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# Paddy and Rice Sector Policy Roadmap: Towards Equity and Sustainability

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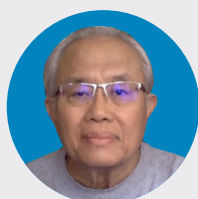
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## Abbreviations

<b>ABDP</b>	Area-Based Decoupled Payment	<b>MAFI</b>	Ministry of Agriculture and Food Industries
<b>APs</b>	Approved Permits	<b>MAX</b>	Maximum
<b>BERNAS</b>	Padiberas Nasional Berhad	<b>MIN</b>	Minimum
<b>BN</b>	Barisan Nasional	<b>MOA</b>	Ministry of Agriculture and Agro-based Industry
<b>COV</b>	Coefficient of variation	<b>MyCC</b>	Malaysia Competition Commission
<b>DOSM</b>	Department of Statistics Malaysia	<b>mt</b>	metric tonne
<b>EPP</b>	Entry Point Projects	<b>mr</b>	milling rate
<b>ESG</b>	Environmental, Social and Governance	<b>NAFAS</b>	National Farmers' Association
<b>ETP</b>	Economic Transformation Plan	<b>NKEA</b>	National Key Economic Areas
<b>EU</b>	European Union	<b>OECD</b>	Organisation for Economic Cooperation and Development
<b>FAs</b>	Farmers Associations	<b>PEMANDU</b>	Performance Management & Delivery Unit
<b>FAMA</b>	Federal Agricultural Marketing Authority	<b>PH</b>	Pakatan Harapan
<b>FAO</b>	Food and Agriculture Organization	<b>PN</b>	Perikatan Nasional
<b>FOB</b>	Free on Board	<b>R&amp;D</b>	Research and Development
<b>FOs</b>	Farmers Organisations	<b>RSS</b>	Rice Stockpile Scheme
<b>GMP</b>	Guaranteed Minimum Price	<b>SD</b>	System Dynamics
<b>GNI</b>	Gross National Income	<b>SME</b>	Small and Medium-Sized Enterprises
<b>GTP</b>	Government Transformation Programme	<b>SP</b>	Selling Price
<b>IADA</b>	Integrated Agricultural Development Area	<b>SSL</b>	Self-sufficiency Level
<b>IADP</b>	Integrated Agriculture Development Area Penang	<b>SST</b>	Super Spesial Tempatan (rice variety)
<b>IDEAS</b>	Institute for Democracy and Economic Affairs	<b>STE</b>	State Trading Enterprise
<b>IFAD</b>	International Fund for Agricultural Development	<b>WTO</b>	World Trade Organization
<b>IMF</b>	International Monetary Fund		
<b>IPB</b>	Bahagian Industri Padi dan Beras		
<b>KADA</b>	Kemubu Agricultural Development Authority		
<b>KETARA</b>	Northern Terengganu Integrated Agricultural Development Area		
<b>KPIs</b>	Key Performance Indicators		
<b>LPN</b>	Lembaga Padi Beras Negara		

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## Preface

Malaysia's paddy and rice industry has been under a protectionist regime for five decades since 1971. The premise for the policy was based on the assumptions that the market was structurally defective to withstand the challenges of world market volatility and instability, which resulted in food insecurity. The interventionist instruments, which lasted until today, include a state trading enterprise (STE) monopoly to import rice, price controls (farm and retail), and subsidies (input and output). As expected, the industry reveals a typical syndrome of a highly protected industry, such as distortive market, slow growth and inefficient use of resources.

When Malaysia's political coalition Pakatan Harapan (PH) succeeded the Pakatan Rakyat (PR) coalition in forming the government in 2018, PH pledged to liberalise the rice import market to allow for more competition. In line with this, IDEAS took the initiative in 2019 to study the role of an STE in food security in Malaysia. The study by IDEAS made several broad recommendations for a more progressive paddy sector through market reformation, such as market deregulation in the paddy and rice import sector.

However, in March 2020, a new government was formed by a new coalition called Perikatan Nasional (PN). PN reversed the decision on the liberalised import stance of the PH government. It extended the government's 10-year concession to Padiberas Nasional Berhad (BERNAS), the privatised body responsible for facilitating the local paddy and rice sector. The concession agreement, which was due to end in January 2021, was extended for another 10 years until 2030. Nevertheless, the issues besetting the industry remain relevant regardless of the change in government and its policy.

This study, conducted from August 2020 to February 2021, attempted to examine further the implications of several market deregulation initiatives in the paddy and rice sector outlined in the IDEAS report, and provided a broad roadmap towards the implementation of the recommendations.

The outcome of this exercise will not only enrich the body of knowledge on the paddy and rice sector, but hopefully will also encourage further intellectual discourse to provide Malaysia with much needed evidence-based input to spur future institutional change towards a more equitable and sustainable paddy and rice sector.

## EXECUTIVE SUMMARY

### 1. Introduction

This study is an extension of the previous study conducted in 2019 by IDEAS. Titled the “Effectiveness of State Trading Enterprises in Achieving Food Security: Case Studies of BERNAS in Malaysia and BULOG in Indonesia”, the study made a number of policy recommendations to transform the sector towards a more progressive, equitable and sustainable industry. As a result of the follow-up study carried out in 2020, we now produce this report that translates those recommendations into a policy roadmap, which will serve as a guide to policy makers, as well as a framework for further intellectual discourse.

### 2. Problem statement

The study done by IDEAS proposed several recommendations, which we re-categorise into four major areas, namely: (1) market deregulation; (2) the National Rice Stockpile; (3) collective action; and (4) establishment of The National Rice Board. Under market deregulation, this study proposes the deregulation of farm subsidies and import.

Deregulating farm subsidies will be implemented in stages. In the first phase all input subsidies will be converted to output-based subsidies with the aim of incentivising farmers to increase their output and saving administrative costs of procurement and distributing inputs by the government. In the following phase, the link between the government payment and farm output will be severed. Initially to compensate for the output-based subsidy withdrawal, the payment by government will be called the compensation, although its value is referred to the value of the previous output-based subsidies.

In the next phase, the temporary link between the compensation and output is severed. In some countries the basis for payment is shifted to farm size and, perhaps, the economic status of the farmers. More importantly farmers are free to make their own decisions regarding crop choice and input use. This will enhance farmers’ entrepreneurial and decision-making capacity that will lead to greater farm productivity and income. Due to the reference to the farm and payment not being linked to output, the payment is called Area-Based Decoupled Payment (ABDP).

ABDP is a fixed and guaranteed payment, which is not influenced by ex-post realisations of market conditions. To be practical, some form of requirements may be attached to the payment. In some countries it may be linked to the adoption of sustainable or environment-friendly farm practices. In Malaysia, to guarantee a certain output of local paddy and rice production, the condition to be attached is in the form of minimum output of paddy.

The second component in market deregulation involves the abolition of the single importer policy. This can be implemented by allowing more importers into the industry. This, however, entails the examination of the impact on the so-called “social obligations” of BERNAS.

### 3. Objectives

The main objective of this study is to present a roadmap towards implementing the recommendations presented in the first study by IDEAS.

The specific objectives of this study are:

1. to examine the impact of an output-based and direct compensation payments on producers' net revenue and yield;
2. to derive the local price of rice under a deregulated market;
3. to review the institutional proposals, such as stockpile management, collective action, and the setting up of a "National Rice Board"; and
4. to describe the policy road map encompassing the said proposals.

### 4. Methodology

The study primarily uses the System Dynamics (SD) approach to realise the above objectives. Small SD models have been used in other studies to assist policy deliberations. Where relevant, the underlying procedures in the SD simulations will be illustrated by simple (and static) Spreadsheet calculations. This is evident in the explanation for the calculations involved in the transitional phases from input-based and output-based subsidies to direct compensation and ABDP system under the deregulated subsidies scenario. Another illustration is in the flow of FOB rice prices from importers and wholesalers to retailers, and from wholesalers to millers, as well as paddy prices to farmers under the deregulated import scenario.

System dynamics analysis is applied to simulate the impact of those payments on farmers' yield and net profit and changes in import price on the local rice prices and stockpile management. The study uses prices from IMF<sup>1</sup> (world rice price) and related data, as well as parameters from the Paddy and Rice Division or Bahagian Industri Padi dan Beras (IPB) under the Ministry of Agriculture and Food Industries (MAFI).

### 5. Findings

5.1 Market deregulation: Subsidy withdrawal and implementation of output-based payment, direct compensation and ABDP.

5.1.1 **Despite the subsidy withdrawal, the three payments yield similar net farm return to farmers as in the current situation.** Using the current level price (guaranteed minimum price or GMP), cost of production and subsidies, the study derives the probable level of output-based payment, direct compensation and ABDP. The study shows that the three payments can provide the farmers a similar level of net farm revenue and help maintain them in production without the subsidies (input and output).

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<sup>1</sup> IMF – International Monetary Fund at <https://www.imf.org/en/Research/commodity-prices>.



5.1.2 **The benefits of the three payments may outweigh their cost.** Although the study does not measure the impact of the three payments, the benefits of such payments should not be under-rated. Based on the experiences of other countries<sup>2</sup> the potential benefits to Malaysia may include : (i) farmers are given the freedom to decide what is best for their farms in terms of input use, which may improve efficiency and develop entrepreneurship; (ii) allow farmers to participate in the market economy; (iii) lesser administrative and bureaucratic hassles to the government and more resources can be channelled to productive efforts, such as R&D and extension and training, infrastructure and institutional development; (iv) ABDP secures the farmers to remain in paddy production; (v) facilitate budget planning as the amount required is known in advance; (vi) help improve land registry; (vii) reaching out to poor farmers; and (viii) can be used to encourage sustainable practices.

## 5.2 Deregulation of import: Impact on domestic prices

Malaysia is a price taker in the world rice complex, hence when import, domestic supply and markets are deregulated, the domestic rice price moves in tandem with the world price. The simulation shows a deregulated import market reduces the revenue for the producers due to the high cost of production. This indicates that support from the government is still needed to improve competitiveness by increasing yield and reducing cost of production. When world price is trending up, consumers may have to pay a price. However, the high price may not hurt that much as the share of rice in monthly expenditure is about 1.1% or RM44/month in 2016<sup>3</sup>. Hence under such a situation, the government may have to provide support to selected needy groups.

## 5.3 Buffer stock

5.3.1 **The major issue with regards to the stockpile is the quantity to be maintained at any point in time to address a rice crisis or emergency.** Since 2018, the stockpile quantity had been reduced to the current 150,000 tonnes and on 3 Dec 2020 it was reduced further to 140,000 tonnes<sup>4</sup>. Based on 2018 consumption figures, this quantity can support 22 days of rice consumption. Simulations are made to assess the stock coverage (i.e. the consumption days) associated with the stockpile, and its ability to withstand shocks in rice supply, domestic production and imports.

5.3.2 Two simulations are carried out to test the impacts of disruptions in supply and changes in the safety or public stock level on total stock and stock coverage. The first set of simulations is concerned with supply disruptions, which are:

1. S1: disruptions in domestic rice production;
2. S2: disruptions in the import of rice; and
3. S3: (i) and (ii), simultaneous disruptions in domestic production and import supply.

<sup>2</sup> See Allen (2016) for comparison between countries and other countries' experiences include: Korea (Choy and Myers 2016, Choy and Myers 2015), Spain (Arriaza et al., (2006) and Greece (Rozakis et al., 2008)..

<sup>3</sup> Department of Statistics of Malaysia, Household Expenditure Survey (2016).

<sup>4</sup> Under the new agreement between MAFI and BERNAS signed on 3 December 2020 (Sinar Harian, 2020), the stockpile level has been reduced to 140,000 mt.

The second set refers to simulations on the impact of changing the safety or public stock on the total stock and stock coverage. The simulations are as follows:

1. S4: A one-third reduction of the current level of safety stock to 100,000 mt; and
2. S5: An increase of one-third of the current level of safety stock to 200,000 mt.

**5.3.3 The study indicates that the current stockpile system handles shocks reasonably well** The first set of simulations is to examine the impacts of disruptions in supply, in the form of reductions (by 50%) for two months of the year (April and May) of local production and of the availability of imports. The scenarios were examined individually and simultaneously. In all cases, the current system is found to be robust and resilient in being able to withstand such shocks. In fact, the system recovers to the pre-shock state in a matter of a few months. This is probably due to the relatively large level of total stocks in the system.

**5.3.4 The determination of the stock level depends on the level of trade-off between the cost of storage and stock coverage the country is willing to bear.** The second set of scenarios involves the reduction and increase of 50,000 mt to the base safety stock level of 150,000 mt. As expected, the reduction resulted in a decrease in stock coverage by 0.24 month (7.2 days) and an increase by the same amount to the stock coverage. Recalling the base level stock coverage of 1.295 months (33.4 days), the question of whether the extra 7.2 days of stock coverage is worth the extra cost of RM8.3 million is a legitimate one.

#### 5.4 Collective action

The government has initiated a number of collective action models to help address the “small and inefficient” farms issues. These include group farming, paddy semi-estates, paddy estates and the latest are paddy estate projects classified as Entry Point Projects (EPP 10 and EPP11<sup>5</sup>). Based on two case studies (MADA and KADA), collective action is feasible to amalgamate small individual paddy lots to a bigger size for increased operational efficiency.

The study proposes a new generation of integrated cooperatives, which facilitate and encourage farmers to be involved in agribusiness and value-added activities to improve their income.

#### 5.5 The National Rice Board

An industry like paddy and rice requires a strong National Rice Board to undertake the functions of planning, regulating and monitoring and evaluation of the industry performance. This study proposes that the Board takes a systems view of the industry which can be regarded as a complex system as it involves a number of elements that are inter-connected in a feedback loop manner. These elements include: climate, natural resources (particularly land and water), technology, urbanisation, market fundamental, multiple stakeholders and other technical factors. Rarely do these elements work independently because they are inter-dependent in a circular causality. Under such a situation, a systems view with stakeholder participation in decision making is necessary to derive optimal solutions.

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<sup>5</sup> *Economic Transformation Programme (ETP) (2010).*

## 6. The Roadmap

In charting the roadmap, it is imperative to set a new vision for Malaysia's paddy and rice sector. The proposed vision:

### *Moving towards a growing, equitable and sustainable rice industry*

The interpretation and roles of the components of this new vision are as follows:

**Growth:** Sectoral expansion and advancement to produce healthy, affordable and diversified rice and rice-based products of high quality and standard for consumers and users.

**Equitability:** Equitable distribution of profit among the market participants for inclusivity and integration.

**Sustainability:** Eco-friendly paddy and rice production to preserve the country's environment and natural resources.

The goals of this new vision:

1. To empower farmers with entrepreneurship under a market economy.
2. To nurture Small and Medium-Sized enterprises (SMEs) to drive value-added industries.
3. To create a fair and healthy competition and equal market opportunities at all market levels, which include input (agribusiness), services, milling, wholesale, retail and import sub-sectors.
4. To adopt environment-friendly farm practices, precision farming, low water footprint paddy production and circular-economy application.

Transformation towards a deregulated market should be carried out smoothly in stages to minimise disruption. Subsidy withdrawal may be replaced first with an output-based payment, followed by less distortionary payment called compensation and an area-based payment to allow freedom to farmers to decide the best input combination for their farms. The public money saved can be used for capacity building, such as local input development (fertilisers, seeds, small machines, infrastructure, and high-tech farm applications), extensive digitalisation, paddy and rice-based SMEs, forward and backward integrated farmer cooperatives or associations and an efficient and progressive National Rice Board.

We would like to emphasize the participation of selected stakeholders in selected regions in the implementation of the recommendations on a trial basis. This would give valuable opportunities to manage unforeseen challenges and provide valuable opportunities for improvement in the implementation of the recommendations. We also believe that there is no one-size-fits-all policy the design of the recommendations to incorporate regional variations will definitely improve the adoption of the recommendations when implemented nationwide.

The convergence of these elements may reverse the decades of slow growth towards a virtuous circle of dynamism and sustainability.

## I. INTRODUCTION

In 2019, IDEAS Policy Research Bhd (IDEAS) and the Center for Indonesian Policy Studies (CIPS) jointly published a report on the role of State Trading Enterprises (STE) in achieving food security in Malaysia and Indonesia<sup>6</sup>. The STE Report presented in-depth analyses of how STEs and their associated food-related policies have affected the agriculture and local food trade sectors in the respective countries. The report presented two case studies, involving BERNAS for Malaysia, and BULOG for Indonesia.

The report provides revealing conclusions on the subject matter particularly for the Malaysian case. The import monopoly role of BERNAS is complemented with protectionist measures, such as price controls along the supply chain for local rice, as well as input subsidies and cash transfer to the producers. Such an eco-system has been in existence for almost 50 years with little change in the policy stance to uphold the following three-pronged objectives. They are:

- to maintain a high price to producers;
- to achieve the self-sufficiency level or SSL stated in the country's policy document; and
- to maintain a stable price and high quality rice price to the consumers.

In general, these policy objectives have been met but with such a high socio-economic cost that it becomes no longer sustainable to continue with the status quo<sup>7</sup>. The structural deficiencies observed are typical, such as; distorted market<sup>8</sup>, inefficient use of resources<sup>9</sup>, inequitable distribution of profit among the market players (with farmers receiving the lowest)<sup>10</sup>, high public fiscal commitment<sup>11</sup> and overall slow growth. Change is imminent, which is the focal point of this paper.

Following the official release of the report, a roundtable discussion between IDEAS and invited experts on the future of Malaysia's paddy and rice industry was held on 16 January 2020. This discussion served as a platform for an in-depth study of the necessity for having more detailed policy recommendations on deregulation, institutional reform, national stockpile management and many other proposals mentioned in the report. The roundtable discussion reiterated the view that a thorough economic analysis and policy simulation is urgently needed to provide evidence-based policy recommendations to improve the rice and paddy industry and ensure food security for the nation.

This document is a follow-up to the recommendations for Malaysia as described in the STE Report, and the points raised in the roundtable discussion.

The main objective of this paper is to present a roadmap towards implementing the recommendations. The specific objectives are:

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<sup>6</sup> Fatimah, Bustanul and Sheng (2019).

<sup>7</sup> Fatimah et al., (2019).

<sup>8</sup> Roslina (2017) and Fadzleen (2017).

<sup>9</sup> Op. cit.

<sup>10</sup> Fatimah, Bustanul and Sheng (2019).

<sup>11</sup> Allocation for paddy and rice sector accounted for about 45% of the total expenditure of the Ministry of Agriculture and Agro-based Industry in 2017 (personal communication).

1. to examine the impact of an output- based and direct compensation payments on producers' net revenue and yield;
2. to derive the local price of rice under a deregulated market;
3. to review the institutional proposals, such as stockpile management, collective action, the setting up of a " National Rice Board" ; and
4. to describe the policy road map encompassing the said proposals.

The study uses both analytical method and system dynamics approach to realise the above objectives. Under the analytical method, several templates are designed, for instance to derive the output-based and direct compensation payments and the market price of rice under a deregulated market. Though the template is static, it can be used to examine the variable changes in the price transmission tables, such as changes in import price, mark-up and marketing cost.

The price analysis is highly useful to measure the impact of import deregulation on the farmers and market players at the micro level rather than using aggregative measurement. These data indicate the deregulation impact on the producers' net revenue, as well as the profit margin of the industry participants and price to the consumers. In short, the data reflect the change in their level of profitability under a deregulated market. Aggregative measures may not be able dissect the impact by the types of participants.

System dynamics analysis is applied to simulate the impact of those payments on farmers' yield and net profit and changes in import price on the local rice prices and stockpile management. This methodology is chosen because; first, it depicts the feedback loops between variables and; second, it explains the impact of structure on behaviour of a system. Once these relationships are established, policy scenario simulations can be made to examine the responses of and impact on the system<sup>12</sup>. The partial equilibrium approach, such as producer and consumer analyses, is not applied here as the industry is insulated and protected where market price is controlled and dictated by the government. Note that the Guaranteed Minimum Price of paddy of RM496/mt has been implemented for sixteen years (1980-1997) and at RM550/mt for eight years (1998-2005). A similar pattern is applicable to the retail prices. Under such a structure, the derivation of supply and curves may not be meaningful<sup>13</sup>.

The study also uses prices from IMF<sup>14</sup> (world rice price) and related data and parameters from the Paddy and Rice Division or Bahagian Industri Padi dan Beras (IPB) of the Ministry of Agriculture and Food Industries (MAFI).

The following paragraphs in Section 2 provide our brief review of the recommendations stated in the STE Report and the subsequent roundtable discussion. Although the STE Report presents a list of six policy considerations and a list of seven recommendations, we categorise these points along four thematic areas: market deregulation, the national rice stockpile, collective action, and the proposed establishment of the National Rice Board.

<sup>12</sup>. The overview of the system dynamics methodology is provided in Appendix 2.

<sup>13</sup>. Personal communication with MARDI official indicates that there were no evidences of price response in the paddy market (2008).

<sup>14</sup>. IMF – International Monetary Fund at <https://www.imf.org/en/Research/commodity-prices>.

The discussion continues with more detailed deliberations on the recommendation for each theme. These are:

1. the transformation of all input subsidies to the output equivalent, which will lead to the formulation of non-distortionary direct payments and later decoupled-payment;
2. an examination of the probable impact of opening up the import market on local rice prices;
3. a review of the national rice stockpile management;
4. the selected institutional reforms to enhance farmer capacity through collective action (farmer involvement in production and value-added activities);
5. enhancing the capacity of IPB leading to the establishment of a National Rice Board;
6. other related issues; and
7. the summary of the roadmap.

The final section concludes the document.

## 2. THE STE RECOMMENDATIONS

The STE Report and subsequent roundtable discussion were conducted in the period of the Pakatan Harapan (PH) government, which was put in place after the fall of the Barisan Nasional (BN) government during the 14th General Elections (May 2018). One of the manifesto promises of the PH coalition<sup>15</sup> before the elections was the “removal” of the rice import monopoly by BERNAS by 2021 (the current 10-year concession is due to end in January 2021). However, as it turned out, by March 2020 the PH government was replaced by the Perikatan Nasional (PN) government. This affects the intended removal of the import monopoly rights of BERNAS. After much anticipation by the public, the media reported that the PN government had agreed to extend the concession to BERNAS for another 10-year period (2021-2030)<sup>16</sup>. In addition to fulfilling its current obligations, under the new concession agreement BERNAS is entrusted with additional obligations, which include: first, to manage miller, wholesaler and cooperative schemes; second, to provide funds for the supply of machines and facilitate mechanisation, manage buffer stock for seeds, emergency and development of paddy industry information system; third, to develop large scale farms; and fourth, manage paddy farm soil fertility.

As far as this document is concerned, the social obligations of BERNAS remain as discussed in the STE Report: (1) fair and stable prices (farm and retail) and cash subsidy distribution (p25); (2) sufficient supply of rice (p30); (3) stockpile management (p31); (4) maintain quality and standard of rice (p32); (5) Bumiputra Miller Scheme (p33); and (6) Buyer of Last Resort (BoLR) (p35).

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<sup>15</sup> Pakatan Harapan (2018, Promise p33).

<sup>16</sup> Sinar Harian (2020).

This report categorises the STE recommendations into four main areas as elaborated in the following sub-sections:

## 2.1 Market Deregulation

### 2.1.1 Deregulating farm subsidies

Currently there are a host of subsidies in the paddy farming sector. The input subsidies range from subsidised seeds, land preparation, fertilisers, and farm chemicals. These subsidies are distributed in kind on a per ha basis. The output subsidies are made up of the price subsidy and the GMP, and implemented on a metric tonne of output basis<sup>17</sup>.

Subsidies are generally viewed as market distortionary and are not recommended by agencies like the WTO. In the case of the paddy sector in Malaysia, the large amount of subsidies has not contributed to the improved performance of the sector. Moreover some have argued that the long-term effects of the subsidy – termed the subsidy mentality – have the unintended consequences of heavy reliance on the government rather than individual creativity. Removal of subsidies will enhance the decision-making skills and entrepreneurship of farmers. Similarly the producers are guaranteed a minimum price or GMP RM1,200 per mt<sup>18</sup> and output subsidy of RM360 per mt<sup>19</sup>. As shown by a number of studies<sup>20</sup>, despite those supports, the net profit earned was very low where more than 90% of paddy farmers were in the B40 group<sup>21</sup>. When their production is subsidised, output price is guaranteed, with little income, the farmers have minimal link with the market (input and rice). This isolation too kills their potential creativity.

In view of a significant share of subsidies in the farmers' cost of production<sup>22</sup> and minimal new entrants into the sector, it is highly probable that withdrawing it may cause the industry to collapse since the majority of the producers own small farms. Advocating outright elimination of support would reduce farm income and may not be socially and politically feasible. Hence, a less interruptive and distortive support that is also socio-politically acceptable and feasible are needed. This would imply a policy reform where the support or payments that are linked with production levels, input and prices are decoupled from these variables<sup>23</sup>. The strict definition of decoupled subsidies is when payments are fixed and guaranteed, and thus, are not influenced by ex post realisations of market conditions<sup>24</sup>. In simple terms, decoupled payment is a type of payment given to farmers that are not linked to input use and output production<sup>25</sup>. The overriding objectives of this policy are to sidestep the issue of market distortionary impacts of subsidies in general and to ensure that the farmers continue producing. In this way, the payment is independent of production decisions, hence it is less distortive to production, which contrasts with the current situation where subsidies and GMP dictate, and not because of market variables.

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<sup>17</sup> See MAFI (2020).

<sup>18</sup> MOA (2014).

<sup>19</sup> IPB (MAFI) (2020).

<sup>20</sup> Amin et al., (2010) and Fatimah et al. (2019).

<sup>21</sup> MOA (2019).

<sup>22</sup> Fatimah et al. 2019 estimated that the share of subsidies in paddy production cost ranged from 30-50%.

<sup>23</sup> World Bank (2003).

<sup>24</sup> Po. Cit.

<sup>25</sup> OECD (2019).

Decoupled payment is supposed to enhance competitiveness, reduce farmers' risk, reduce cost of administration and obligation of keeping or producing crops in order to get payment, and enable structural changes in the food production<sup>26</sup>. In the case of Malaysia, there will be substantial savings in administrative and distributive costs, especially in the input subsidies. Other advantages of the decoupled payment system are that it facilitates budget planning as the amount required is known in advance and does not depend on unpredictable factors, such as production and input purchases. It also helps improve land registry and the cadastral systems. Additional advantages include reaching out to poor farmers in the non-granary and remote areas; and it can be used to encourage sustainable practices<sup>27</sup>. ABDP that is conditional upon environmental practices or protection gives double benefits in that it enables sustainability at the farm level while helping the society at large.

