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The Effect of Climate Change on Rice Production in Malaysia

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INTRODUCTION

The United Nations Millennium Development goals are to reduce hunger and poverty. This was the main reason for the UN declaration of the International Year of Rice in 2004. Rice is the source of more than 500 calories per person per day for over 3 billion people (FAOSTAT). By 2010, world rice consumption was about 53.6 kg per capita an increase of 40% from the late '60s. Furthermore, rice cultivation was the main activity and source of income for more than 100 million households in developing countries in Asia, Africa and Latin America (Nguyen, 2012). On-going research on rice research and development in the 1970s and 1980s enabled global rice production to meet the demand of growing populations. However, in an FAO report published in 2005, world rice production was less than rice consumption (FAO, 2005) as world population growth outpaced rice production growth rate. There are many factors that would affect the production of rice, such as attack by pest and diseases, disasters such as long draught or floods brought about by climate change. This paper aims to discuss the effects of climate change on rice production in Malaysia.

Rice and climate scenario in Malaysia

It is well known that rice is a staple food in Malaysia, a country which consists mainly of small farmers with 116,000 households who depend on rice cultivation as a major source of income (3% of the total households in the country). Another 200,000 households were also engaged in rice farming as their secondary source of income (Department of Statistics, 2010). The total cultivation area planted to rice involved 687,940 ha in 2011 with a net production of 2.5 million MT of rice (DOA, 2011) which fulfilled approximately 72% of the country's needs.

The Malaysian climate is driven by the equatorial position of the country and its extensive coastlines: the climate is tropical and affected by the annual monsoon. Malaysia has a uniformly high temperature and humidity, relatively light winds and abundant rainfall throughout the year. The cause of variation in Malaysian climate is due to differences in altitude and the exposure of the coastal lowlands to the alternating southwest and northeast

monsoon winds; the southwest monsoon winds blow from April to September and the northeast monsoon winds blow from November to February (Ariffin *et al*., 2002).

Rainfall patterns are determined by the seasonal wind patterns and characteristics of the local topography. In east coast states of the Peninsular Malaysia, the wettest months occur in November, December and January while June and July are known to be the driest months. West coast and the central region in Peninsular Malaysia receive peaks of high rainfall from October to November and April to May followed by a period of lower rainfall during January to February and June to July.

Malaysia receives sunlight on average about six hours per day and uniformly high temperatures throughout the year. Most areas vary less than 2ºC for average maximum and minimum temperature per month. Coastal area temperature ranges daily between 5°C and 10°C while inland temperature ranges between 8°C and 12°C (Website of Malaysian Meteorological Department).

Effect of climate change to crops

Generally known, weather plays a major role in determining crop yields. Environmental stresses such as drought, high temperature and air pollution are major limiting factors to crop productivity in the tropics (Ariffin *et al.,* 2003). The impact of these climatic stresses on crop productivity evaluated using morphological, physcio-biochemical and yield responses indicate that climate change does affect agriculture in Malaysia. Study by Zabawi *et al,* 2010 stated that if rainfall or temperature increased by 15%, rice yield will fall by 80%. Hence, it will be a threat to national food security and the economic contribution from the agricultural sector.

Effect of climate change to rice production

Literatures were reviewed to evaluate the impact of climate change on rice production in Malaysia. In general, rice production in Malaysia ranged from 3 – 5 MT per hectare, whereas the average potential yield was 7.2 MT per hectare (Singh *et al*., 1996). However, due to climate change, rice yield declined on a range of 4.6 – 6.1% if temperature increased by 1ºC. Study by Vaghefi *et al.,* 2011 estimates the effects of climate change by using the ORYZA 2000 crop model and indicates a reduction of rice yield if CO_2 was increased from 383ppm to 574ppm and temperature was increased by 2ºC although doubling the CO_2 concentration (from present level of 340ppm to 680ppm) may offset the detrimental effect of a 4ºC increase in temperature on rice production. Another study was by Zabawi *et al.* in 2012 which used the CERES-Rice model in DSSAT on simulating rice yield in the Muda Agriculture Development Area (MADA) granary area. The analysis revealed that by increasing 2ºC of temperature, the yield of rice decreased from 5 MT per hectare to 4 MT per hectare. The yield was reduced mainly due to the effect of temperature increase during flowering and grain filling.

