full integration of adaptation is moving the elements mentioned in the National Climate Change Policy, and others, to action. The question is how? Noted in the multi-stakeholder workshop, the following knowledge development initiatives would help move from a position of written policy to action:

- Identification of entry points on how to move policy and information sharing within and between sectors and or established platforms towards implementation;
- Conduct of perception surveys on adaptation needs to understand the various barriers to climate change adaptation and to generate ideas to overcome these;
- Identification of localized adaptation priorities and strategies employed;
- Understanding how local level adaptation can be supported through stakeholder and community engagement; and
- Policy effectiveness studies, e.g. are vulnerabilities being reduced given an implemented policy, and at what cost?

Strategy for knowledge development

To lead in the generation of the aforementioned knowledge needs, highlighted is the involvement of decision-makers and politicians at the local, state and national levels. Also engaging the process, recommended is for the academe, research organizations, and civil society organizations to co-develop and deliver the needed assessment frameworks and investigative processes. In addition to these knowledge 'generators', also users of such, information gathered will also be used by policy makers at all levels, and organizations that implement capacity development programmes, e.g. UNDP, DRR practitioners, and donors at national and international levels.

Turning policy into action is challenging and will require to first have the relevant stakeholders 'buy-in' to an adaptation movement - public, private, and civil society alike; hence, the need to know feasible 'entry points' to move information within and between sectors to encourage the 'buy-in', learning, and action process. Perception surveys would be key to this initiative. Noted is the need for a sensitization process among decision-making stakeholder groups. This will require backing by ministerial leaders within the various

Table 14 Proposed action plan for climate change adaptation action in consideration of policy and governance.

Indicative 1 – 3 Year Time Table for Action	Indicative Costing	Barriers to Progress
Year 1 Knowledge building research: Entry points on how to move policy and information sharing within/ between a sector towards action; Perception surveys; Policy effectiveness studies, e.g. are vulnerabilities being reduced given an implemented policy, and at what cost; and Policy review-based on National Communication findings/ IPCC studies and assessment and vulnerability reports – noting if current actions can effectively address Malaysia’s adaptation needs/ climate change vulnerabilities.	Year 1 research and associated studies/ surveys: 45,000USD	Human and financial resource limitations – both at the national and state level; and Low priority for information sharing/ outreach amongst civil society actors – limited investment of own resources for shared gains; and Culture of knowledge exclusivity.
Year 1 Action Needs: Coordinated lobbying amongst ‘climate change’ working groups for the ‘buy-in’; and Climate Change Adaptation Platform (CCAP) establishment – structuring and inception.	Lobbying support – information material support: 10,000USD Platform establishment and inception conference: 60,000USD	
Year 2-3 Action Needs Continuation of ‘CCAP’ operations (base on roles and responsibilities defined in year-one, e.g. information campaigns); and Policy effectiveness studies	Costing to be determined Policy studies – as needed: 15,000USD/ study, 3 recommended.	

climate-working groups - knowledge generation, sharing and dissemination as part of their portfolio of responsibilities.

Leading from the aforementioned, two ACTION POINTS have been prioritized, 1) the establishment of an open and participatory national platform for climate change adaptation, and 2) local, state and national awareness and communication efforts – a campaign. A set of operational guidelines for the platform will need to be drafted, complete with roles and responsibilities prior to any form of official structuring and launching. To accomplish this according to needs and cooperation, the Ministry of Natural Resources and Environment, MyCLIMATE, the Malaysia Climate Change Group, the Junior Council of Investment and Sustainable Development, and the Malaysian Youth Climate and Justice Network are a probable group of actors to take the lead. In the Malaysian context, this platform will need to be championed to gaining recognition and cooperation among the various sectors and climate change adaptation actors, and placed within a structure. Although this is undetermined – the office of the president is recommended.



CONCLUDING OBSERVATIONS AND ADAPTATION KNOWLEDGE GENERATION RECOMMENDATIONS

Observations

As mentioned in previous sections, much of Malaysia's efforts in building climate change adaptation knowledge is centered on learning 'what it is' Malaysia is adapting to', i.e. the condition, whereas how to adapt has for the most part taken second stage. Often reiterated by those involved in this study is that how to adapt is a matter of economic efficiency – finding the win-win, no regrets scenario. There is no doubt that Malaysia has the base knowledge and capacity needed to begin mainstreaming climate change adaptation within its development framework, yet, complacency towards real actions on the ground are very evident. This could well be Malaysia's number one challenge in relation to climate change adaptation.