Although the aim of the subsidies is to lessen the burden of rising input prices and raise farmers' income, the global trend is towards a more direct payment (income support) to farmers rather than the distortionary input and output subsidies. In some counties the decoupled payment is conditional upon certain requirements like area size, historical entitlement, input constraints and so on<sup>28</sup>. Generally ABDP indicates that it is based on the area of operation. The issues regarding the eligibility of recipients and other matters pertaining to the implementation and impacts on productivity are not addressed at this stage.

The current aim is to explore a template that can be easily communicated and used to evaluate the very issues surrounding the shift in policy that admittedly, requires a seismic paradigm shift in the thinking of Malaysia's policy makers. ABDP has been adopted in Turkey, South Korea, the European Union (EU) and the United States of America (USA) with some reasonable success. The various models of direct payments and market support in selected countries are listed in Appendix I (Table A1). The Food and Agriculture Organization (FAO) of the United Nations concludes that ABDP is less distortive compared to output and input support and it is found to have a positive production effect<sup>29</sup>. Some studies have shown that such direct payments could achieve the intended objectives, which might or might not outweigh the unintended effects<sup>30</sup>.

To deregulate subsidies, we propose a decoupled payment to the producers. The implementation can proceed in at least two steps. The first is converting the input to output-based subsidies. Besides being relatively easy to implement, this payment method can result in a huge cost saving for the government.

The second stage is to re-categorise the value of subsidies as a direct payment. The payment can be in the form of vouchers for the purchase of inputs or direct transfers from the government to farmers. For Malaysia, whose interest is the availability of domestic rice, the payment can be tied to a production agreement.

In the last stage, the payments (referred to as the area-based decoupled payment), or at least part of it, may not be tied to paddy production. In some countries, farmers are free to use the payment outside of paddy production. Farmers are usually creative in finding better alternatives to raise income. Table I illustrates these stages from the current structure to the decoupled payment and its impact on the farmers' net revenue.

<sup>26</sup> *Poczta-Wajda (2011)*.

<sup>27</sup> *M'hand Fares and Jean-Joseph Minviel (2017)*.

<sup>28</sup> *These include among others: Nicholls and Johnson (1946), Swerling (1959) cited in Baffes and Gortet (2005)*.

<sup>29</sup> *FAO (2004)*.

<sup>30</sup> *Rozakis et al., (2008), Arriaza et al., (2006), Allen (2016), Zawojcka (2007), Douarin et al., (2011) and Feichtinger and Salhofer (2013)*.



## Conversion of input to output-based subsidies

The revenue and net farm revenue under the current structure and under (i) output-based payment, (ii) direct compensation, and (iii) area-based decoupled payment (ABDP) is presented in Table 1. The Current Subsidies column (labelled 1) shows the values of the items connected with farm revenue and cost under the current subsidy set up in paddy production. The value of output subsidies is shown in the row Output subsidy (row a) while the aggregate value of input subsidies in the row Input subsidy (row h). Notice the Net farm revenue (row j) of RM4,137.3 per ha, which is calculated as Revenue (RM/ha) minus Farmer's cost (RM/ha) or  $cell\ j1 = f1 - i1$ .

In the next column (Column 2), the input subsidy of RM2,535 per mt (cell h) is converted to an output-based subsidy by dividing it by the yield (cell  $c2=h1/e1$ ), giving a value of RM679.8 per mt (cell  $c2=h1/e1$ ). Total subsidy is now RM1,039.8 per mt of output (cell  $d2=b2+c2$ ). Notice the Net farm revenue is the same at RM4,137.4/ha as before the conversion of the subsidy and the input subsidy is no longer activated in the equation. Net farm revenue is calculated as Revenue (RM/ha) minus Farmer's cost (RM/ha) or  $cell\ j2 = f2 - i2$ .

Note that this template utilises aggregate data from IPB/MAFI to reflect a broad overview of the country. It is applicable to smaller units, namely regions, non-granary and granary areas and districts and over time.

The potential benefits of output-based subsidies include; (i) reduction in the administrative and distributive cost (including rent-seeking) of input or fertiliser; (ii) opportunities for farmers to decide for themselves to buy and apply the optimal mix of input for their farms and to participate in the market economy<sup>31</sup>; (iv) the public funds saved can be used for investment in farmer capacity building and infrastructure.

**Table 1: Calculation of payment to farmers under the current structure and under deregulated subsidies scenario**

Farm Revenue and Cost (A)	Label (row) (B)	Current Subsidies (1)	Output-based Subsidy (2)	Compensation Payment (3)	ABDP (4)
<b>Revenue</b>					
GMP (RM/t)	a	1,200	1,200	1,200	1,200
Output subsidy (RM/t)	b	360	360		
Value of Input subsidy (RM/t)	c		679.8		
formula			$c2=h1/e1$		
Total subsidy (RM/t)	d		1039.8		
formula			$d2=b2+c2$		
Yield (t/ha)	e	3.73			
Revenue (RM/ha)	f	5,818.8	8,354.6	4,476	4,476
formula		$f1 = (a1 + b1)*e1$	$f2 = (a2 + d2)*e1$	$f3 = a3*e1$	$f4 = a4*e1$
<b>Cost</b>					
Cost of production (RM/ha)	g	4,217.2	4,217.2	4,217.2	4,217.2
Input subsidy (RM/ha)	h	2,535.8			

<sup>31</sup>: That is when the import market is deregulated.

Farm Revenue and Cost (A)	Label (row) (B)	Current Subsidies (I)	Output-based Subsidy (2)	Compensation Payment (3)	ABDP (4)
<b>Cost</b>					
Cost of production (RM/ha)	g	4,217.2	4,217.2	4,217.2	4,217.2
Input subsidy (RM/ha)	h	2,535.8			
Farmer's cost (RM/ha)	i	1,681.4	4,217.2	4,217.2	4,217.2
formula		$i1 = g1 - h1$	$i2 = g2$	$i3 = g3$	$i4 = g4$
<b>Net operating Revenue (RM/ha)</b>	j	4,137.4	4,137.4	258.8	258.8
formula		$j1 = f1 - i1$	$j2 = f2 - i2$	$j3 = f3 - i3$	$j4 = f4 - i4$
<b>Compensation-ABDP (RM/ha)</b>	k	..		3,876.6	3,876.6
formula				$k3 = d2 * e$	$k4 = d2 * e$
<b>Net farm receipts (RM/ha)</b>	l	4,137.4	4,137.4	4,137.4	4,137.4
formula		$l1 = j1$	$l1 = j1$	$l3 = j3 + k3$	$l4 = j4 + k4$

Note: ABDP is Area-based decoupled payment.

Source: IPB:Yield, cost of production and subsidy figures are from IPB/MAFI (2019).

### Compensation and area-based decoupled payment

In the next phase in the process of deregulating the subsidies, the output-based payment is re-classified as a direct payment (hereafter called compensation) not linked to the farm output. This is shown in the compensation-ABDP row, whose value (RM3,878.60) is the product of multiplying the total subsidy of RM1,039.84 by the yield (or  $k3$  and  $k4 = d2 * e$ ) although the payment is now on a per ha basis. This link is unavoidable, but the next stage of the process is to adjust the requirement for the payment. This new payment is the ABDP. It differs from the direct compensation approach as it is conditional upon the farmers that they continue farming. Note that under these two payment methods, both output and input subsidy distribution are inactivated. These payments can be made in the form of direct cash online or vouchers through banks, such as Agrobank.

The level of the so-called decoupled payment that is computed here is meant to be an amount that can compensate fully all the input and output subsidies currently received by the farmers, hence the use of the term total compensation per ha. The amount is considered the uppermost limit that can be provided by the government; that is the level can be further reduced depending on the financial constraints and commitment considerations. The amount could be lower<sup>32</sup> or higher depending on the government's capacity. This is just a starting point for discussion.

The benefits of these two payment methods are; (i) farmers are quick to venture into other crops or more rewarding enterprises (other than paddy) to improve income. By this stage the yield would have risen due to individual motivation and better farm management skills encouraged by the earlier output-based payment; (ii) substantial savings in administrative and distributive costs especially in input subsidies, the allocation of which can be used to increase paddy producers' capacity and skills to improve productivity; and (iii) sustain the farmers in the paddy and rice industry and hence ensure some level of local production<sup>33</sup>.

<sup>32</sup> In Spain, producers are entitled to 65 percent of the amount received in the reference period (three years) irrespective of the crop chosen to grow. The remaining 35 percent (slightly higher) is paid as a payment (Ariazza, 2006).

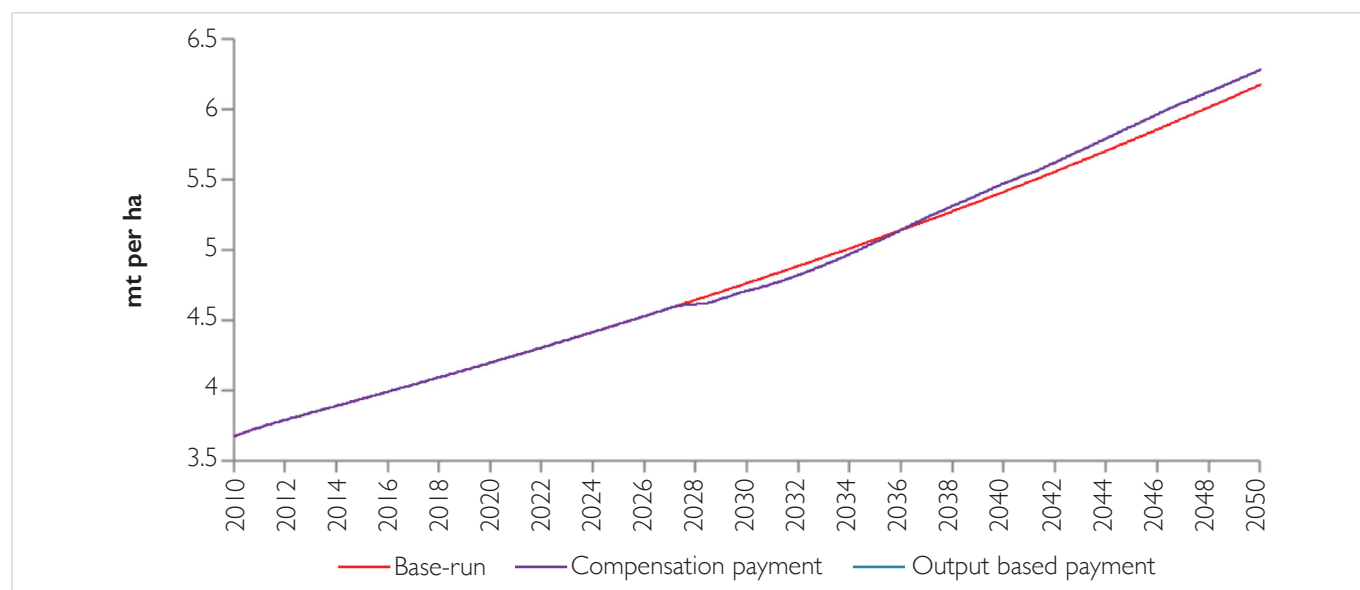
<sup>33</sup> Based on experiences in Korea (see Choy and Myers 2016, Choy and Myers 2015), Spain (Arriaza et al., (2006) ), Greece (Rozakis et al., 2008).

## Simulation

A simple system dynamics model<sup>34</sup> of the paddy and rice sector is developed to examine the structural relationship between production and consumption sub-sectors (Appendix 2, Figure A6). The production sub-model examines the relationship between input, output and net revenue to farmers. A simulation is carried out to examine the impact of the introduction of the output-based and direct compensation to the farmers' yield and revenue.

As shown in Figure 1, the yield increases slightly for both output-based and compensation payment. This indicates that there are other variables that are needed to push higher yield and revenues. These include high yielding variety and cost reduction. These findings support an earlier study on the same theme<sup>35</sup>. As can be seen in Figure 2, the introduction of these payments results in an immediate increase in the net revenue to the farmers. As the earlier input subsidies are withdrawn, farmers have to incur additional input cost and the search and purchase of the additional input may take time. After this initial adjustment period, the additional input cost will reduce the net revenue. However, the differences between the three scenarios are very small (3%), while the differences between scenarios and base-run is about 12%.

**Figure 1: Yield per ha (mt/ha), 2010-2050**

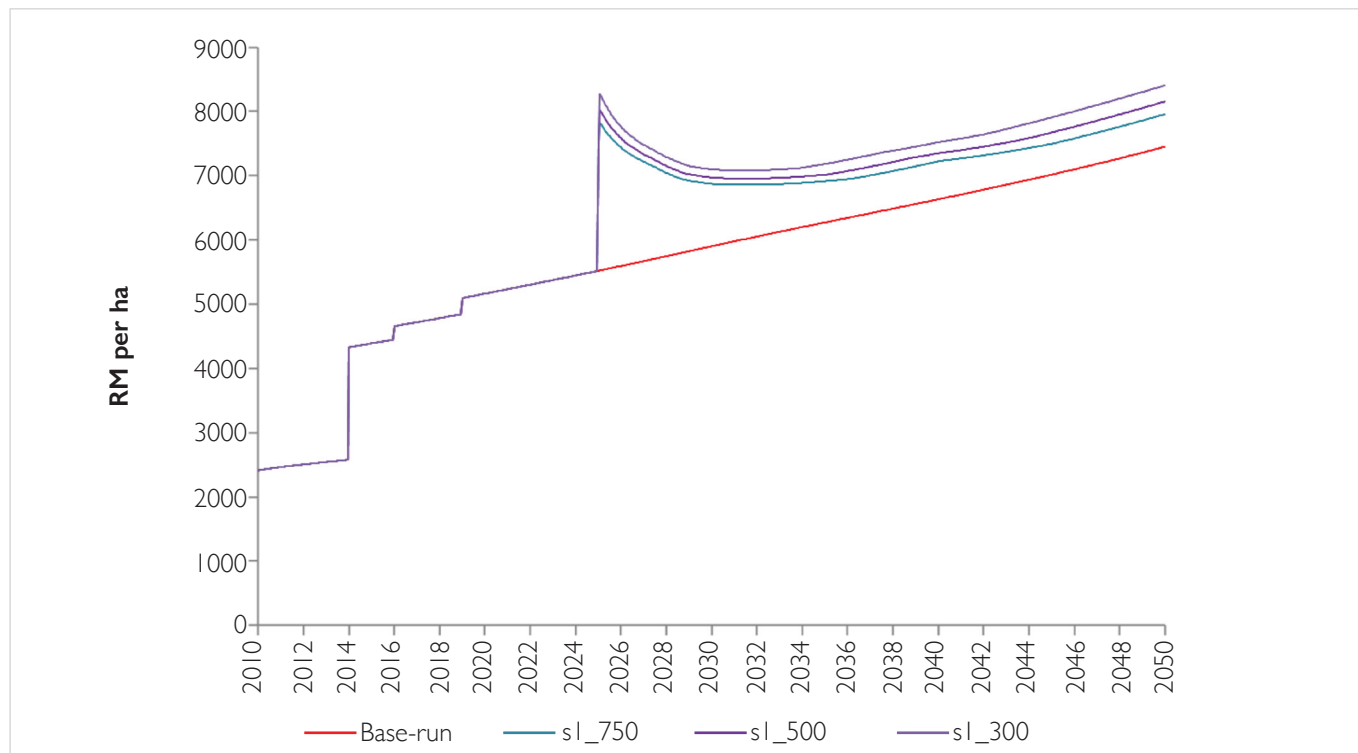


Source: Authors, from model.

<sup>34</sup> See Appendices 2 and 3 for brief description of the methodology and glossary, respectively.

<sup>35</sup> Fatimah et. al (2020).

**Figure 2: Net revenue per ha per crop (2010-2050), RM/ha**



Note: SI: Conversion of input subsidy (RM/ha) to output based (RM/t)  
 Base-run: business as usual  
 SI\_750 -> An increment of RM750/year for output-based variable.  
 SI\_500 -> An increment of RM500/year.  
 SI\_300 -> An increment of RM300/year.  
 Source: Authors, from model.

**Summary and conclusion**

Note that the values shown are estimates based on the “parameters”, such as yield, cost and subsidies. More importantly we have “assumed” that the price (GMP) is not changed throughout the stages. The issue of GMP is a bit tricky because, conceptually, the full amount should not be considered a subsidy. In the past there was mention of the “market price” of paddy (about RM750 per mt), and rightly, the actual “subsidy” is the difference between the GMP and the market price. This is probably because the intervention in the sector has been far too long that the term “market price” of paddy is seldom mentioned.

Transformation requires a gradual process so as to minimise disruption as well as preparing the market players towards a de-regulated market, starting with unshackling the subsidies. This is done by starting with an output-based payment as the payment package resembles the current subsidies except that it is based solely on output. Hence, it can be considered as an improvement in the subsidy disbursement. Once the farmers get familiarised with receiving a lump sum payment based on output, direct payment can be introduced as and when they are acclimatised with the deregulated environment to indicate that the payment is no longer attached to any subsidy. To ensure that the farmer continues farming, an area-based decoupled payment is introduced with a condition that he does so.

A long-term simulation of the impact of the two payments on yield and net revenue indicates improvement in both variables (Figures 1 and 2). Upon the implementation of the three types of payment, the net revenue

per ha increases sharply and later stabilises as it takes time for producers to adjust to the new “culture” they are facing. Without subsidies that they are used to, they may have to realign their farm decision making in terms of input purchases, investing in farm machinery, labour management and so on. Once their situation stabilises, their net revenue begins to pick up, much higher than before.

These exercises are preliminary in nature. Nevertheless the calculations reveal an important finding in that the current net revenue can be maintained with lesser cost to the government by repackaging the payment to output-based payment, direct compensation payment and area-based decoupled payment. These payments are less distortive and allow farmers to interact more with the market economy to source better input and technologies. The public money-saving exercise can be channeled for productive purposes, such as productive capacity, infrastructure development and digitalisation. The net benefits however depend on a number of factors, such as planning, implementation, monitoring and evaluation.

### 2.1.2 Deregulating imports

Deregulating imports implies opening up the import to more players (including BERNAS) and the pricing mechanism (import and domestic) is dependent on the international market movement. In other words, the domestic price is largely derived from the import market. This section describes the flow/transmission and hence derivation of prices at all levels of the supply chain: wholesale, retail, consumer, mill and producer.

The following paragraphs present the relationship of prices at various levels of the rice value chain in a competitive free market setting. In this analysis, we assume that the local rice variety Super Spesial Tempatan (SST) with 5% Broken Milled White Rice grains (SST5%) is equivalent to the quality of the imported Thailand 5% Broken Milled White Rice (TWR5%). We start with the importer price of rice offered to the wholesaler. The wholesaler interacts with two other levels of the value chain; the miller, and retailer, to influence the respective offer prices. The miller, in turn, interacts with the farmer to influence the price of paddy offered to farmers. Lastly, the interaction between the retailer and consumer will influence the retail price offered to consumers.

In these interactions, we assume that the importer, farmer and consumer are price takers. Malaysia's share of the global rice imports market is quite small to exert any influence on global price. Individual farmers are too numerous to have any significant market power to influence the rice price<sup>36</sup>. Moreover, rice is a perishable good with a narrow window of sale before quality deterioration sets in, which limits the farmers bargaining power. Similarly, consumers are also numerous in relation to retailers. Furthermore, the demand for rice, being a staple food constituting a small percentage of household expenditure, is likely to be income- and price-inelastic. As evident in the past, wholesalers are more likely to wield a certain level of market power. To a certain extent, retailers, especially in certain localities, are expected to have more bargaining power relative to consumers.

#### **The components of selling price (SP)**

The basis of the calculations in this section depends on the equation in the determination of the SP by a firm<sup>37</sup>. The components of SP can be written in the following equation:

$$SP=C+E+P$$

<sup>36</sup> According to IPB (2019), there were 322,830 farmers, paddy buyers=218, mills=173, wholesalers=1,598 and retailers=33,511 and consumers=31,528,033. The Herfindahl-Hirschman Index for milling is 2,304, wholesale 4,945 and import 10,000 (Fatimah, Bustanul and Sheng, 2019).

<sup>37</sup> Olivier (2019), p6-184

$C$  refers to the costs of goods sold, which include the purchase cost of the goods, which in this case is the purchase cost of rice, plus any other direct costs, such as transportation and handling charges, packaging and other costs that can be directly attributed to the rice quantity ( $Cr$ ).  $E$  includes indirect costs such as marketing cost, insurance, overhead, etc.  $P$  represents the profits set by the firm. In the pricing literature, the components of  $SP$  is also written as  $C$ , plus what is referred to as a markup ( $M$ ). Referring to the above equation,  $M$  is equal to  $E+P$ , which means that the markup is not equivalent to profits.  $M$  can be estimated as a proportion ( $mu$ ) of cost  $C$ . Thus we can rewrite the equation as:

$$\begin{aligned} SP &= C + \text{Markup} \\ &= C + mu.C \\ &= C(1 + mu) \end{aligned}$$

### The importer

Table 2 shows the determination of imported rice price in Malaysia. The global trade in rice is normally transacted in USD. Thus the foreign exchange rate (RM/USD) will have a large influence on domestic price of imported rice. We assume that the tariff on rice imports, which is waived for BERNAS, will be resumed in a more competitive market. The derivation of imported rice price along the supply chain participants (importer, wholesaler, retailer, miller and producer) is discussed in Appendix 2 (Figures A7 and A8).

**Table 2: Import and wholesale prices under deregulated market (RM/mt)**

Importers perspective	Parameter	Price
FOB price (USD/mt)		410
Exchange Rate (RM/USD)	4.32	
Tariff rate	0.2	
Cost of rice (RM/mt)		2,125.44
Other cost (Handling charges etc) (RM/mt)		186
Importers mark-up ratio	0.15	
Minimum offer price to wholesalers (RM/mt)		2,658.16

Note: \*mark-up = (Selling price - Cost of goods sold)/Cost of goods sold.  
Selling price = Cost of goods sold + Expenses + Profits.  
Selling price - Cost of goods sold = Expenses + Profits.

Handling charges are based on estimates by IPB<sup>38</sup>. Since market data on profits are unavailable, we assume importers will set a mark-up of 15% for their enterprise. From the equation above  $SP=C(I+mu)$ , the price of rice offered by importers to wholesalers is determined as RM2,658.16 per mt.

### The wholesaler

Assuming importers and wholesalers are separate entities, the determination of price at the wholesale level is shown in Table 3. Note that the wholesaler's other cost ( $Co$ ) is assumed at 10% of the cost of rice purchased ( $Cr$ ). A mark-up of 15% is also assumed for the wholesalers.

The wholesaler's offer price to retailers is straightforward. Note that the costs incurred by wholesalers are embedded in the required margin. From Table 3 the price offered to retailers is RM3362.57 per mt. Note that in a competitive market the offer price to millers cannot be greater than the price offered by importers.

<sup>38</sup> IPB, MAFI (2020).

**Table 3: The price to retailer under a deregulated market (RM/mt)**

Wholesaler's perspective	Parameter	RM/mt
Minimum cost of rice from importer		2,658.16
Other wholesaler cost	0.1	265.82
Wholesaler mark-up ratio	0.15	
Minimum offer price to retailers		3,362.57
Maximum offer price to millers		2,658.16

Note: Assuming imported and local rice not differentiated.

### The miller

As mentioned above, we assume that in a competitive market, the offer price (by wholesalers) to millers cannot be greater than the cost of imported rice from importers. Hence, the offer price to millers is RM2,658.16 per mt.

The transaction between millers and farmers are in terms of paddy. Hence, at the millers' level, the determination of paddy price must be related to the price of imported rice. This is shown in Table 4.

**Table 4: The price to retailer under a deregulated market (RM/mt)**

Miller's perspective	Parameter	RM/mt
Maximum offer price from wholesaler		2,658.16
Mark-up ratio ( $\mu$ )	0.2	
$C = SP / (1 + \mu)$		2,215.13
$Cr = C / (1 + co)$	0.1	2,013.75
Milling rate ( $mr$ )	0.65	
Cost of paddy ( $= mr * Cr$ )		1,308.94
Maximum paddy price offer to farmers		1,308.94

Note:  $C$  = Cost of goods sold,  $SP$  = Selling price,  $\mu$  = mark-up,  $Cr$  = Purchase cost of rice,  $Co$  = Other direct cost for eg. transportation, handling charges, packaging etc,  $mr$  = milling rate.

Recall that the miller's enterprise is to purchase paddy (from farmers), and converts it to rice for sale to wholesalers. Therefore the selling price of rice to wholesalers is the reference price for the determination of paddy price offered to farmers. Given the offer price of rice from wholesaler is RM2,658.16 per mt and the mark-up of 20%, the total cost  $C$  in each tonne of rice produced is estimated to be RM2,215.13 per mt. Furthermore given the proportion of other cost ( $Co$ ) in total ( $Cr$ ) of 10%, the component of rice cost  $Cr$  is estimated to be RM2,013.75 per mt.

Given the milling recovery rate ( $mr$ ) of 65% the quantity of paddy needed to get 1 mt of rice is  $1/mr$ , which equals 1.54 mt. Hence, the price to be offered for a mt of paddy is estimated by dividing the cost of rice by  $1/mr$ , which equals RM1,308.94 per mt.

## The farmer

Table 5 shows the farmers' revenue given the maximum offer price from millers, which is equivalent to the revenue per mt. The cost per mt is computed by dividing the cost per ha (RM4,217.23) by the yield (3.73 mt/ha), which gives a value of RM1,130.62 per mt. Hence, the net revenue per mt is RM178.32. This figure multiplied by the yield will give the net revenue per ha of RM665.12.

**Table 5: The price to producer under a deregulated market (RM/mt)**

Farmer's perspective	Parameter	RM
Maximum offer price from miller (RM/mt)		1,308.94
Cost of production (RM/ha)		4,217.23
Yield (mt/ha)	3.73	
Cost of production (RM/mt)		1,130.62
Net revenue (RM/mt)		178.32
Net revenue (RM/ha)		665.12

*Note: This table does not include subsidies.*

This clearly shows the need for government support if we want farmers to continue farming. To resolve this, the government may opt to continue with the current package of subsidies and pay the additional bureaucratic cost and other inefficiencies or to implement ABDP. Table 6 shows the relative impact of the current subsidy rates and ABDP on the farmers' situation. It also shows how the subsidies can be transformed to the ABDP that gives the same net farm revenue to farmers, while enjoying the benefits mentioned earlier.

**Table 6: Area-based decoupled payment to farmers**

Farm revenue and cost	Parameter	ABDP	Subsidy
Revenue			
Maximum offer price from millers (RM/mt)		1,308.94	1,308.94
Output subsidy (RM/mt)		-	360.00
Yield (mt/ha)	3.73		
Revenue (RM/ha)		4,882.35	6,225.15
Cost			
Cost of production (RM/ha)		4,217.23	4,217.23
Input subsidy (RM/ha)		-	2,535.80
Farmer's cost (RM/ha)		4,217.23	1,681.43
Net operating Revenue		665.12	4,543.72
ABDP (RM/ha)		3,878.60	-
Net Farm Revenue (RM/ha)		4,543.72	4,543.72

*Source: IPB (2019). Yield and subsidy figures, p35.*



## The retailer

The determination of price at the retail level is shown in Table 7. As indicated earlier we assume a mark-up of 10% for retailers. The price offered to consumers is estimated at RM3,698.82 per mt or RM3.70 per kg.

