Causality Analysis of Cooking Oil Subsidy Reform in Malaysia: A Conceptual Framework from System Dynamic Approach

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ABSTRACT

This study utilizes a system dynamics approach to analyse the impacts of cooking oil subsidy reforms in Malaysia. Using a causal loop diagram, this paper explores four reform scenarios: the full removal of subsidies and three recycling strategies, where the saved revenue is allocated to household compensation, investment in the oil palm industry, and education funding. The results suggest that while complete subsidy removal could negatively impact households and potentially slow down the economy, recycling schemes could mitigate these adverse effects. The study emphasizes the importance of considering long-term economic growth and the potential benefits of targeted investments in human capital and strategic industries.

Keywords: causality analysis; cooking oil; subsidy reform; system dynamics

INTRODUCTION

Government subsidies play a crucial role in ensuring affordability and accessibility to essential goods, particularly for vulnerable households. However, the long-term sustainability and efficiency of these subsidies are often challenged by issues such as excessive use (Coady et al. 2017), smuggling, and fraud (Ghoddusi et al., 2022). The Malaysian cooking oil market exemplifies the complicated interplay between policy objectives and unintended consequences, since the government subsidises palm cooking oil to provide affordable access to this essential commodity.

Despite an annual subsidy quota exceeding the total demand for palm cooking oil by households (MPC 2022), shortages for low-income households still exist due to leakages to higher-income groups, businesses, and even smugglers (KPDNHEP 2022). This situation necessitates reforms of the cooking oil subsidy, which is also a global trend towards reevaluating the effectiveness of such policies. However, the removal or rationalization of these subsidies presents its own challenges (Couharde & Mouhoud 2020). While studies have explored the impact of rationalizing energy subsidies, research on the effects of food and agricultural product subsidy removal remains limited (Liu et al. 2024).

The limited research on cooking oil subsidy reform is further constrained by a lack of comprehensive analysis. Othman & Jafari (2011) used a partial equilibrium model, neglecting the complete subsidy removal and its impact on household welfare. Liu, Salleh, & Nor (2024) and Yahoo et al. (2017), employing a Computable General Equilibrium (CGE) model, focused on the broader economic impacts but overlooked the welfare implications for different household groups and the specificities of the palm cooking oil sector. Thus, there is need for a more in-depth analysis that considers the complex interactions of households, industries, and potential compensation measures for mitigating the negative impacts of subsidy reforms.

Therefore, this paper addresses these gaps by examining the impacts of cooking oil subsidy reforms in Malaysia, considering the perspectives of households, industries, and government. This study focuses specifically on the subsidy removal and mitigation measures designed to minimize the potential adverse effects of subsidy removal. The paper employs a causal loop diagram to analyse these interlinkages and responses, providing a more comprehensive understanding of the complex dynamics involved.

The paper is organized as follows: Section 2 presents the literature review related to system dynamics and subsidy reforms. Section 3 explains the methodology of system dynamics, and section 4 illustrates the results stemming from the developed causal loop diagram. Section 5 concludes the paper.

RELATED WORK /LITERATURE REVIEW

System dynamics

System dynamics (SD) is a powerful methodology developed by Professor Jay W. Forrester at Massachusetts Institute of Technology, offers a unique approach to understanding and addressing complex systems and problems. SD is widely used in socio-economic studies, it emphasizes the interactions and feedback loops between subsystems, providing a holistic understanding of the bigger picture, as opposed to traditional approaches that focus on dissecting problems into break down sectors and solving them separately. Karami et al. (2017) highlighted the efficacy of system dynamics, demonstrating their ability to integrate quantitative and qualitative data from various sources and methods, offering a more dynamic and effective assessment of social impacts for development projects compared to traditional social impact assessment methods. This approach excels in situations characterized by dynamic complexity and policy resistance, proving particularly valuable in designing successful policies for both companies and public policy settings (Jansen 2000).

