Journal of Infrastructure, Policy and Development 2024, 8(5), 3077.
https://doi.org/10.24294/jipd.v8i5.3077

Article

Implications of policy analysis matrix for competitiveness of Tuong-mango in Dong Nai, Vietnam

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CITATION

Truong KHVT, Vo SM, Nguyen PHN, et al. (2024). Implications of policy analysis matrix for competitiveness of Tuong-mango in Dong Nai, Vietnam. Journal of Infrastructure, Policy and Development. 8(5): 3077. https://doi.org/10.24294/jipd.v8i5.3077

ARTICLE INFO

Received: 23 October 2023
Accepted: 2 January 2024
Available online: 16 April 2024

Abstract: Purpose: The aim of the study is to apply policy analysis matrix (PAM) to identify international competitiveness of marketing channels and policy impacts of government on each marketing channels. **Methodology:** Policy analysis matrix is employed to evaluate influences of macroeconomic policy on the Tuong-mango value chain. The study investigated 213 sampling observation of eight main actors in chain. **Findings:** The findings indicate that although domestic channel 4 exhibits competitiveness (Private cost ratio (PRC) < 1), channels 1, 2, and 3 possess both comparative and competitive advantages (PRC < 1, Domestic Resource Cost (DRC) < 1, and social benefit-cost (SBC) > 1). The government's strategy on production protection, referred to as Nominal protection coefficient on tradable output (NPCO) 0.16, together with the plan for enhancing added value, denoted as Effective protection coefficient (EPC) 0.14 and Subsidy ratio to producers (SRP) −0.18, place a significant emphasis on the first export channel. The government's subsidy plan grants preferential treatment to Channel 4 in terms of the pricing of commercially available products, with a Nominal protection coefficient on tradable input (NPCI) value of 0.75. A value-added strategy is implemented for export channels 2 and 3, which have EPCs of 0.76 and 0.85, respectively. **Policy implications:** If the tradable cost is modified by 20%, there will be a change in the ratio of DRC, SBC, EPC, and SRP. While the EPC does not see a 20% reduction in domestic prices, the DRC and SBC do benefit from this cost reduction. A reduction of 20% in the local cost, coupled with a corresponding rise of 20% in the Free on Board (FOB) price, would result in a significant elevation of the SRP for export channels 1, 2, and 3. **Conclusion:** This is as evidence for the combination of quantitative is a dynamic tool in the policymaking process to ensure targets, constrictions, and consistent policies for agricultural fields. This permits policies to be changed in steps with an alteration in the economy and priorities set up for the tropical fruits and vegetables field.

Keywords: Tuong-mango; competitiveness; profit; social price; Dong Nai

1. Introduction

Mangoes have a level of worldwide appeal that is comparable to just four other tropical fruits. The mango, formally referred to as Mangifera indica, is a well-recognized and esteemed tropical fruit in the scientific community. Mango trees have traditionally shown robust growth and development in places characterized by mild and humid temperatures, notably in various tropical and subtropical nations. Over 100 countries worldwide engage in the cultivation of mango trees for the purpose of harvesting its fruit. Mangoes have a higher prevalence in the global market compared to other well recognized tropical fruits, surpassing them in both quantity and monetary worth, constituting around 29% of each (Food and Agriculture Organization (FAO),

2021). Mangoes, avocados, and pineapples are the three predominant tropical fruits cultivated for commercial reasons. Based on estimations, India accounts for around 25.6 million tons of the global mango production, or approximately 45.9% of the overall output. Indonesia, securing the second position, produced a substantial contribution of 3.3 million tons, accounting for 5.9% of the world aggregate. China and Mexico together provide around 4.3% of the total amount, equivalent to 2.4 million tons. Pakistan, Malawi, and Brazil together account for a proportion of 4.0% each, whilst Thailand, Egypt, and Bangladesh collectively provide a proportion of 2.6% each. Nigeria and Vietnam have emerged as significant manufacturing suppliers, each with a market share of 2% (FAOSTAT, 2019). Asia is responsible for the production and exportation of about 47.3% of the global mango supply. In terms of overall land mass, Central America and the Caribbean rank second only to South America. It constitutes about 20.8% of the Earth's terrestrial surface. It is important to acknowledge that around 8.2% of Africa's aggregate mango output is allocated for the purpose of exportation. During the specified time frame, the United States emerged as the primary recipient of mango imports, constituting a significant share of more than 25% of the worldwide aggregate (FAO, 2021). According to projections, China is expected to surpass the United States as the second-largest worldwide importer of mangoes by the year 2020. According to estimations, it is estimated that China's market dominance would see considerable expansion due to projected developments, with an expected increase from 9.9% in 2016 to 22.2% by the year 2020. From 2016 to 2020, the European Union (EU) had a significant position as the third-largest importer in the worldwide mango import industry, accounting for around 20% of the market share. The worldwide importation of mangoes amounted to around 2.13 million metric tons, based on data provided by (FAO, 2021).