**Table 7: Price to retailer under a deregulated market (RM/mt)**

Retailer's perspective	Parameter	RM/mt
Minimum cost of rice from wholesaler		3,362.57
Retailer's mark-up ratio (mu)	0.1	
Minimum offer price to consumers		3,698.82

## The consumer

As mentioned earlier the consumer is assumed to be a price taker. The price paid by consumers cannot be less than the RM3.70 per kg offered by retailers. As seen in Table 8 based on figures from the 2019 Household Expenditure Survey conducted by the DOSM, the unit value of rice in the survey is computed to be RM3.66 per kg<sup>39</sup>. Thus the estimated price paid by consumers is just slightly higher (1.09%) than this unit value (see Appendix 2 (Figure A9) for the derivation of consumer price).

**Table 8: Price to consumer under a deregulated market (RM/mt)**

Consumers perspective	RM/kg	RM
Retail price (RM/kg)	3.70	
Current expenditure (HES)		
Consumption (kg/hhold)	11.9	
Expenditure (RM/hhold)	43.54	43.54
Unit value (RM/kg)	3.66	
Expenditure2 (RM/hhold)		44.02
Change in expenditure (%)		1.09

## Simulation

Using system dynamics methodology<sup>40</sup>, a simulation is carried out to examine the impact of a change in the import price on the local price (Appendix 2, Figure A9). Unlike the earlier static analytical deliberations of price transmission, the system dynamics calculation involves time dimension as well as feedback loop between variables. Hence, the derivation of prices is affected by the time element as well as impacted by other variables in the system. Tables 9 and 10 examine the results of simulations of increases in import rice prices (by 10%, 30% and 50%) and reductions (by 10%, 20% and 30%) on local prices. The exchange rate is assumed to increase by 40% for the period 2020-2030 based on the historical trend. Comparisons are made between the future prices (2021-2030) with the base year price in 2020. The results indicate that changes in the import prices affect the local price accordingly. An increase of 10% in the import price increases the local prices by about 17% and 7% between 2020-2025 and 2025-2030, respectively. Similar

<sup>39</sup>. Calculated by dividing the monthly household expenditures on rice of RM43.54 by the average consumption quantity of 11.9 kg per household.

<sup>40</sup>. See Appendices 1 and 2 for brief description of the methodology and glossary.

pattern is observed with an increase of 30% in imported rice price but the change is 27% and 7% in the first and second periods, respectively. An increase of 50% results in an increase of close to 60% and 6% in the two periods (Figure 3).

Clearly an increase in import price is a boon to the producers, who may enjoy price as high as RM1,585 in 2025 when import price increases by 10%, RM1,853 (30%) and RM2,121 (50%), respectively<sup>41</sup>. However, it is a bane to consumers as price rises to RM4.482 (an increase of 10%), RM5,241 (30%) and RM5,999 (50%) (Figure 3). However as mentioned earlier, the increase in price is not that significant considering the monthly expenditure on rice is relatively small<sup>42</sup>. The Government may intervene to help only those needy ones.

**Table 9: Impact of an increase in import price of rice on local prices (RM/mt)**

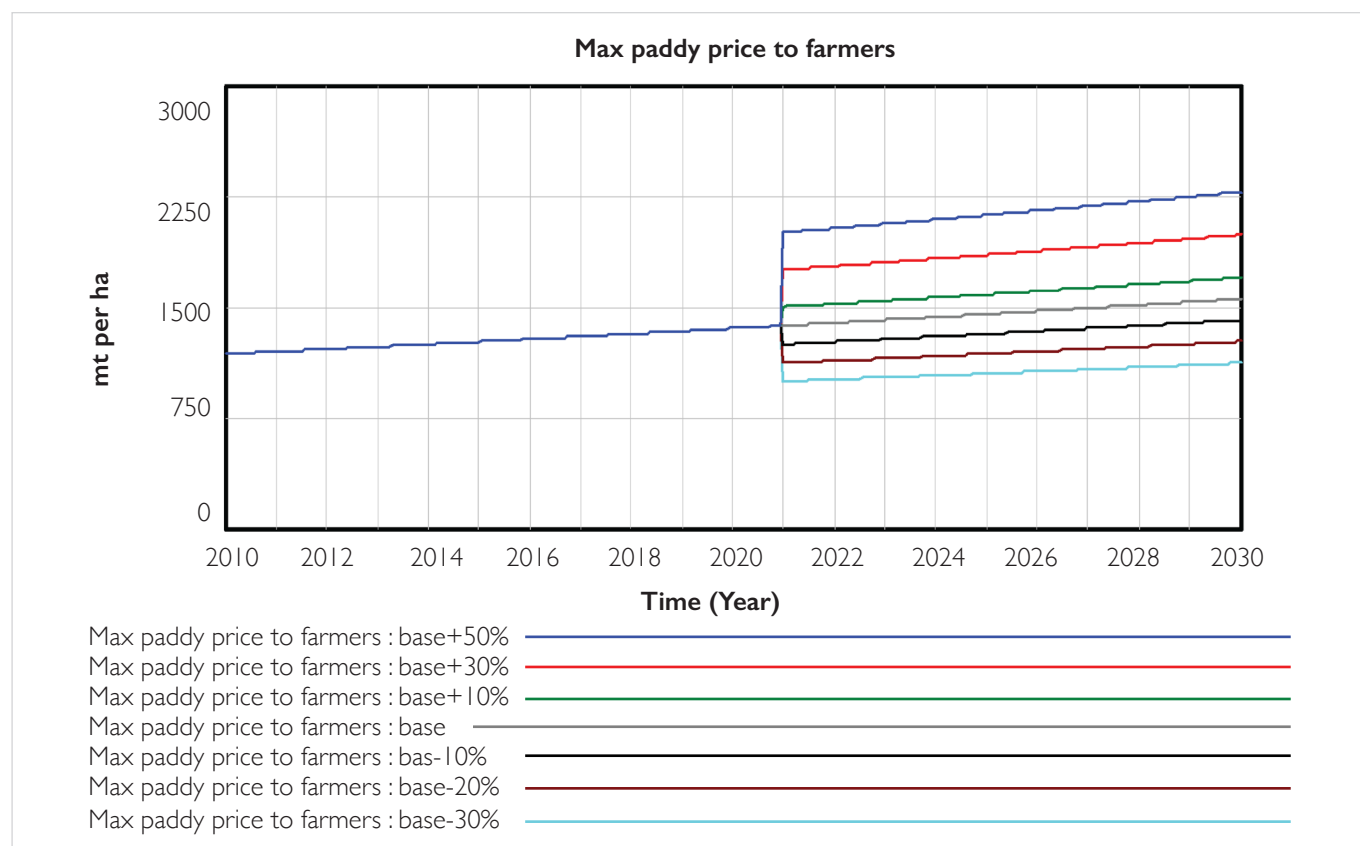
Level	Increase in import price (RM/mt)						
	Base/ 2020	Increase by 10%		Increase by 30%		Increase by 50%	
		2025	2030	2025	2030	2025	2030
Import	2,107	2,498	2,692	2,952	3,182	3,407	3,671
Local							
Wholesale	2,752	3,221	3,454	3,766	4,041	4,311	4,629
Retail	3,482	4,075	4,369	4,764	5,112	5,454	5,855
Mill	2,752	3,221	3,454	3,766	4,041	4,311	4,629
Producer	1,354	1,585	1,699	1,853	1,988	2,121	2,277
Consumer	3,830	4,482	4,806	5,241	5,623	5,999	6,441

A decrease of 10% in the import price reduces the local prices by about 3% for the period 2020-2025, but increases by 7% in 2025 and 2030, respectively (Table 10). The increase in the later period is due to the continuous increase in exchange as in the earlier case. Similar pattern is observed with a reduction by 20% in imported rice price but the local price reduces by one-third and 7% in the first and second periods, respectively. An increase of 50% results in a reduction of 22% and 7% in the two periods, respectively. Producers will be negatively affected by a reduction of 20% of imported price (Figure 3). Farmers will receive RM1,182 (20% reduction) and RM1,048 under 30% reduction. On the other hand, the consumers enjoy good price as low as RM3,344 in 2025 when import price decreases by 20% and RM 2,965 in 2025 when price decreases by 30% (Figure 4).

<sup>41</sup> Note that the prices may differ somewhat from the earlier static tabulations. This is because the prices derived here are from a dynamic model which involves a time element.

<sup>42</sup> According to the Household Expenditure Survey (2016), the average expenditure on rice is RM44/month, which is 1.1% of the total expenditure. The figure is RM42/month or 1% for urban consumers and RM51% or 1.9% for rural consumers.

Figure 3: Paddy price to producers (RM/mt), 2010 – 2030

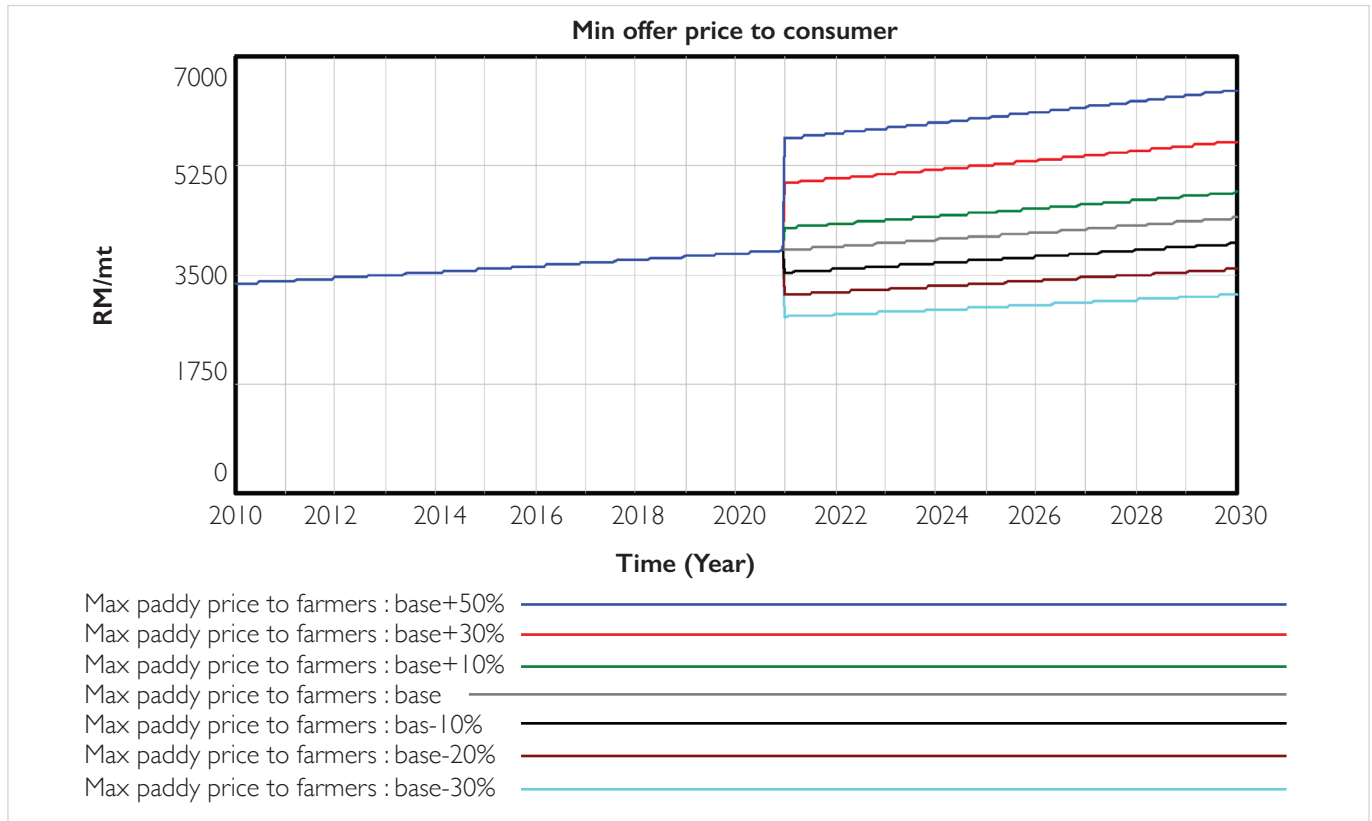


Source: Authors, from model.

Table 10: Impact of a decrease in import price of rice on local prices (RM/mt)

Level	Decrease in import price (RM/mt)						
	Base/ 2020	Decrease by 10%		Decrease by 20%		Decrease by 30%	
		2025	2030	2025	2030	2025	2030
Import	2,107	2,044	2,203	1,817	1,958	1,590	1,713
Local							
Wholesale	2,752	2,676	2,866	2,403	2,573	2,131	2,279
Retail	3,482	3,385	3,626	3,040	3,255	2,696	2,883
Mill	2,752	2,676	2,866	2,403	2,573	2,131	2,279
Producer	1,354	1,316	1,410	1,182	1,266	1,048	1,121
Consumer	3,830	3,724	3,989	3,344	3,580	2,965	3,171

**Figure 4: Paddy price to consumer (RM/mt), 2010-2030**



Source: Authors, from model.

### Summary and conclusion

Based on the concept of determination of selling price and system dynamics simulations, deregulation of import and domestic market brings the following impact. First, unlike before the local prices fluctuate in tandem with the international market prices. Second, the magnitude of change is dependent on the foreign exchange rate. Third, in time of high price, the consumers experience a much higher increase in price compared to producers. However, when the import price decreases, the consumers experience a bigger reduction in price compared to the farmers.

### 2.2 The National Rice Stockpile

Like other countries in the region, the creation and maintenance of a public rice stockpile is an important issue in Malaysia. The main reason cited for this stockpile is related to food security, specifically the availability of food in times of emergency. The role of a stockpile as a price stabilisation mechanism has been mentioned in the past but according to most analyses, this objective has been rarely achieved<sup>43</sup>.

An issue surrounding the stockpile is the quantity to be maintained. In the 1970s, Lembaga Padi dan Beras Negara (LPN), which was the government agency responsible for the stockpile then, kept stockpile quantity of between 260,000 and 300,000 tonnes<sup>44</sup>. When BERNAS took over the functions of LPN, the quantity

<sup>43</sup> Lassa et al. (2019), Caballero-Anthony et al. (2016).

<sup>44</sup> Caballero-Anthony et al. (2016).

of stockpile was reported to be 92,000 tonnes. Since then the quantity had varied between 239,000 and 292,000 tonnes. Since 2018, the quantity had been reduced to the current 150,000 tonnes<sup>45</sup>. Based on 2018 consumption figures, this quantity is able to support 22 days of rice consumption.

The main aim of this section is to assess the stock coverage (i.e. the consumption days) associated with the stockpile, and its ability to withstand shocks in rice supply, domestic production and imports. Towards this end, this study has developed a system dynamics model to assess the impact of supply shocks and public stock level. The data for this exercise is obtained from IPB of MAFI<sup>46</sup>.

Two simulations are carried out to test the impacts of disruptions in supply (S1-S3) and changes in the safety or public stock level (S4-S5) on total stock and stock coverage. The first set of simulations is concerned with supply disruptions, which are:

1. S1: disruptions in domestic rice production;
2. S2: disruptions in the import; and
3. S3: (i) and (ii) simultaneously.

The second set refers to simulations on the impact of changing the safety or public stock on the total stock and stock coverage. The simulations are as follow:

1. S4: A one-third reduction of the current level of safety stock to 100,000 mt; and
2. S5: An increase of one-third of the current level of safety stock to 200,000 mt.

The current level of safety stock stands at 150,000 mt at any one time. The changes in parameter value for simulation runs are summarised in Table 11.

**Table 11: Simulation runs**

Simulation Run	Production (%)	Import (%)	Public stock
Base	..	..	150,000
S1	↓50	..	150,000
S2	..	↓50	150,000
S3	↓50	↓50	150,000
S4	..	..	100,000
S5	..	..	200,000

Notes: .. means inactivated.

<sup>45</sup> Under the new agreement between MAFI and BERNAS signed on 3 December 2020 (Sinar Harian, 2020), the stockpile level has been reduced to 140,000 mt.

<sup>46</sup> See Appendices 2 and 3 for brief description of the methodology and glossary and Appendix 4 for the data used in this simulation.

**Supply disruptions in production.** Disruptions in production are modelled by effecting change in the local production. Local production is assumed to reduce by half between the fourth and fifth months (April and May) of the production year. We call this variable production shock.

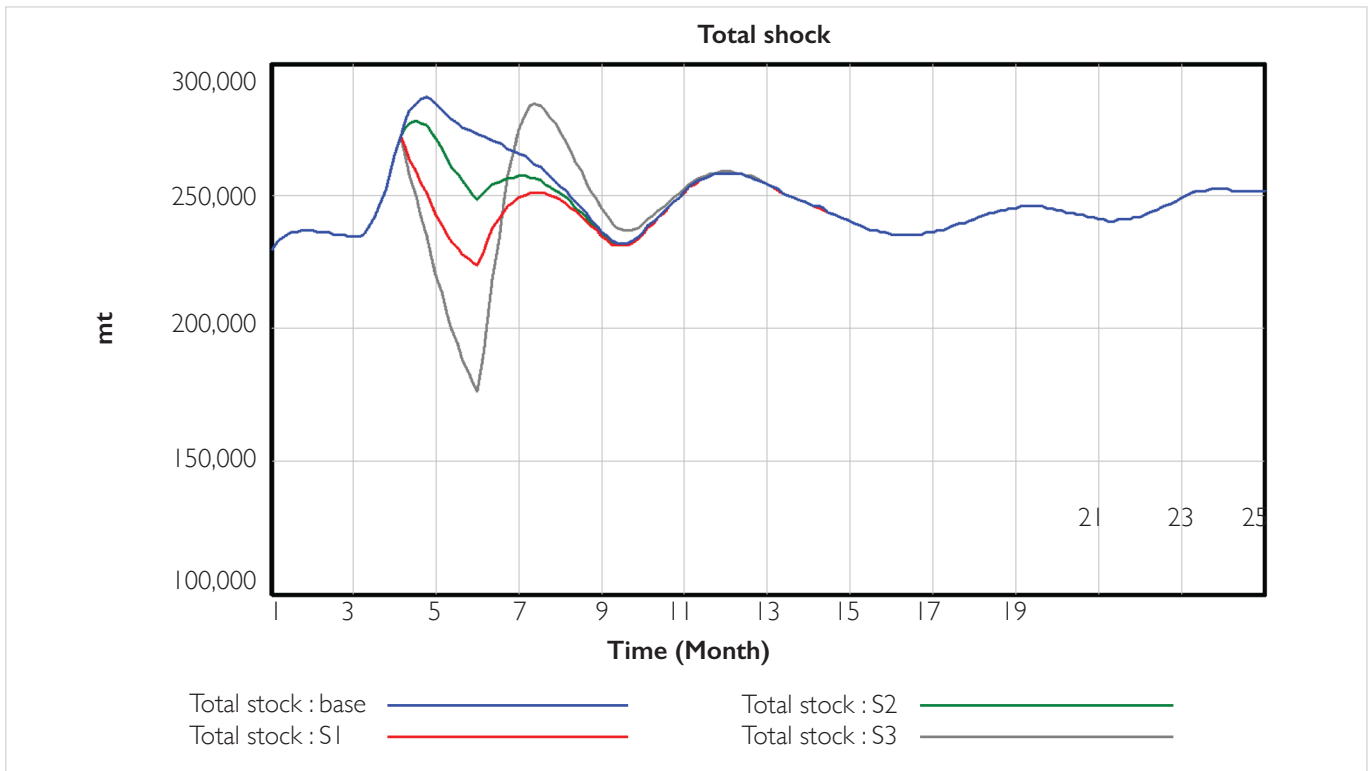
**Supply disruptions in import.** To simulate the disruptions in import supply we use the same approach as used in S1. The disruption in import is reflected in the reduction in the import by the private sector. As in S1 the value of 0.5 is used for the months of April and May to mimic the disruptions (reduction by half) in imports in these months.

**Simultaneous disruptions in production and import.** The third scenario examines the impact on total stock and its coverage of simultaneous disruptions in farm production and import. This scenario is affected by the simultaneous changes in the availability variables in S1 and S2 above.

The impact variables measured are: (i) Total stock, which is the sum of private and public stock and; (ii) Stock coverage, which refers to the total stock divided by consumption per day.

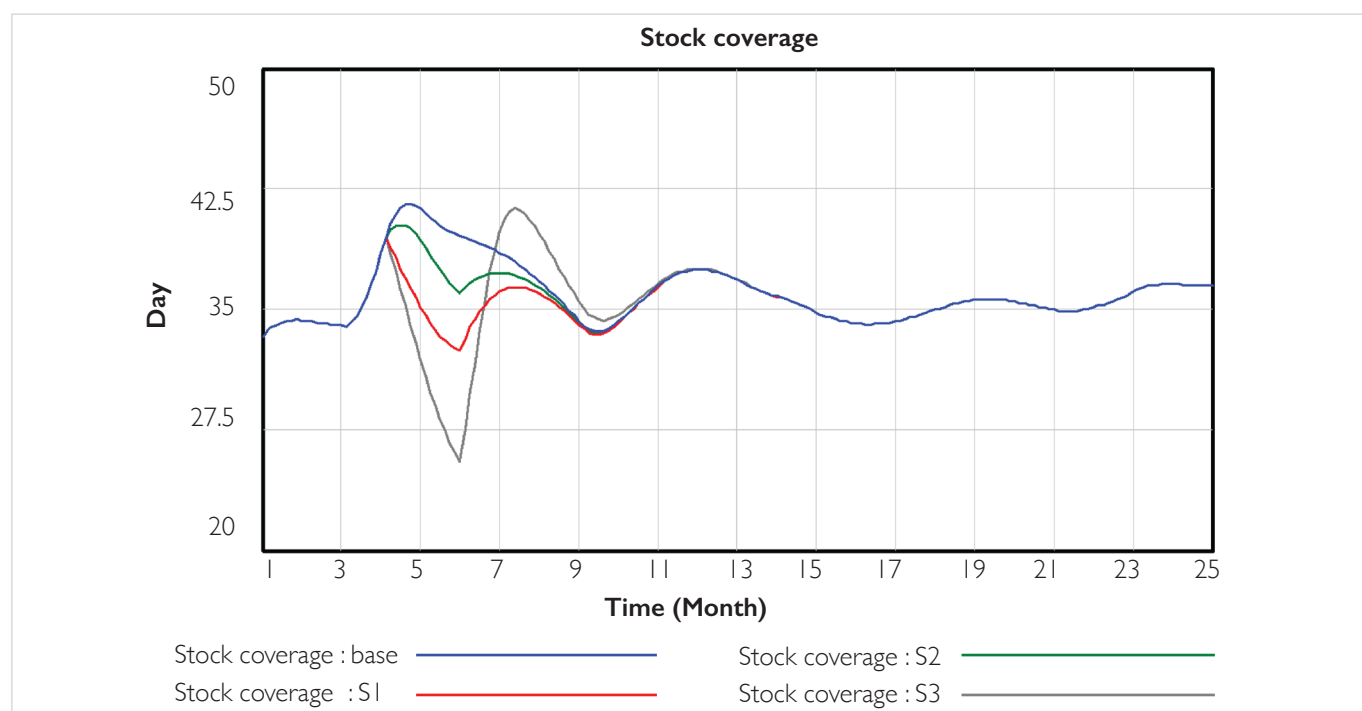
Figure 5 shows the impact of the three shocks (S1-S3) on total stock. As can be seen, the system is robust enough or resilient to what can be considered big variations (reduction in half) in local production and import. Even in the case where both supply shocks occur simultaneously (S3), the total stock returns to normal somewhere in month 11. In other words, even with simultaneous reductions of 50% in domestic production and import levels lasting two months, the system rebounds in a matter of four to five months. Figure 6 exhibits a similar behaviour in terms of stock coverage (days).

**Figure 5: S1 – S3: The impact of disruptions on total stock (mt)**



Source: Authors, from model.

Figure 6: The impact of disruptions on stock coverage (days)



Source: Authors, from model.

Table 12: S1 – S3: Descriptive statistics for stock coverage

Statistics	Stock coverage (day)**			
	Base	S1	S2	S3
MAX	41.5	37.5	37.5	42.9
AVG	36.0	35.0	35.4	34.9
MIN	33.3	31.8	32.9	26.5
SD	1.9	1.4	1.1	3.3
COV	0.053	0.039	0.031	0.095

Note: \* COV is the coefficient of variation (SD/AVG).

\*\* Based on estimated monthly rice consumption of 204,100 mt.

Source: Authors, from model.

Table 13: S1 – S3: Descriptive statistics for total rice stock

Statistics	Total rice stock ('000 mt)			
	Base	S1	S2	S3
MAX	286.9	258.7	258.7	296.1
AVG	248.7	241.5	244.1	241.1
MIN	230.0	219.4	226.9	182.7
SD	13.1	9.5	7.7	22.8
COV	0.053	0.039	0.031	0.095

\* COV is the coefficient of variation (SD/AVG).

Source: Authors, from model.

Tables 12 and 13 show the descriptive statistics for the total stock and its coverage for the three scenarios. The average total stock for the base case is 248.7 thousand mt giving a stock coverage of 36 days. Because the total stock is impacted for only a few months, the overall average (for the 24 months) is not that different between the scenarios. The average total stock for S1, S2, and S3 are 241.5 thousand mt, 244.1 thousand mt and 241.1 thousand mt, respectively.