Ahmad et al. (2016) conducted a comprehensive review of electricity sector modelling using system dynamics, analyzing 35 relevant papers. Their reviews revealed that policy assessment is the most prevalent application of system dynamics in electricity sector modelling. Furthermore, several studies have explored the impact of policies on other energy fields and CO2 emissions. For instance, Han & Hayashi (2008) developed a system dynamics model to assess policies and CO2 mitigation potential in inter-city passenger transport in China. Their findings indicated a significant CO2 emission reduction under policy-controlled scenarios compared to scenarios without mitigation policies. Ansari & Seifi (2012) utilized system dynamics modelling to investigate the impact of energy price subsidy reforms on steel demand, production, and energy consumption in Iran. Similarly, Rusiawan et al. (2015) developed a system dynamics model to simulate urban economic growth and CO2 emissions, providing a valuable tool for evaluating sustainable urban development policies in Jakarta, Indonesia. Among these studies, there is a lack of research on food subsidy reforms, particularly studies employing system dynamics methodology (Liu et al. 2024). Guma, Rwashana & Oyo (2018) offer a noteworthy exception, utilizing system dynamics to explore food security challenges at the subsistence farming level. Their paper evaluates policies for better livelihoods and explores strategies for profitable subsistence farming and food security through a system dynamics model. This model, conceptualized into four sectors: food production, sales, income, and consumption, provides a realistic representation of a real-life food security system. There is also lack of conceptual framework on the impacts of food subsidy reforms from a system dynamics model perspective to better visualize the interactions among all the sectors. Such a framework would be invaluable in visualizing the complex interactions among various sectors and understanding the broader implications of policy changes.

The Impacts of Subsidy Reforms

The removal of government subsidies carries significant implications for households, industries, and the overall economy. While subsidy removal might lead to price increases for subsidized goods, the overall impact on gross domestic product (GDP) can be either positive or negative, influenced by many factors like capital movements, investment, and industry upgrading. Household welfare, however, is a key concern. While some households may adapt their consumption patterns and experience minimal expenditure changes, others might see increased expenditure to maintain their current consumption levels (Ying & Harun 2019). Furthermore, the impacts of subsidy removal on different income groups may vary (Karami, Esmaeili & Najafi 2012).

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Employment might also be affected, with increased production costs and reduced profits potentially leading to job losses (Roos & Adams 2020). However, export performance might remain unaffected or decrease due to reduced supply (Kapoor, Ranjan & Raychaudhuri 2017), or even increase due to increased export supply resulting from a decline in domestic demand (Othman & Jafari 2011).

To mitigate the negative impacts on households, some compensation strategies were studied. Universal and targeted cash transfers are commonly used methods to redistribute the savings from subsidy removal (Cockburn et al. 2018; Murjani, 2020; Prabowo et al., 2022). Beyond household compensation, redirecting revenues to specific industries has also been implemented (Lin & Jiang, 2011; N. Ansari & Seifi, 2012; Narayanan G & Rungta, 2014). This reallocation can stimulate sectoral economic growth (Ying & Harun 2019), improve household welfare and employment (Ying and Harun, 2019), and promote overall economic (Fathurrahman, Kat & Soytaș 2017) and social stability (Lin & Jiang 2011).

Furthermore, the redistribution of resources from subsidies to other sectors, such as education and infrastructure, has the potential to reduce inequality and promote long-term growth (Coady et al. 2017; Jiang, Ouyang & Huang 2015). Investments in education, in particular, can lead to greater productivity, higher wages, and a more equal income distribution, since human capital investments have productive value (Hanushek, Leung & Yilmaz 2003).

METHODOLOGY

Causal loop diagrams are one of fundamental tools in system dynamics modelling. They visually represent the interconnectedness of variables within a dynamics system, revealing how changes in one variable influence others. Nodes, representing key variables, are connected by arrows, indicating the direction of influence. This visualization allows for a clearer understanding of how the system behaves, incorporating both quantitative and qualitative variables.