It is projected that the mango output would see a rise from its present level to around 58 million tons by the year 2024, followed by a subsequent peak of 61 million tons in 2028. The current level of production has seen a substantial boost compared to the projected figures for the year 2018, reaching an estimated quantity of 9 million metric tons. According to predicted data, it is anticipated that Asia, which had a prominent presence in global production in 2019, would encompass around 68% of worldwide production by the year 2028. In contrast to the 71% figure recorded in 2019, a little reduction has been seen. According to projections, India, now recognized as the foremost producer in Asia, is anticipated to see a reduction in its market share from 38% during the reference period to 35% by the year 2028. Mango farming is widely practiced in both commercial and noncommercial contexts within the territorial confines of India (FAO, 2020). According to research conducted by experts in mango exports, it is projected that the aggregate export volume would reach 2.2 million metric tons by the year 2028. According to the estimate, it is expected that the annual growth rate for exports would be 3%. Nevertheless, it is expected that the ratio of exports to output will continue to be quite low. Currently, it is evident that developed countries are responsible for around 65% of all imports. Nevertheless, it is anticipated that the percentage would decline as the quantity of economic connections across and within areas expands. According to FAO (2020), there is a predicted growth in the market share of exporters from Latin America and the Caribbean. Moreover, it is expected that by the conclusion of the projected year, there will be an approximate increase of

62% in this market share. The aforementioned transformation may be linked to Mexico's rapid rise as the leading global exporter.

According to statistical data (FAO, 2020), it is projected that Asia's market share would see a decline from 35% in 2019 to 28% in 2028. Thailand now maintains the position as the leading exporter within its own area. Consequently, there has been an increased significance attributed to the acquisition of data pertaining to Thailand's exports. Anticipated growth in the export of these items in the future is projected to be much lower compared to the overall growth rate of global commerce. There exists a high probability that India's exports will continue to see substantial growth in the foreseeable future. It is important to note that expert predictions indicate the aforementioned development may have a little impact on Asia's share of the global mango market. According to estimations provided by industry experts, it is expected that India would represent around 12% of the worldwide mango market by the year 2028. Based on calculations, it is projected that individuals affiliated would have an average annual mango consumption of 7.8 kilograms by the year 2028. Based on projections, it is anticipated that Asia will continue to hold its status as the area with the largest per capita consumption, with an estimated average consumption of 10.7 kg per person. By contrast, it is expected that the typical Latin American individual will eat a mere 8.4 kg of food over their lifespan. The average per capita consumption of mangoes is now below one kilogram. Nevertheless, it is crucial to acknowledge that the consumption of mangoes has seen a substantial rise in economically advanced countries FAO (2020). The period from 2016 to 2020 saw a significant surge in Vietnamese mango exports, culminating in a cumulative value of $211 million at the conclusion of this temporal span. The substantial surge may be attributed to a compound annual growth rate of 60%. Based on statistical data from 2017, there was a substantial rise of 129% in comparison to the figures recorded in 2016. It is feasible that the COVID-19 pandemic might lead to a decline in the export value of fruits and vegetables in the years 2019 and 2020. There was a substantial growth in the value of mango exports throughout the period spanning from 2016 to 2020. The market is projected to reach a value of $650.0 million by the year 2030, if the growth trend persists (Khoi, 2021).

In certain instances, the academic analysis of producers' microeconomic activities may overlook the inclusion of marketing tactics, dynamics of international commerce, and macroeconomic aspects. It is essential for governmental entities, economists, and policymakers to possess a comprehensive comprehension of the intricate interdependencies among trade, macroeconomic policy, and levels of output. Individuals has the capacity to establish norms and institutions that are beneficial and suitable for their own societies. Hence, instead of diminishing the significance of macroeconomic policy, it is essential to conduct a comprehensive assessment.