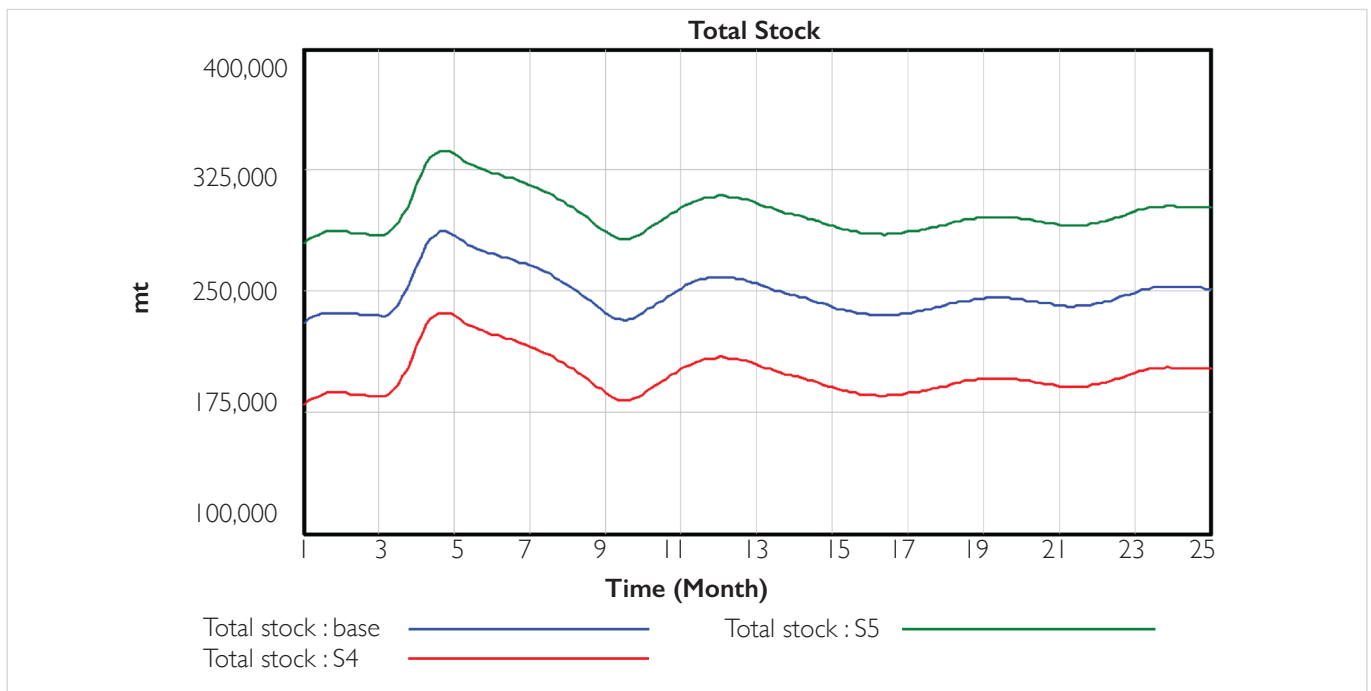
The reductions in total stocks naturally reduce the stock coverage. The average stock coverage is reduced from the base value of 36 days to 35 days (S1), 35.4 days (S2), and 34.9 days (S3).

**The impact of changing the stockpile level on total stock and coverage**

As mentioned earlier, the base safety stock level is 150,000 mt, which is the lowest level set so far. To examine the impacts of changes in the safety stock level on stock coverage, two scenarios were run involving a decrease to 100,000 mt (S4) and an increase to 200,000 mt (S5) in the safety stock level.

Figure 7 shows the result for the two scenarios, a decrease (S4) and an increase (S5) in safety stock levels. As might be expected, the rice total stock is reduced with lower stockpiling levels.

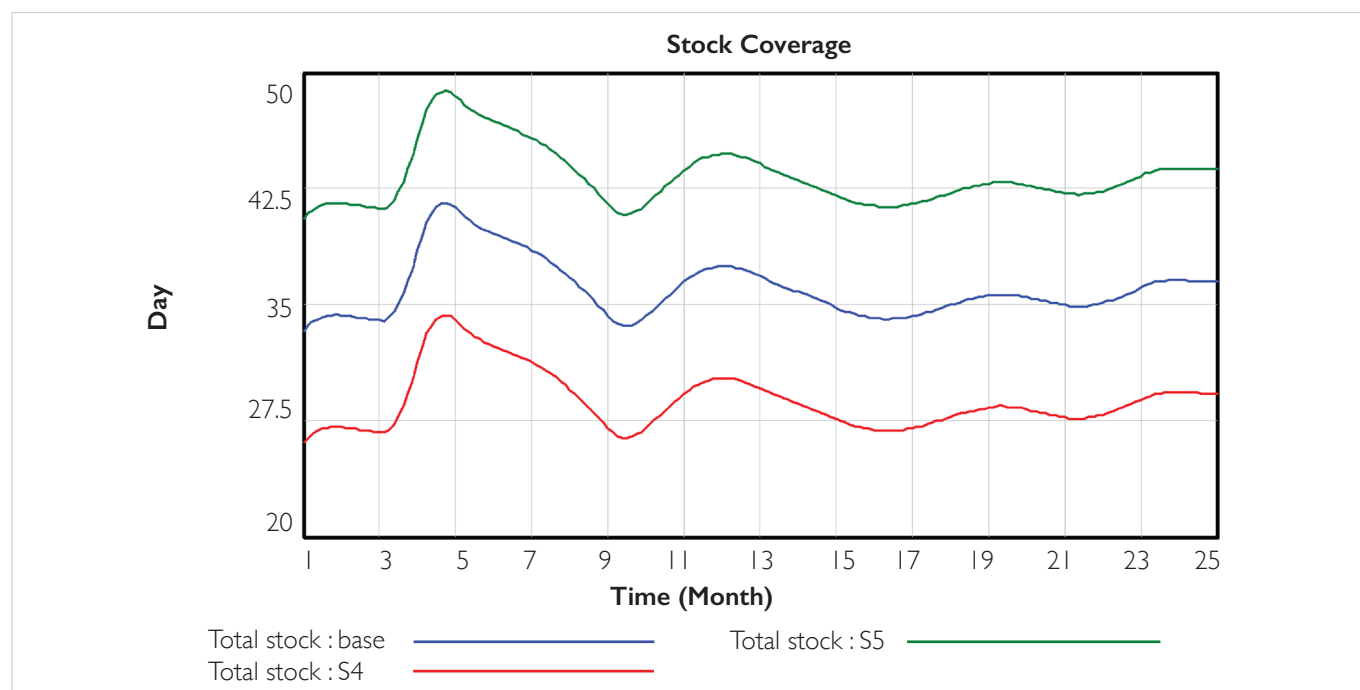
**Figure 7: The impact of changing the stockpile levels on total stock**



Source: Authors, from model.



Figure 8: The impact of changing the stockpile levels on total stock and coverage



Source: Authors, from model.

Table 14: Descriptive statistics for total rice stock

Statistics	Total rice stock ('000 mt)		
	Decrease	Base	Increase
MAX	236.9	286.9	336.9
AVG	198.7	248.7	298.7
MIN	180.0	230.0	280.0
SD	13.1	13.1	13.1
COV*	0.066	0.053	0.044

\* COV is the coefficient of variation (SD/AVG).

Source: Authors, from model.

Table 15: Descriptive statistics for total rice stock coverage

Statistics	Total rice stock coverage (day)**		
	Decrease	Base	Increase
MAX	34.3	41.5	48.8
AVG	28.8	36.0	43.3
MIN	26.1	33.3	40.6
SD	1.9	1.9	1.9
COV*	0.066	0.053	0.044

Note: \* COV is the coefficient of variation (SD/AVG).

\*\* Based on estimated monthly rice consumption of 204,100 mt.

Source: Authors, from model.

Tables 14 and 15 present the descriptive statistics for total stock from base, S4 and S5. Note that compared to the reduction of 33.3% in the safety stock level, the average total stock is reduced by about 17.6%. As indicated earlier there is interest in knowing the minimum level of total stock in the system and in which month this occurs. For the base, the minimum coverage of 33.3 days while for the reduced safety stock the minimum is 26.1 days. For the increased safety stock, the minimum coverage is 40.6 days. The average total rice stock coverage is 28.8 and 43.3 days for the respective lower and higher stock level, compared to the base coverage of 36 days (Table 15 and Figure 8).

At the estimated cost of storage of RM150<sup>47</sup> per mt, the cost of keeping the lower and higher stock levels is around RM15 million and RM30 million, respectively. Compared to the base total cost of RM22, the question is then is it worth the extra cost of RM8 million to add 7.3 days to the stock coverage? The converse of this is the comparison of reduction in coverage (of 7.2 days) and the RM 8.3 million savings in cost of maintaining the lower stock level. The answer lies with the trade-off between the stock coverage and the storage that is considered "optimal", taking into account of the country's food security status.

### **Stockpile management**

As for stockpile management, it is proposed that Malaysia emulates the Singapore model as the rice sector is traded in an open economy. Singapore does not produce rice locally and relies on imports for all its rice needs. Rice, or more specifically stockpile grade rice consisting of White Rice, Ponni Rice and Parboiled Rice, is declared a controlled item and its imports requires a permit as mandated by the Price Control (Rice) Order 1990 of the Price Control Act (Chapter 244). Enterprise Singapore (ESG), which is a statutory board under the Ministry of Trade and Industry, administers the Rice Stockpile Scheme (RSS).

All approved importers must keep a portion of their stock in a government designated warehouse (currently Singapore Storage and Warehouse Pte Ltd.). For White Rice, the quantity is 100 mt, which is double the minimum Monthly Import Quota of 50 mt. For the others, the minimum is double the average of monthly import. The total quantity of rice kept in the RSS is not known but 2018 consumption of rice is estimated at 321,000 mt for the population of about 5.639 million. The per capita consumption is around 22.5 kg per year (2020). Indxmundi<sup>48</sup> (2020) estimates that the stockpile can support two months of average consumption.

It is important to note that the government does not take ownership of the rice stockpile and it is assumed that the owners will rotate the stock. However, in times of emergency, the government may acquire the stock with compensation as specified in the Act (Kopi, 2020).

### **Summary and Conclusion**

The study indicates that the current stockpile system handles shock reasonably well. The first set of simulations examined the impacts of disruptions in supply, in the form of reductions (by 50%) for two months of the year (April and May) of local production and of the availability of imports. The scenarios were examined individually and simultaneously. In all cases, the current system is found to be robust and resilient in being able to withstand such shocks. In fact, the system recovers to the pre-shock state in a matter of a few months. This is probably due to the relatively large level of total stocks in the system.

<sup>47</sup>. This figure is estimated by IPB (personal communication).

<sup>48</sup>. [www.indxmundi.com](http://www.indxmundi.com).

The second set of scenarios involves the reduction and increase of 50,000 mt to the base safety stock level of 150,000 mt. As expected, the reduction resulted in a decrease in stock coverage by 0.24 month (7.2 days) and an increase by the same amount to the stock coverage. Recalling the base level stock coverage of 1.295 months (39.4 days), the question of whether the extra 7.2 days' is worth the extra cost of RM8.3 million is a legitimate one.

### 2.3 Collective action

Collective organisation is a broad term encompassing farmer organisations and agricultural cooperatives. However, they have of late been referred to as producer organisations to reflect the global transformation of their social and community functions towards more business and market-driven organisations for the economic benefits of members<sup>49</sup>. The benefits include “expanded access to markets and finance, enhanced access to and management of natural resources, improved access to infrastructure, greater access to information and knowledge, and strengthened voice and power in policy processes<sup>50</sup>.”

The management models in Malaysian crop agriculture range from the estates (or plantations) to commercial farms, contract farming, organised smallholders, and independent smallholders. Estates, defined as production units operating more than 40 ha, are primarily restricted to perennial crops. Commercial farms, as the name implies, are production units that are commercially oriented. Size is not an issue but the tendency is that they are involved in high value crops, such as high value ornamental plants (floriculture), and fruits and vegetables. Contract farming usually involves small farms having production contracts with bigger commercial farms or processors. The formations of organised smallholders, FELDA and FELCRA being the prime examples, are attempts to increase the scale of operations among smallholders. Lastly, the independent smallholders are normally operating on small-sized farms with the attendant problems of low productivity and uneconomic returns.

The issues surrounding estates, producer organisations (farmers organisations and rural cooperatives) are well-known<sup>51</sup> but they are outside the scope of this review on the paddy and rice sector. Furthermore, this section will focus on the rather recent innovation of adopting the estate management model in paddy farming, proposed by the Performance and Delivery Unit (PEMANDU) in the Economic Transformation Programme (ETP) (PEMANDU 2010). Although the ETP stresses the contribution of the economic sector to potential growth and GNI, paddy, despite a contribution of 4% to the 2019 GNI, was included for food security reasons<sup>52</sup>.

In paddy production the issue of scale has been the subject of much discussion. The paddy farm characteristics are not conducive to efficiency benefits without reorganisation. These include: uneconomic farm size, low yield, shortage of labour supply, weak countervailing power, poor coordination of water and ageing farmers, among others. Thus far five major initiatives were introduced to address these structural deficiencies. These include: Group Farming (1968), Paddy Semi-estate (1983), and Paddy Estate Projects (1999 and 2007)<sup>53</sup>. The latest is the Entry Point Projects of EPP10 and EPP11<sup>54</sup>.

<sup>49</sup> Bijman (2016)

<sup>50</sup> IFAD (2016).

<sup>51</sup> For instance Fatimah et al., (2012) examined the performance of agricultural cooperatives in Malaysia.

<sup>52</sup> The contribution of the other five sectors were: Food processing (28%), Cash crop fruits veg (27%), Others (18%), Livestock (16%), and Marine & aquaculture products (7%).

<sup>53</sup> Kamarudin (2017).

<sup>54</sup> Prime Minister's Department: Economic Transformation Programme (ETP) (2010).

The ETP estimates that the economic size of paddy production is 300 ha<sup>55</sup>. The paddy mini-estates programme initiated under the National Key Economic Areas (NKEA) through the implementation of the EPPs (EPP 10 and EPP 11) are basically an exercise in land amalgamation. EPP 10 intends to scale up and strengthen productivity of paddy farming in the Muda area; while EPP 11 for other irrigated areas<sup>56</sup>. EPP 11 is meant for the Kemubu Agriculture Development Authority (KADA) and six Integrated Agriculture Development Authorities (IADAs) comprising IADA Barat Laut, IADA Seberang Perak, IADA Kemasin-Semarak, IADA Kerian Sg Manik, IADA Penang and IADA KETARA. In KADA, the area involved was 1,738.46 ha, with 4,811 farmers, recording yield achievement of 6.639 mt per ha in the main season of 2018/2019<sup>57</sup>. It is worthy to note that increasing the scale of operations is also being carried out privately through the development of the land rental market.

The attempts to increase the scale of operations in paddy farming are not new. Nasiruddin (2012) and Sakinah et al. (2019) describe the role of the Farmers Organisation in the transition from individual farming operations to centralised management of paddy estates in the Muda Irrigation Scheme (MADA). MADA as an irrigated scheme with two cropping seasons per year is naturally interested in an optimum water management policy. This requires strict farmers' adherence to a synchronised planting schedule. Since its beginning in the early 1970s, MADA has encouraged group farming (*kelompok*) activities for optimum water use. Through the Farmers Organisations, farmers participate in irrigation management operation and maintenance as a move towards self-governance. In 1983, the semi-estate project was launched involving Farmers Organisations (FOs), Malaysia Agricultural Bank (now called Agrobank), and LPN. Under this scheme, credit was extended through the Agricultural Bank and paddy sales were made to LPN. In 1999, the semi-estate project was transformed to a centrally managed paddy estate. The idea of a paddy estate was further boosted under the ETP.

Although initiated almost a decade ago, there is little information in the public domain regarding the performance or evaluation of the estate projects. The discussion here is based primarily on two presentations made at the 2019 Paddy Convention in Alor Setar, Malaysia<sup>58</sup>.

### ***The paddy estate in MADA***

The estate project in MADA covers a geographical area spanning four villages involving 82 farm families. Before the project, there were about 500 small paddy plots individually operated by the farmers. Prior to the estate project, the small paddy plots have been realigned to about 37 plots with an average size of 2 ha each, giving a total of about 65.2 ha under a centralised management. This was carried out by MADA.

Beginning in the first season of 2016, the project central management was entrusted to the local Area Farmers Organisation. The land was leased from the land owners for a period of five years (due to end in season 2 of 2021). Farmers are able to work according to the work packages of the estate management.

A total RM2.7 billion has been spent between 2011 and 2020 on MADA area alone. About 78.5% was spent on tertiary infrastructure, 18% on government incentives and the rest were seed grants, paddy buying centres and research and development (R&D). By 2016 the project reached 30,623 ha (30.4% of MADA

<sup>55</sup> *Op. cit.* p519.

<sup>56</sup> *Op. cit.* Chapter 15: Agriculture.

<sup>57</sup> Razif et al., (2019).

<sup>58</sup> Sakinah et al. (2019) and Razif et al. (2019).

area) and 16,595 farmers (28.8% of MADA farmers) and 551 projects<sup>59</sup>. Clearly gross cost per ha and per capita bases are very high indeed<sup>60</sup>. In terms of yield performance, on average the yield has increased from an average of 5.8 mt per ha in 2012 to 6.64 mt per ha in 2016, an increase of 13.2%. The yield incremental is small ranging from 4.1% to 8.7% above the MADA yield average between 2012 and 2016<sup>61</sup>. For instance the yield achieved per four regions was recorded on average of 6.639 mt per ha compared to 6.315 mt per ha for the whole of MADA in 2016.

### **The paddy estates in KADA**

The Kemubu Agricultural Development Authority (KADA) established in 1972 began in 1981 a land amalgamation exercise that by 1991 had 212 ha under a project manager appointed by KADA. By 2018, there were 17 estates with a total of 782 ha involving 3,153 farmers. The average paddy plot is between 1 ha to 1.5 ha.

The NKEA project (EPP 11) in KADA began in the second season of 2012 with 18 projects involving 1,768 ha. The management is entrusted to the Area Farmers Organisation.

The above evidence reveals a number of insights. First, the old models, which are cheaper in developmental cost and have its own advantages, such as group farming, was not given continuous support to realise its full potential. A successful group farming scheme has the capacity to build community spirit among farmers to take charge of their farms and environment. This bottom-up group has a high probability to sustain as self-driven members and make a strong axis compared to top-down project.

Second, cooperative models receive little attention when, like group farming, it has the potential to be an effective member-serving entity as proven in countries like Korea and Thailand and in advanced countries. Cooperative movement was overshadowed by the existence of Farmers' Associations (FAs) where cooperatives are members of FAs. Since Area Farmers' Associations are under the stronghold of politicians they have not been able to empower the members fully to take charge of their associations. Hence, cooperatives may provide a better alternative compared to the politically-laden FAs.

Third, the cost of the EPPI0 particularly is relatively huge, i.e. relative to the achievement realised in yield and income. Besides, the investment should have been channelled to improve the primary and secondary irrigation efficiency rather than tertiary as it is farm-based, which should be the responsibility of the farmers as users.

Fourth, a number of studies have shown that under the current market structure, the paddy farmers have limited opportunities to expand their enterprises beyond the farms. Rice milling is highly concentrated and regarded as high barriers to entry<sup>62</sup>, which bar the farmers to venture into this activity. Similarly, the barriers to entry into agribusiness (input, machinery, and fertilisers) are equally high as the distribution input is

<sup>59</sup>. MADA (2019).

<sup>60</sup> Gross estimation of cost per capita is about RM162.6 thousand (RM2.7billion divided by 16,595 farmers) and about RM88.2 thousand per ha for the period of 2011-2020.

<sup>61</sup>. MADA Paddy Development programme from [http://www.mada.gov.my/?page\\_id=13761&lang=en](http://www.mada.gov.my/?page_id=13761&lang=en). Also refer to Prime Minister's Department: Economic Transformation Programme (2013).

<sup>62</sup>. See Fatimah Bustanul and Sheng (2019). In Malaysia there are ...millers compared to more than one thousand in 1970s and the minimum capital required to own a mill is about RM5 million.

centralised to one agency (NAFAS<sup>63</sup>) in the last five decades<sup>64</sup>. Similarly, before 4 November 2020, seed distribution was confined to a total of nine individuals appointed by the ministry. However, recently the government has announced that NAFAS would function as the sole wholesaler for the Certified Paddy Seeds Incentive programme, which is supposed to provide space for existing registered agents, individuals, or companies to distribute seeds<sup>65</sup>. All these have created concentration of fertiliser and input businesses into one agency. This explains for the slow growth of local input sector and tendencies for rent-seeking behaviour among officials<sup>66</sup> and high distribution cost and inefficient distribution<sup>67</sup>. This implies that openings must be provided for a competitive market to allow farmers and individuals to participate in the value-added and agribusiness activities individually or in groups.

Fifth, to ignore the roles of non-granaries is unjustifiable as they accounted for 38% of paddy areas and 25% production<sup>68</sup>, respectively and these areas are lagging behind on all fronts. A totally new approach of paddy farming can be encouraged in these areas to focus on local varieties in Sabah and Sarawak or in Peninsular Malaysia so as to diversify varieties while enhancing local bio-diversities.

Basing on the above observations, collective action is imperative to address the structural deficiencies. There are a number of models implemented as mentioned above. Besides these models, to provide a wider space for farmers' diversification activities, it is proposed that a "new generation forward-integrated (and/or back-integrated) cooperative" should be encouraged. Forward integration requires the invention of small mills or machines for small and medium quantities of paddy. Similarly to allow them to be involved in agribusiness, development in the local input market must be encouraged as well as competitive market to involve many players as proven by the Korean and Indian agricultural and dairy cooperatives model respectively<sup>69</sup>. Digitalisation should be the enabler for the new cooperatives in their administration, management and business functions.

## 2.4 The National Rice Board

The STE report describes the evolution of institutions in the paddy and rice sector, from the establishment of the Marketing Board of FAMA in 1965, the creation of LPN in 1971, the creation of BERNAS as a corporate entity in 1994, and its delisting in 2014 (STE pp 11-16). According to BERNAS, the single importer policy was entrusted to LPN in 1974 and while BERNAS took over the commercial and social functions, the regulatory functions remain with LPN<sup>70</sup>.

<sup>63</sup> NAFAS is the National Farmers' Association.

<sup>64</sup> Input fertiliser distribution is centralised to NAFAS. The agency is beset with rent-seeking activities and inefficiency in distribution. According to the National Audit Department (2019), the average delay of input delivery ranged from 14 – 222 days in 2016 – 2018.

<sup>65</sup> MOA (2018).

<sup>66</sup> www.thecoverage.my (2019).

<sup>67</sup> National Audit Department (2019) reported delay in fertiliser distribution between 14-278 days.

<sup>68</sup> DOA (2019).

<sup>69</sup> Koh Young-Kon (2017) and Jivani, M. J., & Murray, E. V. Agricultural Cooperatives of South Korea.

Kurien, V. (1997). *The AMUL dairy cooperatives: putting the means of development into the hands of small producers in India. Reasons for hope: Instructive experiences in rural development, 105-119.*

[https://www.academia.edu/25904083/Agricultural\\_Cooperatives\\_of\\_South\\_Korea\\_An\\_Integrated\\_Value\\_Chain\\_Finance\\_in\\_Agriculture](https://www.academia.edu/25904083/Agricultural_Cooperatives_of_South_Korea_An_Integrated_Value_Chain_Finance_in_Agriculture): Experience of Agricultural Cooperatives in Korea, Presented at the Policy Dialogue Forum on Value Chain Finance in Agriculture sponsored by the APRACA FinServAccess Project Sep.3-5, Katmandu, Nepal <https://www.apraca.org/wp-content/uploads/2017/06/Korean-value-chain-finance.pdf>.

<sup>70</sup> Fatimah, Bustanol and Sheng (2019)

Currently IPB within MAFI has two sections: Paddy and Rice Monitoring Section, and a Paddy and Rice Industry Section, together with an Administration Unit. There are four units within the Monitoring Branch: Licensing Unit, Enforcement Unit, Prosecution Unit, and the State Paddy and Rice Monitoring Unit.

IPB produces an annual document called Basic Information Statistics Paddy and Rice Industry but it is meant for internal circulation only, and occasionally made available to outsiders on request. According to the 2019 edition, there were 35,770 active license holders in Malaysia broken down by states and major cities. The licences are also categorised by type: wholesale, export, import, commercial paddy mills, paddy buyers, and retail. It is interesting to note that there were 223 Approved Permits (APs) issued in 2019. Apparently even BERNAS has to obtain a permit for each import exercise. It is not clear whether other importers can apply directly to IPB or they have to apply through BERNAS.

Note that information about farmers is not reported in this document. More importantly there is no Branch or Unit involved in the analysis of data and publishing the results of such analyses. Presumably such studies or analyses are placed under the jurisdiction of the Policy and Strategic Planning Division of MAFI. However, information about the output of this division is not available in the public domain.

As indicated earlier, the Rice Board was proposed in anticipation of the termination of the single importer policy, which means that BERNAS will presumably not be obligated to implement the social obligations (including the management of the national public rice stockpile). Recall that the social obligations were under the jurisdiction of the previous LPN. With the recent extension of the single importer policy, BERNAS is expected to continue with the execution of the social obligations. In short, this makes the functions of the proposed Rice Board to be entrusted with the social obligations functions irrelevant. However, since the regulatory functions remain with the government, we feel that the current responsibilities of IPB could be enhanced beyond the traditional regulatory and monitoring framework. With the vast amount of data currently residing within IPB, it could be tasked to provide timely and accurate analytical reports on the industry. For this to happen, the analytical capacity of the IPB needs to be enhanced. Wood remarked that the most limiting resource in developing countries is the limitation of administrative skills (pp. xi).<sup>71</sup>

### ***Systems thinking in public policy***

It is clear that the present paddy and rice industry environment has changed drastically compared to the situation that existed in the past when the current policies were drafted. It has been said that the issues that will be faced in the 21st Century are unlike that of the past. The hyper-connectivity and unprecedented rapid and dynamic change are creating uncertainties and chaos that contribute to a more complex global environment. This calls for a change in public policy making.

The need for a systems approach in agriculture was made as early as 1980 by Wood<sup>72</sup>. He devoted a section of the book on the systems approach. This is not surprising as agriculture from the very beginning is embedded in nature's diverse system, dependent on the weather system and frequently disrupted by uninvited pests and diseases from the biologically diverse ecosystem. The diversity of activities in the farm also led to the view that the farm is a system in its own right, as outlined in the farm management text of McConnell and Dillon<sup>73</sup> that has "a systems approach" in the title. More recently, the same need for systems thinking in public policy and evaluation was echoed by Barral<sup>74</sup> and the OECD<sup>75</sup>.

<sup>71</sup> Wood (1980).

<sup>72</sup> Wood (1980).

<sup>73</sup> McConnell and Dillon (1997)

<sup>74</sup> Barat et al. (2012) and OECD (2019).

<sup>75</sup> OECD (2019).

**PEMANDU**

The establishment of the Performance Management and Delivery Unit (PEMANDU) in 2009 can be considered an institutional innovation or a paradigm shift in policy formulation and public sector delivery in Malaysia<sup>76</sup>.

The innovation can be seen in the very process practised by PEMANDU. The process, the so-called eight-step transformation process, can be seen in Figure 9. The first step in the process starts at the very top of government. Immediately after this, the PEMANDU laboratories (labs) are convened to deliberate on the strategic directions identified in Step 1. Step 3 follows with the Open Days where the public can view the output from Step 2. In Step 4, the publication of the Roadmaps outlines the planned activities. In Step 5, the Key Performance Indicators (KPIs) crucial in the monitoring and evaluation of the activities are developed. The actual implementation is carried out in Step 7 while in Step 8, the results are validated by independent reviewers. The whole process is completed with the publishing of the Annual Reports (Step 8).