Policy implementation

In Malaysia, National Policy in climate change was formulated to provide a framework which could be used as a guide for all government agencies, industry, community as well as other stakeholders in order to face challenges in climate change scenario. The policy was to ensure climate-resilient development to fulfil national aspiration for sustainability. Their objectives were:

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

As far as food security is concerned, minimizing the climate impact, especially in rice sector, is a must. One of the key actions proposed by the policy was strengthening the adaptation and mitigation measures.

Adaptation to climate change

Part of climate change is the occurrence of extreme events such as droughts or floods. In order to overcome this, or at least offset the effect - varieties that are tolerant to water stress should be developed. Hybrid rice was developed with an estimated potential yield from 4.5 to 6.5 MT/ ha. Though this is lower in the range of 20 – 30% as compared to current lowland varieties grown under flooded conditions, it is still comparable, particularly when they consider the predicted losses due to climate change.

In order to lower the impact, rather than new varieties, climate modelling can be used. Improving the understanding of how local weather pattern change with the global warming would be beneficial to create early warnings systems of extreme weather events. Farmers should be informed and guided on appropriate varieties, their management and how to adapt with changes in climate. However, within any one year, there are limitations on how much adaptation can take place – agriculture is, of course practiced outdoors and weather extremes will have an increasingly detrimental impact on yield.

Considering the importance of water to agriculture, especially rice production, upgrading the non-granary area into a granary area is one option for the government. Government should consider an additional non-granary area to be equipped with recent technologies and upgrade the facilities and infrastructure; for example the irrigation system which was the most important thing for rice cultivation. Non-granary area, which is not facilitated with proper irrigation system, had a lower average production per hectare, which is at 3.1 MT as compared to the granary area at 4.1MT per hectare (Rozhan *et al.,* 2013).

Policy Recommendations

To minimize the impact of climate change, government should not just focus on developing the rice varieties, mechanization, and farm management. It should also concentrate on pests and diseases as part of climate change issues. Other than varieties, mechanization and farm management policy, methods of controlling pests and diseases under different environment conditions should be in mind as well.

The El Niño scenario, which occurred in 1997/ 98, caused a long period of drought in Malaysia. During this period rainfall was recorded to be less than 100mm per month. However, the difference of production during the El Niño and previous normal periods were relatively small. The loss was at about 7%. Nevertheless, this was offset by rice production in other areas. For longer periods of drought, technology for water saving will be very important.

As mentioned earlier, new hybrid rice which is tolerant to water stress has already been introduced. However, yield also fell due to excessive rainfall, which implies that development of new varieties that tolerate high rainfall and flooding should be undertaken as well. Establishment of new varieties as everyone knowns, can take many years. For short term solutions, local authorities could consider the benefits (and cost) of upgrading water management capability. As mentioned earlier, policy related to weather information should be established to make sure that farmers are aware of climate change.

CONCLUSIONS

Climate change of course is not only something that exists in Malaysia: it is recognized as a global problem and requires a global solution to mitigate the driving greenhouse gas emissions With the increasing likelihood that the accumulating greenhouse gases will change the climate, a consensus has emerged in the international community over the need to stabilize GHG atmospheric concentrations and provide long-term solutions to climate change problem (ADB report, 2009). Researchers have been trying to assess the impact of climate change on crops in order to sustain food supplies. In Malaysia an adaptation strategy, including crop management, soil management and irrigation management was proposed to farmers in order to minimize the impact of climate change.

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