When considering Malaysia's environmental sustainability efforts, which are robust, yet they only address the 'environmental change threat' and not specifically the 'climate change threat'. This is of concern for numerous amphibians, birds, and mammals are living within very climate sensitive habitats, i.e. climate variations may exceed environmental thresholds where habitats and ecosystems could not recover to existing equilibrium and stable conditions. This situation is not unique to Malaysia and a change that many countries will have to accept.

Reflecting a little on the water resources sector in Malaysia, actions within exemplify points of integration and knowledge building, thus setting the direction for national cooperation and problem solving on climate change adaptation – a shared responsibility among the ministries. However, noted is that more could be done, e.g. integration with the health sector respective of vector management. Conversely, considering agricultural, in action towards adaptation is largely driven by the presence of unknown future factors/ knowledge needed to devise climate change adaptation responses economically and efficiently, at the least, prepare the sector for some degree of productivity losses. These unknowns range from understanding the past climate record with confidence, to local policy issues on micro-scales, e.g. rural livelihoods and how 'localized adaptation' CAN be engaged to reduce vulnerabilities respective of small farm holdings – key to food security among the most vulnerable to climate change and climate variability.

Unfortunately, there is no 'magic bullet' for Malaysia, and for some time, expected is that climate change adaptation will remain in a reactive mode rather than proactive. Yes, there are some, but very few, locally based DRR efforts taking proactive measures, e.g. the COMBI project, but when considering DRR efforts, these are focused in areas that have previously experienced hazardous events; leaving much of the country unaware or inactive towards DRR and climate change adaptation needs.

Policymaking for 'climate change adaptation' is heavily dependent upon external assistance, and in many cases, building adaptive capacities involves dealing with uncertainties. For Malaysia, uncertainties have strong implications on both national and local level policy development and governance vis-à-vis action or inaction... how can this be overcome?

Table 15 Overview of key knowledge components to be addressed vis-à-vis climate change adaptation capacity gaps – non-exhaustive.

Priority Areas	Priority Knowledge Component for Development
Environmental Sustainability	<p>Research on storm surges to help establish quantitatively the trends of storm surges and wave patterns therefore facilitating the understanding of long term coastal evolution;</p> <p>Research on coastal reforestation to develop optimal planting methods and the creation of robust coastal forests that can strengthen the stability of coastlines and contribute to biodiversity enhancement;</p> <p>Understanding of ‘incentives’ for States and the private sector to implement initiatives and to comply with national policies and objectives on environmental sustainability in a climate change context;</p> <p>Environmental economics on payment for environmental services – research to develop the understanding of and associated framework for assessment to be incorporated within vulnerability assessments/ models;</p> <p>Limitations of ecological and biological sustainability/ stability under climate change; and</p> <p>Cost-benefit analysis (Benefit: economic evaluation of ecosystems and services) vis-à-vis vulnerabilities and costs associated with losses expected; and</p> <p>Ecological resilience and land use studies – identification of costs and benefits to rehabilitation, and or adaptation into other land uses i.e. options vs. resilience gained in holistic terms, e.g. economics, human safety, food security, shoreline stabilization, infrastructure protection etc.</p>
Water Resource Management	<p>Improved climate impact modeling that would allow for the integration of water resources management with other sector elements, e.g. health vector management, biodiversity, to localized food production; and</p> <p>The development of efficient water harvesting techniques for water conservation, e.g. reservoir and distribution efficiency.</p>
Sustainable agriculture production	<p>Research on the adaptation and mitigation options provided by ecological agriculture, taking into account context and location specificities such as soil types, crop types, management practices and climate conditions;</p> <p>*Understanding localized research and extension for the development and sharing of ‘best practices’;</p> <p>*Research in the context of ‘Fair Trade’ to promote ecological agriculture and small rural farm holders;</p> <p>Networks and platforms for knowledge transfer between governance, intermediaries, and community entities – including the private sector; and</p> <p>Knowledge management arrangements for the sharing of information and experiences, transfer of and training in good practices that constitute adaptation and mitigation in ecological agriculture, including that through extension services.</p>
Public safety and wellbeing	<p>Research on integrated malaria control should be enhanced with the intent of developing cost effective malaria control strategies;</p> <p>Food sufficiency: stress on food production due to anticipated rise in temperature and prolonged periods of drought;</p> <p>Knowledge of the differences in diagnostic methods and reporting systems, e.g. meteorological knowledge vs. disease transmission dynamics;</p> <p>*Localized information related to climate hazard risk and vulnerability mapping - to include localized climate risk reduction/ vulnerability needs assessments;</p> <p>*Research on the development and deliver of such assessments for effectively and efficiency by local level researchers/ facilitators;</p> <p>Integrated modeling information that includes factors of climate change, socio-economic implications, biology, ecology, and human health parameters; and</p> <p>Understanding of local government (top-down) process and procedures for cross sector and vertical collaboration.</p>
Policy and Governance	<p>*Entry points on how to move policy and information sharing within/ between a sector and or established platform towards implementation;</p> <p>*Perception surveys – adaptation needs; barriers to climate change adaptation and ideas to overcome; local adaptation priorities and strategies employed; what are and how can local level adaptation be supported, i.e. stakeholder and community engagement; and</p> <p>*Policy effectiveness studies, e.g. are vulnerabilities being reduced given an implemented policy, and at what cost?</p>
<p>* Include in the Action Plan developed in the stakeholders workshop – non-exhaustive listing.</p>	