Enhancing the competitiveness of the value chain associated with Tuong-mango is the primary objective. The application of a matrix facilitates the assessment and quantification of numerous financial facets. In analysing domestic marketing channels, market pricing is frequently regarded as a critical criterion, whereas social price is typically regarded as a critical criterion when investigating international marketing channels. The research employed the policy analysis matrix (PAM) to ascertain the impact of governmental policies on individual marketing channels as well as their

global competitiveness. Furthermore, the organisation generated policy scenarios that propose trade policies for tropical fruits and vegetables in accordance with the comparative advantages of the producers. These results are supported by the empirical evidence that is presented in this paper.

2. Literature review

2.1. Theory of PAM

Agricultural policy is often used by the government as a mechanism for exerting influence on the operations of the agricultural market. Government involvement in the agricultural sector has a crucial role in ensuring food security, providing raw materials for industry, and maintaining a sufficient labor force. According to Tsakok (1990), implementing an increase in income taxes and providing assistance to enterprises engaged in export activities will effectively enhance the nation's capacity to generate foreign currency. The government has implemented measures to give precedence to the development of agriculture in the specified region. A number of emerging nations have adopted a legislative strategy that prioritizes income generation, sometimes at the expense of allocating enough resources to their agricultural industries. The fundamental tenet of this strategy is based on the assumption that the implementation of taxation measures on the agriculture sector will lead to a decrease in agricultural output. Advocates of the proposition further suggest the allocation of excess resources to the industrial sector, widely recognized as the principal catalyst for economic advancement. The pricing approach had a significant role in the reduction and redistribution of surplus agricultural produce. Although there was extensive use of small input price subsidies, incentives were not completely eliminated as long as negative output prices remained. The agriculture industry's disadvantage was exacerbated by macroenvironmental circumstances and the trade system. The economic, trade, and fiscal challenges faced by several nations have been further intensified by the repercussions stemming from agricultural issues, which have had a significant impact on a diverse range of businesses. Numerous governmental entities were driven to reassess their development policies upon realizing that an exclusive reliance on agriculture was insufficient to support a prosperous industrial sector.

Government initiatives aimed at supporting the agricultural sector may have extensive and profound ramifications for the whole economy. In developing nations, the agricultural industry generally accounts for 30–45 percent of the Gross Domestic Product (GDP). According to a 2003 evaluation conducted by the World Bank, the agricultural industry is facing a significant shortage of labor. Given the pivotal role that agriculture plays in the economy of several developing nations, governments often see it as a strategic instrument for attaining their objectives. Governments are anticipated to aggressively intervene in agricultural markets by several means, including trade policy, macroeconomic measures, and sector-specific initiatives. Pricing techniques have a considerable impact on the relative prices incurred by individuals, families, and the agriculture economy. The pricing of goods and services is influenced by the expenses incurred during production as well as the profits generated, therefore eliciting responses from producers, merchants, and customers. According to Shultz (1978), pricing incentives have an impact on social welfare,

income distribution, and economic progress. Policymakers use agricultural policy analysis as a means to evaluate the anticipated and unanticipated consequences of policy changes on agricultural markets. Furthermore, it is important to conduct an analysis in order to ascertain the potential impact of these market-specific responses on the overall viability of the development plan. The information presented in graphical form illustrates the inherent tradeoffs between different objectives and methodologies. Policymakers may use this dataset to facilitate deliberations about the advantages and disadvantages associated with alternative approaches. The determination of research priorities for pricing strategies and markets will be based on a thorough analysis of the problems involved and the allocation of existing resources. Within the context of macroeconomic trade policy, the assessment of agricultural price policy encompasses an extensive array of macroeconomic variables. Examples of variables that are often included in economic analysis include exchange rates, interest rates, export and import prices, as well as sector-specific factors such as the production costs of goods and the costs of inputs. The classification of research may include a diverse range of categories, including static, dynamic, partial, general, single market, multiple markets, sectorial, intersectoral, and macro.

The policy analysis matrix (PAM) approach is a modern methodology used to evaluate the impacts of governmental agricultural policies on the agricultural sector. The use of this approach requires the establishment of a fundamental standard for the inquiry and the identification of precise indicators. The vertical system spans the whole of the manufacturing process, including various phases such as farming, procurement of raw materials, and distribution of completed items. Monke and Pearson conducted the first comprehensive examination of the aforementioned system in 1989. This research aims to assess the influence of governmental policies on the production of horticulture crops by using the Policy Analysis Matrix (PAM) framework created by Babiker (2012).

