

Research Article

Issues and Challenges Facing Rice Production and Food Security in the Granary Areas in the East Coast Economic Region (ECER), Malaysia

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Abstract: This study is an effort to explore and investigate the issues and challenges are facing rice production and food security in Malaysia. It is also to identify the contribution of the granary areas in East Coast Economic Region (ECER) to the national food security. The important of rice as a staple food crop of Malaysia and is grown on 673,745 ha of land, producing annually 2.6 million tons of paddy grain valued at RM 2 billion, which is contribute with average growth rate of 3.7% of year, in the last five years. However, the current country's self-sufficiency level for rice production is about 71.4% and the balance imported from countries abroad. Efforts are being undertaken by government to increase the productivity, cropping intensity prediction and crop acreage to cope with the growing demand for the produce. This study examines the various issues of rice production for food security and analyses the challenging of rice production in Malaysia. Various policies, strategies and programmes for rice production will be thoroughly analysed for attaining the study objectives. In the ECER, Kemubu Agricultural Development Authority (KADA), Kemasin Semerak and North Terengganu (KETARA) Integrated Agriculture Development Area (IADA) is among the granary areas, which emphasised on paddy cultivation to the country. The role of the area is important to enhance the self-sufficiency level of rice in Malaysia. Issues and challenges related to rice production, food security and self-sufficiency are discussed. Various efforts and government intervention have been implemented to ensure that these areas will remain as the important granary area. Several approaches to improve the productivity and stability of food production as well as outlining the agenda to ensure the country food supply are discussed.

Keywords: Food security, Integrated Agriculture Development Area (IADA), Kemubu Agriculture Development Area (KADA), Kemasin Semerak IADA, North Terengganu (KETARA IADA), rice production

INTRODUCTION

Rice is the second most widely grown cereal crop and the staple food for more than half the world's population. The people depend on rice for food calories and protein, especially in developing countries (IRRI, 2004). One fifth of the world's population or more than a billion household in Asia, Africa and the America rely on rice systems for their main sources of employment and livelihoods. It is also on the frontline in the fight against world hunger and poverty (Nguyen and Ferrero, 2006). Global rice production, so far, has been able to meet population demands. However, its ability performance is in question unless there are appropriate actions taken in the near future. The challenge facing rice production includes the declining/stagnating productivity, degradation of soil and water resources and increased use of agrochemical with decreased use efficiency, adverse changes in microclimate, land fragmentation, labour and energy shortage and including health risks of farmers and consumers. FAO (2003) mentioned about stagnation of rice yield in many Asia countries and intensification of rice

production has caused considerable damage to the environment and natural resources, including the build-up of salinity/alkalinity, water pollution, health hazards due to excessive use of agrochemicals and the emissions of important greenhouse gasses and increases the genetic erosion in rice production. Understanding the potential effect of these changes on agriculture is critical because it provides food for the world's population, now estimated at 5 billion and projected to rise to 8.9 billion by 2050 (United Nation, 2004). A large portion of this estimated population increase will take place in Asia (Iglesias *et al.*, 1996). Therefore, the efforts to identify the issues and challenging encountered in the production of rice is required and to ascertain the contribution of the granary areas in East Coast, comprising KADA, IADA Kemasin Semerak IADA and KETARA IADA on food security in Malaysia.

National food security: Food security has several dimensions, all of which face difference threats. There are a number of definitions for food security both at national, community and household level. The Worlds

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Food Summit (1996) defines food security concepts is a more complex way, which is when all people, at all times, have sufficient access to safe and nutritious food to meet dietary needs and food reference for a more active and healthy life. The Food and Agricultural Organization (FAO, 2003) defines food security as a situation in which all households have both physical and economics access to adequate food for all members and where households are not at risk of losing such access. At the community level, as defined by The Community Nutritionist Council of British Columbia Canada (2004) that food security exists when all people get safe food and personally received the food with a nutritious diet through a sustainable food system that will maximize food choices of healthy, self-reliant community and receiving similar access for all people. This definitions also includes:

- The ability to get food is guaranteed
- the food is obtained by means of holding on to human dignity
- Food secure, adequate and personally acceptable and culturally
- The quality and quantity of food is sufficient to maintain healthy growth and development as well as to ward off diseases
- There is no compromise in terms of production, processing and distribution of food in the use of land, water and air for the next generations.

World Health Organisation (WHO) Demetre *et al.* (2011) defines the concept of food security as physical and economic access to food that meets dietary needs and food preferences. For them, the health problems associated with excessive eating, malnutrition and food-borne diarrhoea become increasingly burdensome threat. Meanwhile, at the household level, Frankenberger *et al.* (1995) state that food security at the individual level will be achieved when individuals get access to adequate nutrition and diet for the purpose of physical activity, disease preventing and sufficient for growth including during pregnancy and breastfeeding. Timmer (2004) emphasises both micro and macro perspectives that food security can be viewed as a continuous spectrum, from the micro perspective of nutritional requirements of individuals and the macro perspective that assures stable supplies in national, regional and local markets.

Rice self-sufficiency levels in Malaysia: In the Malaysian context, food security includes 3 key pillars, namely:

- Food availability in terms of consistency of food supply and adequacy,
- Accessibility of adequate and nutritious food

- Nutrient food that is capable of providing sufficient nutrition (MOA, 2008).

