CLIMATE CHANGE

Noor Haslizawati Abu Bakar
Farahiyah Ilyana Jamaludin

Malaysia


Arctic Ocean
©GraphicMaps.com
ARCTIC CIRCLE
66°30'N
ASIA
EUROPE
Black Sea
Caspian Sea
Aral Sea
Med. Sea
MIDDLE EAST
TROPIC OF CANCER
23°5'N
Red Sea
Arabian Sea
Bay of Bengal
Malaysia
Pacific Ocean
OCEANIA
AFRICA
Gulf of Aden
0°
EQUATOR
Indian Ocean
TROPIC OF CAPRICORN
23°5'S
AUSTRALIA
1500 mi
1500 km
worldatlas

Malaysia

- Is a tropical country consists 2 land masses (West and East).
- West Malaysia: 11 states, East Malaysia: 2 states
- **Total Area**: 330,803 km²
- **Population**: 31.265 million (2016)

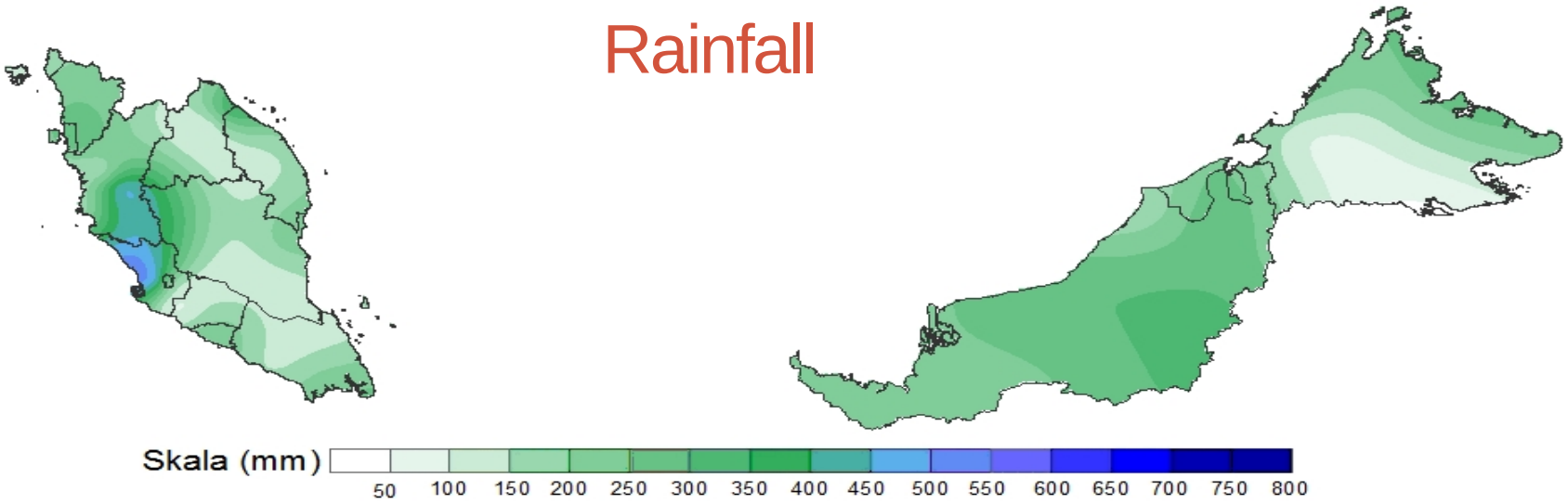
Malaysia climate

- ✓ Tropical country – located near the Equator
- ✓Hot & humid throughout the year
- ✓ High humidity – over 80%
- ✓ Average rainfall around 250 cm/year
- ✓ Average temperature is between 21 – 32 °C
- ✓ In Highland area temperature is between 14 – 24 °C