It is clear that the approach is neither top-down nor bottom-up. Despite its apparent linearity in the listing of the steps, the consultative process is continuous and, in fact, mini-labs (with reduced number of participants and shorter duration) are convened to address specific issues. The enhanced communication between the government and other stakeholders is a key feature of the approach. The process has been called iterative or adaptive<sup>77</sup>.

**Figure 9: Driving performance from the centre: Malaysia’s experience with PEMANDU**



Source: World Bank (2017).

<sup>76</sup> Sabel and Jordan, 2015; Narasimhan and Pillai, 2018; World Bank, 2017.

<sup>77</sup> Sabel and Jordan (2015)



The first initiative of PEMANDU is the identification of key areas as outlined in the GTP. In the beginning, six areas were identified (reducing crime, fighting corruption, improving student outcome, raising living standards for low income households, improving rural basic infrastructure and improving urban public transport). Later a seventh key area, addressing the rising cost of living, was added.

Soon after the publication of the GTP, the ETP was released. A total of 12 economic focus areas, called the National Key Economic Areas (NKEA), were selected in the ETP. The selection was based on the potential for growth and contribution to GNI and employment.

Agriculture was one of the key areas identified. Within agriculture, six sub-sectors were included primarily based on the criteria of growth, employment, and GNI, except for paddy and rice, included for food security concerns. The contribution to 2009 GNI from the six sub-sectors were: Food processing (28%), Cash crop: fruits and vegetables (27%), Others (18%), Livestock (16%), and Marine & aquaculture products (7%), and paddy (4%).

One of the innovations is the creation of the Labs. This is an intensive consultative process where all the stakeholders in a policy area are brought together for about 6-9 weeks to design solutions to existing challenges. There are also “mini” labs convened to address specific issues arising from the Labs. The number of participants is smaller and the time duration is shorter.

PEMANDU's contract with the government was due to end on February 2019 but by February 2017 PEMANDU became a private consultancy firm (called Pemandu Associates Sdn Bhd).

### **Other matters**

Under a deregulated market, some of the social functions of BERNAS may no longer hold. For instance, as for the buyer of last resort function, the private market has its own ways of market clearing of surplus or rationing during deficit. In fact under a freer market, the industry is incentivised to add value to rice-based products for diversification as well as to expand their businesses to remain competitive. Similarly the issue of Bumiputra Miller Scheme can be solved if the small farmers are provided with small mills and machines to allow them to participate in value-added activities. Mills that are interested in enhancing their performance may refer to SME Corp under the Ministry of International Trade and Industries. On a similar note, the distribution of input should also be opened to a number of players to encourage competition and hence investment into the sector. These may spur the growth of the local input production utilising local resources and help reduce cost of production.

Paddy and rice industry is vulnerable to natural hazards, such as floods, draught, pest and diseases, among others. Hence, the government should be vigilant of those phenomena and make allowances for social and market supports, such as temporary assistance. Other market supports include tariff instrument, subsidies to crop insurance and credit facilities.

### 3. THE ROADMAP

#### New Vision

After more than five decades under protectionist policy and rice import monopoly through an STE, the paddy and rice industry exhibits typical symptoms of such a structure. These include market distortions, inefficient use of resources and overall slow growth in development. Despite the tripling of subsidies, the yield growth has been linear at about 1% per year and the SSL has remained unchanged. The industry has not advanced beyond paddy and rice production, while the value addition to rice is minimal. Among the market players, the producers are the poorest, with a majority in the B40 category. Fast forward, there is a need for a new vision to redesign the landscape for a better future.

We propose a new vision for the Malaysia's paddy and rice sector, as follows:

#### *Moving towards a growing, equitable and sustainable rice industry*

The interpretation and roles of the components of this new vision are:

**Growth:** Sectoral expansion and advancement to produce healthy, affordable and diversified rice and rice-based products of high quality and standard for consumers and users.

**Equitability:** Equitable distribution of profit among the market participants for inclusivity and integration.

**Sustainability:** Eco-friendly paddy and rice production to preserve the country's environment and natural resources.

The goals of this new vision:

1. To empower farmers with entrepreneurship under a competitive market economy.
2. To nurture Small and Medium-Sized enterprises (SMEs) to drive the value added industries.
3. To create a fair and healthy competition and equal market opportunities at all market levels which include input (agribusiness), services, milling, wholesale, retail and import sub-sectors.
4. To adopt environment-friendly farm practices, precision farming, low water footprint paddy production and circular-economy application.

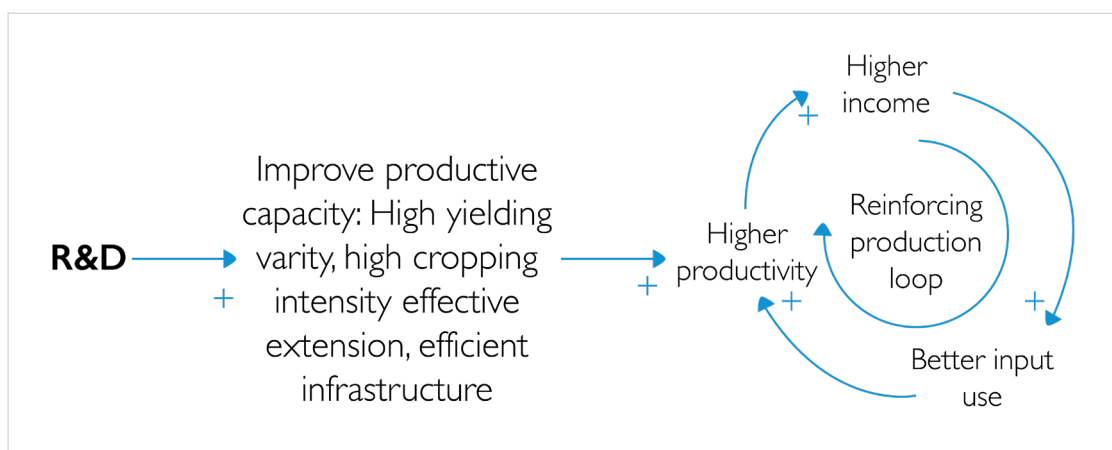
#### Generating a virtuous circle

Studies upon studies show the reinforcing traps of a vicious circle of slow growth and poverty. For instance, in the case of Malaysia, slow growth in yield, low cropping intensity and ineffective extension lead to low productivity, net profit and hence capital formation and non-optimal mix of input use<sup>78</sup>. This in turn affects the yield and income outcome that completes the loop. This vicious circle can be reversed to a virtuous circle by creating a positive loop all the way as shown Figure 10.

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<sup>78</sup> Fatimah et al. (2020).

Figure 10: Virtuous cycle of paddy production



## Strategies

### (i) ***“To empower farmers with entrepreneurship under a competitive market economy”***

To nurture creativity and entrepreneurship, the farmers must be given the freedom to respond to the market economy and decide for themselves as to the best input mix for their farms with technical guidance of the extension officers. Note that the Malaysian farmers have not been exposed to a market economy for almost five decades as their production decision is dictated by the input subsidies, and their receipts by the GMP and output subsidies. To soften the impact of change on them, the deregulation of subsidies are withdrawn in three stages, which are:

- Output-based payment.
- Direct compensation.
- Area-based decoupled payment.

The transition as well as the pros and cons of each type of payment have been explained earlier. The next step after the deregulation of subsidies is the deregulation of the import market where it is open to more players instead of one, to create competition (see Figure 11).

The timing and sequence of the implementation of the subsidy withdrawal and import market deregulation is tricky and precarious. The political sensitivity and the readiness of the market participants to embrace the new structure are the two major stumbling blocks that need to be addressed with careful planning. Ideally the two major moves; subsidy withdrawal and import deregulation, should be carried out simultaneously to give a full spectrum of impact. An engagement with the stakeholders as well as an education programme on the benefits of liberalisation are a must to get their full support.

Since the majority of farmers own small farms, they are easily victimised by the large scale millers or buyers, who have market power. Besides the current land consolidation efforts, cooperative models can be implemented with other small farmers particularly in the non-granary areas. This move entails a brand new concept of “new forward/backward integrated cooperatives” to allow farmers to expand their enterprises beyond farms. The pre-conditional supports for these strategies are discussed earlier.

**(ii) To nurture SMEs to drive the value-added industries**

The development of rice-based food and products requires a proper plan to encourage R&D, and in relation to this, entrepreneurship training, fiscal incentives to SMEs and trade support must also be given.

**(iii) To create a fair and healthy competition and equal market opportunities at all market levels**

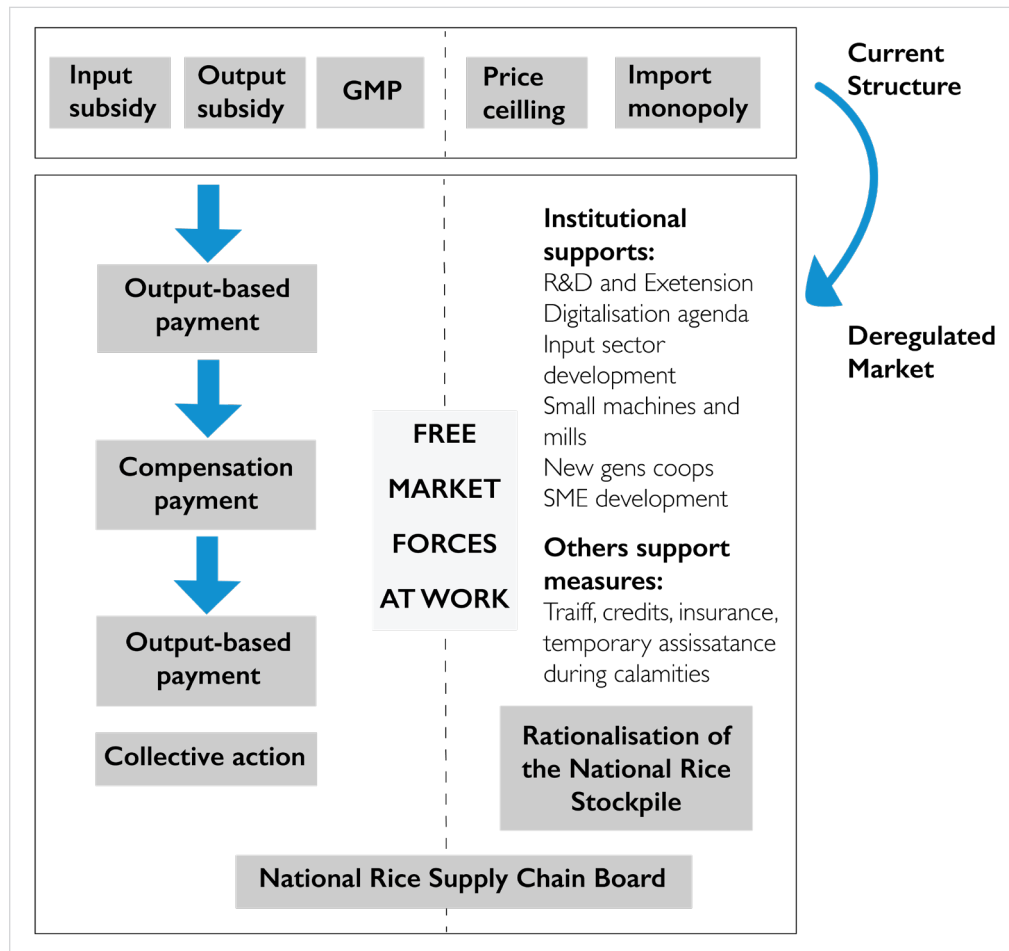
This requires the setting up of a National Rice Board with the following functions.

- To monitor demand, supply and price of local and imported price and price dissemination and develop early warning systems.
- To develop a comprehensive database of the paddy and rice industry and to develop relevant big data analytics to monitor the performance of the industry.
- Together with MyCC and other agencies to regulate and monitor the market in terms of market practices, behaviour (merger and acquisition) and competition.
- To implement digitalisation of farm production and supply chains.
- To carry out continuous monitoring and evaluation or policy analyses on government projects based on empirical evidence. The data on farm management must be made regularly available by regions or districts as input for policy monitoring.
- To monitor the economic and welfare improvement of the farmers.
- To facilitate farm institutions, such as cooperatives and group farming to venture into processing agribusiness through extension and advisory services and incentives/subsidies for small machines or mills or other instruments.
- To monitor stockpile performance.

**(iv) To ensure the adoption of environment-friendly farm practices**

This is an inevitable agenda to implement urgently as the sector is exhibiting symptoms of unsustainable practices. These include serious soil degradation, toxic farm water, high water foot print, and overuse of fossil-based fertiliser. A strong coordination between farmers, research institutions and extension agents is needed to create eco-friendly farming system.

Figure 11: Paddy and rice sector road map



## 4. CONCLUSIONS

BERNAS has signed a 10-year extension (2020-2030) to the Import Monopoly (Concession Agreement) with MAFI<sup>79</sup>, while NAFAS has been appointed as the sole wholesaler for paddy seeds<sup>80</sup>. These developments reflect the stance of the government on the paddy and rice sector, which is to maintain the status quo. It reflects the government's belief that the current structure serves well the three-pronged objectives of high price to producers, achieving the targeted Self-sufficiency Level (SSL) and ensuring stable supply and fair prices to consumers.

The continuance of the business as usual is unlikely to bring much change in the paddy and rice industry. Stability may be assured at the expense of growth, equitable distribution and sustainability, which will be seriously challenged. In particular, farmers' growth will be stunted as proven in the past. With digitalisation technology changes taking place with speed and other emerging factors, the landscape is fast changing. Under such a scenario, market information and transparency are the order of the day, hence trade secrecy and monopoly are merely an antithesis of such a structure. However, the ten-year gap is long enough for planning a change to ensure an effective landing when the time comes. Under any market structure, the basic fundamental tenets of healthy growth and competition, as well as equitable distribution and sustainability are the strongholds. Hence, these three pillars are the axes of our vision for the new food security policy roadmap proposal.

The policy roadmap is designed along the following lines. The first agenda involves market deregulation (gradual withdrawal of subsidies) and import deregulation agenda. It is proposed that in the early stage of transformation, an output-based payment is implemented by providing vouchers. Later it is replaced by a direct compensation payment, followed by area-based decoupled payment (on condition that the farmers continue farming), which are unrelated to their production decisions. The two payments are less distortive and hence allow farmers to respond to the market economy. The major benefits are:

- the farmers take charge of their farms better with efficiency gains; and
- big savings to the government, which can be invested on improving productive capacity, such as R&D and its extension, infrastructural supports, and most of all, digitalisation, and sustainable practices.

As for the sustainable practices agenda, it should be on project basis to be tested on selected areas rather than based on national implementation.

Deregulating the imports allows the local market to discover its own prices in tandem with the international market situation. Under such a situation, resources will be used efficiently and innovations are encouraged as players strive to improve their positions in the market. Deregulating the market may not be favourable on grounds that it is unstable and hence farmers are subjected to price risk. However, despite stable prices under the protectionist regime, their livelihood has not improved and non-price risks that they face are severe. These include input risk, such as low yield due to poor quality seeds and variety, inefficient input delivery and personal risk among others. Under a deregulated market some of these risks may be minimised as market participants endeavour to achieve efficiency in efforts to optimise profit.

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<sup>79</sup>. MAFI (2020).

<sup>80</sup>. *themalaysianreserve.com* (2020).

However, in view of its slow growth in the past, under a deregulated market the sector requires bigger institutional support to enable the producers to be independent and resilient so as to take advantage of the dynamic market economy. This support includes R&D and its extension, infrastructural development, local input production, credit and other productive capacity building.

Without proper understanding and preparation, liberalisation of an STE in food marketing systems may not produce the intended results, namely competitive and efficient market. Experiences in some countries indicate that liberalisation sometimes transfers the market power from public marketing authorities to private intermediaries<sup>81</sup>. Among these are the close relationship between the public sector with private sector, poor implementation and weak farm sector. As for the farm sector, the farmers need more support in terms of; (i) capacity enhancement (better variety, input, infrastructure, institutional credit and so on); and ii) opportunities in agribusiness and value-added activities to enhance and diversify income. As for the latter, the constraints lie in the various chokepoints in the system, such as high barriers to entry into the relevant markets such as milling, agribusiness and rice trading sectors.

Hence in order to expand their enterprises, collective actions are proposed particularly a new generation of forward or backward integrated cooperatives besides the current estate models. Toward this end, it is imperative that the cooperatives or producer groups are provided with small or medium mills so that they can venture into value-added activities to sell their produce directly to consumers or for exports. R&D must be expedited to produce machines and mills that fit small and medium cooperatives or enterprises. Similarly, input distribution is to be decentralised to open up for more participants and attract investment in the input sector.

Other institutional proposals include the enhancement of stockpile management. The current level of the public stockpile is adequate to absorb shocks and bounce back to normality within four to five months. It is proposed that Malaysia studies the Singaporean model of stockpile management for reference and benchmarking. The new National Rice Board must embrace the consultative process with the stakeholders as well as carry out systems view of issues in arriving at policy decisions and strategies. Without doubt the most important agency in this transformation process is the IPB with the tasks to plan, implement and monitor change. Toward this end, it is imperative that IPB equips its human resource with analytical skills in policy and industry analyses, data analytics, regulatory and logistical evaluations and overall understanding of market structure, conduct and performance. These skills are necessary to ensure the success of the transformation.

Finally, we would like to emphasize the participation of selected stakeholders in selected regions in the implementation of the recommendations on a trial basis. This would give valuable opportunities to manage unforeseen challenges and provide valuable opportunities for improvement in the implementation of the recommendations. We also believe that there is no one-size-fits-all policy and the design of the recommendations to incorporate regional variations will definitely improve the adoption of the recommendations when implemented nationwide.

These proposals undoubtedly may seem radical but it is worth noting that they have been well tested, in one form or another, in other countries. After more than 50 years of being under a more or less similar structure we firmly believe the convergence of these elements may reverse the decades of slow growth and move the industry towards a more virtuous circle of dynamism and sustainability.

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<sup>81</sup>. Barret (1997), Duncan and Howell (1992) and Barrett (1994).

## References

- Allen, M. (2016). Forms of farm support/subsidy as operated in selected countries and associated conditions.
- Amin Mahir Abdullah, Fatimah Mohamed Arshad, Alias Radam, Mohd. Mansor Ismail, Mohd Rusli Yacob, Mahfoor Harron, Zainal Abidin Mohamed, Ismail Abd Latif and Emmy Farha Alias (2011). Impact of the Paddy Price and Fertilizer Subsidy Schemes, research report submitted to the Ministry of Agriculture and Agro-based Industries, Malaysia.
- Arriaza, M., Gomez-Limon, J. A., Gonzalez Arenas, J. and Ruiz Aviles, P. (2006). Viability of the raw cotton production in Spain after the decoupling of the subsidies. Proceedings 'XXVI Congress of the International Association of Agricultural Economists (IAAE)', Brisbane (Australia).
- Bala, Bilash Kanti and Alias, Emmy Farha and Mohamed Arshad, Fatimah and Mohd Noh, Kusairi and Abdul Hadi, Ahmad Hanis Izani (2014). Modelling of food security in Malaysia. *Simulation Modelling Practice and Theory*, 47. pp. 152-164. ISSN 1569-190X
- Barral, S. and Pillot, D. (2012). Assessing smallholder farming. Diagnostic analysis of family-based agricultural systems in a small region.
- Barrett, C. B. (1994). Understanding uneven agricultural liberalization in Madagascar. *Journal of Modern & African Studies*, 32(3), 449-476.
- Barrett, C. B. (1997). Food marketing liberalization and trader entry: evidence from Madagascar. *World Development*, 25(5), 763-777.
- Bossel, H. (2007). *System Zoo I Simulation Models: Elementary Systems, Physics, Engineering (Vol. 1)*. BoD—Books on Demand.
- Caballero-Anthony, M., Teng, P., Lassa, J., Nair, T. and Shrestha, M. (2016). Public stockpiling of rice in Asia Pacific.
- Choi, S., Dyck, J., & Childs, N. (2016). The rice market in South Korea. United States Department of Agriculture Economic Research Service.
- Department of Agriculture (2019). Booklet Statistik Tanaman (Sub Sektor Tanaman Makanan) 2019, Jabatan Pertanian, Kementerian Pertanian dan Industri Asas Tani, Putrajaya. Retrieved from [http://www.doa.gov.my/index/resources/aktiviti\\_sumber/sumber\\_awam/maklumat\\_pertanian/perangkaan\\_tanaman/booklet\\_statistik\\_tanaman\\_2019.pdf](http://www.doa.gov.my/index/resources/aktiviti_sumber/sumber_awam/maklumat_pertanian/perangkaan_tanaman/booklet_statistik_tanaman_2019.pdf)
- Department of Statistics (2017). Report on Household Expenditure Survey (2016). Putrajaya.
- Duncan, A. and Howell, J. (1992). Conclusion: Beyond Adjustment'. J «Duncan, A. and J. Howell (eds.). *Structural Adjustment and the African Farmer*. London: Overseas Development Institute, 199-208.
- Douarin, E. and Latruffe, L. (2011). Potential impact of the EU Single Area Payment on farm restructuring and efficiency in Lithuania. *Post-Communist Economies*, 23(01), 87-103.



Emmy Farha Alias (2013). A System Dynamics Analysis to Improve Self-sufficiency Level for Rice Security Policy in Malaysia. (Unpublished Thesis (M.S.)). Universiti Putra Malaysia, Serdang, Selangor, Malaysia.

Fadzleen Abdul Fatah (2017). Competitiveness and efficiency of rice production in Malaysia (Doctoral dissertation, Georg-August-Universität Göttingen).

Fatimah Mohamed Arshad, Kusairi Mohd Noh, Allia Farhana Rosmansyah (2019). Empirical Study on the Impact of Subsidies on Paddy Production and Income, policy research report submitted to the Paddy and Rice Industry Section, Ministry of Agriculture and Agro-based Industry, Malaysia, 189p.

Fatimah Mohamed Arshad, Bustanul Ariffin and Yeong Sheng Tey (2019). Effectiveness of State Trading Enterprises in Achieving Food Security: The Evaluation of BERNAS in Achieving Food Security and Food Policy at the Crossroads: Wither Roles of BULOG? Kuala Lumpur: Institute of Democracy and Economic Affairs or IDEAS, (Malaysia Agriculture report, 2019), 45pp.

Fatimah Mohamed Arshad, Kusairi Mohd Noh, Bach Nguyen Luong, Illisriyani Ismail, Abdulla Ibragimov, Gregory Ho Wai Son, Siti Aisyah Tumin and Ahmad Ashraf Shaharudin. (2020). System Dynamics Model of the Paddy and Rice Sector. Kuala Lumpur: Khazanah Research Institute.

Fatimah Mohamed Arshad, Kusairi Mohd. Noh, Amin Mahir Abdullah (2012). Penilaian Koperasi Pertanian Terpilih, Serdang: Universiti Putra Malaysia Press, 375 pp.

FAO (2004). FAO Trade Policy Technical Notes on issues related to the WTO negotiations on Agriculture No. 5 Domestic Support: trade related issues and the empirical evidence. Retrieved from [http://www.fao.org/fileadmin/templates/est/meetings/wto\\_comm/Tech\\_note\\_5\\_Dom\\_support.pdf](http://www.fao.org/fileadmin/templates/est/meetings/wto_comm/Tech_note_5_Dom_support.pdf).

Feichtinger, P. and Salhofer, K. (2013). Influence of the Common Agricultural Policy and Heterogeneous Land Quality on Land Rent and Land Allocation, European Union, Working Paper. Retrieved from <https://ageconsearch.umn.edu/record/146963?ln=en>.

Harian Metro (2018). Tiada jaminan harga beras akan turun, 5 Julai. Retrived from <https://www.hmetro.com.my/bisnes/2018/07/354737/tiada-jaminan-harga-beras-akan-turun>.

Indexmundi (2020). [www.indexmundi.com](http://www.indexmundi.com).

International Monetary Fund (IMF). Commodity Prices. Retrieved from <https://www.imf.org/en/Research/commodity-prices>.

Jivani, M. J. and Murray, E.V. (1997). Agricultural Cooperatives of South Korea. Retrieved from [https://www.academia.edu/25904083/Agricultural\\_Cooperatives\\_of\\_South\\_Korea](https://www.academia.edu/25904083/Agricultural_Cooperatives_of_South_Korea) An Integrated Value Chain.

Kamarudin Dahuli, Nik Fazlina Nik Ahmad, Engku Mazlin Engku Halin and Ahmad Sukri Saad. (2017). Peningkatan Pengeluaran Tanaman Padi di Kawasan Muda. Presentation at Persidangan Padi Kebangsaan 2017 Dorsett Grand Subang 26-28 Sept 2017. 39s.

Koh Young-Kon (2017). An Integrated Value Chain Finance in Agriculture: Experience of Agricultural Cooperatives in Korea, Presented at the Policy Dialogue Forum on Value Chain Finance in Agriculture sponsored by the APRACA FinServAccess Project Sep.3-5, Katmandu, Nepal. Retrieved from <https://www.apraca.org/wp-content/uploads/2017/06/Korean-value-chain-finance.pdf>.

Lassa, J.A., Teng, P., Caballero-Anthony, M. and Shrestha, M. (2019). Revisiting Emergency Food Reserve Policy and Practice under Disaster and Extreme Climate Events. *International Journal of Disaster Risk Science*, 10(1), 1-13.

MADA (2013). Paddy Development programme from [http://www.mada.gov.my/?page\\_id=13761&lang=en](http://www.mada.gov.my/?page_id=13761&lang=en).

McConnell D.J. and Dillon J.L. (1997). *Farm management for Asia: A systems approach*. Rome: FAO.

Mely Caballero-Anthony, Paul Teng, Jonatan Lassa, Tamara Nair and Maxim Shrestha (2016). Public Stockpiling of Rice in Asia Pacific. NTS Report No. 3. Retrieved from [https://www.researchgate.net/profile/Paul\\_Teng2/publication/315090754\\_Public\\_Stockpiling\\_of\\_Rice\\_in\\_Asia\\_Pacific/links/58c9e97292851c4b5e6c9f311/Public-Stockpiling-of-Rice-in-Asia-Pacific.pdf](https://www.researchgate.net/profile/Paul_Teng2/publication/315090754_Public_Stockpiling_of_Rice_in_Asia_Pacific/links/58c9e97292851c4b5e6c9f311/Public-Stockpiling-of-Rice-in-Asia-Pacific.pdf).

