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Research Article

Impact of El-Niño on Agro-economics in Malaysia and the Surrounding Regions: An Analysis of the Events from 1997-98

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Abstract

This study explores the influence of El-Niño related climate change that impacts the development of agriculture sector in Malaysia. In order to identify the impacts, this study analyzes the information of El-Niño events from 1997-1998. This would offer of having a standpoint to formulate the future strategy with an understanding of the nature of El-Niño and its vulnerability which has been hit by the Pacific Rim region and the Southern oscillation, including in Malaysia. Since, the currently available researches are inadequate to observe the events of El-Niño, formulation of strategic planning is mainly based on assumption and hypothetical projection locally. Under such climate, this study proposes the 'Action plan' for furthering the strength by chalking-out the prevailing weakness of adapting capacity of El-Niño and its adverse impact on agriculture. The proposed action plan ultimately offers the socio-economic wellbeing in Malaysia by significantly reducing the vulnerability of El-Niño and enhancing the performance.

Key words: El-Niño, climate change, agro-economics, impacts, agriculture

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INTRODUCTION

The criteria of El-Niño* and their schemata complexly impact the production cycle of agriculture of all regions of the earth^{2,3}. The events of El-Niño are neither uniformly co-related by the phenomena, nor based on comparisons. This also doesn't bear the connections of knowledge of physical record and archival information accumulated from the historical periods^{1,4-8}. A significant number of researches provide attention to understand the nature of the short-term to long-run climatic variations and their effects on the complex ecosystems⁹⁻¹⁴. However, there are numerous of number of disputes and controversies on the short-term to long-run climatic variations, relating to the interactions amongst environmental system, atmospheric composition, climate, terrestrial ecosystems, monsoon, usage of land, coverage change of land and the nonlinear processes¹⁵⁻²⁰.

In order to establish a single case, many studies refer to the knowledge of physical record and evidence by ignoring the need of multiple dimensions, which develop various disputes controversies, deviation and uninformed phenomenon²¹⁻²⁹. Therefore, current and future researches should provide extra attention on multiple dimensions and across-disciplines shifting from single-ism, in order to overcome the historical ununiformed phenomena, disputes and deviations of El-Niño. Thus, a decent and in-depth understanding on the nature of historical ununiformed phenomena and deviations and the climatic obstacles associated with the probable actions is a fundamental requisite for developing the successful research tools. Since by nature, the developing countries are more vulnerable compared to their developed counterparts, subsequently-in determining the impact of El-Niño, researchers and legislators should acknowledge those issues that are critically vary from one region (country) to the others. The same tenet also applies fir different economic sectors, particularly in agro-industry as agriculture is one of the key economic sectors that highly susceptible to the influences of climatic inconsistency and El-Niño. Principally, the agricultural productions, rural incomes, food prices, farmers socioeconomic conditions, employments and losses of value and supply chain to other sectors in many parts of the world are already explored various times to find the link between the vulnerability and the impact of El-Niño as agro products and yields are highly related to climatic

conditions. The related scientific studies are by Cane *et al.*³⁰, Phillips *et al.*³¹, Podesta *et al.*³², Kapuscinski³³, Zhang *et al.*², Roberts *et al.*³ and Deng *et al.*³⁴.

The El-Niño is widely recognized as an important factor of climate variability in the Pacific Rim region and Southern oscillation, which is also known as ENSO³⁴. The ENSO typically carries irregular climate variability to Northern Pacific Rim region and Southern oscillation and influences the atmospheric circulation. It subsequently triggers low precipitation weather patterns and exists a southward shift of the West Pacific subtropical high El-Niño events. The uneven condition also found in the climate variations due to the complex relations between the monsoons and climatic system in the Pacific and Southern oscillation and that uneven condition appear in Asian and Southeast Asian regions. El-Niño has other footprints, such as of 1997-98 events when Lidonesia was severely affected for a shortage of rainfall and but drought and India escaped it. These appeared very clearly and perceived from archival records in Southeast Asia and noticed that the passages of climate disrupted the normal functioning and subsistence in duration, consequences, forerunners and impacts¹. There are several studies referred to these El-Niño-Southern oscillation events for the Asian and Southeast Asian regions^{2,3,33,35,36-42}. The El-Niño event in 1997-1998 was severe compared to recent other El-Niño events in nature and namely sea surface temperature anomalies (SSTAs) typically lead to delayed onset of the monsoon and results in droughts in the in the Pacific Ocean and impacts have been observed in Southeast Asia and Lidonesian regions^{2,43}.