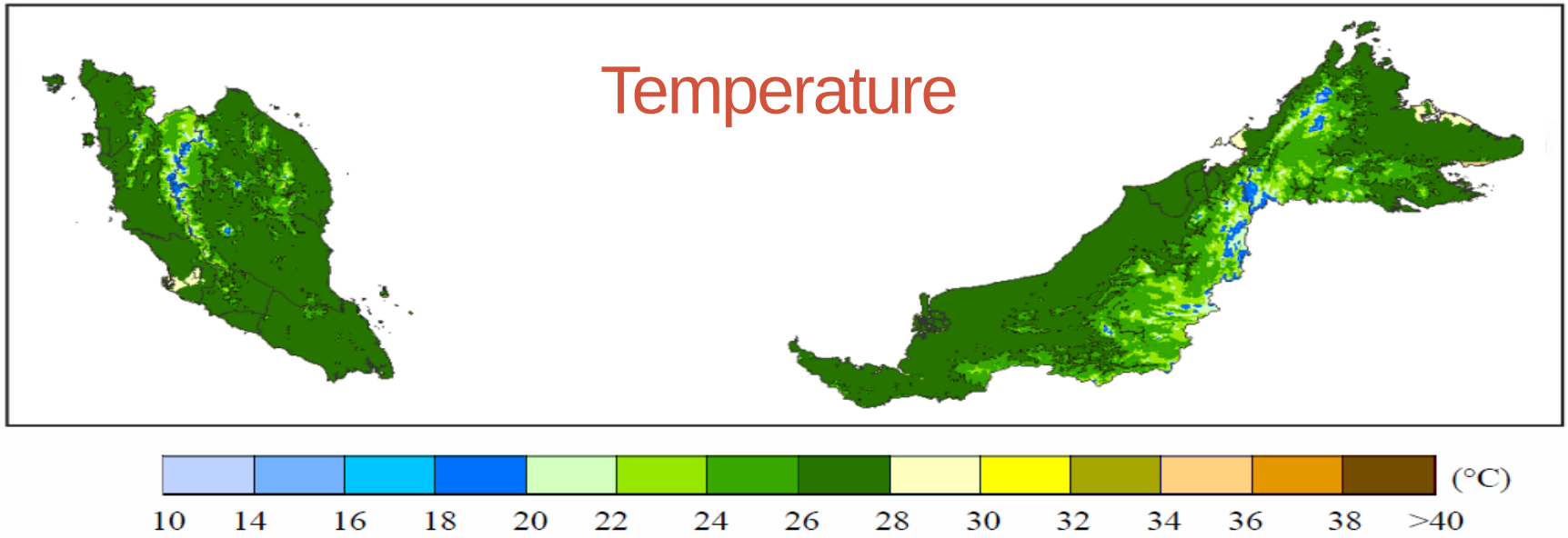


Rainfall



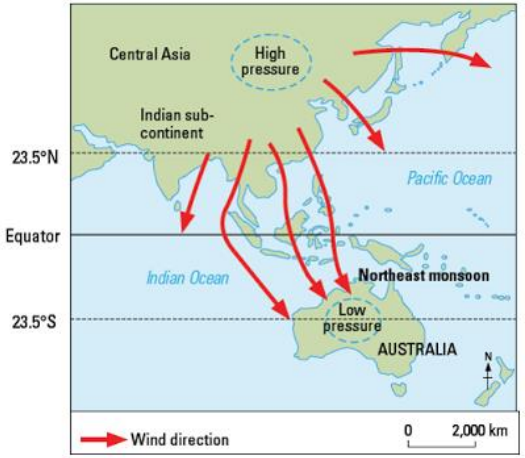
RAJAH 2A : PURATA SUHU BULANAN (°C)

Temperature

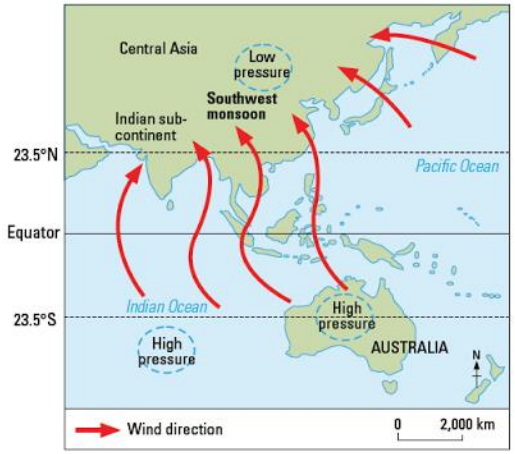


Malaysia faces 2 monsoon wind season:

- The Southwest Monsoon
  - End of May to September
  - Originating in China and North Pacific



- The Northeast Monsoon
  - November to March
  - Originates from deserts of Australia