Based on the definition, basically the concept of food security at the national level is to emphasize the ability of countries to provide adequate food in the context of domestic production. While at the household and individual level, emphasis is on the ability of each household to obtain enough nutritious food and sustained without any obstacle. Ability and affordability to pay for this food is an important component in determining the level of food security of the household. Simultaneously, government involvement in food security is in ensuring citizens have access to sufficient food supplies unhindered. However, this effort may not be easy because it requires a robust and continuous planning and coherent commitment from all parties.

Malaysia has more than 100,000 farmers depending on rice production for their livelihoods and many more working in rice-related industry. Furthermore, the sustainable production of rice is critical for ensuring food security and addressing poverty. Increasing food safety is also a growing concern either locally and globally. In Malaysia, National Agro-food Policy (NAP) is intending to replace the Third National Agricultural Policy (NAP3). NAP aims to increase food production in the country to meet the growing demand and high value agricultural development which is an increase in the contribution of the rice production to national income and agriculture entrepreneurship development. The main focus of this policy is to increase the production and productivity to ensure food supply, exploration of high-value agriculture, strengthening supply chain, the implementation of sustainable agricultural practices and human capital development and more participation by the private sector and effective government support (MOA, 2011). The local rice production should be increasing to ensure sufficiency rice supply as only 7% of total world rice production is traded. The stability of supply, growing demand and the small quantity of rice being traded in the international market tend to cause volatility in prices of rice. In this regard, the contributions of three granary areas located in the East Coast Economic Region (ECER) are needed in order to help achieve the self-sufficiency level of rice production in the country. The government efforts on strengthening the national paddy and rice industry will focus on strengthening the relevant institutions, increasing productivity and efficient stockpile management.

To ensure the stability of the food security, the government interprets the achievement in the form of

Table 1: Self-sufficient level of rice in Malaysia

Master Plan/NAP	Period	Self sufficiency level (SSL) target	SSL achieved (%)
First Malaya plan	1956-1960	-	54.0
Second Malaya plan	1961-1965	-	60.0
First Malaysia plan	1966-1970	-	80.0
Second Malaysia plan	1971-1975	-	87.0
Third Malaysia plan	1976-1980	90	92.0
National agricultural plan I	1984-1991	65	75.9
Fourth Malaysia Plan	1981-1985	65	76.5
Fifth Malaysia plan	1986-1990	65	75.0
Sixth Malaysia plan	1991-1995	65	76.3
National agricultural plan II	1992-2010	65	65.0
Seventh Malaysia plan	1996-2000	65	71.0
National agricultural plan III	1998-2010	65	71.0
Eighth Malaysia plan	2001-2005	65	71.0
Ninth Malaysia plan	2006-2010	65	72.0
National food security policy	2008	80 by 2010	72.0
New economic model	2010	85 by 2020	-
National agro-food policy	2011-2020	70 by 2012	-

MOA 2012; (Fatimah *et al.*, 2010)