2.2. Empirical studies of PAM

The study conducted by Bushara et al. (2018) revealed that agriculture has a crucial role in fostering economic growth in low-income countries. The impact of this component on GDP is well recognized, constituting a significant share ranging from 30% to 50%. The agricultural sector has a greater level of employment compared to all other industries. In recent years, there has been a notable transformation in the relationship between the agricultural sector and the industrial sector. Agriculture is widely acknowledged as a fundamental component in facilitating the provision of resources, labor, and sustenance required to support the progress and growth of industrial endeavors. The agriculture sector plays a crucial role in fostering economic growth and generating positive outcomes for businesses and the overall economy. Numerous nations regularly partake in substantial interventions within the agriculture market via the utilization of sector-specific instruments, the execution of macroeconomic measures, and the establishment of trade pacts. The objective of this study is to investigate overarching macroeconomic phenomena, including the whole of the economy, individual firms, and entire industries. The field of macroeconomics encompasses the examination of ideas related to interest rates and currency rates.

Import and export activities serve as fundamental components within the realm of commerce. Within the realm of the manufacturing industry, pertinent considerations include the levels of output and input. The provided graphic visually depicts the interrelatedness of many phases within the supply chain, including production, processing, distribution, wholesale, and retail. The enhancement of individuals' ability to identify and address problems is advantageous in several ways. Examining the ramifications of diverse policies on agricultural markets, alongside exploring alternative courses of action, has significant importance for policymakers, hence underscoring the criticality of agricultural policy research.

The research conducted by Soetriono et al. (2019) demonstrates that the cultivation of snake fruit in the Pronojiwo hamlet exhibits both comparative and competitive benefits, mostly attributed to its low DRC (0.20) and PCR (0.13) values. It is crucial to consider that the government has allocated little funding towards the advancement of snake fruit cultivation. The Siamese orange, a citrus cultivar, has a significant competitive advantage (DRC 0.11) within the geographical region of Kanagarian Koto Tingg in Indonesia. The region's copious natural resources and temperate environment are widely acknowledged for providing it with a competitive advantage. According to Romdhon (2018), citrus exporters have the potential to enhance their competitive advantage in global markets by allocating resources towards the improvement of transportation infrastructure, hence facilitating improved connectivity with remote regions. América and José (2011) used the PAM approach to leverage Mexico's comparative advantage in guava production. The nominal protection coefficient on tradable output (NPCO) score of 0.66 suggests that there is insufficient legislative protection for guava farming, since it allows fertilizers and agrochemicals to be treated as commodities and freely traded. The nominal protection coefficient on tradable inputs (NPCI) is a firm with a valuation of 1 billion rupees.

Familusi et al. (2015) demonstrated that the absence of governmental safeguards resulted in a lack of assurance about the accessibility of essential resources for tomato cultivation. In terms of tomato production, South Africa and Mozambique have superior performance compared to the DRC. During the summer season, customers are confronted with a substantial indirect tax burden of 48.9%, which arises due to the imposition of production price limits. Based on the negative NPCO data, it may be inferred that the cultivation of fresh-season tomatoes has an implicit burden of around 24.2%. In a study conducted by Khan et al. (2006), an investigation was carried out to analyze the yield of sugarcane. The researchers reached a conclusion that Pakistan should reassess its export ambitions, as shown by the comparative disadvantage revealed by DRC 1.31 and SBC 0.84. The DRC and the SBC exhibit comparative advantages, with the DRC scoring 0.59 and the SBC scoring 1.50. These findings indicate that the DRC might potentially explore the adoption of an import substitution strategy as a means to attain economic self-sufficiency. The use of the PAM facilitates further investigation into the two production systems, hence presenting an opportunity to identify hitherto unexplored similarities and distinctions.

According to the study conducted by Olayinka et al. (2014), it was shown that within the Nigerian pineapple industry, the Sucker approach (PCR 0.31) exhibited more competitiveness compared to the Crown strategy (PCR 0.4). This result is reached by considering the fluctuation of market prices and the presence of a PCR