Agriculture in Malaysia

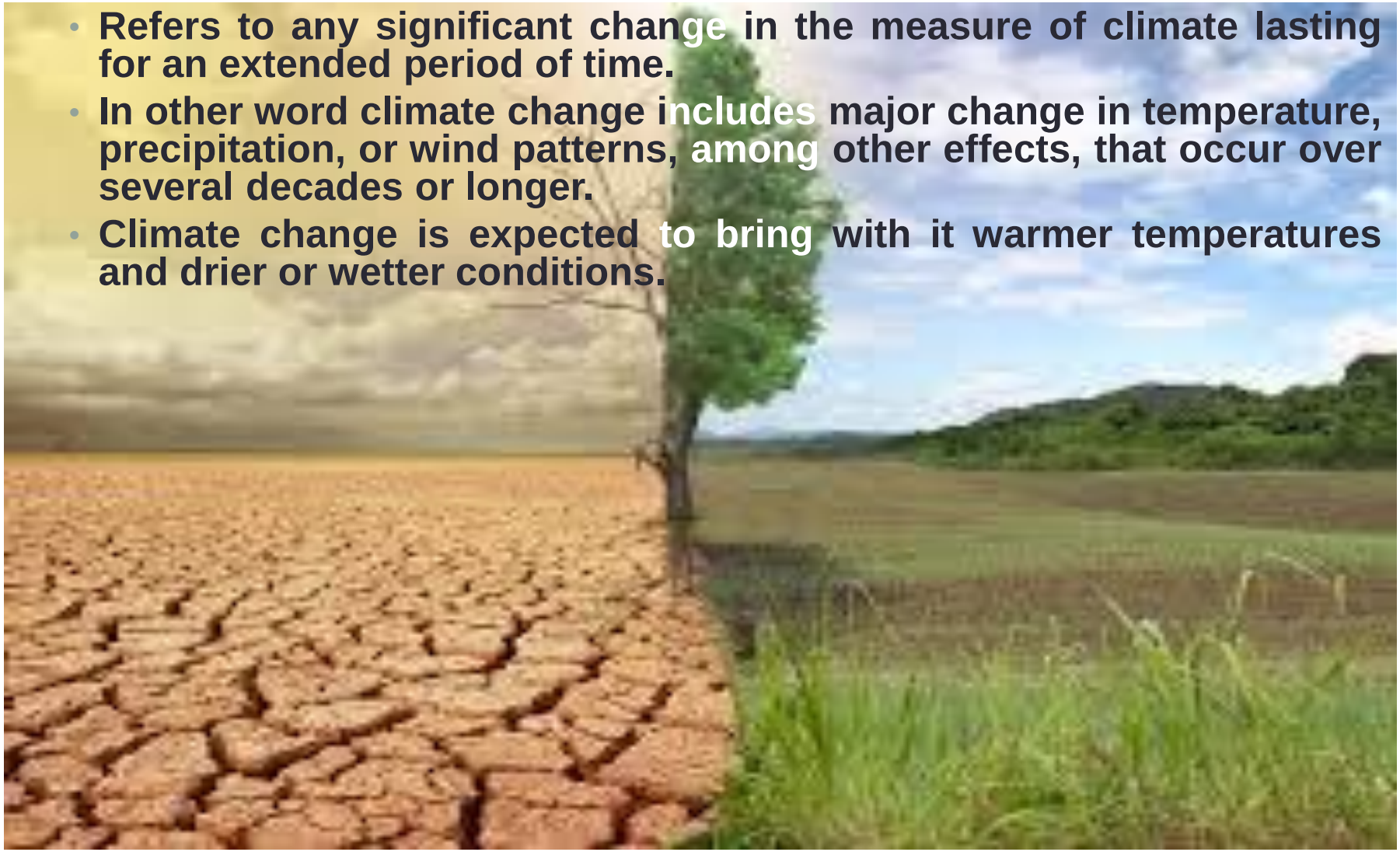
- In Malaysia, both annual and perennial crop production is prevalent. While rice, fruit, pepper and vegetable production is important, the tree crops (oil palm, rubber and cocoa) dominate agriculture, involving both large plantations and small farmers.
- The tree crops occupy more than 86% of the total agricultural area and involve most of the fertile alluvial coastal plains and undulating foothills. Oil palm alone uses about 63.4% of the total agricultural area, followed by rubber.