Table 16 Overview of key action components to be addressed vis-à-vis climate change adaptation gaps – non-exhaustive.

Priority Areas	Priority Action Point**
Environmental Sustainability	Promote courses in ecological economics within existing universities/ research profiles; Establishment of a platform and database for knowledge exchange; and Development of a National Register on biodiversity.
Sustainable agriculture production	<p>Increasing awareness:</p> <ul style="list-style-type: none"> • Education – formal & informal approaches and practices to ecological agriculture – multi-level; and • Developing an alternative mindset/ approach to food production. <p>Increasing economic viability:</p> <ul style="list-style-type: none"> • Action research on the benefits and profitability of ecological agriculture; and • Research on market entry points and profitability of using alternative commercial farm spaces for ecological agriculture. <p>Policy & financial support:</p> <ul style="list-style-type: none"> • Redesigning of the National Agriculture Policy (reprioritization) to include integrated elements: ecology, sustainability, and climate change.
Public safety and wellbeing	<p>Comprehensive awareness building campaign – Community based DRR (Key State and local government levels);</p> <p>Knowledge development and framework assessment development workshop;</p> <p>Field testing and feedback processes (schools to vulnerable / marginalized communities;</p> <p>Mainstreaming / institutionalization of the participatory assessment and planning process at the level of ‘province’ – continuous assessment and action;</p> <p>Pilot programme development - Integration of a ‘climate change’ lens into health sector staff and facilitators; and</p> <p>Stakeholder/ community sensitization initiative to lead to the lateral expansion of a COMBI like initiative on a wider scale.</p>
Policy and Governance	<p>Coordinated lobbying amongst ‘climate change’ working groups for the ‘buy-in’;</p> <p>Climate Change Adaptation Platform (CCAP) establishment – structuring and inception; and</p> <p>Policy effectiveness studies.</p>

** Include in the Action Plan developed in the stakeholders workshop – non-exhaustive listing.

Adaptation Knowledge Generation Recommendations

This scoping study has identified numerous climate change adaptation capacity gaps, that stated within available literature and numerous knowledge and action based gaps identified during the multi-stakeholder workshop. As a general recap, key priority knowledge capacity gaps to fill are presented in Table 15 and key actions needs in Table 16.

Leading from the aforementioned policy and governance knowledge and action needs noted in Table 15 and 16, and two key previously made statements; ‘complacency towards real actions’ and ‘uncertainties have strong implications on both national and local level policy development and governance vis-à-vis action or inaction’, noted has been a strong need for a climate change adaptation knowledge platform – one that is free from influence and transparent. This holds true for all sector involvements regarding knowledge generation, to sharing, to climate change adaptation action; done in a coordinated manner through a platform with the following roles and responsibilities:

- Connecting stakeholders and knowledge together – linking climate change adaptation expertise, technology and human resources;
- Compelling action on climate change adaptation;
- Driving and guiding advocacy – focusing on issues of climate change adaptation and responses equally and constructively;
- Maintenance of a climate change adaptation knowledge bank;