value below one. The comparative profitability of cultivating pineapples by ground-up feeding as opposed to crown-based growth exhibits variability. The coefficient of determination (DRC) associated with the vacuum method is exactly 0.22. Based on the Crown approach, policy distortions lead to an additional 16% of producer earnings being acquired by the public and the government (shown by the subsidy ratio to producers, SRP, of −0.16). The results of the study demonstrate a resemblance to the Sucker method, revealing that policy distortions have the effect of redistributing 14% of producers' revenues (SRP −0.14). The study conducted by Bushara et al. (2018) used the PAM approach to investigate the growth and characteristics of onion, melon, mango, and banana. Although the majority of NPCOs exhibited magnitudes more than 1, the NPCO specifically for melons was shown to be just 0.62. In order to promote the exportation of scallions, mangoes, and bananas, the government provides export incentives. Nevertheless, the imposition of export tariffs on melons serves as a means to restrict their international distribution. Export subsidies are advised when the NPCI is below unity, as a means to counterbalance the expenses associated with the production of inputs. Onions, mangoes, and bananas possess many EPCs. There is definitely potential for expansion in the production of these commodities. It is noteworthy to mention that the country of origin charges a substantial tax on melons. The DRC has varying comparative advantages in the cultivation and production of onion, melon, mango, and banana. The observed production strategy suggests that the citrus cultivation system is feasible, according to the conventional PAM findings. Nonetheless, the PAM findings indicate that profit-efficient production strategies may further increase the current profitability in both private and societal pricing. According to the data, producers who place profit as their primary objective achieve a significantly greater yield per hectare. To enhance the sustainability of the production strategy, a recommendation was made to raise the social pricing from 3500.8 USD ha^{-1} to 8071.5 USD ha^{-1}. To ensure sustained competitiveness within the Turkish citrus industry, it has been concluded that enterprises ought to transition to a manufacturing framework characterised by enhanced efficiency (Subaşı, 2023).

The results suggest that the cashew nut sector exhibits substantial financial and economic viability, as evidenced by its favourable net margin and favourable financial and economic earnings. However, the level of safeguarding for producers is insufficient, as indicated by the Nominal Protection Coefficient (0.95) falling below 1. Conversely, traders enjoy a marginal comparative advantage and an implicit subsidy, as evidenced by the Domestic Resource Cost of 0.855, which is also less than 1 (Kouakou, 2019).

Hence, it is essential to undertake a comprehensive examination of agricultural policy with the objective of enlightening policymakers about the prospective consequences of forthcoming policy modifications on agricultural markets and motivating them to seek feasible alternative approaches. The agricultural policy analysis framework proposed by Monke and Pearson (1989) consists of three tiers, including macroeconomic linkages, marketing and trade dynamics, and micro production elements. Prior research mostly focused on the microeconomic behaviors of producers, neglecting the significance of marketing, trade, and macroeconomic connections. It is crucial for governments, agricultural economists, and policymakers to possess a comprehensive comprehension of the interrelatedness between farming

systems, regional and global markets, and macroeconomic policy. This facilitates the progress of mankind in formulating pragmatic regulations and societal norms. The use of agricultural policy analysis techniques is crucial in evaluating the effects of quantitative trade restrictions on economic activity, real effective exchange rates, and fertilizer response functions.

3. Methodology

3.1. Sampling technique

The data gathering techniques were carefully planned and executed with painstaking attention to detail at every stage of the process. The rationale for directing the study's attention on the southern part of Vietnam stemmed from the region's unique approaches to mango cultivation. According to the findings of the General Statistics Office in 2022, Dong Nai province accounted for 50% of mango production area in the Southeast region and 55% of mango production volume in the region. The aforementioned information was derived from a projection conducted in the year 2022. A representative sample of 213 data points was selected from a substantial collection of accessible data. The sample for the research study consisted of 158 producers, who together generated 43, 49, and 66 observations for the first, second, and third seasons, respectively. A complete dataset was generated by aggregating data from a representative sample consisting of 20 retailers, 4 cooperatives, 15 collectors, 8 wholesalers, and 8 supermarkets.

3.2. Empirical model

The Policy Analysis Matrix (PAM) is a comprehensive analytical framework used to assess the impacts of policy modifications on various stakeholders, including commodity producers, consumers, and the overall economy, throughout the whole spectrum of the commodity's supply chain. In order to facilitate efficient and seamless information dissemination, the policy analyst must make a decision on whether to assess the extent of government intervention and price manipulation, or to appraise the efficacy of alternative policies. The objective of this study is to analyze the influence of policy on regional agricultural markets and pricing. The phenomenon under examination was first explored by Monke and Pearson in 1989, with further contributions to the study conducted by Masters and Winter-Nelson in 1995.