Agricultural land use in Malaysia (10^3 Ha: 2000-2010)

Crop	2000	2005	2010	Annual growth rate (%)
Oil palm	3377	4049	4555	2.4
Rubber	1431	1250	1179	-1.2
Rice	479	452	450	-0.1
Fruits	304	330	375	2.6
Coconut	159	180	180	0
Cocoa	76	33	45	6.2
Vegetable	40	64	86	6.1
Tobacco	15	11	7	-7.4
Pepper	13	13	14	0.6
Total	5893	6383	6891	1.5

[Source: Ministry of Plantation Industries and Commodities, Malaysia (2006).]

What is Climate Change?



- **Refers to any significant change in the measure of climate lasting for an extended period of time.**
- **In other word climate change includes major change in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer.**
- **Climate change is expected to bring with it warmer temperatures and drier or wetter conditions.**

IMPACT OF THE CLIMATE CHANGE ON AGRICULTURE

Land/Soil/Water

The summarises the effects of climate change on land use and livelihood systems. (Devendra 2011)

Land use systems	Livelihood systems of the poor *
• Reduced soil moisture	• Reduced food and nutritional security > Availability > Access > Utilisation; and > Food systems stability
• Problems with agricultural water management	• FAO (2008)
• Changes in soils due to modification of water balance	• Increased risk of poverty and hunger
• Ecosystems changes: genetic resources and biodiversity	• Increased vulnerability
• Expansion of semi-arid and arid AEZs	• Inability to adapt to heat stress
• Increased droughts	• Inability to sustain animal production as a key feature of rural livelihoods
• Increased rangelands	• Reduced products and services from agricultural biodiversity
• Woody encroachment	• Increased susceptibility to diseases
• Desertification	• Reduced productivity
• Increased overstocking of heat tolerant animals e.g. goats especially in the rangelands with resultant soil degradation	• Reduced income
• Alter the suitability of land to grow crops	• Reduced self-reliance
• Increased salinisation	• Unstable households
• Reduced biodiversity	• Increased urban migration
• Species adaptation and distribution	
• Shift out of agriculture	

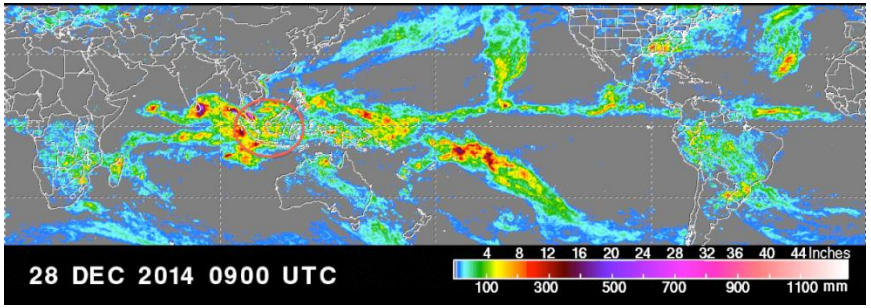
* Includes the landless

AEZ= agro-ecological zones

What are the effects of climate change?

1. Dry season and water shortage – Selangor and Klang Valley

2. Unexpected Bad weather – downing of AirAsia flight (Surabaya to KL 28 December 2014)



3. The mini-tornadoes – Kedah (14 October 2014)

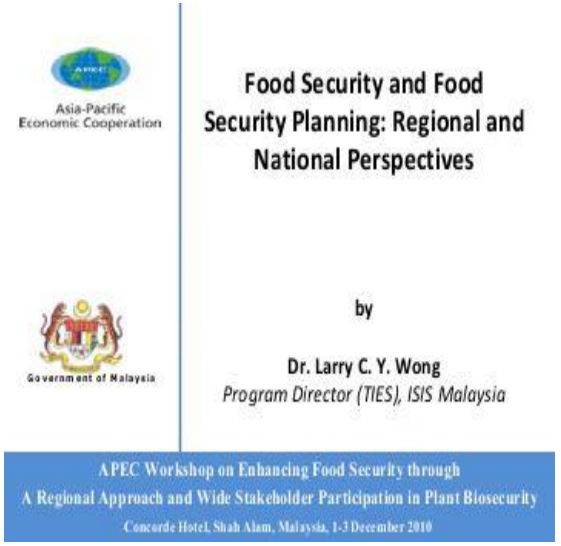
4. Floods/
5. Flash flood

Strategies to Cope with Climate Change:

- Policy/Strategies
- Research and Development
- Mitigation and Adaptation
- Agricultural Diversification

Example policy:

- In Malaysia, the Food Security Policy (FSP 2008–2010) was introduced during the global food crisis but has since expired. It is likely that the FSP will be extended this year, along with the implementation of the National Agricultural Policy. The key strategies of the FSP are:
- • Increasing rice production
- • Increasing production and productivity
- • Reinforcing marketing and distributing network
- • Bumi Hijau programme; and
- • Development of abandoned areas.