The structure of a causal loop diagram highlights the feedback processes within a system. It demonstrates the chain of cause-and-effect relationships, where variables loop back to influence their original cause or effect (García 2006). These feedback loops can be either reinforcing (positive) or balancing (negative). Figure 1 shows a basic causal loop diagram example between the positive loop (reinforcing loop) and negative loop (balancing loop) of revenue and subsidy. A positive loop amplifies changes in the same direction, while a negative loop signifies inverse influence. The direction of influence, indicated by the arrows, determines whether a loop is positive or negative. If the number of negative relationships is even, then the loop is positive. Conversely, if the number of negative relationships is odd, then the loop is negative (Mohammad et al., 2021).

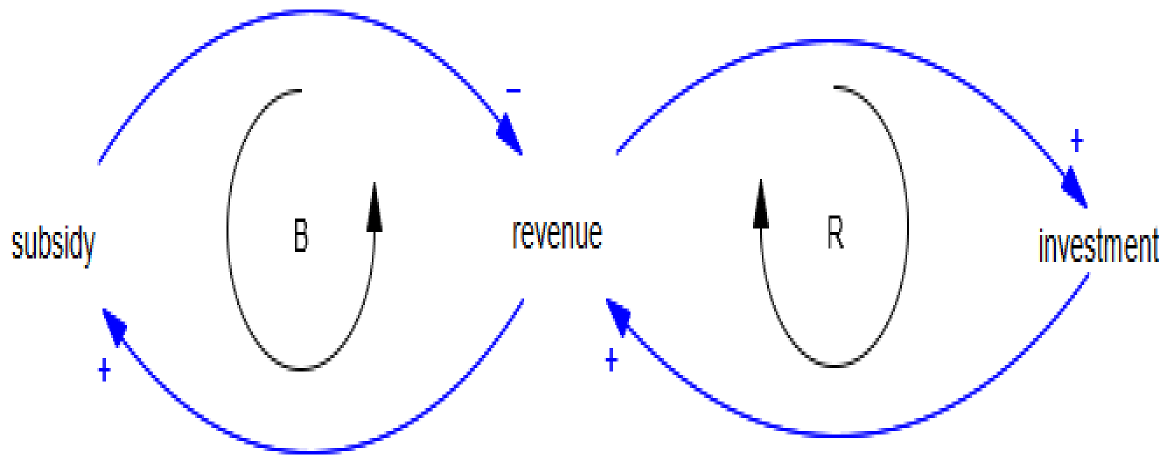

Figure 1. A basic causal loop diagram representing cause and effect of revenue and subsidy.

Causal loop diagrams utilize distinct symbols to represent these two types of feedback loops. A reinforcing loop, denoted by 'R', amplifies positive changes. For example, increased investment might lead to increased revenue, further stimulate investment. Conversely, a balancing loop, denoted by 'B', works to stabilize a system.

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For instance, increased revenue might lead to increased subsidies, which in turn could decrease revenue. These indicate how it changes the system (Maani & Cavana 2007).

RESULTS AND DISCUSSION

This study develops the causal loop diagram for four scenarios of cooking oil subsidy reforms: subsidy removal and three types of recycling schemes: reallocating the revenue from subsidy removal to household compensation, to oil palm industry investment, and to education investment. The impact variables illustrated below are commonly employed in the literature on the effects of food subsidy reforms from general equilibrium perspectives (Liu, Salleh & Nor 2024; Lofgren & El-Said 2001; Solaymani et al. 2019). The impacts of these reforms are depicted in Figure 2 through the development of a causal loop diagram.