The PAM formula for the third row, which pertains to a policy intervention, may be obtained by deleting the corresponding values from the preceding two rows. The assessment of a nation's worldwide competitiveness may be conducted by using a framework that takes into account the implications of policies, the economic efficiency based on comparative advantage, and the level of protection provided to agricultural regions (Gonzales et al., 1993). **Table 1** presents the PAM for each advertising platform. The table is composed of four columns and three rows. The determination of revenue involves the multiplication of the amount of goods or services sold by the unit price, as shown in the first column of the table. The permitted items for utilization as direct payments for imported goods may be seen in the second column. The third column encompasses domestic expenditures, which include costs associated with the

leasing of natural resources and the remuneration of staff. The net profit is obtained by deducting the revenues, which are shown in the fourth column, from the total expenditures incurred for all inputs, including both domestic and exportable ones.

Table 1. Policy analysis matrix (PAM).

Items	Revenues	Costs		Profit
		Tradable inputs	Domestic factors	
Market Prices	*A*	*B*	*C*	*D*
Social Prices	*E*	*F*	*G*	*H*
Policy effects	*I*	*J*	*K*	*L*

Source: Monke and Pearson, 1989.

The price of PAM is influenced by several stakeholders involved in the Tuong-mango value chain, including as producers, suppliers, and retailers. The comprehensive cost of PAM includes expenditures not just on marketing activities, but also on personnel, equipment, and other resources. Market pricing and social pricing are two distinct types of expenses. The expenditures stated above may be classified into two categories: locally obtained commodities and tradable input expenses. In our current study, we want to distinguish input costs that are spent inside a specific locality from those that are used in international trade. The whole cost accounts for everything from insecticides to fungicides to herbicides to paclobutrazol to roots and leaves. The allocation of resources is contingent upon the proportion of overall domestic demand that is fulfilled by each individual product. Land leases, electricity costs, packing fees, transportation fees, contractual labor pay, equipment depreciation, and packaged product pricing represent a subset of the many domestic expenses linked to agricultural marketing. In the context of market pricing, it is customary to exclude specific opportunity costs, such as equipment depreciation, family labor, and land rent, when evaluating domestic factor costs. The determination of the shadow exchange rate (SER) may be achieved by using either the Free on Board (FOB) value of traded commodities or the Cost, Insurance, and Freight (CIF) value of tradable inputs.

The shadow exchange rate can be estimated through the following formula:

$$\text{SER} = \text{OER} \times (1 + \text{FX premium}) \quad (1)$$

whereas: SER: Shadow Exchange Rate; OER: Official exchange rate (OER—Official Exchange Rate); FX premium is suggested 20% (0.2) by the World Bank applying for developing countries (Minh et al., 2016).

The theoretical foundation of opportunity cost may be traced back to the notion of a labor market that is characterized by freedom and openness. Within this particular context, the concept of opportunity cost in the production and exchange of products is juxtaposed with the tangible costs incurred by families. The current land rental charges encountered by coffee farmers in the country might serve as an indicator for forthcoming land costs. The assessment of the property's worth necessitates careful consideration of the expenses associated with the upkeep of its internal resources. The study conducted by Lorenzo (2013) used a methodology that included making predictions about future costs within a predetermined time period. This estimation

took into account both the annual depreciation of agricultural equipment and the potential for consistent production.

Output transfers:

$$I = A - E \tag{2}$$

Input transfers:

$$J = B - F \tag{3}$$

Factor transfers:

$$K = C - G \tag{4}$$

Market profits (Actual Profitability):

$$D = A - \mathrm{B} - \mathrm{C} \tag{5}$$

Social profits (Economical Profitability):

$$H = E - F - G \tag{6}$$

Net profit transfers:

$$L = D - H = I - J - K \tag{7}$$

$D > 0$, the domestic channel at market price generates profit under the current policy and market conditions and is competitive. $H > 0$, the export channel at social price would be able to make a profit even without benefiting from a subsidy or being constrained by taxes, and is said to have a comparative advantage.

Relative competitiveness indicators:

Private cost ratio (PCR):

$$\mathrm{PCR} = C/(A - B) \tag{8}$$

PCR > 1, it means that the domestic channel utilizes a greater value of domestic factors than the value added, and is not profitable; PCR < 1, the system is profitable.

Domestic Resource Cost (DRC):

$$\mathrm{DRC} = G/E - F \tag{9}$$

DRC = 1, the export channel is not conducive and foreign currency savings is not equal to domestic production (products produced beneficial neutrality); DRC < 1, the value of domestic resources for smaller production value net foreign savings (products with a competitive advantage on the international market), vice versa; DRC > 1, the value of domestic resources for greater production value net foreign savings (product no competitive advantage on the international market).

DRC/SER < 1, the product has a comparative advantage; DRC/SER > 1, the product does not have a comparative advantage.