M'hand Fares and Jean-Joseph Minviel (2017) The role of decoupled subsidies in agriculture providing ecosystem services <https://afse2017.sciencesconf.org/143705/document>

Ministry of Agriculture and Agro-based Industry (2014). PENETAPAN HARGA BELIAN PADI YANG SERAGAM DI SEMENANJUNG MALAYSIA PADA KADAR RM1,200/MT, from Director, Paddy and Rice Division, Min. of Agriculture.

Ministry of Agriculture and Agro-based Industry (2018). *Agro-food Statistics 2017*. Putrajaya: Ministry of Agriculture.

Ministry of Agriculture and Agro-based Industry (2019). *Agro-food Statistics 2018*. Putrajaya: Ministry of Agriculture.

Ministry of Agriculture and Food Industries (2020). *Maklumat Asas Perangkaan Industri Padi dan Beras 2019*. Muda Agriculture Development Authority (MADA) (2019).

Perangkaan MADA 2018. Retrieved from [mada.gov.my/FLIPBOOKMADA1/index.html](http://mada.gov.my/FLIPBOOKMADA1/index.html)

Nasiruddin Abdullah. (2012). Paddy Production in Muda Area: From Individual Based to Commercial Farming. Paper presented at the Asian Irrigation Forum, 11-12 April 2012, Manila, Philippines. Retrieved from <https://events.development.asia/system/files/materials/2012/04/201204-paddy-production-muda-area-individual-based-commercial-farming.pdf>

Narasimhan, A.T., & Pillai, A. A Paradigm Shift in Public Service Delivery: The Malaysian PEMANDU. *ERUDITIO*, Vol. 2(5), December 2018, 114-138.

National Audit Department. (2019). Laporan Ketua Audit Negara (2018) Siri 2. Retrieved from [https://www.audit.gov.my/images/pdf/2019/LKAN2018\\_S2/LKAN2018%20Siri%202%20-%20Aktiviti%20persekutuan.pdf](https://www.audit.gov.my/images/pdf/2019/LKAN2018_S2/LKAN2018%20Siri%202%20-%20Aktiviti%20persekutuan.pdf).

Nicholls, W. H. and Johnson, D. G. (1946). The Farm Price Policy Awards, 1945: A Topical Digest of the Winning Essays. *Journal of Farm Economics*, 28(1), 267-283. Swerling, B. C. (1959). Income Protection for Farmers: A Possible Approach. *Journal of Political Economy*, 67(2), 173-186.

Organization for Economic Co-operation and Development (OECD) (2018). *Embracing innovation in government: Global trends*.

Organization for Economic Co-operation and Development (OECD) (1994). Decoupling : A Conceptual Overview [https://www.iatp.org/sites/default/files/Decoupling\\_\\_A\\_Conceptual\\_Overview.htm](https://www.iatp.org/sites/default/files/Decoupling__A_Conceptual_Overview.htm)

Olivier, J. (2019). Business Math: A Step-By-Step Handbook. Open textbook Library. Retrieved from <https://open.umn.edu/opentextbooks/textbooks/642>.

Paddy and Rice Division, Ministry of Agriculture and Agro-based Industry (IPB). (2020a). Sumber import ikut gred. Paddy and Rice Division: Ministry of Agriculture and Agro-based Industry.

Paddy and Rice Division, Ministry of Agriculture and Food Industries (IPB). (2020b). Data Import Bulanan 2015 – 2020. MAFI.

Pakatan Harapan (2018). Buku Harapan, Kuala Lumpur: Pakatan Harapan.

Papachroni A., and S. Lochrie (2015). Chapter 5 Case Studies and Data In: K. O’Gorman, and R. MacIntosh, (ed), Oxford: Goodfellow Publishers.

Performance Management and Delivery Unit (PEMANDU) (2010). Transitioning from Agriculture to Agribusiness. Chapter 15 in Economic Transformation Programme.

Poczta-Wajda, A. (2011). Decoupled payments in the agricultural policy of well-developed countries. Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu, 6(13).

Prime Minister’s Department (2010). Economic Transformation Programme. Putrajaya: Prime Minister’s Department.

Prime Minister’s Department (2013): Economic Transformation Programme (2013). Retrieved from [https://www.pmo.gov.my/dokumenattached/NTP-Report-2013/ETP\\_2013\\_ENG.pdf](https://www.pmo.gov.my/dokumenattached/NTP-Report-2013/ETP_2013_ENG.pdf).

Razif A., Halim S. and Fadhil M. (2019). Pengalaman KADA dalam pengurusan estet padi. Konvensyen Padi Kebangsaan 2019, anjuran Kerajaan Kedah Darul Ehsan, Kedah.

Roslina Ali (2017). Economic and Policy Evaluations and Impacts of the National Rice Development Policy Strategies in Malaysia: Self-Sufficiency, International Trade, and Food Security, PhD thesis, University of Arkansas, Fayetteville.

Rozakis, S., Tsiboukas, K. and Petsakos, A. (2008). Greek cotton farmers' supply response to partial decoupling of subsidies (No. 725-2016-49702).

Sabel C. and Jordan L. (2015). Doing, Learning, Being: Some Lessons learned from Malaysia’s National Transformation Program, World Bank Report p. 19.

Sakinah Ahmad Tarmizi, Noor Azlina Mhd Rosli, Nik Fazlina Nik Ahmad and Suriani Kasim. (2019). Pengalaman MADA dalam pengurusan Estet Padi. Pembentangan pada Konvensyen Padi Kebangsaan 2019, Alor Setar, Kedah, 10-12 September 2019.

Sinar Harian (2020). BERNAS terus diberi mandat, 3 Disember. Retrieved from <https://www.sinarharian.com.my/ampArticle/113121>.

Swerling, B. C. (1959). Income Protection for Farmers: A Possible Approach. *Journal of Political Economy*, 67(2), 173-186.

Sterman, J. (2010). *Business dynamics*. Irwin/McGraw-Hill c2000.

Thai Rice Exporters Association (2020). Rice Prices. [http://www.thairiceexporters.or.th/price\\_eng.html](http://www.thairiceexporters.or.th/price_eng.html).

TheMalaysianReserve.com (2020). Govt. extends Bernas concession for another 10 years, 10 November. <https://themalaysianreserve.com/2020/11/10/govt-extends-bernas-concession-for-another-10-years/>

www.thecoverage.my (2019). NAFAS RM 1.4 Billion "Jalan Belakang" Contract Scandal : Cronyism Involved As Members of PH Served In Nafas On The Board of Director, 22 November.

Wood, G. P. and Theodore, M. A. (1980). *Readings in agricultural administration*. Agricultural Development Council, Inc. (ADC) New York, NY.

World Bank (2017). *Driving Performance from the Center: Malaysia's Experience with Pemandu*. Knowledge and Research, Malaysia Development Experience Series, Global Knowledge and Research Hub. Accessed on 13 September 2020, <http://documents1.worldbank.org/curated/en/318041492513503891/pdf/114270-WP-PUBLIC-13-4-2017-13-0-58-WorldBankReportPemanduFAFULLWeb.pdf>.

Zawojka, A. (2007). The distribution of direct payments of CAP to producers amongst EU Member States. *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie. Problemy Rolnictwa Światowego*, 1.

## Appendix I: Support mechanism for agriculture in selected countries

Table A1: Support mechanisms for agriculture utilised in a selection of countries

Country/ Jurisdiction and Direct payments to farmers	Associated conditions	Additional forms of support
EU (Northern Ireland)		
Direct payment: Part of the CAP Basic Payment Scheme under	Farmers must be 'active' and are required to meet 'greening' and cross-compliance requirements as they relate to environmental protection/enhancement and animal welfare	Market-support measures in circumstances such as extreme weather. The EU has also intervened due to trade disruptions.  Access to Rural Development funding for various activities including farm diversification, Agri env schemes, modernisation, knowledge exchange and forestry.
Norway		
Direct payment: Include area and headage payments (based on numbers of livestock) and a production-based payment for meat.  Payments appear to differ by region and farm size	Suggestions that there is cross-compliance but potentially more limited in scope.	Market price support, in the form of wholesale target prices, is provided for milk, pork, grains, some fruits and some vegetables. These target prices and the budgetary framework for farmers' payments, are negotiated annually between the government and farmers' organisations.  Export subsidies of processed products to the EU and marketing activities for horticultural products are financed directly by the government.
Switzerland		
Direct payment per area to secure food supplies, payments to maintain farming in less favoured conditions and in the form of payments to farmers who voluntarily apply stricter farming practices related to environmental and animal welfare objectives.	Environmental cross-compliance conditions and animal welfare conditions.	Market price support (MPS) resulting from important trade barriers applied at the border.  Export subsidies for selected processed products
Australia		
No guaranteed annual payment but can receive targeted direct support in certain circumstances	na	No market price support, with domestic and international prices aligned.  There are Federal programmes to facilitate structural adjustment, temporary assistance during droughts, and for natural resource and environmental management.  Research and development (R&D) programmes are a major component of Australian support to agriculture. Rural research and development corporations (RDCs) are the Australian Government's primary vehicle for supporting rural innovation and drive agricultural productivity growth.

Country/ Jurisdiction and Direct payments to farmers	Associated conditions	Additional forms of support
		<p>Some direct targeted payments, in particular, to deal with issues relating to drought include:</p> <ul style="list-style-type: none"> <li>• Farm Household Allowance (FHA) provides up to three years of income support for eligible farmers and their partners</li> <li>• Managing Farm Risk Programme encourages farm businesses to take up insurance to cover against drought and other production and market risks;</li> <li>• Tax measures designed to reduced cash flow concerns.</li> </ul>
Canada		
<p>No guaranteed annual payment but can receive targeted direct support in certain circumstances</p>	<p>na</p>	<p>Farmers can avail of support under the Growing Forward 2 Initiative that includes provisions for the following:</p> <ul style="list-style-type: none"> <li>• Developing and commercialising new products and technologies;</li> <li>• Increasing industry adoption of food safety and traceability systems and seizing new markets;</li> <li>• Increasing profitability in domestic and global markets.</li> </ul> <p>Business Risk Management Programmes also exist to help farmers deal with market volatility and disaster situations.</p> <p>Also support in the form of the Advance Payments Program (APP), the federal loan guarantee programme gives producers easier access to credit through cash advances for their produce.</p> <p>Supply-managed sectors (dairy, poultry and eggs), which are protected by high custom tariffs and oriented towards the domestic market.</p>
China		
<p>Direct payment – but only for grain producers and paid at a flat rate per hectare</p>	<p>Lack of available data</p>	<p>Market price support is the main channel for providing support to Chinese farmers. It is provided through tariffs, tariff-rate quotas (TRQ) and state trading, combined with minimum guaranteed prices for rice and wheat and ad hoc interventions on other agricultural commodity markets.</p> <p>Farmers also receive state subsidies for chemicals and seeds and can avail of state-subsidised agricultural insurance schemes.</p> <p>Payments for returning farmland to forests and for the exclusion of degraded grassland from grazing reflect environmental concerns.</p>

Country/ Jurisdiction and Direct payments to farmers	Associated conditions	Additional forms of support
		Wide variety of programmes supporting the development of agricultural infrastructure, including irrigation and drainage facilities.
South Korea		
<p>Direct payment – since 1997 and include:</p> <ul style="list-style-type: none"> <li>• early retirement payment;</li> <li>• rice income compensation;</li> <li>• promotion of environmentally- friendly agriculture;</li> <li>• maintaining agriculture in less-favoured areas; and</li> <li>• rural landscape conservation</li> </ul>	Lack of data	<p>Tariffs and a wide range of tariff- rate quotas (TRQs) continue to be the main instruments to support domestic prices.</p> <p>A public stockholding scheme for rice is maintained in the form of a purchase and release mechanism operated to reduce price fluctuations in the domestic market and face emergency situations such as natural disasters.</p> <p>The agricultural insurance scheme, introduced for apples and pears in 2001, has increased its product coverage to 62 items including 46 crops and 16 livestock - government subsidises 50% of insurance premium.</p> <p>Development and maintenance of infrastructure and agricultural knowledge and innovation system – example is the ‘Smart Farm’ concept: greenhouses and cattle sheds that can be remotely controlled using smart phones and PCs are starting to develop improved farm production management models based on big data analysis.</p>
Turkey		
<p>Direct payment – focussed on commodity-specific deficiency payments and payments based on current area or animal number – coupled support.</p> <p>Regarding deficiency payments, producers of oilseeds, olive oil, cotton, cereals and tea (since 2005) benefit from such payments. Hazelnut producers receive payments based on area. Payments are also provided for fodder crops, organic farming, certified seeds, gasoline and fertiliser use implemented on the basis of area</p>	A number of regulations control water and soil pollution, and provide protection to wetlands, but unclear if these are direct payment conditions.	<p>Most farmers are exempted from income tax (mainly due to the small size of farms).</p> <p>Input subsidies are provided mainly in the form of interest concessions and payments to improve animal breeds and farm production capacity (e.g. field levelling, drainage, soil improvement and protection, land consolidation and research and development).</p> <p>Region-specific programmes and investment support to improve dairy and beef farm structures are in place.</p> <p>Government financing for the development and maintenance of infrastructure, especially for irrigation.</p>

Country/ Jurisdiction and Direct payments to farmers	Associated conditions	Additional forms of support
		<p>Four state-owned marketing boards for agricultural products: the Turkish Grain Board, the Meat and Milk Board, Sugar Authority, and Tobacco and Alcohol Market Regulatory Authority - influence the determination of prices in the market by providing price support through commodity purchasing and stockpiling, disbursing subsidies, procuring and supplying input to farmers, or importing and exporting agricultural commodities.</p>
USA		
<p>No - had until 2014 when the Farm Act repealed Direct Payments, the Countercyclical Payments Program and the Average Crop Revenue Election (ACRE) Program. The repeal of direct payments, which were a decoupled form of support, constituted a major shift in US agricultural policy.</p>	<p>Direct agricultural budgetary support and rural development payments were subject to cross-compliance requirements.</p> <p>Cross compliance required individual farm-based conservation plan to protect highly erodible cropland and wetlands – less clarity now given the removal of direct payments.</p>	<p>TA move towards crop insurance support has replaced direct payments..</p> <p>Minimum pricing and border tariffs for a range of different agricultural products. Also marketing loans available for certain products.</p> <p>Additional support schemes and programmes as follows:</p> <ul style="list-style-type: none"> <li>• specialty crops;</li> <li>• organic farmer;</li> <li>• bioenergy;</li> <li>• rural development; and</li> <li>• new/young farmers and ranchers</li> </ul>
New Zealand		
<p>No guaranteed annual payment since 1984, but can receive targeted direct support in certain circumstances (see 3rd column in table).</p>	<p>-</p>	<p>No direct market price support as prices are aligned with world market prices due to open trade. Exceptions are due to New Zealand's Import Health Standards which effectively prevent fresh poultry, eggs and some bee products from being imported under current economic conditions, thus generating some indirect market price support for these sectors.</p> <p>Government support provided mainly in the context of:</p> <ul style="list-style-type: none"> <li>• animal disease control;</li> <li>• relief in the event of natural disasters;</li> <li>• the agricultural knowledge and information system – to improve efficiency of industry.</li> <li>• In the case of natural disaster relief including drought support can include: <ul style="list-style-type: none"> <li>• Tax credits</li> <li>• Childcare assistance</li> <li>• Accommodation supplement</li> <li>• Emergency benefit payment</li> <li>• Unemployment benefit</li> </ul> </li> </ul>



Country/ Jurisdiction and Direct payments to farmers	Associated conditions	Additional forms of support
Iceland  Yes - based on payment entitlements, directly or indirectly coupled with production factors. Direct payments are provided to cattle (mainly dairy) and sheep producers, and on a smaller scale to certain greenhouse producers.	In relation to sheep - Keeping a minimum of winter-fed sheep on the farm is, however, required for being eligible to receive the payments.	Market price support, maintained by border measures. Market price support is provided for all livestock products and some horticultural products.  Wholesale prices continue to be managed for approximately half of the dairy products. A government-chaired committee, representing both the Farmers' Association and – on behalf of the consumer side – the labour union, annually determines guaranteed minimum prices for milk delivered within production quotas.  Agricultural revenues are subject to a levy which is distributed within and between various agricultural bodies. Among these bodies is the Emergency Relief Fund: it grants compensation payments to farmers who suffer major financial losses after natural disasters or because of extreme weather conditions, animal diseases or accidents for which there are no insurances available on the market.

Source: Allen, M. (2016). *Forms of farm support/subsidy as operated in selected countries and associated conditions.*

## System Dynamics Methodology

### System Dynamics at a Glance

Systems thinking is a discipline concerned with an understanding of a system by examining the linkages and interactions between the components that comprise the entirety of that defined system. One of the effective tools to understand a complex system is “system dynamics” which is capable of addressing complexities such as interdependency, mutual interaction, information feedback, delays, circular causality, trade-offs and identify unintended consequences. Sterman<sup>82</sup> defined system dynamics as a perspective and set of conceptual tools that enable us to understand complex systems' structure and dynamics. It is a rigorous modelling method that enables one to build formal computer simulations of complex systems and use them to design more effective policies and organizations.

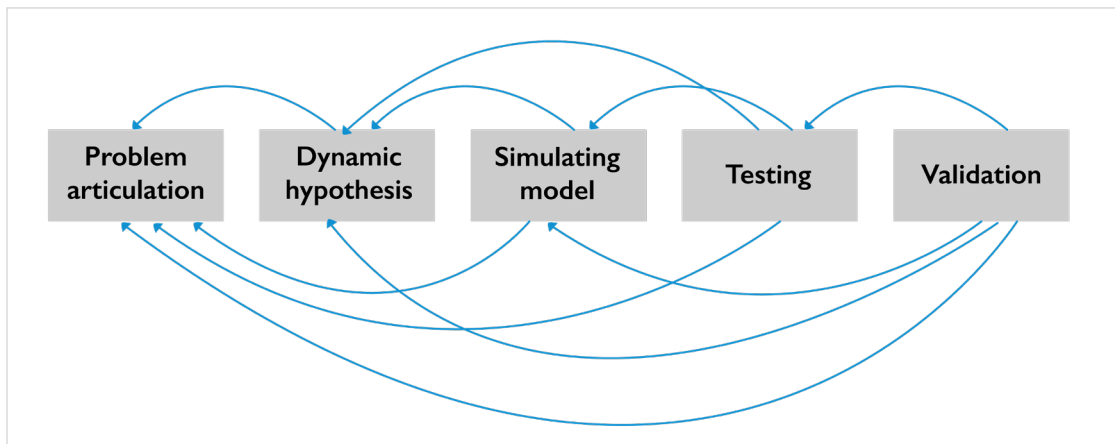
- Problem articulation: To define the problem at hand and identify the study boundary.
- Dynamic hypotheses: Mapping the causal loop diagram based on an initial hypothesis and develop stock and flow diagram.
- Formulation of the simulation model

<sup>82</sup>. Sterman (2010).

- Testing and validating the model
- Policy design and evaluation

Figure A1 presents the process of building a system dynamics model. As shown, the modelling process is a feedback process, not a linear one. The model built goes through constant iteration, continual questioning, testing, validating and refinement. The modelling process starts with the problem articulation and identifying the boundary of the problem. This is followed by proposing the dynamic hypothesis, model simulation, testing and policy design and evaluation. Iteration can occur from any step to any other step.

**Figure A1: The Process in Building a System Dynamics Model**



*Adapted from Sterman (2010).*

A system dynamics model is developed to examine the impact of deregulating subsidies and imports as well as stockpile management. The analytical analysis using MS Excel is static while system dynamics contains time element. The structure of the model is based on empirical studies by Fatimah et al. (2020), Bala et al. (2014) and Emmy Farha (2013). The sub-sections below describe the theoretical framework of the simulation model under deregulated farm subsidies and imports.

### **Examples of small system dynamics models**

An SD model views a system as an interconnected set of elements organized around a purpose. It can exhibit dynamic, adaptive, goal-seeking, self-preserving and evolutionary behaviour. This emergent property makes the system more than the simple sum of its parts.

A class of elements in the system is referred to as a stock. It represents the current state of the system. It is an accumulation, store, level or quantity of material, energy or information. In an SD diagram, a level variable is enclosed in a box.

The level of a stock is affected by the rates of inflow, which may be influenced by other variables in the model or from variables outside the model, called the source. The stock level is also influenced by the rate of outflow from the stock, which may influence other variables in the model or might leave the model, called the sink. In an SD diagram rate, variable are pictured as valves while sources and sinks as clouds. Thus, sources and sinks can be viewed as representing the boundary of the system. The stocks and associated rate variables are joined double lines.

Usually, a system consists of more than stocks and rates. Other variables may be included to represent parameters or constants, and others called auxiliary variables. These relationships are drawn as line arrows connecting the variables. The arrowhead at the end of the arrow denotes the direction of causation. Thus, an arrow from a variable to another variable b, and another arrow from b to a indicate a feedback relationship. The two variables mutually influence one another. In other words, the feedback relationship will form a loop, called, naturally, a feedback loop

The feedback loop usually will involve other variables and may involve significant delays between variables. Delays are depicted by putting double slashes in the middle of the line between the two variables. What characterizes a loop is that the chain can be traced as a closed-loop..

A positive or reinforcing loop means that the effects will be increasing over time while a negative or balancing loop means that the influence will be decreasing over time. To reiterate the effects can involve significant delays.

The entire set of variables and relationships is referred to as the system's structure, which will determine the system's behaviour over time. The system can be in equilibrium where contents may be changing, but the overall level is constant. It can exhibit growth and decay and oscillatory behaviour.

#### Example 1: Exponential growth in SD<sup>83</sup>

Figure A2 illustrates a simple example of the basics of the SD approach. It refers to the case of exponential population growth. As shown in the CDD diagram, the higher the birth rate, the number of births increases, hence the *population* grows exponentially. This simple CLD can be quantified using a stock and flow diagram. As in Figure A2, there are three variables; population, births and birth rate. The population is a stock variable which accumulates over time<sup>84</sup>. A stock variable changes through flow variables that are represented by a double-lined arrows pointing into or out of the stock. The other two variables are birth rate (fraction per person per year) and births (births per year). These are auxiliary variables which determine the stock<sup>85</sup>.

An arrow connecting two variables denotes a causal-effect link between variables. A polarity at the arrow head shows the direction of relationship: a '+' indicates an increase in the independent variable causes the dependent variable to increase or vice versa. Likewise, a '-' denotes that an increase in the independent variable causes the dependent variable to decrease or vice versa. The loop identifier R1 indicates a positive or self-reinforcing feedback loop. While the loop identifier B1 indicates a negative or balancing feedback loop.<sup>86</sup>

Observe that time unit is one year. The stock variable is represented by a box (in this case population). It is an accumulation of incoming flows (number of babies born per year). The level of the stock is a determinant of the number added (a flow) depending on the birth rate. The birth rate is a parameter for this model as it is not influenced by other variables. Multiplying the *population* with the birth rate gives *births* which is the number of births per year.

<sup>83</sup> This example, and the next, is taken from Bossil (2007).

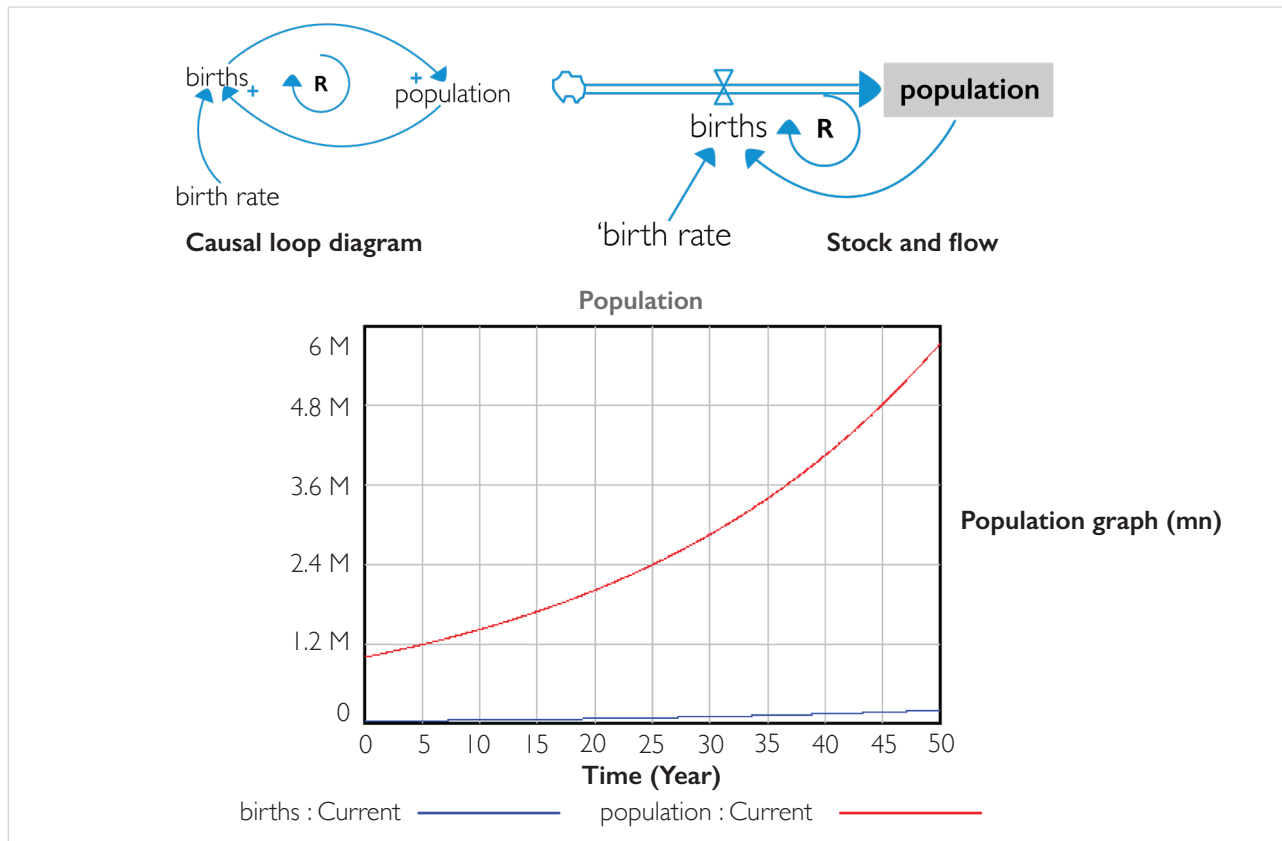
<sup>84</sup> A stock variable changes through flow variables that are represented by a double-lined arrows pointing into or out of the stock (Sternan, 2004).

<sup>85</sup> Examples of auxiliary variables are parameters, constants or exogenous input. In this case they are birth rate (fraction per person per year) is a parameter and births (births per year) is a rate.

<sup>86</sup> Sternan (2004).