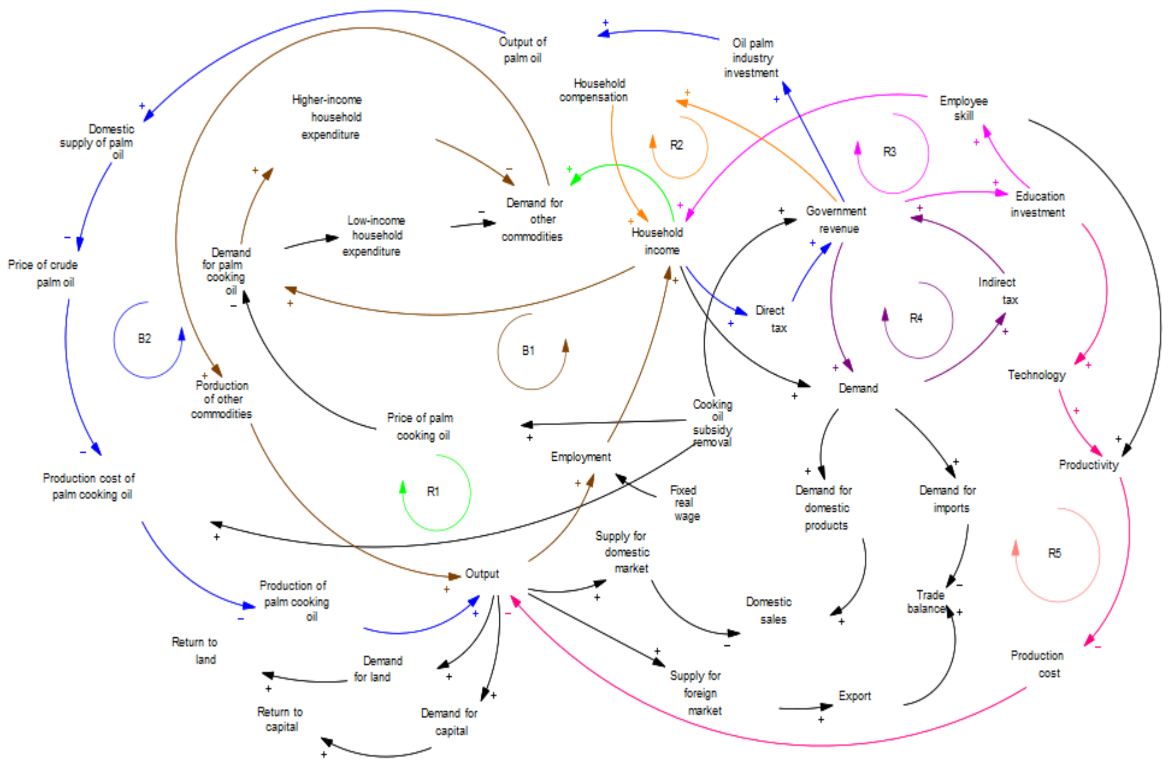

Figure 2. Causal loop diagram of cooking oil subsidy reforms in Malaysia

There are five reinforcing loops (R1-R5) and two balancing loops (B1-B2). Reinforcing loop R1 describes the household income, demand for other commodities, production of other commodities, output and employment, as illustrated in Table 1. R1 begins with household income, and households are likely to purchase more goods and services when they have more disposable income. Thus, an increase in household income leads to a higher demand for other commodities, stimulating production, which in turn increases output and employment. More employment further boosts household income, perpetuating the cycle, closing the loop as the cycle repeats with the increased purchasing power of households perpetuating demand for commodities.

Reinforcing loop R2 describes the fiscal multiplier effect of government spending on household compensation. If the recycled government revenue were allocated to household compensation, it will increase household income. This higher income leads to increased direct taxes, further increasing government revenue, creating a positive feedback loop. Reinforcing loop R3 emphasizes the role of education investment in driving economic growth. Higher government revenue leads to increased investment in education, which improves employee skills and boosts household income. Increased household income then generates more direct taxes, further increasing government revenue, creating a self-reinforcing cycle.

Reinforcing loop R4 illustrates the relationship between demand and government revenue through indirect taxes. Higher government revenue leads to increased demand, which in turn increases indirect tax revenue, further boosting government revenue. Reinforcing loop R5 combines multiple factors, showing the impact of education investment on economic growth. Government revenue fuels investment in education, leading to advanced technology, increased productivity and lower production costs. This results in higher output, creating more jobs and increasing household income, ultimately boosting demand and generating more indirect taxes for the government.

Balancing loops B1 illustrates a negative feedback mechanism that regulates demand for palm cooking oil. Higher demand for palm cooking oil leads to increased household expenditure, which reduces demand for other commodities. This, in turn, impacts the production of other commodities, lowering output and employment, ultimately reducing household income and decreasing demand for palm cooking oil, creating a balancing effect.