To the best of our knowledge, there are insufficient scientific researches done on the events of El-Niño for the local research communities**, particularly to observe the ununiformed phenomena, appraisals and influences on the climatic system. As the El-Niño conditions and agricultural yields are interrelated and highly sensitive to climatic conditions, thus it is essential to establish the interactions between El-Niño and agriculture to identify the cause of effects. Therefore, this study was engaged as a way of viewpoint for future action and strategy by knowing the nature of El-Niño and its impacts on agriculture that has been hit in the Pacific Rim region and the Southern oscillation in 1997-98, including in Malaysia, which had a weak adaptive capacity (Fig. 1). Thus, some suggestions were present

*Every few years, sea surface temperature in the east equatorial Pacific ocean becomes warmer and the centre of the West Pacific warm pool migrates Eastwards, so that the walker circulation ceases or reverses and rainfall patterns and atmospheric circulation changes significantly in both tropical and temperate latitudes. Times when Eastern Pacific sea surface temperature is anomalously warm are referred to as El-Niño¹.

**The insufficient researches are referred as agricultural sectors and related to socioeconomic impacts.

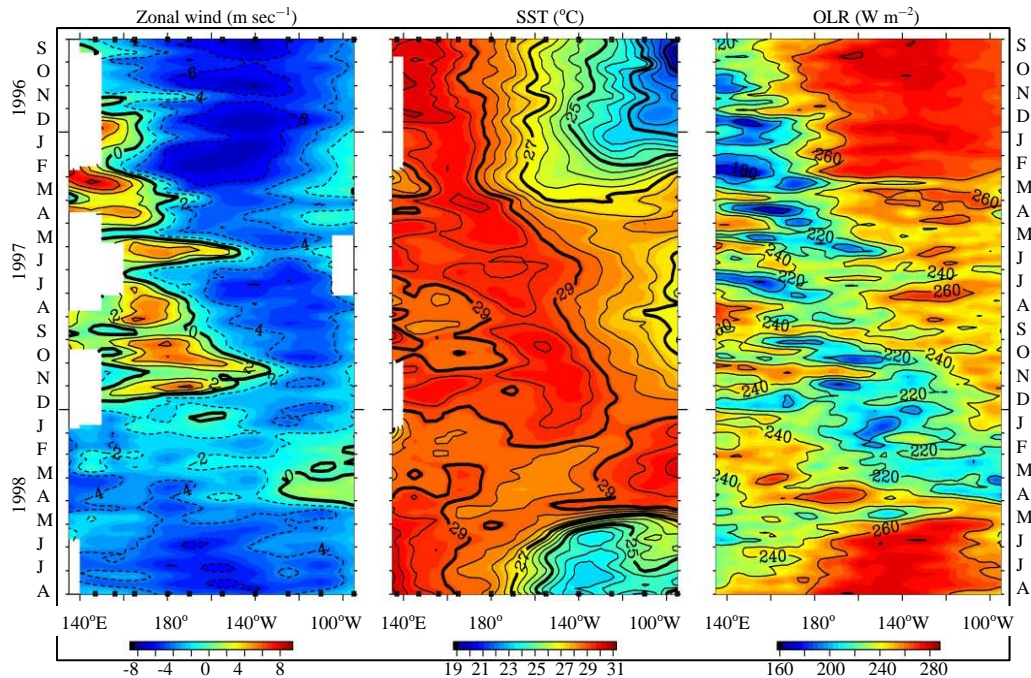


Fig. 1: El-Niño events: the zonal wind, SST and OLR in year 1997-98, source: Various sources

regarding how the existing weak adaptive capacity of El-Niño and agriculture in Malaysia can be overcome and strengthened further. The attention is mainly paid in overall rice, oil palm and horticulture sector. In doing so, the tasks associated with the implementation preferences based on the impacts and the provisions to seek for an insight view about the future direction for the policy makers were discussed.