This is a clear example of a positive feedback loop. The greater the number of babies added, the larger the population, and the more births, the larger populations and the loop continues. If there were no deaths, a steadily (exponentially) growing would occur as shown by the population graph. The plus sign inside the loop indicates this positive influence. The cumulative total population after 50 years indicate an exponential growth of the population. With an initial population of 1 mn and birth rate of 0.035/person/year, the population reaches 5.74 mn in the 50 th year.

**Figure A2: Population growth: causal loop diagram, stock and flow and graph**

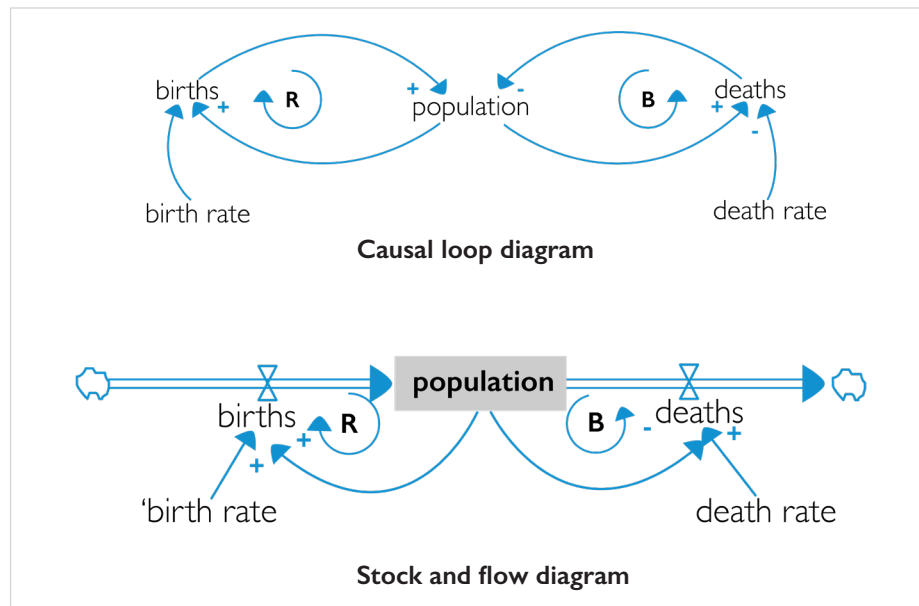


Source: Bossel (2007).

Example 2: Population dynamics

It is unrealistic to assume that population continues forever as death is as certain as day and night. When the death rate is added into the model at 0.01/person/ year, the result will differ if the number of births is exactly equal to the number of deaths. A dynamic equilibrium will be created. However, if the number of deaths outweighs the births, the population shrinks. For instance, if one assumes the death rate is 0.01/ person/year, the population will only reach 3.48 mn by 50th year. Note the balancing loop, which is reflected in a negative effect (Figure Figure A3). The graph shows an interplay of reinforcing and balancing loops where growth dominates initially until finally, an equilibrium state develops, where growth is balanced by decay.

**Figure A3: Reinforcing and balancing loops in population model: Causal loop diagram and stock and flow diagram**



The model is based on a number of simplifying assumptions. To be meaningful in addressing a particular population problem, the underlying assumptions have to be reviewed critically. Some of the major relevant variables that may affect population include; carrying capacity, age structure, food supply, medical system or other random variables. The model structure applies to business dynamics such as product stocks, accounts, capital stocks where there are inflow and outflow.

### Example 3: Infection dynamics

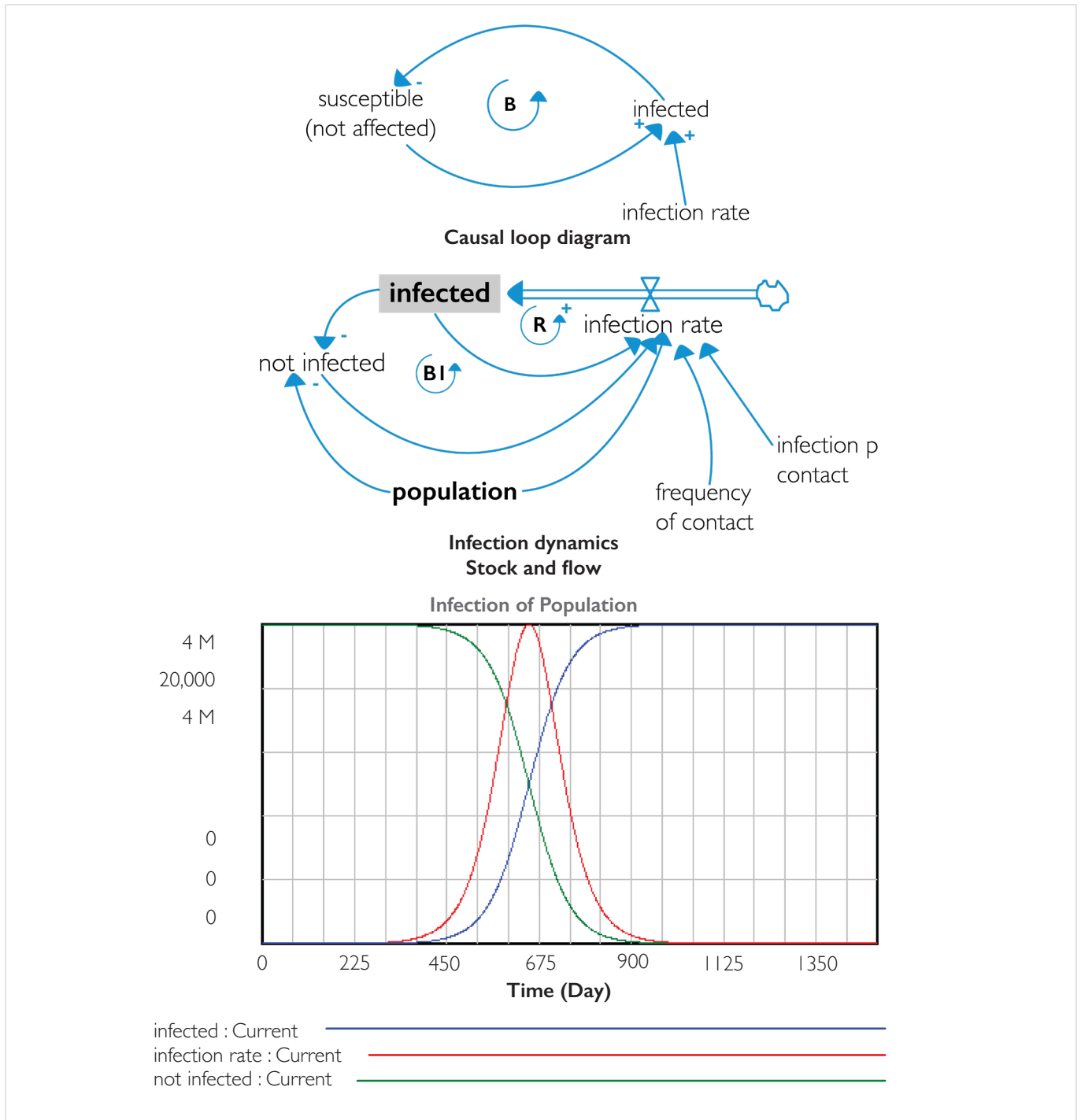
The current Covid-19 pandemic can be explained using a simple infection dynamics model, as shown in Figure A4. If an infectious disease infects a part of the population, the disease can easily spread to the rest of the population through contact. The number of contacts and the probability of “infection” during the contact determine the speed of the *rate of infection*. The higher the number of people infected, the higher the infection rate indicating a positive reinforcing loop (R1). The opposite trend behaves accordingly.

On the other hand a high number of the infected population reduces the number of “not infected”. This in turn, reduces the *infection rate* and *infected cases*. This happens at the beginning and end of the epidemic. However, the rate of infection is highest when both the number of infected and the number of not infected is at the maximum that is about half of the (*infectable*) population has been infected.

As shown in the diagram, two stocks are related to each other which *infected* and *population*. The value of the population is assumed constant. Hence, a number of *infected* increases, the number of *not infected* reduces. The *infection rate* determines the transformation from *not infected* to *infected*. The later, in turn, depends on the *number of infected*, number of *not infected*, *frequency of contact* and the *number of infections per contact*.

The simulation values are as follow: population is 40 mn, simulation time unit s day, initial value is 10 persons infected, frequency of contact =0.2 contacts per person per day, infections per contact=0.1. The simulation period is 1500 days. Based on these parameters, the infection spreads very slowly during the first few months (600 days). Thereafter, it progresses very rapidly, infecting almost population within a year. The behaviour, however, depends on the value of the parameters. This behaviour applies to innovation or news.

**Figure A4: Infection dynamics model: Causal loop diagram, stock and flow and graphs**



## Theoretical framework of the simulation model

### Deregulating farm subsidies

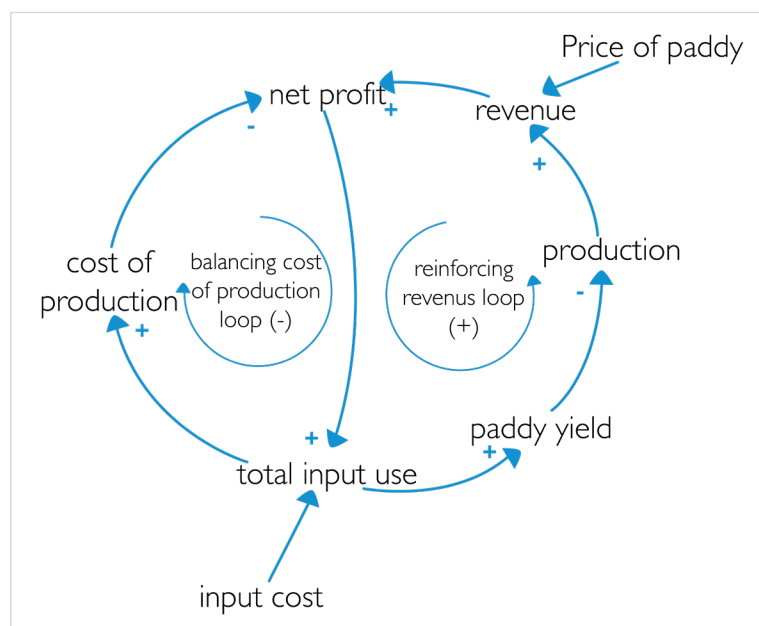
A simple representation of the production sub-system causal loop diagram (CLD) is presented in Figure A5. It is called a CLD diagram as it shows a circular causality of variables in a selected sub-system. The diagram shows that the paddy production sub-system comprises two inter-connected loops: Reinforcing Revenue and Balancing Cost of Production Loops.

One may start to trace the loop from the point of input cost (which is considered as an exogenous variable) that affects the total input use. Higher input use increases yield and production and hence revenue (note that revenue is a function of price). Revenue minus cost of production (from the Balancing Cost of Production Loop) yields net profit. A higher net profit encourages higher input usage, which closes the Reinforcing Revenue Loop. As the narratives imply, a reinforcing loop is a positive relationship which produces an exponential graph.

However, higher input usage may incur higher production cost, which in turn may lower the producer's net profit. This is a balancing loop called Balancing Cost of Production Loop. It mirrors a negative relationship between the variables which produces a downward sloping or decaying graph or goal-seeking behaviour. The net effect to the producer depends on the relative dominance between the two loops. Higher yield and good price may absorb an increase in the cost of production, resulting in a favourable net profit. On the other hand, low yield and low price will be outweighed by the cost of production. Similarly, farm efficiency improvement due to technology may reduce the cost of production and increases net profit.

In reality, there are many more intervening variables or parameters affecting each variable's behaviour in the said paddy production sub-system. For instance, the yield is a function climatic factor, farm practices, input use and water level among others. Similarly, the cost of production is determined by input prices, labour rates, inflation, technology, etc. The boundary of the study depends on the definition of problem to be modelled.

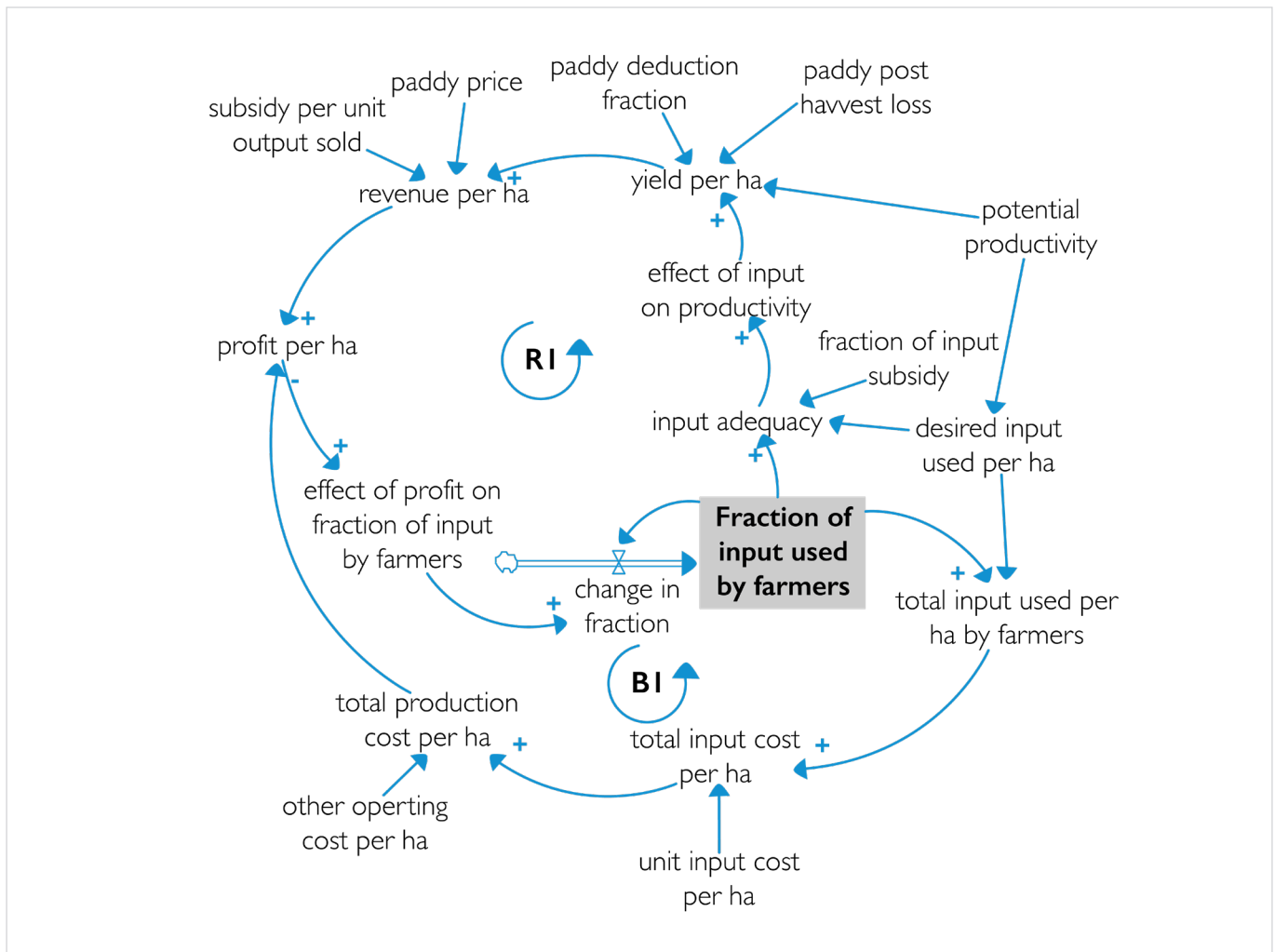
**Figure A5: Simplified causal loop diagram for paddy production sub-system**



Based on the simple model described in Figure A5, a generic model of the paddy sub-system is presented in Figure A6. To examine the impact of input on yield and hence net profit per ha, we first examine the relationship between input on yield and hence revenue. How much input used by a farmer is represented as *Input adequacy* in the diagram. This is calculated as the ratio of the fraction of input used (subsidised and own expenses) over *Desired input used per ha*. Note that the *Desired input used per ha* is determined by the *Potential productivity* of paddy. A withdrawal of input subsidies will affect input adequacy and in turn, will lead to a decline in yield per ha in the short run and vice versa. A decrease in yield per ha will lead to decreases in revenue and net profit per ha. Less net profit per ha will influence the change in fraction of farmers' input in the same direction. The links between input adequacy, yield per ha, revenue per ha and fraction of input used by farmers form a reinforcing feedback loop (RI).

The total input used by farmers determines the total production cost for cultivating paddy. An increase in input used by farmers tends to increase total production cost and later reduces net profit per ha. Reduction in net profit per ha will decrease the input used by farmers in the following season. These causal links form a balancing feedback loop (BI).

**Figure A6: Generic structure of a paddy production sub-system.**



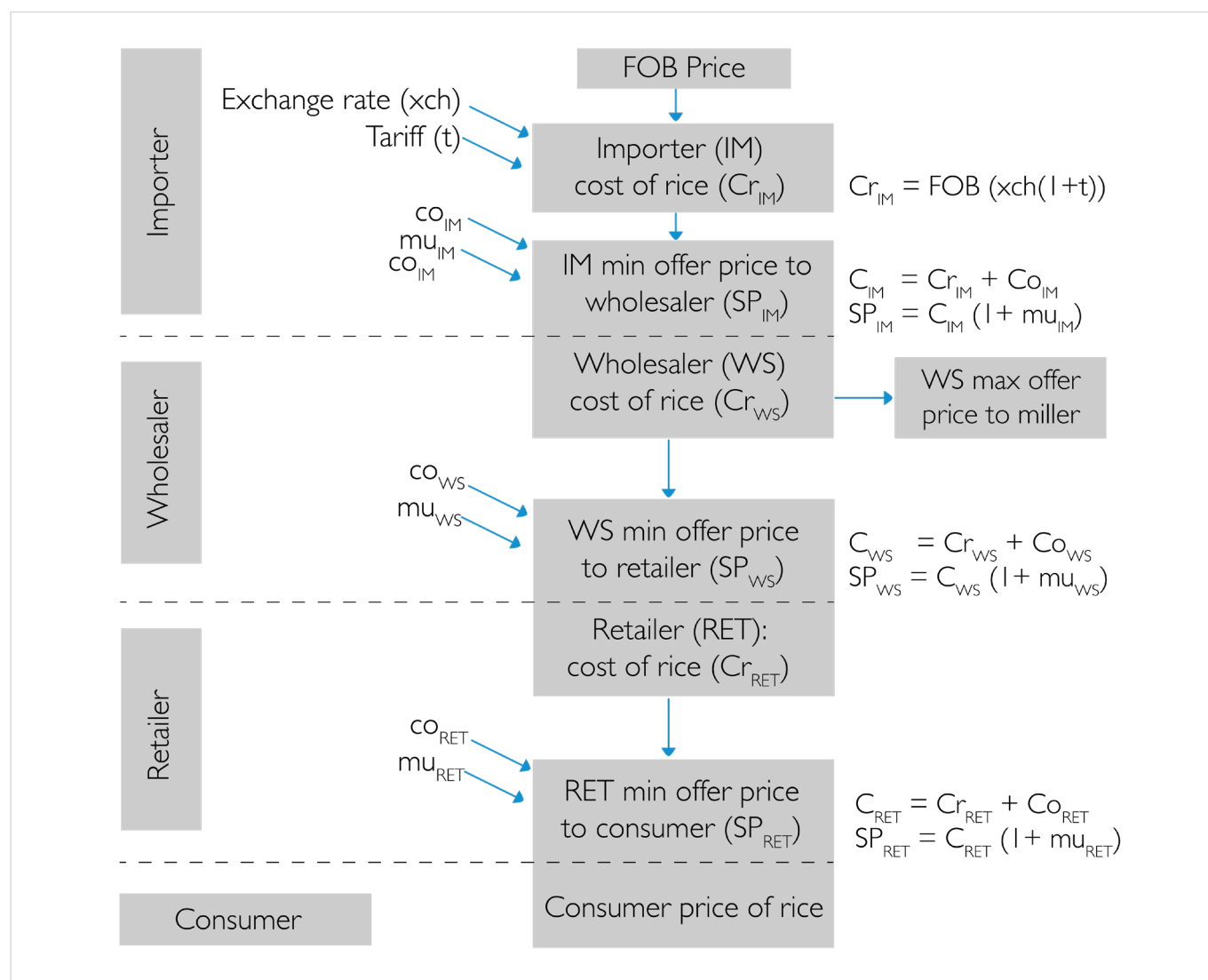


## Deregulating import

By deregulating the import market, the domestic price will supposedly be in tandem with the world price. The derivation of the imported price at various levels; wholesale, mill, farm and retail is based on the standard pricing formula as described in the text (Olivier, 2019<sup>89</sup>). Based on Olivier's framework, the transmission of price from the import level to retail and farm is presented in Figure A7. As shown, the flow of price of imported rice starts with the importer, followed by the wholesaler, retailer, and consumer.

The cost of rice to the importer is determined by the FOB price of rice, exchange rate, tariff rate and other direct costs that can be attributed to the rice purchase (transportation, handling, and storage). Together with his markup policy (which can be shown to include other costs that are difficult to attribute to the quantity of rice (such as marketing costs, overhead and general insurance) and the profit level will determine the minimum selling price. Hence the importer's minimum offer price to the wholesaler comprises all the stated elements (Figure A7).

**Figure A7: The level of prices at import, wholesale, retail and consumer levels in a competitive market**



<sup>87</sup> Olivier (2019).

The importer selling price (to wholesaler) can be summarised as:

$$SP_{IM} = C_{IM} + E_{IM} + P_{IM}$$

Where SP<sub>IM</sub> is selling price offered by importer, as determined by C<sub>IM</sub> (cost of goods which comprises the purchase cost of rice (C<sub>r<sub>IM</sub></sub>) and other direct costs (C<sub>o<sub>IM</sub></sub>), such as transportation and handling charges. E<sub>IM</sub> is the indirect costs (such as administrative, overhead, general insurance, and marketing costs). P<sub>IM</sub> is the profit level set by the importer.

In practice, a simple pricing policy is the so-called cost- plus pricing where

$$SP_{IM} = C_{IM} + M_{IM}$$

Where the Markup (M<sub>IM</sub>) is usually estimated as a proportion (mu<sub>IM</sub>) of C<sub>IM</sub>.

Hence, SP can be rewritten as:

$$SP_{IM} = C_{IM} + mu_{IM} C_{IM} = C_{IM} (1 + mu_{IM})$$

Note that E<sub>IM</sub>, other indirect costs, by definition, is embedded inside M<sub>IM</sub>. Thus SP<sub>IM</sub> is the minimum price offered by Importers (IM) to wholesalers (WS).

Here we assume that in a competitive market the price transacted between willing sellers and buyers levels represent the competitive prices. In other words, the resulting market price offered by WS will be the price paid by the WS.

Similarly, the WS selling price offered to retailers (RET) will be the price paid by RET. In turn the SP offered by RET to consumers (CON) will also be based on the same considerations. Again assuming consumers are price takers, the price paid by CON will be the same as that offered by retailers.

The transaction between WS and millers (MIL), however, is a bit different than the above flow of prices between IM, WS, RET and CON where the unit transacted is in the same form (rice) and the flow of rice starts at the IM level. The transaction between WS and MIL, although transacted in rice units, the flow of rice starts from the MIL to the WS. Since the price is set at the interaction between IM and WS, the maximum purchase price offered by WS to MIL must be the same as the purchase price they have to pay to IM (i.e. SP<sub>IM</sub>).

Note that the transaction between MIL and farmers are in units of paddy. Thus the determination of the offer price for paddy purchase from farmers must be influenced by the selling price of rice by MIL to WS. In a competitive situation, we assume that WS are price takers in dealing with IM, and MIL are price takers in dealing with WS, and farmers are price takers in dealing with MIL. both the purchase price offered by WS to MIL must be the same as the selling price quoted by IM to them (WS).

From the SP<sub>MIL</sub> equation, we know that the cost of goods for MIL (C<sub>MIL</sub>) can be estimated by

$$CMIL = SPMIL / (1 + muMIL)$$

Since C<sub>MIL</sub> = C<sub>r<sub>MIL</sub></sub> + C<sub>o<sub>MIL</sub></sub>, and assuming C<sub>o<sub>MIL</sub></sub> can be estimated as a proportion (co<sub>MIL</sub>) of C<sub>r<sub>MIL</sub></sub>,

$$C_{MIL} = C_{r_{MIL}} (1 + co_{MIL}), \text{ which leads to the estimate for } C_{r_{MIL}} = C_{MIL} / (1 + co_{MIL})$$

Note that so far the unit of reference is in terms of rice. As mentioned earlier, the MIL activity is to convert paddy to rice. The conversion of paddy to rice is affected by the milling recovery rate (mr). Hence a tonne of rice requires 1/mr tonnes of paddy. Thus the cost (value) of rice for MIL can be directly linked to a tonne of paddy, by multiplying Cr by the milling rate (mr). This is the price offered to farmers for the paddy based on the SP<sub>MIL</sub> to WS (which is influenced by the SP<sub>IM</sub> to WS).

The above links are summarised in Figure A7 which shows the flow between IM and RET and Figure A8 the flow between MIL and farmers. The figure shows clearly the levels concerned. Note that the actual numerical values for the calculations are shown in the relevant tables in the text. (Tables 2 – 10).