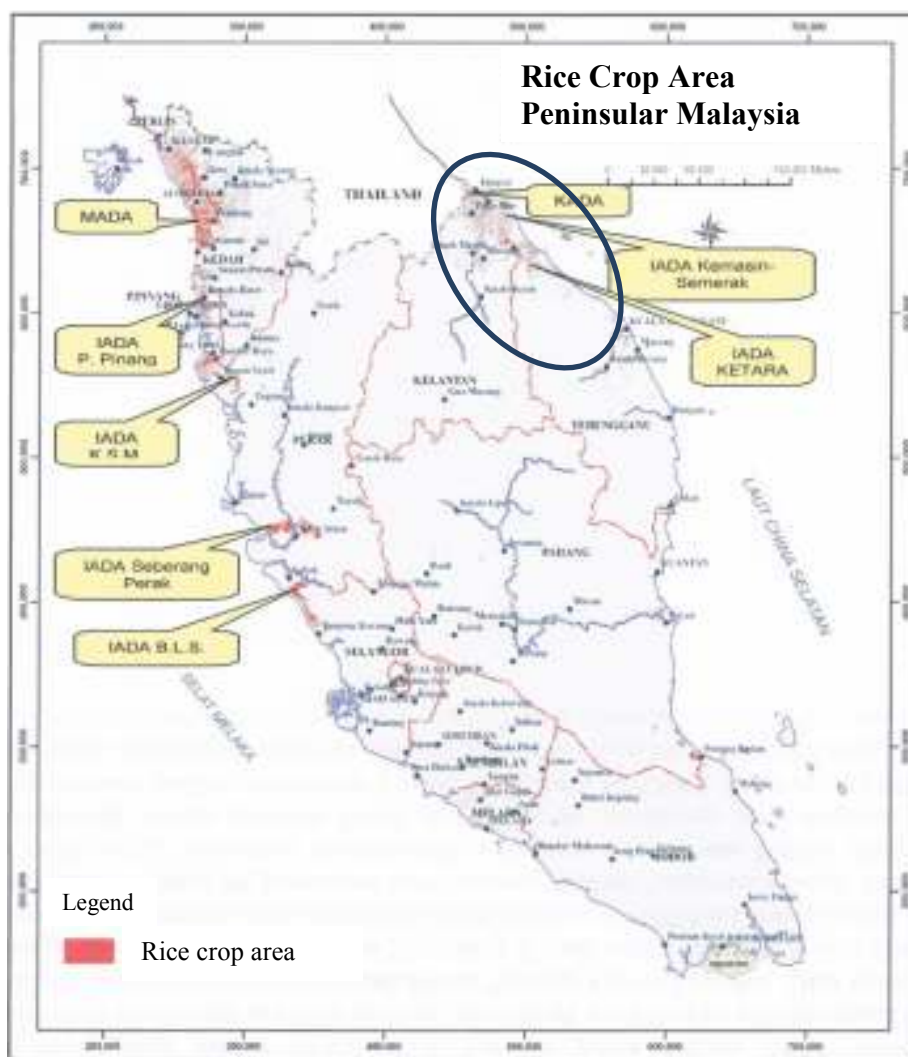


Fig. 1: Distribution of IADA's in Malaysia; Soil Management Division, Department of Agriculture, Peninsular, Paddy statistics of Malaysia (2008)

self-sufficiency level (SSL) of rice production. The level of SSL is derived from the total production in the

country compared to the total domestic demand of rice (Fatimah, 2010). It has been used as a proxy to indicate

the level of food security of rice, which is the staple diet of the majority of the population in the country (Fatimah and Abdel-Hameed, 2010). SSL target and achievement of this commodity is shown in Table 1.

Malaysia is a high cost producer of rice and for this reason the National Agricultural Policy (1992-2010) does not aim for full self-sufficiency (Najim *et al.*, 2007). Indirectly it also reflects the effectiveness of the government investment and agrarian reform in rural area especially in granary area for enhancing the productivity target of the country.

MATERIALS AND METHODS

Integrated approach: The concept of integrated agricultural development based on '*in-situ*' program was introduced with the establishment of the Muda Agriculture Development Authority (MADA) in 1970 followed by the establishment of KADA in 1972. Since the concept of this kind of development has grown with the establishment of the Integrated Agricultural Development Project (IADAs) based on rice crops (Fig. 1). To ensure the securing of food security, KADA, Kemasin Semerak IADA and KETARA IADA granary areas are located in the ECER, are also identified as a contributor to the production of paddy rice in Malaysia beside five other granary areas: MADA, Penang IADA, Seberang Perak IADA, Kerian-Sg. Manik, IADA and Northwest Selangor IADA. The study areas are KADA and Kemasin Semerak IADA in Kelantan and KETARA IADA in Terengganu (Fig. 1). The secondary data was used to identify the location, objective of the implementation and contribution of rice production of these three areas to the national food security in Malaysia.

RESULTS AND DISCUSSION

Paddy production: In the ECER, KADA, Kemasin Semerak IADA and KETARA IADA are among the granary areas, which emphasised on paddy cultivation to the country. The role of the area is important to enhance the self-sufficiency level of rice in Malaysia. The contribution of the three-bowl area in ECER is presented by Table 2.

Based on Table 2, rice production in the three-granary area contributed 8-11% to the national SSL in the period 1990-2011. The production shows the reduction of rice production marginally in 1990-1995 in both domestically and nationally. These directly impacts to the SSL reduce from 79 to 76 respectively. However, in the last 10 years (2000-2010) the production of rice increasingly by year to year in average 2% per year. Meanwhile, both KADA and Kemasin Semerak IADA had been fluctuation of production trend except KETARA IADA that is continuing increasingly. Albeit, the contribution to the SSL is still in average eight percent. Several diseases destroyed paddy growth in Kemasin Semerak namely Bena Perang, stalk rot, leaf rolls worm, Golden Apple snails, stem worm, mice, hawksbill disease and *Perang Seludang*. Meanwhile, weedy rice constitutes a threat to rice production in KETARA area and drought occurring in KADA.

However, trends of average paddy yield for the three regions show that the KADA and KETARA IADA are able to rival the average level of granary and national rice production. In fact, the cropping intensity of KADA and KETARA IADA has reached 161% and 199% respectively in 9MP and it has achieved the rice production for the granary is target (Table 3). On average, the percentage contribution and volume of

Table 2: The contribution of KADA, IADA Kemasin Semerak and KETARA to national rice production

Years	National rice production (mt /yr)		Rice production (mt /yr)			Contribution on SSL (%)
	mt /yr	SSL (%)	KADA	Kemasin	Ketara	
1990	1,377,339	79	135,854	5,422	21,184	9.32
1995	1,372,584	76	150,423	16,390	29,295	10.8
2000	1,342,370	70	114,579	20,921	33,513	8.81
2005	1,455,440	81	112,028	13,639	33,808	8.87
2010	1,642,000	71	130,738	17,056	43,750	8.28

MOA Annual Report, 2010

Table 3: Average yield of paddy 2005-2011

Year	Average Yield of Paddy (mt/ha) (2005-2011)				
	KADA	Kemasin	Ketara	Granary area	Malaysia
2005	3.528	3.286	3.965	4.132	3.471
2006	3.519	3.000	4.020	4.768	3.236
2007	3.599	2.489	4.337	4.207	3.514
2008	3.586	2.639	4.682	4.249	3.584
2009	3.754	2.831	4.985	4.645	3.720
2010	3.973	3.346	5.353	4.539	3.636