Social benefit-cost (SBC):

$$\mathrm{SBC} = E/(F + G) \tag{10}$$

SBC > 1, the export channel is an efficient business channel; SBC < 1, the export channel is not profitable for the exporting business.

Nominal protection coefficient on tradable outputs (NPCO):

$$\mathrm{NPCO} = A/E \tag{11}$$

NPCO > 1, it indicates that the domestic channel at market price is benefiting from protection; NPCO < 1, it indicates that the policy intervention occurs for incentive of the export channel at social price.

Nominal protection coefficient on tradable inputs (NPCI):

$$\text{NPCI} = B/F \tag{12}$$

NPCI > 1, it indicates that the domestic channel at market price is paying higher than for tradable input cost (promotion for the export channel at social price); NPCI < 1, it indicates that the domestic channel at market price is benefiting from protection by subsidization of tradable inputs cost.

Effective protection coefficient (EPC):

$$\text{EPC} = (A - B)/(E - F) \tag{13}$$

EPC > 1, the domestic channel at market price is a protection with higher added value than the export channel; EPC < 1, the domestic channel at market price receives lower added value than the export channel at social price (incentive to export activities).

Subsidy ratio to producers (SRP):

$$\text{SRP} = L/E \tag{14}$$

SRP > 0, indicate the overall transfer profit from the export channel to the domestic channel, and limited export; SRP < 0, it indicates overall transfer profit from the domestic channel to the export channel, and export incentive.

4. Result and discussion

The distribution network for Tuong-mango, facilitating the transportation of the fruit from the agricultural source to the end customer, revolves on two primary markets (domestic and export markets). Channel 4 prioritizes catering to the needs of local customers, whereas channels 1, 2 and 3 are mostly oriented towards facilitating international commerce.

Channel 1: Farmer → Cooperative → Export Enterprise.

Channel 2: Farmer → Collector → Wholesaler (China).

Channel 3: Farmer → Wholesaler (China).

According to Lorenzo (2013), the differentiation between competitive advantage and comparative advantage may be delineated by using Value Chain Analysis (VCA) and the Policy Analysis Matrix (PAM) within the framework of policy planning. The strategy includes an analysis of the level of competition within the market, with particular emphasis on the company's home market. As a consequence of this, the firm acquires a significant competitive advantage in the market. Social pricing is a prevalent approach used for evaluating economically interdependent vertically integrated chains within the export industry. The concept of comparative advantage may be attributed to this proposition. The marketing channels used by different agricultural systems have received little attention from scholars in the academic community. However, the PAM research aims to bridge this gap by examining and analyzing these channels. Possible modes of distribution including engagement in agricultural operations, engagement in commerce with exporters and processors, and provision to wholesalers. The valuation of Channel 4 necessitates an assessment of the financial worth of the company's work, which involves considering prevailing market prices. The objective of this study is to conduct a comparative analysis of Channel 4's pricing strategies in relation to other export channels. The objective of this study is to conduct a comparative analysis of Channel 4's social pricing strategy and those used by other marketing channels in order to identify similarities and differences.

Table 2 presents the estimates of economic indicators derived from market and social pricing for channels 1, 2, and 3 inside the distribution channel. The data presented in this analysis is derived from the pricing information of Tuong-mango in the domestic market, namely marketing channel 4, inside Vietnam. These findings indicate that the market prices of economic indicators in channels 1, 2, and 3 are comparable. The market profitability values of the Tuong-mango production system range from 825.44 to 845.52 USD/ton, influenced by factors such as technical advancement, input and output price, and policy adjustments. Anticipated expansion in industrial systems is imminent. The observation that channels 1, 2, and 3 exhibit positive social profitability is of special significance, since it indicates that these marketing channels demonstrate efficient use of their constrained resources. This illustrates that the exportation of Tuong-mango has the potential to generate foreign currency via many routes, namely channels 1, 2, and 3. The marketing channels used for promoting Tuong-mango have shown both financial and social efficacy.

Table 2. Policy analysis matrix for the Tuong-mango marketing channels 1, 2, 3 and 4 (Unit: USD/ton).