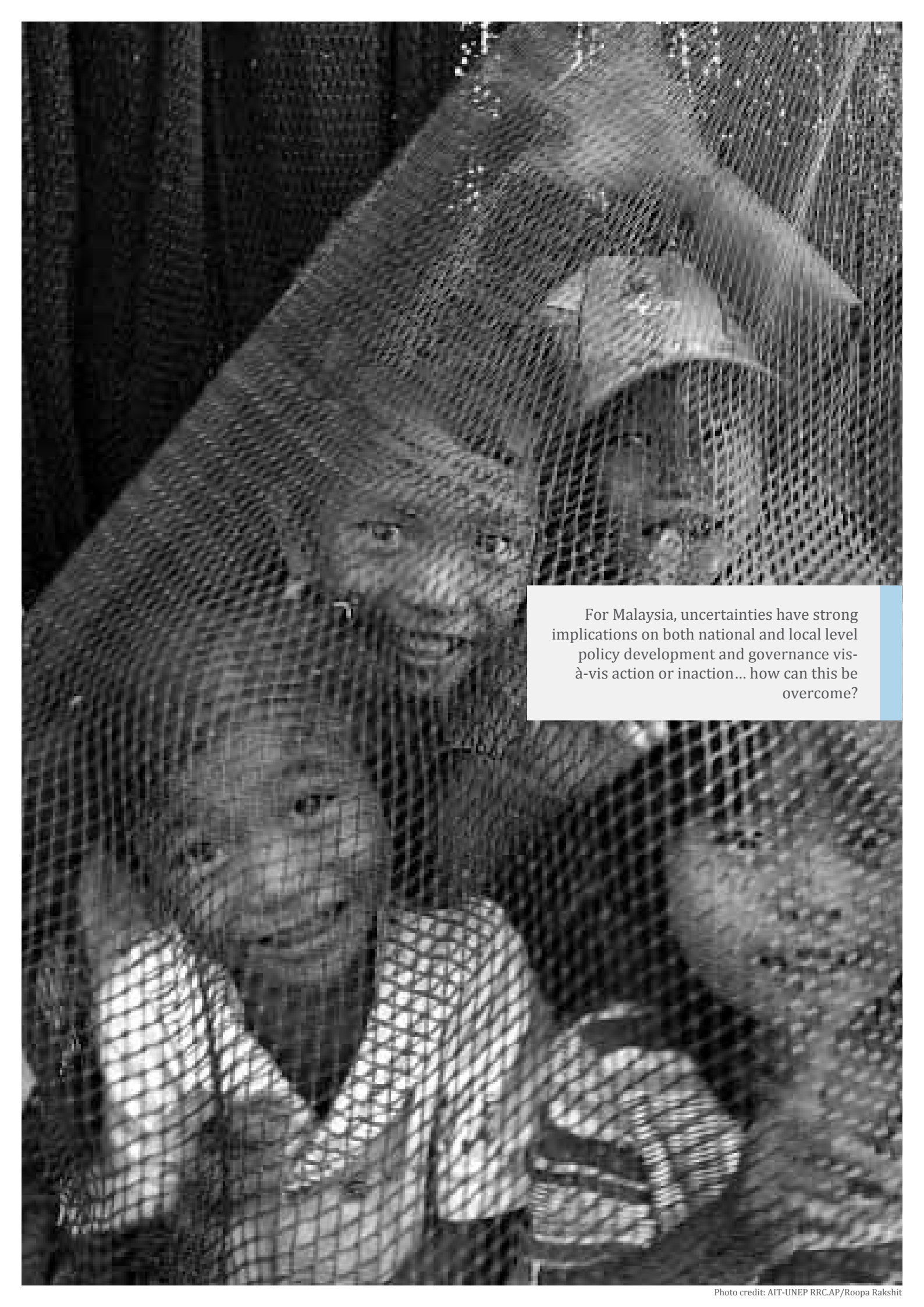
- Forum development aligned to thematic areas and open to all – active forums year round; and
- Noting funding and research opportunities

There has also been the suggestion that the proposed platform be focused on generating learning value above all - avoid redundancy, and encouraging continuity of action. Additionally, strategic users to casual participants in the proposed platform must benefit by way of gaining a common understanding of climate change adaptation, and by way of being empowered to harness opportunities to engaged in response actions from a shared stance.

Operationally, the platform should work through ‘membership’, be self-sustaining, placed outside of a ministry, and facilitated through focal points within a within a secretariat. Noted is that government representation should take on a concerted role as focal points along with others from civil society and the private sector. There should also be key areas within the platform that would create points of integration between the Green Technology Council and climate change technical working groups active in Malaysia.

To accomplish the aforementioned according to needs and cooperation, the Ministry of Natural Resources and Environment, MyCLIMATE, the Malaysia Climate Change Group, the Junior Council of Investment and Sustainable Development, and the Malaysian Youth Climate and Justice Network are a probable and willing group of actors to take the lead in the formation of the platform. In the Malaysian context, this platform will need to be championed to gain recognition and cooperation among the various sectors and climate change adaptation actors, and for its placement within a structure. Although this is undetermined – the Office of the President has been recommended.

Accordingly, stakeholders engaged in this scoping study have outlined a three-year Action Plan to fill knowledge gaps and address points of inaction noted in Section 6.0. It should be underscored that the complete action plan has been tentatively budgeted at just over one million United States Dollars; a small investment for such rich gains to spur focused knowledge generation and sharing, and action towards sustained climate change adaptation.



For Malaysia, uncertainties have strong implications on both national and local level policy development and governance vis-à-vis action or inaction... how can this be overcome?

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