Balancing loops B2 showcases the government's role in stimulating the oil palm industry but also incorporates a balancing effect. When the recycled government revenue is invested in the oil palm industry, it will lead to an increase in output and domestic supply of palm oil. While this lowers the price of crude palm oil, it also reduces the production cost of palm cooking oil, which stimulates production. This increased production leads to more output, employment, and household income, ultimately boosting demand, generating indirect taxes and feeding back into government revenue. However, the lowered price of crude palm oil could potentially impact the industry's profitability in the long run, creating a balancing effect on future investment and growth.

The developed causal loop diagram reveals that subsidy removal would lead to a decrease in demand for palm cooking oil among low-income households due to budget constraints. Conversely, higher-income households, with greater affordability, might maintain their previous consumption of palm cooking oil or substitute it with other oils and fats, leading to increased household expenditure. This, in turn, could result in a decrease in demand for other commodities. These decreased demands could ripple through other sectors, stimulating a decrease in production by industries, ultimately slowing down the economy, potentially leading to decreased imports and exports in an open economy. A decline in government revenue would also occur. The trade balance would be influenced by the magnitude of changes in export and import volumes.

Despite the potential adverse effects caused by complete removal of cooking oil subsidy, recycling schemes, whether through household compensation, oil palm industry investment, or education investment, could provide positive stimuli to the economy and mitigate some of the adverse effects of complete subsidy removal. This result aligns with the study conducted by Liu, Salleh & Nor (2024) on the impacts of cooking oil subsidy reforms using CGE model. The analysis reveals that investing in education, for example, can create a positive feedback loop by stimulating technological advancements and boosting productivity, leading to economic growth. Similarly, targeted investments in the oil palm industry can stimulate production, employment, and government revenue. This supports the findings of Sze-Ying Loo & Mukaramah Harun (2020) that transferring funds to the agricultural sector stimulates domestic sector performance. Understanding these complex interactions allows policymakers to strategically design subsidy reform policies that minimize negative impacts and maximize positive outcomes for the Malaysian economy.

Table 1. Summary of feedback loops representation on the impacts of cooking oil subsidy reforms in Malaysia

Feedback loop	Analysis Representation
R1	Household income > Demand for other commodities > Production of other commodities > Output > Employment > Household income
R2	Government revenue > Household compensation > Household income > Direct taxes > Government revenue
R3	Government revenue > Education investment > Employee skill > Household income > Direct tax > Government revenue

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R4	Government revenue > Demand > Indirect Tax > Government revenue
R5	Government revenue > Education investment > Technology > Productivity > Production cost > output > Employment > Household income > Demand > Indirect Tax > Government revenue
B1	Demand for palm cooking oil > Higher household expenditure > Demand for other commodities > Production of other commodities > Output > Employment > Household income > Demand for palm cooking oil
B2	Government revenue > Oil palm industry investment > Output of palm oil > Domestic supply of palm oil > Price of crude palm oil > Production cost of palm cooking oil > Production of palm cooking oil > Output > Employment > Household income > Demand > Indirect Tax > Government revenue

CONCLUSION

This study has developed a causal loop diagram to analyse the potential impacts of four different scenarios of perspectives cooking oil subsidy reforms in Malaysia. The model identifies five reinforcing loops and two balancing loops that highlight the interconnectedness of various economic factors. While complete subsidy removal could negatively impact low-income households and potentially slow down the economy, the proposed recycling schemes, including household compensation, oil palm industry investment, and education investment, offer potential pathways to mitigate these adverse effects.

The model does not consider other external factors that might influence the economy, such as the policy resistance, policy operating cost, environmental impacts, and global commodity prices. Future research could incorporate more complex modelling techniques or variables and consider these variables to provide a more comprehensive understanding of cooking oil subsidy reforms. Future research exploring other food stuff policy interventions in other countries is essential to develop a broader understanding of their effectiveness and potential implications.

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