MATERIALS AND METHODS

Climatic observation (1997-98 events): The warming trends in the Pacific during an El-Niño event always contribute to higher impacts and that was the incident in 1997-1998, catastrophically so. Historically not all El-Niño events are the same affects globally, but one particular place can be adversely affected. This kind of incidence can be observed in 1997-98 event and the incident is an ununiformed in nature and that is the concern. It is evident from SST anomalies and related research works that the El-Niño event in the year 1997-1998 was the worst in the recent times and Southeast and East Asia endured one of its worst droughts due to the El-Niño event (Table 1). Particularly, Malaysia recorded the hottest temperature effects (record with a 40.1°C/104 F) and results in abnormally dry conditions with droughts. Figure 2 shows the El-Niño events and temperature variations in 1980-2014 and Fig. 3 shows the El-Niño events with winds and SST anomalies from year 1995-2014 where, the El-Niño events and its subjects to the temperature

Table 1: Historical El-Niño events from year 1952-2010

| El-Niño events and classifications | | |
|------------------------------------|----------|---------|
| Weak | Moderate | Strong |
| 1952-53 | 1951-52 | 1957-58 |
| 1953-54 | 1963-64 | 1965-66 |
| 1958-59 | 1968-69 | 1972-73 |
| 1969-70 | 1986-87 | 1982-83 |
| 1976-77 | 1991-92 | 1987-88 |
| 1977-78 | 1994-95 | 1997-98 |
| 2004-05 | 2002-03 | - |
| 2006-07 | 2009-10 | - |
| 2013-14 | - | - |

Source: Various sources and author compilations

anomalies can be observed. There are a good number of recent studies carried out worldwide to observe those impacts and phenomena of El-Niño in terms of economic losses and vulnerabilities^{2,3,40-42}. Particularly, some studies addressed the impact and some identified differentiation between risks and vulnerability by the procedural approaches and some others addressed only modelling dimensions.

However, the studies of El-Niño related natural disasters are inherently complex and deal with important methodological complexities and problems as the events of El-Niño are not uniformly based on incidence, nature and influences. The physical record and archival information from the historical periods are engaged to observe the problems and densities. The researchers are continually working to that end and the variety of climatic observation and many recent studies are addressed the important methodological distress