The summary of the adaptive options in the agriculture sector is as follows:

- Plant breeding for increased drought and flood tolerance and disease resistance
- Use of heat-resistant varieties
- Application of new technologies for water harvesting, conservation and recycling
- Development of food-feed systems
- Nutrient management and soil fertility
- Changes in management and farming practices
- Diversified farming, intercropping, crop rotation and food-feed systems
- Development of early warning systems Improvement of irrigation efficiency.
- Integration of animals with annual and tree crops systems
- Sustainable intensification of improved crop-animal systems
- Appropriate economic incentives, subsidies, pricing and taxes; and
- Linking production to post-production systems and the international food supply chain.

How to improve water management?

- IWMI (2007) has suggested five key issues to improve agricultural water management, building resilience to climate change and reduce risks to poor communities:
- (1) **Thinking more creatively about water shortage**, which will be critical to overcome short- and long-term dry spells
- (2) **Increasing water productivity**: globally, this will also help to reduce GHG emissions by curbing the need to convert land for agricultural purposes
- (3) **Improving basin water management and allocation** this will require both knowledge of water flows and social and institutional governance mechanisms- key areas for research
- (4) **Early warning and insurance**: establishing targeted safety nets for farmers who are unable to adjust quickly enough, providing credible insurance against catastrophic asset loss and facilitating rapid recovery; and
- (5) **Ensuring that the water management strategies** to support changes in cropping and land use patterns are tailored to local need sand secure storage of carbon that would otherwise be emitted or remain in the atmosphere (Watson *et al*. 2000), notwithstanding the fact that animals emit methane from enteric fermentation.

IWMI= International Water Management Institute

IMPACT OF THE CLIMATE CHANGE ON FISHERIES & AQUACULTURE

Malaysia coastline

- Total length of Malaysian coastline is **~ 4800 km** consisting of Peninsular Malaysia, Sabah & Sarawak (Eastern part of Malaysia)

Fisheries & aquaculture in Malaysia

- **2015** - Total fish production is **1.99 million MT** in which 1.49 million MT (capture fisheries) & 506, 465 MT (aquaculture)

- **25.4%** production of fish – aquaculture, remaining **74.6%** from capture fisheries

- Climate change has a great impact to the fishery industries – dependency of fish from capture fisheries

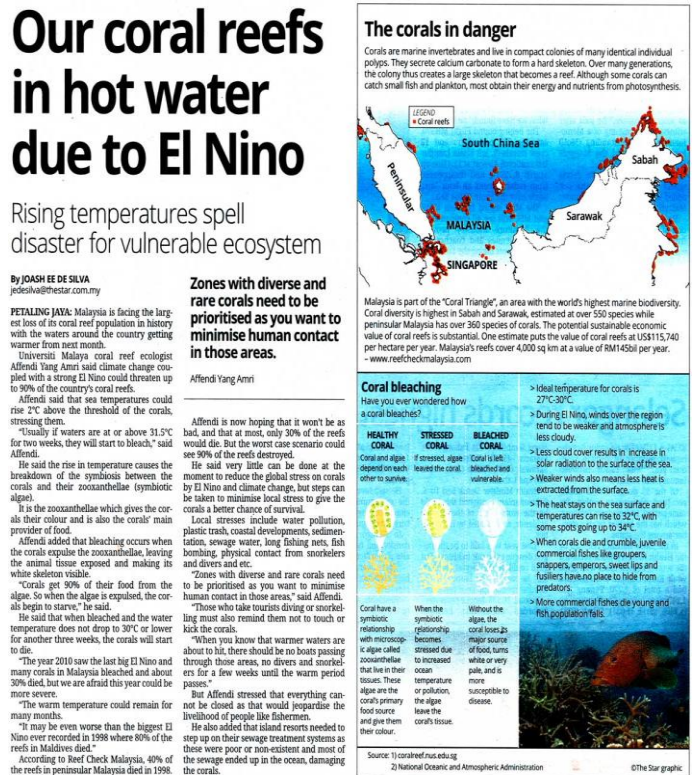
El Nino Southern Oscillation (ENSO)

- Periodic occurrence - sea surface temperatures in the central and eastern Pacific Ocean become warmer.