Agro food statistic, 2011

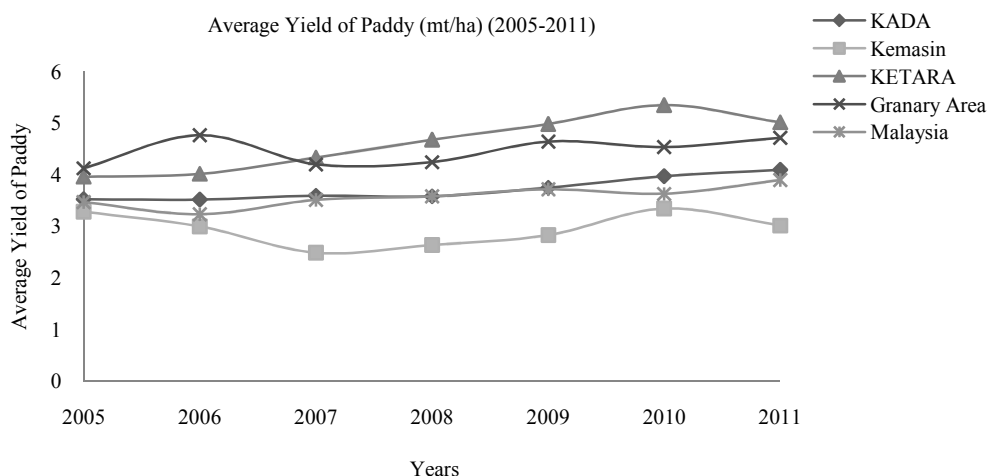


Fig. 2: Average yield of Paddy (2005-2011)

production indicate that the productivity of rice in the three granary areas should be upgrade to ensure the national food security could be achieve (Fig. 2).

Strategies to increase rice production yield: KADA and IADA's have initiated various programs and strategies to increase the rice production yield and the implementation have successfully soared the contribution of this region to SSL of the country. Among the programs that have been identified as key driver to increase rice yield are as follow:

Paddy Mini Estates (MEP): The paddy mini estate (MEP) is an effective farm management to enhance rice production and social relationship among the farmers and officers through the established committees. The credit system is accessible from farmers association in the respective areas that could assist farmers to operate their land. Farm management handled by farmers themselves is under the supervision and advice of agencies officers. In KADA, a total of 107 MEP are operating with an area of 6,231 ha compared to 6,146 ha., involving about 2,145 farmers in the year 2009. The implementation of MEP has a positive impact on average yield of rice, increasing by 5% to 3.64 tonnes/ha compared to 3.48 ton/ha and 3.45 ton/ha in the main and offseason, respectively, in the year 2009. In Kemasin Semerak IADA, about 241 farmers are involved, cultivating about 262 ha, compared to 443 farmers, operating 566 ha, in 2009.

Ten (10) tonnes project: The 10 tonnes project of rice is a Rice Yield Improvement Program. It is a practice of improved technology on paddy crop management to achieve high yield in the certain period to make the paddy industry more commercial and competitive. In KADA, the programs was launched under the 9MP and

were caring out in main season 2005/2006 with 53 projects such as Mini Estate, Group and Ladang Merdeka Projects, involving an area of 5,008 ha and 3,202 farmers. As a whole, the implementation of these high impact projects have a good achievement, involving a total of 215 projects with 3,773 farmers and cultivating 8, 224 ha with the return of 5.41 ton/ha and 4.97ton/ha in main and off season in 2010 respectively. This is due to the efforts and crop improvement program over time, farmers' commitment and extension service. The compliance to Good Agriculture Practice (GAP) and agronomic practice during field work activities and proper water management practices contributed to 2% of farmers have managed to produce more than the targeted levels of production. Meanwhile, in KETARA IADA it was implementing since 2002 with focussed guidance is on potential farmers to produce 10 metric tons of rice per hectares per person. Qualifying as a member of Club 10 tons was in recognition of the production achievement and also a great impetus for a better performance.

Ladang Merdeka project: *Ladang Merdeka* concept focused on commercial and large scale rice farming, designed with appropriate farm size to produce profitable and viable enterprises to improve participant's income and assist farmers to move out of poverty. It was implemented in 1991 with the initial management of 5 farms with an area of 211.78 hectares. *Ladang Merdeka* is a holistic infrastructure development project in one complete package comprising of improved irrigation and drainage systems, farm roads and land levelling. This endeavour while overcome the operational inefficiencies and thus to replace the role of elderly owners to work on farm individually.