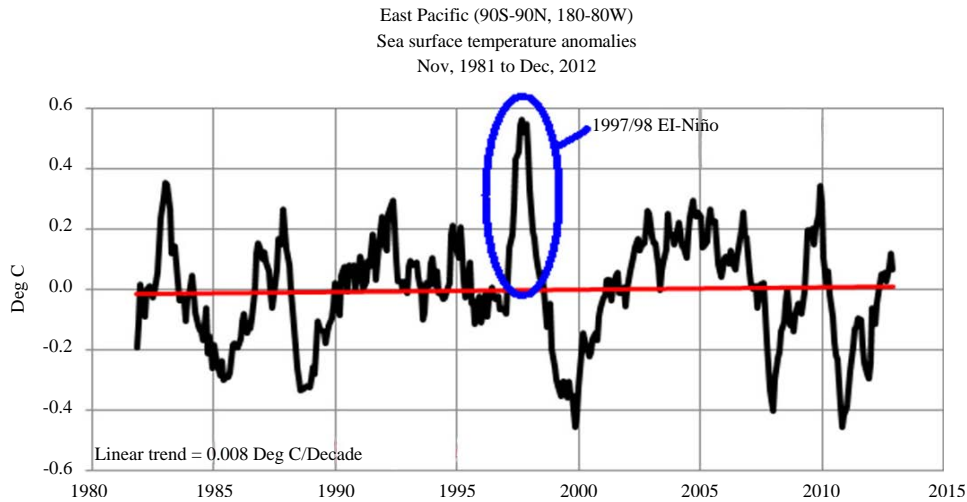


Fig. 2: El-Niño events in year 1980-2014, source: Various sources

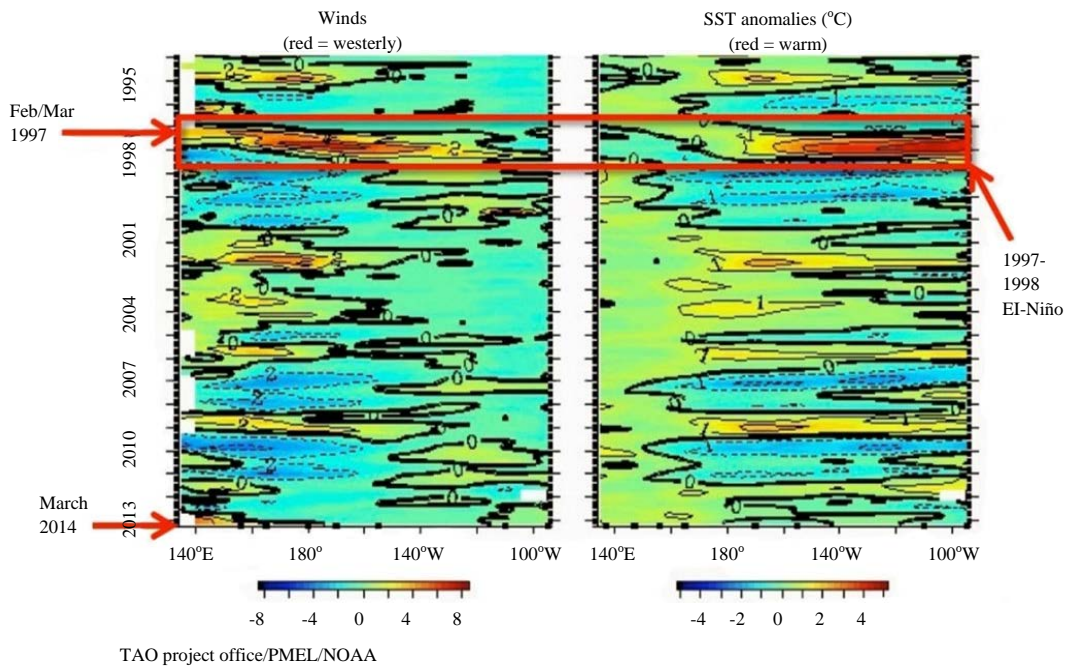


Fig. 3: El-Niño events with winds and SST anomalies in year 1995-2014, source: Various sources

to El-Niño related natural events. Particularly, recent study considered how uncertainty regarding when, to what degree and how it would affect areas of potential risk despite the overall predictability have been addressed in many recent related phenomena^{2,3}. Despite, the efforts are placed, but there are still many uncertainties on the climatic observation in 1997-98 events and beyond and there are differences to observe the 'Trend' on the Pacific reasons for the El-Niño events. The 'Trend' is important as using it in the different methodologies can indicate the risk and vulnerability

of different areas based on influences and susceptibility and it can show the guided policies aim to prevent from the potential future events.

The same goes to agriculture in particular and its related sectors but the question is-what about Malaysia? There are a few numbers of researches are placed for the agriculture and agro based sectors worldwide, but those are not sufficient for Malaysia. Thus, the climatic observation for historical El-Niño events and particularly 1997-98 event is an important issue in Malaysia to know the right action and right measures

about the potential risk in the likely future effects in the different areas. As the issue is a great concern for the local sub-tropical basis, but unfortunately there is a huge lacking to the scientific findings, particularly to understand the effects of agricultural drought, economic and socioeconomic aspects of the 1997-98 El-Niño event. From an economic perspective, as the El-Niño, agricultural yields, agricultural drought, supply side shock are interrelated and highly sensitive to climatic conditions, but there is no scientific study is available to give the indication from the viewpoint on the exogenous supply side shock from the El-Niño. Now the time has come to act on it and needs to find how El-Niño effects on the environment, society and the economy both in direct and indirect ways. Thus, the following section discusses the economy-wide perspective and related issues particularly addressing on agriculture.