- Described as a warm oceanic phase, a current of warm nutrient-poor water replaces the cool nutrient-rich water within the Pacific area.

- Coral reefs area died and bleached – hot water temperature above coral threshold temperature, Malaysia coral reefs area (1998- 40% coral reefs died; 2010 – 30% coral reefs died)

- Disturbance in fish habitat & ecosystem



Our coral reefs in hot water due to El Nino

Rising temperatures spell disaster for vulnerable ecosystem

By JOSH EE DE SILVA
jedesilva@thestar.com.my

Zones with diverse and rare corals need to be prioritised as you want to minimise human contact in those areas.

Affendi Yang Amri

PETALING JAYA: Malaysia is facing the largest loss of its coral reef population in history with the waters around the country getting warmer from next month.

Universiti Malaya coral reef ecologist Affendi Yang Amri said climate change coupled with a strong El Nino could threaten up to 90% of the country's coral reefs.

Affendi said that sea temperatures could rise 2°C above the threshold of the corals, stressing them.

"Usually if waters are at or above 31.5°C for two weeks, they will start to bleach," said Affendi.

He said the rise in temperature causes the breakdown of the symbiosis between the corals and their zooxanthellae (symbiotic algae).

It is the zooxanthellae which gives the corals their colour and is also the corals' main provider of food.

Affendi added that bleaching occurs when the corals expulse the zooxanthellae, leaving the animal tissue exposed and making its white skeleton visible.

"Corals get 90% of their food from the algae. So when the algae is expulsed, the corals begin to starve," he said.

He said that when bleached and the water temperature does not drop to 30°C or lower for another three weeks, the corals will start to die.

The year 2010 saw the last big El Nino and many corals in Malaysia bleached and about 30% died, but we are afraid this year could be more severe.

"The warm temperature could remain for many months.

"It may be even worse than the biggest El Nino ever recorded in 1998 where 80% of the reefs in Maldives died."

According to Reef Check Malaysia, 40% of the reefs in peninsular Malaysia died in 1998.

Affendi is now hoping that it won't be as bad, and that at most, only 30% of the reefs would die. But the worst case scenario could see 90% of the reefs destroyed.

He said very little can be done at the moment to reduce the global stress on corals by El Nino and climate change, but steps can be taken to minimise local stress to give the corals a better chance of survival.

Local stresses include water pollution, plastic trash, coastal developments, sedimentation, sewage water, long fishing nets, fish bombing, physical contact from snorkelers and divers and etc.

"Zones with diverse and rare corals need to be prioritised as you want to minimise human contact in those areas," said Affendi.

"Those who take tourists diving or snorkelling must also remind them not to touch or kick the corals.

"When you know that warmer waters are about to hit, there should be no boats passing through those areas, no divers and snorkelers for a few weeks until the warm period passes."

But Affendi stressed that everything cannot be closed as that would jeopardise the livelihood of people like fishermen.

He also added that island resorts needed to step up on their sewage treatment systems as these were poor or non-existent and most of the sewage ended up in the ocean, damaging the corals.

The corals in danger

Corals are marine invertebrates and live in compact colonies of many identical individual polyps. They secrete calcium carbonate to form a hard skeleton. Over many generations, the colony thus creates a large skeleton that becomes a reef. Although some corals can catch small fish and plankton, most obtain their energy and nutrients from photosynthesis.

Malaysia is part of the "Coral Triangle", an area with the world's highest marine biodiversity. Coral diversity is highest in Sabah and Sarawak, estimated at over 550 species while peninsular Malaysia has over 360 species of corals. The potential sustainable economic value of coral reefs is substantial. One estimate puts the value of coral reefs at US$115,740 per hectare per year. Malaysia's reefs cover 4,000 sq km at a value of RM145bil per year. – www.reefcheckmalaysia.com

Coral bleaching

Have you ever wondered how a coral bleaches?

HEALTHY CORAL	STRESSED CORAL	BLEACHED CORAL
Coral and algae depend on each other to survive.	If stressed, algae leaved the coral.	Coral is left bleached and vulnerable.
Coral have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are the coral's primary food source and give them their colour.	When the symbiotic relationship becomes stressed due to increased ocean temperature or pollution, the algae leave the coral's tissue.	Without the algae, the coral loses its major source of food, turns white or very pale, and is more susceptible to disease.