Among the three areas, KADA has implemented the project and successfully changes the status of idle

Table 4: New government incentive/subsidize for paddy sector in Malaysia

Incentives/Subsidies	Rate
Rice fertilizer scheme of the federal government	240 kg/ha: 12 beg ×20 kg of compound fertilizer;100 kg/ha: 5 beg ×20 kg of urea fertilizer
Paddy rice subsidy scheme	RM248.10 for every metric ton paddy production
Rice production incentive	RM140/ha/season: Additional fertilizer (organic @ foliar fertilizer); RM100/ha/season: Aid wages for plowing
Increase in revenue incentive	RM650/mt of yield for at least 1% increases from the base season
Rice price subsidy	RM750/mt to millers in peninsular Malaysia whose are produce ST15% rice. RM600/mt to millers in Sabah and Sarawak. RM700/mt for the purpose of standardization of price in Sabah and Sarawak
Paddy seeds incentive	RM1.03/kg to the paddy seeds producer who supply seeds to farmers.

Agro food policy, 2011

land, low quality and uneconomic size of paddy field into more structured and well-organized farms. This is in line with government policy to increase rice production and food security assurance of the country. To date, this operation involves 15 farms with an area of 576 hectares for both seasons. Using the indicators: number of participant, acreage and the revenue per hectares, KADA has about 2,188 farmers, with average yield of 5.38 ton/ha and revenue of RM1123/ha and 2,109 farmers, with average yield of 7.48 ton/ha and revenue of RM1561/ha, involving a total area of 588 hectares, respectively (KADA, 2010). It was supporting by efforts of rehabilitation and maintenance of infrastructure, restoration of soil fertility, purchase of farm equipment and provision of agricultural inputs. The overall impact of the project implementation will increase income of participants, value of land, registered seed sources and producers, create job opportunities, inspire the participation of farmers, rice zakat resources, create the harmonious relationship among the agencies and participant as well as increase the revenue of seed and rice production of KADA.

Water management group (KPA): KPA is responsible to consolidate farmers within the same interests groups and supply of water facilities that could have a great impact on rice production. The business concept has been adopted by the KPA where financial resources can be used to increase rice production which in turn helps the continuity of some activities towards higher yield. Some of the activities under the KPA include performing farm project and under-training farm project. Under the performing farm project, farm infrastructure development and land conservation programs as well as training and trips sessions are providing to give exposure of the current technology practice to participants.

Irrigation scheme: An allocation of RM37 million was provided for the realization of Yong River Irrigation at Pasir Puteh under Kemasin Semerak IADA. This enables the implementation of double cropping or twice year paddy cultivation and do not have to rely entirely on rainfall and act as alternative water drainage during dry season. The expectation of rice productions were increase over 3 tons/hectares compared to the 2.3 ton/hectares/year before water supply project in New Besut Barrage and Paya Peda is a long-term project undertaken by KETARA IADA for the irrigation and

flood mitigation purposes in Besut and Setiu will be expecting to benefit the non-granary areas in the region.

Government intervention in rice production and food security: To ensure the stability and continuity of national rice production, the government initiates the subsidy policy as a mechanism to promoting and achieving the food production targeting for Malaysian population. This intervention can be seen through three main objectives, namely:

- To ensure food security
- To improve farm productivity and income
- To ensure the consumers get the food at affordable price

Accordingly, the government has allocated RM11, 435 million for agricultural development in the 9MP (2006) has increased by RM3, 686 million (47.6%) compared to RM7, 749 million in 8MP. In 10MP (2010), the cluster of five corridors were identified as high-density cluster and has the advantage in terms of sector and region. ECER development plan has emphasises on the key initiatives related to agriculture apart from tourism, education, oil, gas and petrochemical industry. The government has introduced some new form of subsidies and incentives to boost the country staple food production as shown in Table 4.

To further enhance the country agricultural sector, this sector was identified as one of the National Key Economic Areas (NKEA) under the Economic Transformation Programme. NKEA agriculture will focus on the sub-sector that has great potential growth to drive Malaysia to participate in global markets which focuses on strategic sub-sector to ensure the country's sufficient food supply. 16 initial Entry Point Projects (EPPs) and 11 potential projects were identified to generating about RM49.1billion Gross National Investment (GNI) by 2020. Simultaneously it can create 74,600 new jobs, mainly in rural areas (MOA, 2011). Three out of sixteen EPPs identified, will involve the rice sector namely EPP 9 (variety of fragrance rice cultivation in idle land) EPP 10 (cultivation of rice in Muda) and EPP 11 (rice cultivation in the other granary (including KADA, Kemasin Semerak IADA and KETARA). Furthermore, the government has allocated RM839.3 million for the purpose of projects implementation which comprises RM6.75 million for

EPP9, RM97.78 million for EPP 10 and RM136 million for EPP 11 (MOA, 2011).

Challenges in rice production in Malaysia: The following discussion reviews the problem of production and food security at the global scale including Malaysia. Raising food prices, uncertainty of climatic condition, overpopulation and limited resources are the key issues and challenges facing of rice production and food security in Malaysia.