RESULTS AND DISCUSSION

The effect of El-Niño on agricultural is considered as exogenous, which is a like as supply side shocks and directly affect the agricultural production. The El-Niño event in 1997-1998, effects on agriculture in the local sub-tropical region that hit the agricultural productivity and directly sharp reduces the production and the losses associated with declines in rural income and employment. The recent scientific incidence we can observe as droughts due to El-Niño event in Malaysia and caused droughts as severe disasters and resulting in a short-fall in rice production and prolonged water rationing in most parts of the state in Selangor. Particularly, the 1997-98 El-Niño had resulting in a short-fall of rice yields that necessitated the import of over million tons to safeguard food availability in Malaysia. It had also the extensive impact on the environment and society due to due to the prolonged dry conditions and caused threatened many parts including Sabah and Sarawak. The similar impacts we can also observe from the case of Indonesia, China and Philippines. The economic implications of 1997-98 El-Niño for Indonesia was also severe and resulting over five million tons of rice imports to balance food availability to the economically weaker society.

Not only in the rice, there are scientific references on the El-Niño effects on palm oil production. The 1997-1998 El-Niño had also resulted in a short-fall palm oil of yields in Malaysia

and El-Niño pattern decline production by 15%^{***}. The similar effect of El-Niño events have impacted on oil palm production in Indonesia and in the region even though there are some evidences of conflicts, lagged on impacts of oil palm yields. The scientific query is straight as the El-niño related climate variability stretch on the period of time and impact on output and production but in a delayed manner. The optimal condition for palm oil production depends on the rainfall without dry periods of more than a month ranging from 1,500-4,000 mm a year. Once there is a variation of rainfall, the palm oil production fluctuates. Particularly, if there is a shortage of rainfall of 100 mm over two consecutive months, then yields reduce output by 5%[†]. The yields may reduce up to 20% if there is a longer drought due to inconsistent El-Niño events. There was an impact also in the horticulture sector and it is estimated that the El-Niño Southern Oscillation (ENSO) 1997-1998 episodes in Malaysia have resulted in 16.8-21.0 percent loss⁴⁶.

There are sometime inconsistencies found between agricultural yields and the occurrence of ENSO event in 1997-1998 and the causes behind the correlations are still incomplete to the research communities. However, the overall effects on related socioeconomic conditions resulting from inclement climate are due to the lacking in proper infrastructure to deal with the incidents and due to lacking of awareness development⁴⁴. This lacking was observed in many related scientific researches. However, the evidence we observe from the Malaysia, Philippines or china's perspectives as the ENSO climate variability effects on the water supply in the rice production system and results in production loss. Particularly, as the food security is concern in Malaysia the El-Niño events are a research and public interests to understand the agricultural productivity and its relations to climate change. In addition, the lacking of the interaction between human adaptation practices and climate variability to assessing climate change impacts are totaling additional burden on agriculture. The similar observation of lacking is factual for Malaysia, Indonesia, Philippines and in the sub-tropical and local region. The direct impacts are obvious for agriculture and forestry sectors, but there are some indirect effects on tourism, transportation and public health that are referred in some scientific literature and that must be brought in the future research agendas.

It is evident and obvious that particularly, the 1997-1998 El-Niño event brought widespread direct economic losses across Southeast Asia, including Malaysia and the total estimated loss was about RM12.87 billion. The local evidence

^{***}However there are some disputes of palm oil yields and temperature increases anomalies, temperature, the critical magnitude and extent of geographical distribution⁴⁴.