- Ideal temperature for corals is 27°C-30°C.
- During El Nino, winds over the region tend to be weaker and atmosphere is less cloudy.
- Less cloud cover results in increase in solar radiation to the surface of the sea.
- Weaker winds also means less heat is extracted from the surface.
- The heat stays on the sea surface and temperatures can rise to 32°C, with some spots going up to 34°C.
- When corals die and crumble, juvenile commercial fishes like groupers, snappers, emperors, sweet lips and fusiliers have no place to hide from predators.
- More commercial fishes die young and fish population falls.

Source: 1) coralreef.nus.edu.sg
2) National Oceanic and Atmospheric Administration

©The Star graphic

- Rise of surface water temperature: water temperature increase 1-2˚C, causing pelagic fish to migrates out from the states water to higher altitude or colder area

- Implication: estimated a decline of about 30% fish landing in coming years (Department of Fisheries, Malaysia)

- Water temperature increases, high evaporation - reduce dissolved oxygen in aquaculture ponds

- Drought – lowering water levels in rivers, causing rivers to become shallow and fish died

Monsoon effect : irregular rain and heavy rainfall

- SW monsoon and NE monsoon rainfall schedule altered – irregular heavy rainfall

- Implication :

  - ✓ flood in some areas – runoff from land into the river - affect cage culture & aquaculture ponds

  - ✓ Rise in mean sea level – runoff from land, decrease salinity in coastal area

  - ✓ Salt water inundation to fresh water- detrimental effect to the aquatic life in freshwater

• December 2011- huge waves hit Kuala Besut, Terengganu, people have to move- damaging the fisherman's livelihood assets: houses, boats, nets, boat engines

Flood : affect cage culture of Seabass in the East coast region states, causing thousands of fish to die

Coastal and marine habitat lost

- Erosion of coastal areas (30%) – mainly the east coast region of Peninsular Malaysia (2007)
- Erosion risks within and around coastal settlements and increase sedimentation of river mouths
- East Coast region of Peninsular Malaysia – temperature increase- high impact and main fishing activities are from this area

Implication of climate change on fisherman community

- Impact on fisherman's health-decrease hygienic and poor sanitation, unstable weather conditions, expansion of vector and pest breeding areas

- Unstable climate- limit fishing operation days and social activity , fewer days for fisherman to go to sea – decrease fisherman's income and lowering the capture fisheries production

- Instability of the current, wind and waves will eventually endanger fishermen while they conduct their routine work – East coast region farmers (Yaacob and Chau, 2005)

- Migration of fish to other location – fisherman needs to find new fishing ground, thus increase capital investment (fuel cost and new crew members)

Table 1: Climate change risk cases on aquaculture sector in Malaysia.

Climate Change Drivers	Year	Place / States
Water intrusion, water deterioration and White Spot Disease[1]	1992	Penang
Drought (El Nino Southern Oscillation or ENSO)[2]	1997	Selangor, Sabah, and Sarawak
Floods and water stratification[3]	2008	Sungai Semerak, Kelantan
Drought (ENSO)[4]	2009	All states
Disease outbreaks (Streptococcus)[5]	2010	All states in Peninsular Malaysia

Sources: [1]Hambal, Arshad & Yahaya (1994); [2] Sulong (2008); [3]Mustafa (2007); [4] Farabi (2009); [5] MOF (2011).

Adaptation & Mitigation Measures

- Reduce the rate of spreading seeds and feeding rate for the cultured organisms & harvest fish accordingly

- Avoid operation during the El Nino

- Long term effect : use RAS (Recirculation Aquaculture System) to minimize water usage in a controlled system

- Implement Integrated Multi Trophic Aquaculture (IMTA) – culturing different species in one system to maximize use of space and increase production : For example; fish, shrimp and oyster/seaweed in a pond of brackish water

- Developing high resistance breeds towards climate change – reduce dependency on wild brood stock

- Continuous monitoring of El Nino impact on water quality, ecosystems and plankton abundance in marine and freshwater ecosystem
- Stop exporting the fish commonly consumed by the Malaysian people and provide buffer stocks of the fish for 6 months supply.
- Pelagic fishes caught from the West Coast will be supplied to the market on the East Coast for a long term
- Use of remote sensing technology to determine the location of fish to increase fish production
- Coral reefs area, minimizing local stress – improve sewage treatments from resorts on island nearby


Thank you…
Terima kasih…
Shukran…