**Figure A8: Farm price discovery under a deregulated market**

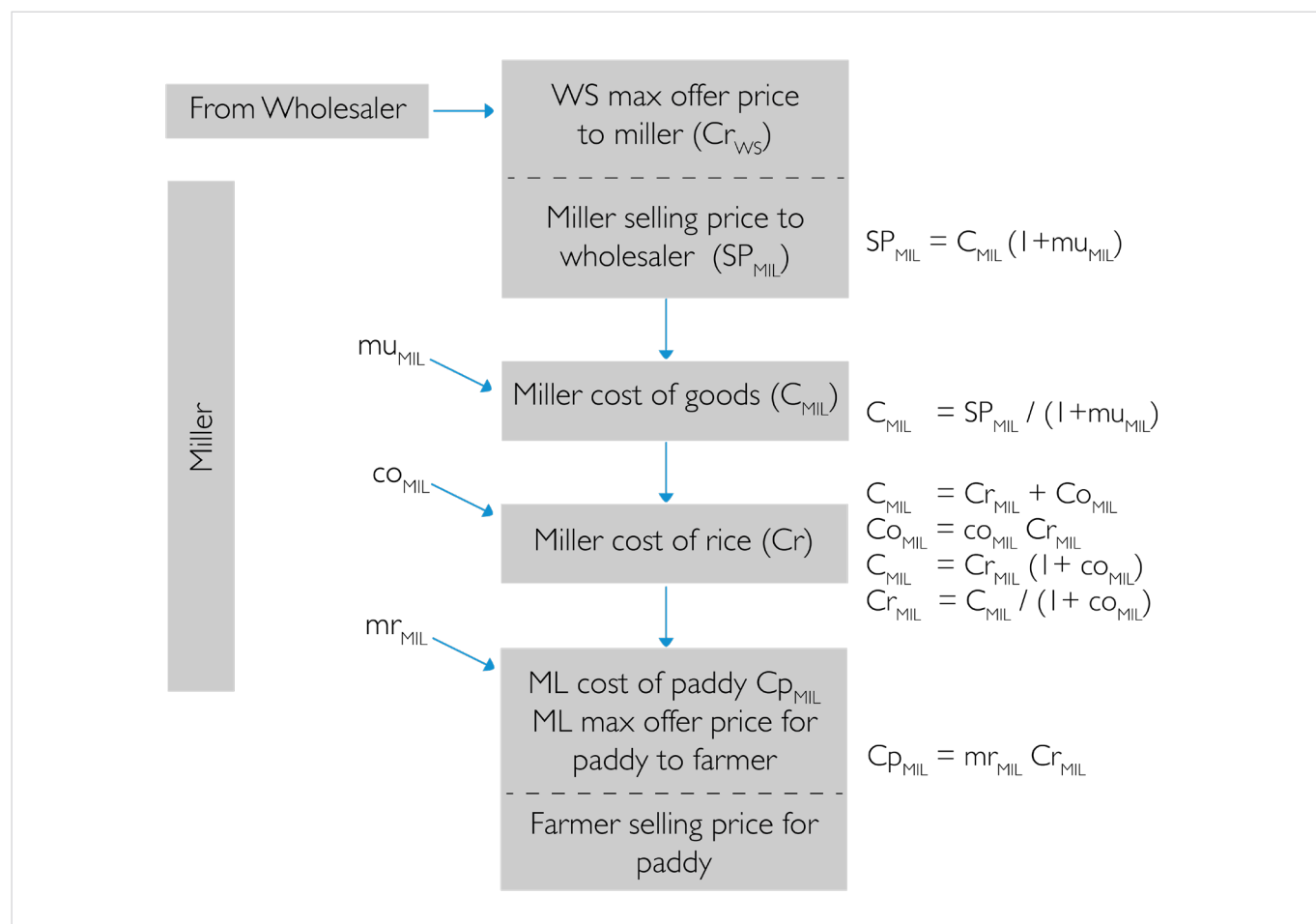
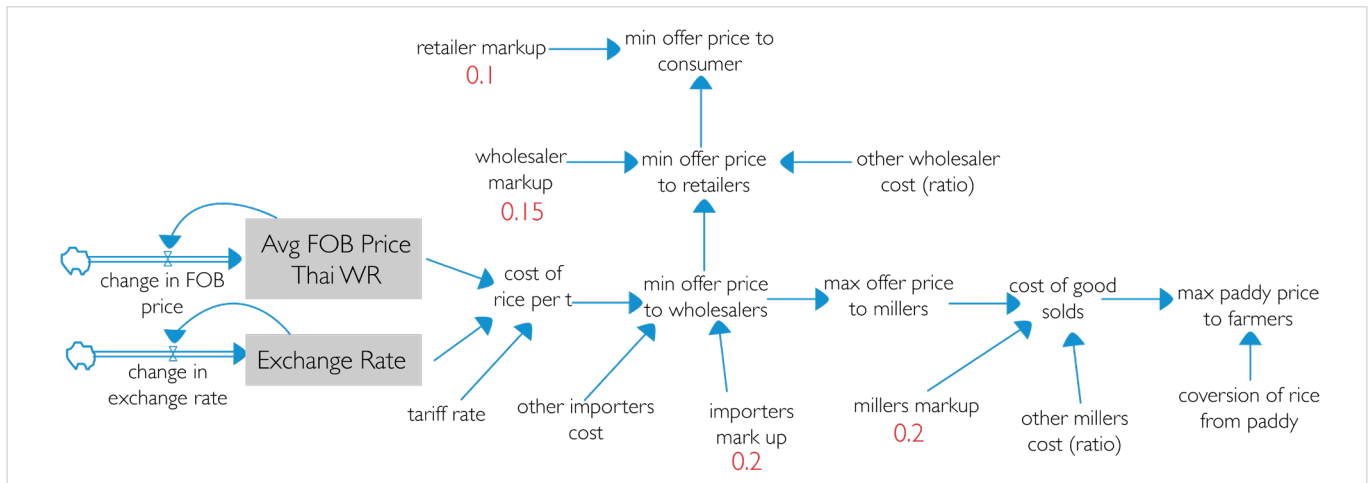


Figure A9 depicts the flow of rice price from import to retail and local rice from the mill to farm under a deregulated market using a simple dynamics model. Based on the pricing charts above, two stocks *Average FOB Price of Thai WR* and *Exchange rate* are introduced to incorporate their expected future trends as discussed earlier. From these two stocks, imported price is determined, and it is used as a price reference for the wholesaler:

The changes in both average fob prices and exchange rate are based on the annual average growth rate. The average annual growth rate is calculated for the past 10 years (2010-2019). A linear chain of cause and effect of prices offered to wholesaler; miller; paddy farmer, retailer and consumer are determined based on the equation for selling price as shown in Olivier (2019).

**Figure A9: Flow of price along the supply chain**



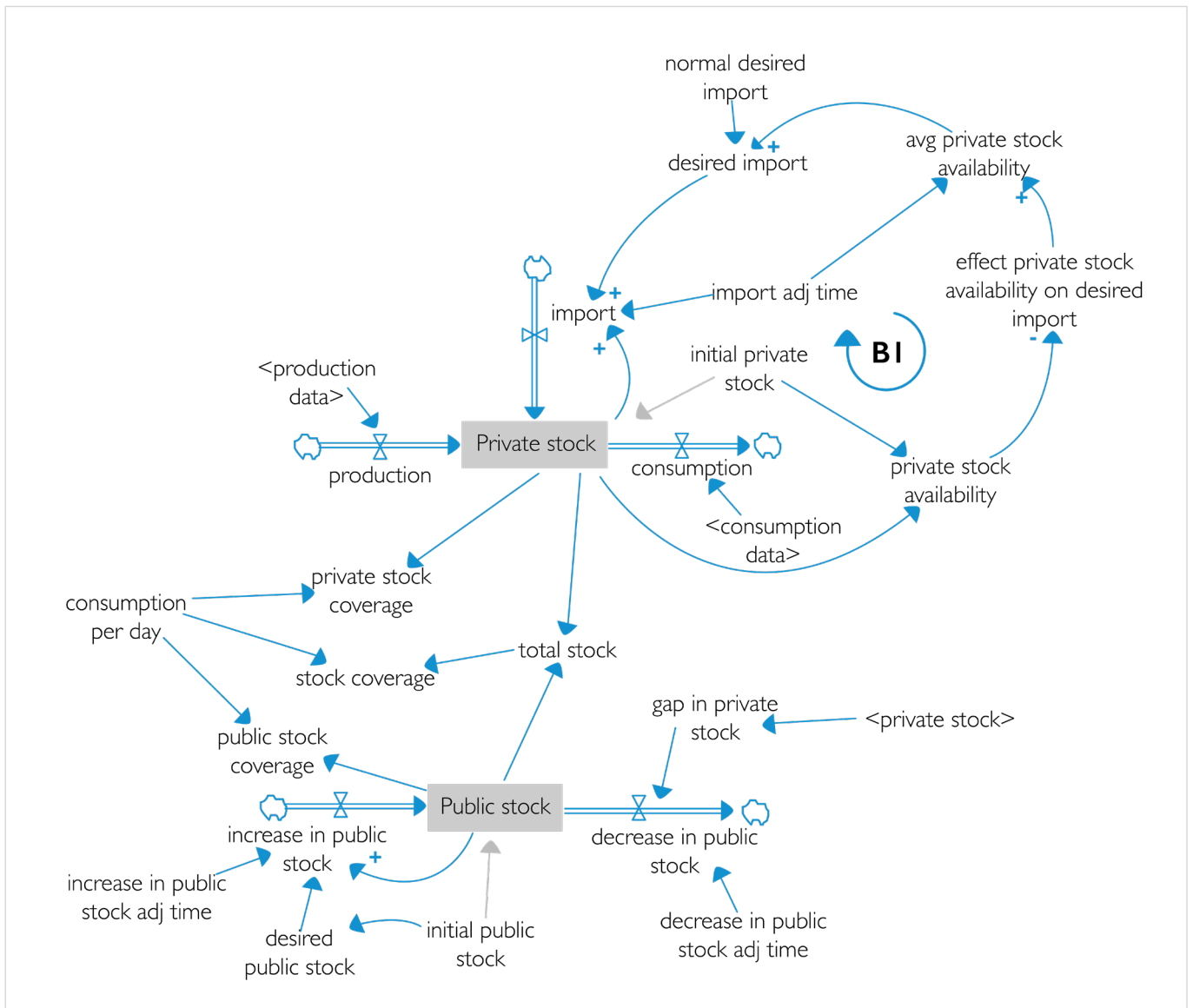
### Stockpile Management

The stockpile management structure is shown in Figure A9. The model structure is segmented into two main sub-sectors - the private stock and the public stock sub-sectors. The sources of private stock or inflows are from import and local production while the outflow is the local consumption.

The second stock in this model is public stock, which represents the national stockpile. The public stock needs to maintain at 150 thousand mt at all the time. If the private stock does not have sufficient rice, rice in the public stock is used for consumption. Then, the public stock is increased again to the desired level of 150 thousand mt.

The import of rice by the private sector is determined by consumption. The amount of import is initially determined by the private stock availability, which in turn determines the desired amount of import. The relationship between the private stock availability and the amount of desired import is depicted as a table lookup function. That is if the stock availability is high, the lower the import and vice versa. The relevant variable here is the effect of availability on desired import. However, the realised import depends on the lead time between the order and delivery, which is represented as "import adjustment time". The relationship between private stock and import forms a balancing feedback loop (B1).

**Figure A9: Flow of price along the supply chain**



**Mathematical structure of the simulation model**

The conceptual framework presented in Figures A6, A9 and A10 have been translated into a mathematical model for analysing the impact of (i) deregulating farm subsidies on net profit per ha and yield per ha; (ii) deregulating imports on the price offered to the wholesaler, miller, paddy farmer, retailer and consumer; and (iii) stockpile management on stock coverage.

**Deregulating farm subsidies**

A system dynamics model uses stock and flow diagramming which was originated by Forrester (Sterman, 2000). Stock accumulates or integrates its flow. The flow here is the rate of change of the stock. Thus, in the case of fraction of input used by farmers (stock) in Figure A2 can be presented as:

$$(I) \text{ Fraction\_of\_input\_used\_by\_farmers}(t) = \text{ Fraction\_of\_input\_used\_by\_farmers}(t - dt) + \text{ change\_in\_fraction} * dt$$

The stock fraction of input used by farmers is a state variable and it represents the state or condition of the system at any time t. The net flow connected to the fraction of input used by farmer is the change in fraction (inflow). This inflow represents an important decision point in the system. The decision to add or reduce fraction of input used by farmers is influenced by net profit of paddy farming. An increase in net profit leads to a nonlinear increase in fraction of input used by farmers.

Net profit per ha of cultivating paddy is determined by the difference between revenue per ha and total production cost per ha. It is expressed as:

**(2)**  $\text{Profit\_per\_ha} = \text{revenue\_per\_ha} - \text{total\_production\_cost\_per\_ha}$

Yield per ha is a function of input adequacy, paddy deduction fraction and post-harvest loss. The influence of Input adequacy on yield per ha is also nonlinear. These relationships can be presented as:

**(3)**  $\text{Yield\_per\_ha} = \text{effect of input adequacy on productivity} * \text{potential productivity} * \text{paddy deduction fraction} * \text{post harvest loss}$

***Deregulating import***

There are two stocks, i.e the average fob price Thai White Rice and exchange rate in the price relationship model. Those stocks can be expressed as below:

**(4)**  $\text{The\_average\_fob\_price\_Thai\_WR}(t) = \text{The\_average\_fob\_price\_Thai\_WR}(t - dt) + \text{change\_in\_fob\_price} * dt$

**(5)**  $\text{Exchange\_rate}(t) = \text{Exchange\_rate}(t - dt) + \text{change\_in\_exchange rate} * dt$

The prices offered to the wholesaler, miller, paddy farmer, retailer and consumer are described in Section 2.1.2 above.

***Stockpile management***

Several key indicator variables can be computed from the stockpile management model. These include the stock coverage variables. Perhaps the most important indicator is the stock coverage, which can be expressed as:

**(6)**  $\text{Stock coverage} = \text{total stock} / \text{consumption per day}$

Total stock is derived from the summation of private and public stocks. The equation for private and public stock can be presented as below:

**(7)**  $\text{Private\_stock}(t) = \text{Private\_stock}(t - dt) + \text{production} * dt + \text{import} * dt - \text{consumption} * dt$

**(8)**  $\text{Public\_stock}(t) = \text{Public\_stock}(t - dt) + \text{increase\_in\_public\_stock} * dt - \text{decrease\_in\_public\_stock} * dt$

## Model parameterization

Constant parameters and initial values were obtained through triangulation procedures, including literature review and data analysis. Triangulation of data sources provides more accurate information and improves the reliability of the findings (Papachroni and Lochrie, 2015). An overview of the data source and key constants are summarised in Table A2.

**Table A2: Data sources and values used in the calibration and simulation process**

Variable	Unit	Value	Source
Initial value			
Fraction of input used by farmers	Dml	0.1	Assumption
Average FOB Price Thai WR 5%	USD/mt	491	Thai Rice Exporter Assoc. (2020)
Exchange rate	RM/USD	3.08	IMF (2020)
Public stock	mt	150,000	Fatimah et al. (2020)
Private stock	mt	80,000	Mely (2016), estimated
Parameter/constant			
Initial input per ha	Index/ha	100	Assumptions
Subsidy per unit output sold	RM/mt	248 (2010-2015); 300 (2016-2018); 360 (2019)	Fatimah et al. (2020)
Paddy deduction fraction	Dml	0.16	Fatimah et al. (2020)
Paddy post-harvest loss	Dml	0.05	Fatimah et al. (2020), Emmy Farha (2013)
Fraction of fob rice price	Dml	-0.018	Thai Rice Exporter Assoc (2020), estimated
Fraction of exchange rate	Dml	0.033	IMF (2020), estimated
Consumption per day	mt/day	6,904	Estimated from Consumption per capita of rice from Agro-food Statistics (2018)
Time series for model calibration and behaviour reproduction tests			
Average of FOB Price Thai WR 5%	USD/mt		Thai Rice Exporter Assoc. (2020)
Exchange rate	RM/USD		IMF (2020)
Yield per ha	mt/ha		IPB/MAFI (2020)
Paddy production	mt		IPB/MAFI (2020)
Rice import	mt		IPB/MAFI (2020)

## Model credibility

Structural and behavioural tests are iteratively applied to build credibility on the model. Behaviour credibility was achieved by applying various test such as behaviour reproduction test, extreme conditions test and sensitivity analysis. After applying these tests, the output of the model is compared with the behaviour observed in the data. The simulation model time period for analysis and simulation runs are summarised in Table A3.

**Table A3: Simulation setting**

Simulation model	Time period	Simulation runs
1. Deregulating farm subsidies	Year	2010-2050
2. Deregulating import	Year	2010-2030
3. Stockpile management	Month	1-25

Various simulation runs are carried out to test the impact of: (i) the introduction of the output-based and direct compensation to the farmers' yield and revenue under deregulating farm subsidies; (ii) a change in the import price on the local price for deregulating import; and (iii) the impacts of disruptions in supply and changes in the safety or public stock level on total stock and stock coverage under stockpile management. The details and changes in parameter values for those simulation runs are explained in the next section.

### Deregulating farm subsidies

Two simulation sets are carried out to test the impact of introduction of direct payment, i.e output-based and compensation on yield and revenue (Table A4). The first scenario, known as business as usual or base run, involves input subsidy at rate of 70% of desired input per ha and it is equivalent to 70 index/ha. S1 refers to output-based payment. In this simulation run, the value of input subsidy is transferred to the output-based payment. Note that the quantity of input subsidy is fixed at 70 index/ha. However, the unit of input cost per ha is assumed to increase by 1%/year. Thus, the output-based payment is expressed as:

$$\text{Output-based payment} = \text{Input subsidy per ha} \times \text{Unit of input cost per ha (Eqn. A1)}$$

Simulation S2 is on compensation payment. To simulate S2, the same approach is used as in S1. S1 serves as an intermediary to derive compensation payment. The similar amount of payment under output-based and compensation is used. S1\_750, S1\_500 and S1\_300 are a set of simulation to measure the impact of increasing direct payment yearly from the base by

**Table A4: Deregulating farm subsidies: Simulation runs**

Simulation Run	Input subsidy	Direct payment	
		Output-based	Compensation
Base	fraction: 0.7	..	..
S1	..	√	..
S2	..	..	√
S1_750	..	√ + RM750/year	..
S1_500	..	√ + RM500/year	..
S2_300	..	√ + RM300/year	..

Notes: .. means inactivated.



## Deregulating imports

Three simulation sets are carried out to examine a change in the import price on the local price (Table A5). The business as usual or base run is a simulation run where the import price and exchange rate is changing yearly by -1.8% and 3.3% based on their historical trend. The first set of simulations, i.e base+10%, base+30% and base+50% are to test an increase in import rice prices by 10%, 30% and 50%, respectively on the local price. While the simulation runs base-10%, base-20% and base-30% are carried out to test the impact of reduction in import price by 10%, 20% and 30%, respectively on the local price.

**Table A5: Deregulating imports: Simulation runs**

Simulation Run	Average FOB Price of Thai WR5%
Base	No change
Base+10%	↑10%
Base+30%	↑30%
Base+50%	↑50%
Base-10%	↓10%
Base-20%	↓20%
Base-30%	↓30%

## Stockpile management

In stockpile management model, two simulations are carried out to examine the impacts of disruptions in supply and changes in the safety or public stock level on total stock and stock coverage. The summary of those simulations is presented in Table A6.

**Table A6: Stockpile management: Simulation runs**

Simulation Run	Production	Import	Public stock (mt)
Base	..	..	150,000
S1	↓50%	..	150,000
S2	..	↓50%	150,000
S3	↓50%	↓50%	150,000
S4	..	..	100,000
S5	..	..	200,000

Notes: .. means inactivated.

The first simulation or base is a simulation with no disruption in production and import, while the current level of safety stock stands at 150,000 mt at any one time. Simulation S1 refers to the simulation of disruption in production by 50% and S2 refers to the disruption in import by 50%. Both disruption in production and import by 50% is simulated under simulation S3. Simulation S4 and S5 captures the changes in the safety or public stock from 150,000 mt to 100,000 mt and 200,000 mt, respectively.

## Appendix 3: Glossary

1. **Auxiliary (convertor) variable** : an intermediate, conventional variable to facilitate the expression of functional dependency of a flow to system stocks. A convertor is capable of changing its value instantaneously.
2. **Balancing feedback loop** : a feedback loop in which the resultant effect of the causal links over time limits or constrains the movement of variables. Balancing loops seek equilibrium, trying to bring stocks to a desired state and keep them there. Also called a negative, compensating, goal-seeking or controlling feedback loop.
3. **Calibration** : the process of setting model parameter values to reflect an actual case (or specific hypothetical conditions of interest).
4. **Causal** : a driving or influencing relationship between two variables; in contrast to correlations, when two variables change together in time and/or space, but one does not necessarily drive or influence the other.
5. **Causal link** : an arrow in a causal loop diagram or system structure diagram that describes a relationship between two variables with the direction of causality (from cause variable to impacted variable) and the nature of impact (same direction of change or opposite direction of change). If there is a significant delay in the influence of the driving variable on the driven variable, it can be represented by a link “broken” by parallel lines.
6. **Causal link polarity** : a positive (+) or negative (–) sign that indicates the direction of impact of the driving variable on the driven variable. Positive polarity indicates that the impacted variable moves in the same direction (increase or decrease) as the driving variable. Negative polarity indicates that the impacted variable moves in the opposite direction (increase or decrease) to the driving variable. Alternatively, positive link polarity is sometimes indicated by the letter “S” (causing to move in the *same* direction) and negative link polarity by the letter “O” (causing to move in the *opposite* direction).
7. **Causal loop diagram** : a tool that represents closed loops of cause–effect linkages (causal links) as a diagram intended to capture how the system variables interrelate and how external variables impact them. Causal loop diagrams identify and label feedback loops to facilitate understanding, dynamic reasoning and formal modeling.
8. **Cloud** : a symbol in a structure diagram that represents an infinite source or sink. An origin or ending place of a flow that is outside the boundary of the system as modeled. A cloud represents an unrepresented input or output stock of the system that is inconsequential to the behavior of interest.
9. **Dynamic** : changing over time. The opposite of static.
10. **Dynamic hypothesis** : a structure that the modeler advances to explain a dynamic behavior of interest.
11. **Feedback** : when the effect of a causal impact comes back to influence the original cause of that effect. A feedback loop is a sequence of variables and causal links that creates a closed ring of causal influences. See *reinforcing feedback loop* and *balancing feedback loop*.

- 12. Feedback loop polarity** : a characteristic of feedback loops represented by a positive (+) or negative (-) sign that indicates whether a loop is a reinforcing (positive) or balancing (negative) one. Loop polarity is found by the algebraic product of all signs around a loop.
- 13. Flow (rate)**: the movement of quantities between stocks within a system boundary or across the model boundary and thereby into or out of the system (sinks and sources); changes in stocks over time. Flows represent activity, in contrast to stocks, which represent the state of the system.
- 14. Generic structure** : a structure that can be applied across different settings due to having the same fundamental underlying components and relationships. See *system archetype*.
- 15. Goal-seeking behavior** : a behavior mode in which the system moves towards an equilibrium or target condition. The flow that changes the stock value is typically modeled as a fraction of the difference between the equilibrium condition (or target) and the current condition. Therefore, the further the system is from the goal, the more it changes towards that goal and as it approaches the goal the increase or decrease slows. The corresponding structure is associated with negative feedback. See *exponential behavior*.
- 16. Linear system** : a system in which all relations between variables are mathematically linear. In such systems, the complete behavior can be found by superimposing different behavior modes without interacting with one another.
- 17. Link polarity** : see *causal link polarity*.
- 18. Model credibility (validity)** : how well a model represents a given problem; a model's suitability for a particular purpose. A model is credible/valid if it can accomplish what is expected of it, as demonstrated by structure and behavior tests.
- 19. Model justification (validation)** : the process of developing confidence in a model's credibility and usefulness, performed with tests of model structure similarity to actual structures, simulated behaviors that reflect the behaviors of the system modeled, and ultimately impacts of the model suggestions on actual systems and problems.
- 20. Negative feedback** : feedback that works against deviations from a goal. In isolation or if dominant, negative feedback generates goal-seeking behavior.
- 21. Nonlinear relationship** : a causal relationship between two variables in which the change in the impacted variable is not directly proportional to the change in the impacting variable.
- 22. Parameters** : constant factors in relationships in a model.
- 23. Policy** : a decision rule or structure that uses information streams to generate decisions.
- 24. Policy analysis** : analysis employed to evaluate policies to alleviate undesirable behaviors of a system. It allows the model builder to compare how a system would react to different policies through simulation.
- 25. Positive feedback** : a structure that produces exponential growth or collapse. Change in one direction

results in more and faster change in the same direction. Positive feedback : a structure that produces exponential growth or collapse. Change in one direction results in more and faster change in the same direction.

- 26. Positive feedback loop** : see *reinforcing feedback loop*.
- 27. Reference mode** : a behavior/over-time graph that depicts how one or more system variables change over time, often used in problem articulation to describe the dynamic hypothesis, and in model validation to test a model's ability to reproduce realistic behavior patterns.
- 28. Reinforcing feedback loop** : a feedback loop in which the sum effect of the causal links tends to strengthen (reinforce) the movement of variable values in a given direction due to positive feedback.
- 29. Sensitivity analysis** : analysis used to determine how responsive model outputs are to changes in specific parameters, or policies or structures. Behavior that changes drastically suggests a critically important factor or high sensitivity. Conversely, if a large change in a parameter value or a structure results in small changes in behavior, that factor is not likely to be central to the dynamics in question; that is, the behavior shows low sensitivity.
- 30. Simulation** : the generation of the behavior of a system with a formal computer model.
- 31. Stock (level)** : an accumulation of quantities in specific locations or conditions in a system. A component of a system that accumulates or drains over time. Stocks are the memory of a system and can only be changed by flows.
- 32. Stock-and-flow diagram** : a visual depiction of the stock, flow and auxiliary (converter) variables in a system and how they are connected.
- 33. Structure diagram** : A diagram that displays the system feedback and accumulation structure.
- 34. Structure** : The underlying relationships and connection between the components of a system.
- 35. System** : a collection of parts that interact in a meaningful, inseparable way to function as a whole.
- 36. Systems thinking** : the use of conceptual system models and other tools to improve the understanding of how the feedback, delays and decision-making policies in a system's structure generate the system's behavior over time. Systems thinking does not use computer simulation. Systems thinking involves (i) seeing interrelationships and feedback loops instead of linear cause-effect chains, and (ii) seeking processes of change over time rather than events/snapshots. Systems thinking helps people see things on three levels: events, patterns of behavior and system structure.
- 37. Unintended consequence** : an unplanned and typically undesirable side effect of well-meaning intentions and actions, often occurring after a time delay and across an organizational boundary from the intended action.
- 38. Vicious cycle** : a reinforcing loop or amplifying structure that yields undesirable results.
- 39. Virtuous cycle** : a reinforcing loop or amplifying structure that yields desirable results.

## Appendix 4: Data used in the system dynamics model (national rice stockpile) (mt)

Year	Month	Mill <sup>a/</sup>	Consumption <sup>b/</sup>
2018	1	95,718	168,713
	2	96,567	182,099
	3	88,569	176,169
	4	174,572	168,938
	5	111,243	164,186
	6	103,011	155,992
	7	88,154	150,883
	8	77,693	159,604
	9	67,472	169,191
	10	99,395	166,918
	11	103,037	157,122
	12	97,906	158,784
2019	13	95,747	169,988
	14	104,654	183,374
	15	90,091	17,7444
	16	83,636	170,213
	17	85,587	165,461
	18	84,454	157,267
	19	80,415	152,158
	20	81,798	160,879
	21	88,558	170,466
	22	95,377	168,193
	23	95,754	158,397
	24	91,481	160,059

Source : IPB (MAFI, 2020).

Note: <sup>a/</sup> Mills data refer to the monthly inventory of rice reported by the mills to IPB, MAFI.

<sup>b/</sup> Consumption refers to the estimated monthly consumption of rice. Since the monthly data is unavailable, it is derived by dividing the annual consumption by 12. The variation in monthly consumption is inferred from the variation in the monthly inventory of rice at the mills.





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