- **Food price increase:** Food prices have been rising in years but have accelerated in the recent years. The soaring food price is eating into the incomes and savings of people around the world. The price surge has been blamed on multiple factors including higher energy and fertilizer costs, greater global demand, drought, the loss of arable land to biofuel plantations and price speculation. The effects of the dramatic swing in food prices experienced from 2007 to 2008 were felt around the world, including Malaysia. As a net food importer, the crisis affected Malaysia in terms of higher food import bills, increase in Consumer Price Index (CPI) (Fatimah and Abdel-Hameed, 2010). The rising of food prices has been seen in the increase of the Consumer Price Index of Food from 100 in 2010 (basic year) to 107.2 in the year 2012 with contribution of food and beverages by 30.3% (Department of Statistic (DoS), 2012). These issues is expected to become more challenging due to the climate change, limited of production factors, the increase in input prices and competition in the use of food to biofuel production, food safety and lacking of arable land and water (MOA, 2011; Fatimah *et al.*, 2011). Khor (2008) noted that the shortfall in production of food commodities will effect total food imports which in the year 2010 contribute to food trade deficit to reach RM12.4 billion with food imports at RM14.9 billion (Malaysia, 2006). Forecasting by IRRi shows that world rice price will be higher than the level before the 2008 food crisis and requires government to review the policy of self-sufficiency through increased production. In effort to protect poor consumers, the Malaysian government implemented price control schemes for rice and continue the producer support price by increasing the minimum guaranteed price from RM650 per tonne to RM750 per tonne in May 2008. To ensure enough supplies of rice to poor consumers, the government has decided to provide a temporary subsidy of RM800 per tonnes to millers, including BERNAS, to produce the lower grade ST15% rice (Fatimah and Abdel-Hameed, 2010). Impact study done by Amin *et al.* (2010) on impacts of government intervention on fertilizer and price of rice in Malaysia reveals that the importance of this mechanism to ensure that farmers are protected from the world price

volatility of rice. Simultaneously, it also reduces the production cost and increase the income of farmers, while ensuring that this industry will be sustained and globally competitive.

- **Climate change:** Rice production is affected by environmental changes, such as climate change (IWRM, 2007) and it climate change has emerged as key concern for environmentally and economically vulnerable countries (Sarker *et al.*, 2012). Climate change impacts on production of crops in many countries around the world (FAO, 2005), damage to infrastructure, affecting food prices and increased reliance on food aid import (FAO, 2008). The impacts of climate change on rice production have been a subject of research by many researchers due to its importance on human life. It also effects food production, food prices and social well-being of the country. Some studies have investigated the economic effects of climate change on agricultural production in developing countries (Lansigan *et al.*, 2009; Kurukulasuriya and Ajwad, 2007; Deressa and Hassan, 2009; Wang *et al.*, 2009; Vaghefi *et al.*, 2011). These studies reveal that crop agriculture in developing countries is highly susceptible to climate change. In Malaysia, empirical investigations on the influence of climate change on agricultural production have been limited. Climate impacts on agriculture span a wide range of attributes and outcomes depending on the specific climate scenario, geographical location and nature of study (Alam *et al.*, 2011). Climate change will definitely affect this sector, particularly with respect to agricultural output and productivity (Roslina and Abu Kasim, 2009). According to Mad-Nasir and Makmom (2009), the direct impact of climate change to agriculture can be classified in:

- Decreasing the agricultural productivity
- Increasing of food insecurity and
- Affecting the supply chain of production

Chamhuri *et al.* (2009) reviewed that production and yields changes may be due to reduction in the water available for irrigation, loss of land due to sea level rise and salinization and also risk of weeds, insect and diseases could increase. The crop productivity will be altering due to changes in climate and weather events (Chamhuri and Abul Quasem, 2009). Simulations for the major rice-growing regions of Asia find that yield decreases 7% for every 1°C rise in temperature above current mean temperature at existing atmospheric carbon dioxide concentration (IWRM, 2007). Roslina and Abu Kasim (2009) studied the impact of global warming on Malaysian agriculture by using time series data of 28 years (1980-2007). The study indicates that agricultural activity comprising harvesting area (ha), yield (kg/ha) and quantity of production (ton) were

estimated to decrease by between 0.94-2.06, 0.43-0.61 and 1.2-5.5% respectively, due to the global warming. According to Vaghefi *et al.* (2011) the impact of climate change due to increase in temperature and carbon dioxide on rice production will give adverse implication on economic growth in Malaysia. The authors used ORYZA crop model to simulate rice yield data of MR 219 variety in eight granary areas of Malaysia from 1997-2007. Under the scenario of an increase in temperature by 2°C and the current level of CO₂ of 383 ppm, the model predicted a reduction in rice yield of 0.36 t/ha and subsequent the economic loss was estimated at RM162.531 million per year. If the temperature increases by 2°C in tandem with level of CO₂ increases to 574 ppm, there will also be a decline in rice yield by 0.69 t/ha and consequently the economic loss will be at RM299.145 million per year. The most acute challenge faced by this sector has been the shortfall in the production of rice commodities in meeting domestic demand (Khor, 2008). Consequently, it will cause the market price to rise due to shortage of supply and adversely affect the consumption level and consumer welfare. Mahmudul *et al.* (2010) found that a 1% increase in temperature and rainfall, would effect on current and next season paddy yield in the Integrated Agricultural Development Area (IADA), North West Selangor in Malaysia. They conclude that the contribution of climatic factors will decrease paddy yield in between 3.44, 0.03, 0.12 and 0.21%, respectively. Peng *et al.* (2004), report that yield reduction in rice mostly correlated with increased nighttime temperatures: grain yield decline 10% for every 1°C increase in growing-season minimum temperature in the dry season in irrigated tropical rice. The main concern is that, most of the vulnerable peoples to climate change are the poor and hard core poor who have relatively larger household member, including the East Coast states of Terengganu and Kelantan in Malaysia, projected to have large temperature and rainfall changes (Rawshan *et al.*, 2011). Furthermore, the good methods of adaptation to the changes in various climatic vulnerabilities are needed to avert any adverse effect on farmer livelihood sustainability and national food security (Alam *et al.*, 2012). Quantifying the impacts of climate change on agriculture is a challenging task because of large uncertainties in the regional climate change projection, in the response of crop to environmental changes, in the coupling between climate models and crop productivity functions and in the adaptation of agricultural systems to progressive climate change (Roudier *et al.*, 2011).