[†] The water requirement needs to increase by 10% to counter balance the production loss for a 1 °C increase of temperature⁴⁵.

shows that peninsular Malaysia and Sabah was heavily affected for the 1997-1998 El-Niño event and the affect areas where, more than 2,797 km² and 170,000 people including 7,200 farmers were directly affected. The direct economic loss was estimated at least approximately RM87 million and rice, oil palm and horticulture sector were heavily affected. However, the indirect losses were undoubtedly more as the other economic sectors are interrelated with agriculture. It is obvious that the indirect effects are important factors within the socioeconomic community to identify different types of risks that are indirectly associated with El-Niño events and how they generate degrees of vulnerability from one event to the other in the society.

An appropriate knowledge of the correlation between 1997-1998 El-Niño event, crop yield, future action and strategy is important because correlation can potentially provide insight into the future impacts of El-Niño or ENSO events and effective remedial measures. There are a good number of models have been developed for the known El-Niño events in the past using relatively reliable oceanographic and meteorological data to find the correlation. Even though there are some disputes and disagreements on the issues modeling scenarios and forecasts for the future as the future are relatively uncertain for the longer run option, but the apparent outcomes are effective to know the major climatic fluctuations for the action guidelines. However, to have a successful strategy, apparently the most difficult aspects of El-Niño to the forecasting option and its duration, rapid development and the intensity of El-Niño and that should be research interest in Asian tropical and sub-tropical regions, particularly in Malaysia.

The importance of El-Niño forecasting in the Asian tropical and sub-tropical regions are too significant to estimate as those economies are dependent directly and indirectly on agriculture and agricultural production. There is a modest progress made over the years in Malaysia to get the scientific understanding of El-Niño events and the causes, but still there are gaps to know the frequency of extreme El-Niño patterns and how irregular El-Niño may affect in the Southeast Asia region. However, the scientific researches of El-Niño events on the pure science basis are still better compared to social-science aspects in Malaysia. There is hardly any scientific evidence on the issues of socio-economic aspects and what are the direct and indirect linkages of El-Niño events to the socio-economic aspects, particularly looking at the El-Niño events on the agricultural and socio-economic matters. Therefore, the real impacts of El-Niño and its effects on agro based sectors are lagging behind and in addition, the indirect multiplier impacts to the overall

economy are far behind to know. There are however, few studies are prepared by the foreign researchers and on the regional basis[‡] but the impact information is tiny to the Malaysian case. In addition, the sectoral information on the socioeconomic issues is unable to figure out. Thus, specific and accurate scientific research must be done by looking at the El-Niño events on the agricultural and socio-economic matters in Malaysia.

CONCLUSION

This study has shown that El-Niño related to climate change offers many negative impacts on the agriculture sector in Malaysia. Particularly, the agriculture sector is inherently sensitive to climate variability and thus Malaysia needs to have a strong focus on effective agricultural adaptation guidelines to mitigate and lessen the El-Niño impacts. This research also confirms that with the dearth of local researches for many decades to observe the events of El-Niño from multiple angles, this research also failed to provide a comprehensive strategic guideline. However, this research with a short-span of time importantly identifies the need of conduction of regular studies on the events of El-Niño. The research further advocates that to lessen the irregular El-Niño impacts, rigorous continuous research should be conducted in agricultural sectors included in all socioeconomic aspects as they are in lacking in guided knowledge and the threat of impact and vulnerability in the long run is incredibly huge.

Acknowledging the unavoidable and inevitable limitations of this short research period, may we note that the government and all stakeholders should work with close collaboration in order to promote further adoption provision and to improve the adaptive capacity on El-Niño as a long term priority. In conclusion, it is record that a single appropriate and accurate approach to climate change for lessening the El-Niño impacts is yet to be invented, it is thus, continuous research for the further development is only the means to tackle; by identifying the best alternative.

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[‡] The reference study is done by Suresh⁴⁵ on adaptation and mitigation strategies for climate-resilient oil palm. Climate-resilient horticulture: Adaptation and mitigation strategies: Singh, Harish Chandra Prasad, Rao, Nadipynayakanahally Krishnamurthy Sriniv, Shivashankar, Kodthalu Seetharamaiah Eds. Springer.

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