- **Population growth:** The total consumption of rice has increased from 2.7 million metric tonnes in 1985 to 4 million metric tonnes in 2009 because of the increasing population (Fatimah *et al.*, 2011). Another estimate states that rice consumption has increased from about 2.30 million metric tons to 2.69 million ton, from the year 2010 to 2020, with the growth rate of 1.6% (MOA, 2011). The growth

of the country's population is expected to reach 29.8 million in 2015, compared to 28.92 million in 2012 (Malaysia, 2010). This will affect the SSL level of rice in the country. To cater the requirement for staple food, SSL level of the country at 70% should be reviewed from time to time, considering food security, global market price and the relative cost of importing scenarios. It is projected that to support current population growth rate and self-sufficient level, Malaysia requires additional rice production by 1,320,000 tonnes per year to fulfil the 90% self-sufficient level in rice production for year 2060 (Al-Amin *et al.*, 2011). Increased consumption of rice is one of the challenges that must be addressed through strategic and holistic approach. Moreover, the increase in income and standard of living leads to changes in consumer tastes which is expected to have an impact on local food production industry.

- **Resources scarcity:** Land available for agriculture is becoming limited due to competition for industrialization, urbanization and expansion of residential areas so that the need arises to maximize land productivity. Fatimah *et al.* (2011) reveal that the reduction in paddy area expected due to the conversion of the paddy area to other agricultural and non-agricultural activities. Therefore, the original SSL target cannot be maintained together with the increasing demand from a growing population. At national level, the production of rice can only strictly accommodate 71.4% of their own domestic needs. Although the acreage of paddy planted increased by 2,956 ha (0.4%) in 2010 compared to 674,928 ha in 2009, but rice production decreased by 50,000 Mt (2%) which is 2,511 Mt in 2009 as compared to 2,464 million Mt in 2001. Meanwhile, about half of the eight granaries experienced reduction of production including KADA. The decline is approximately 8,814 Mt (4.2%) which is 0.2 million Mt at the year 2010 as compared to 0.21 million Mt in 2009. Due to a reduction in cultivated area of about 5,306, ha this (9.5%) is 55,921 ha in 2009 to 50,615 ha in 2010 apart beside form a season of uncertainty and natural disasters such as floods and droughts. It is the most common process which directly affects the relation between agriculture and climate change (Baharuddin, 2007).

The granary is an irrigated area and water is essential for rice cultivation and inadequate availability of water is one of the most important factors in rice production (Akinbile, 2010; Mondonedo, 2008; Rosegrant *et al.*, 2002; Akinbile *et al.*, 2011). Irrigated agriculture is a dominant user of water and helped boost agricultural yield and outputs, stabilize food production and prize. Most of the water use is for paddy rice irrigation. Rice production is highly dependent on irrigation. In fact, irrigation is used on a higher proportion (70%) of the agricultural land than anywhere

else in the world and it also covered 90% of irrigated rice area in East Asia (Iglesias *et al.*, 1996). However, the agricultural sector is expecting to face increased competition for water from other sectors in the future due to environmental considerations and economic growth (Chung *et al.*, 2011). Undoubtedly, water resources are renewable but limited resources. Efficient use of limited water resources, particularly for agricultural irrigation, will not only increase the producer's yield per unit of water, but also prevent such negative impact on environment as drainage, salinity and increase in the water level, resulting from the overuse of water (Yusuf *et al.*, 2010). Several studies have shown that water is the limiting factor in crop cultivation and that deficit irrigation has been widely investigated as a valuable strategy for dry regions (Fereses and Soriano, 2007).

In the context of Malaysia, the Agro Food Policy 2011-2020 (2011) emphasizes that the adequate water supply and water management systems will be enhanced to ensure the maximization of agriculture productivity. The rate of low-density water channels in the rice bowl of KADA is 18-20 m/ha will be further increased to 50 m by 2020 by the provision of drainage and irrigation infrastructure system. It is reported by estimated that about 3,000 farmers in KADA around Lemal and Kasar are facing the water supply crisis due to the drought (Syamsi, 2012). It is due to the water levels in eight major pumping stations are at critical point of 0.48-0.5 m compared to 1.06-1.07 on normal levels. This affects the water flow into the system and paddy production. In fact, farmers are faced with the water-rationing problem. If the drought persists, it will have adverse effect on 29,450 ha of paddy area and an estimated 10,000 farmers suffered a loss of RM150 million in the year. The irrigation system failure extremely caused high impact on the production and income of farmers. As reported by Bernama (2012), approximately forty-two farmers suffered about RM200, 000 when 60 ha of paddy in Kampung Gong Kulim, Kemasin Semerak IADA were destroyed by *Scotinophoracoarctata* (kutu beruang). Crops was attacked by the lice had dried up due to the heat that resulted in 70% pre-mature rice crop being destroyed. This failures lead to lice nesting in the stubble and difficult to control with insecticides. Plants become scorched despite all the efforts, including the intensive use of pesticides. The losses borne by farmers are for field rental, pesticides, oil and water pumps and wages for plowing. This requires immediate allocation of government of about RM51 million for technical support in the construction of the drainage system and replanting cost to the affected area.

Approach to ensuring the nation's food supply: The government has outlined a number of approaches and efforts in improving the productivity and stability of food production to ensure food production is

guaranteed. In the 10th Malaysia Plan, the government emphasizes strategic approach to food security, which aims to ensure the sustainability of the food supply, food accessibility and affordable food prices to the public. To ensure an adequate supply of rice, the government will maintain buffer stocks of rice at 292, 000 metrics tons to meet the food requirement for 45 days. Stockpile management mechanism will be improved to ensure more strategic management and cost-effective. Simultaneously, long-term contractual agreements for importing rice with matching agreement of oil palm and oil are signed. The government will also ensure that production yield could be increased by upgrading the existing infrastructure to improve the productivity in the granary and non-granary area.

An assessment of climate change and vulnerability on agriculture based on Global Circulation Model (GCM) and Crop Modelling (DSSAT) model by Al-Amin *et al.* (2011), conclude that government should follow three broad instruments.

These are such as:

- Management related instruments
- Infrastructure related instruments and
- Community (cbos and ngos) initiated instruments for long-term policy strategy to increase productivity of rice by 20% up to the year 2060. Fatimah *et al.* (2011) also suggests additional approaches to diversity policies enacted by the government to ensure the country's food security. Among the additional recommendations, include:
- **“Green revolution II” to increase rice productivity agenda:** Malaysia needs a transformation plan for research and development (R&D) to outbreak the green revolution innovation in paddy and rice industry. It should be supported with an extensive package and incentives development, skills development among farmers and provision of infrastructure facilities. The continuous support of funding and productivity target to produce new high yielding varieties, that could sustained the SSL targeted level to 70% in rice until 2020 under a changing environment (Fatimah *et al.*, 2011).
- **Strategic food industry development agenda:** It is proposed that the policy be formulated for the rapid development of strategic food industry such as fisheries, livestock, vegetable and fruits. However, the R&D agenda should be formulated based on advanced technology, with more comprehensive package of incentives, more professional development and supported by infrastructure and markets development.
- **Institutional restructuring agenda: Strengthening farmer/producer:** Restructuring of agricultural institutions is a potential reform agenda to increase food production in agriculture. Among the successful model of agricultural

institutions are cooperatives, farming groups and model creation such as crop estate of Malaysia under Federal Land Development Authority (FELDA), Federal Land Consolidation and Rehabilitation Authority (FELCRA) and Rubber Industry Smallholder Development Authority (RISDA). However, the government with a comprehensive support and assistance drives this model. It is proposed that an alternative model in which farmers/ producer's cooperatives and capabilities are reinforced through institutional structures that promote their self-reliance based on entrepreneurship. A proven model of cooperative as a leading producer and consumer institutions are found in developed countries such as Taiwan, Korea and Japan. Malaysia has a strong base towards the restructuring of agriculture cooperative since this institution has been established long ago with relative success. However, the agenda for strengthening cooperatives as independent entities, as "develop for the benefit of the member to member" need to be implemented.

- **Increase investment in the food sector:** The decline in food sector investment is a factor that systematically leads developing countries including Malaysia to experience a slowdown in the industry. It is proposed that the investment and provisions for food sector is enhanced in accordance to the importance of this sector for security and growth.
- **Safety net program:** Malaysia showed an excellent track record in dealing with the food crisis with the fluctuation of food prices through price controls and other market support. However, a more comprehensive safety net and inclusive program is needed to improve the quality of food and nutrition for children and families of the poor and marginalized.
- **Agenda of sustainable food consumption:** The average post-harvest loss of food in Malaysia is high reaching over 20%. Sustainable use of food is encouraged by reducing post-harvest losses and excess waste. Recycling of waste is recommended to produce high-value by-product to be channelled back to the production and consumption system. Processing and marketing activities expanded to increase the value-added commodities and food products.

CONCLUSION

The establishment of KADA and IADA's an effort to ensure the self-sufficient country is assuring. Through the upgrade paddy production program, collaboration between organizations can be realized through the combination of expertise and the provision of subsidies and incentives to ease a burden of farmer's production costs are among the strategies in their effort

to strengthen National Food Security as targeted under the Agro-Food Policy (2011-2020). However, the challenge in the global and domestic such as natural disasters and climate change factors are inevitable. Furthermore, research and development in food security should be holistic and inclusive other noteworthy. The systematic farm management practices and right along the chain growth of crops must be emphasizing to ensure the food production is guarantee. Efforts to enhance food security at the national and household level are deserving of support from all sectors.

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