Channels	Revenue	Cost		Net profit
		Tradable Inputs	Domestic Factors	
The channel 1 at social price, the channel 4 at market price				
Market price	1455.30 ± 0	294.03 ± 276.29	335.83 ± 180.59	825.44 ± 439.91
Social price	8860.44 ± 0	617.47 ± 580.20	5856.90 ± 640.27	2386.07 ± 1166.35
Policy effects	−7405.14 ± 0	−323.43 ± 303.91	−5521.07 ± 495.60	−1560.63 ± 752.64
The channel 2 at social price, the channel 4 at market price				
Market price	1455.3 ± 0	279.46 ± 245.33	330.32 ± 174.71	845.52 ± 404.19
Social price	1926.96 ± 0	372.24 ± 326.78	816.37 ± 363.97	738.36 ± 651.58
Policy effects	−471.66 ± 0	−92.78 ± 81.45	−486.04 ± 234.48	107.16 ± 289.28
The channel 3 at social price, the channel 4 at market price				
Market price	1455.30 ± 0	279.46 ± 245.33	330.32 ± 174.71	845.52 ± 404.19
Social price	1778.52 ± 0	372.24 ± 326.78	725.57 ± 363.97	680.72 ± 651.58
Policy effects	−323.22 ± 0	−92.78 ± 81.45	−395.24 ± 234.48	164.80 ± 289.28

Source: Field survey data in 2022. Note: Tradable input is CIF price, Tradable output is FOB price.

Table 2 shows the monetary movement from the market price to the social price. Both Channel 2 and Channel 3 exhibit positive profit transfers. This suggests that channels 2 and 3 have the potential to generate profits even in the absence of government help or a subsidy scheme. Nevertheless, there is a tendency for the transfer of income and profit from market price to social price to diminish in channel 1. This illustrates that government policy intervention aims to enhance export activity via channel 1, but this may come at the cost of reduced profitability for the company and production system associated with channel 4. As a consequence, Channel 4 transfers funds to Channel 1 at the prevailing market price, while Channel 1 reciprocates by transferring funds to Channel 4 at the social price. To increase exports, the government has pushed for allotting resources to registering with VietGAP and GlobalGAP, using traceability codes, providing training programs, and facilitating commercial promotion.

Table 3 presents data pertaining to the global competitiveness of mango export and production. The PCR value in channel 1 was determined to be 0.25, while in channels 2 and 3, it was seen to be 0.36, with reference to the prevailing market price. According to this source, it is indicated that Channel 4 requires a range of 0.75 to 0.64 domestic resource units in order to produce 1 domestic resource unit of added value. The absence of government intervention in Channel 4 may be seen as a reflection of its potential competitive edge in the Vietnamese market via import substitution. It is noteworthy to mention that the coefficients for social pricing in the DRC model exhibit values that are less than one. The precise correlation coefficients for each channel are as follows: channel 1 exhibits a correlation coefficient of 0.72, channel 2 demonstrates a correlation coefficient of 0.65, and channel 3 displays a correlation coefficient of 0.75. Based on the aforementioned features, it can be inferred that the production and export of Tuong-mango via the indicated channels exhibit competitiveness and possess a comparative advantage. The aforementioned outcome is a result of the existing technological advancements, prevailing production levels, prevailing input expenses, and prevailing policy transfers. The signal-to-background ratios (SBC) for Channels 1, 2, and 3 were recorded as 1.40, 2.05, and 2.14, respectively. The ratios of 1.40, 2.05, and 2.14 indicate that exporting mangoes might potentially result in foreign currency savings when considering the accompanying expenses at societal prices. Export channels 2 and 3 create a greater amount of foreign currency compared to channel 1.

Table 3. Synoptic view of PAM indicators in the Tuong-mango marketing channels.

Indicators	Channel 1	Channel 2	Channel 3
PCR	0.25 ± 2.79	0.36 ± 0.51	0.36 ± 0.51
DRC	0.72 ± 0.14	0.65 ± 0.89	0.75 ± 1.90
SBC	1.40 ± 0.20	2.05 ± 0.89	2.14 ± 1.02
NPCO	0.16 ± 0.00	0.76 ± 0.00	0.82 ± 0.00
NPCI	0.48 ± 0.00	0.75 ± 0.00	0.75 ± 0.00
EPC	0.14 ± 0.03	0.76 ± 0.00	0.85 ± 0.09
SRP	−0.18 ± 0.08	0.06 ± 0.15	0.09 ± 0.16

Source: Field survey data in 2022.

The NPCO values observed in the export channels exhibit comparability, with corresponding values of 0.16, 0.76, and 0.82 for channels 1, 2, and 3. When the values of NPCO are below one, the output price policy incentivizes the production and trade of the three export channels. These findings suggest that the income generated from the three export channels, when considering the social price, is 94%, 34%, and 18% more compared to the revenue generated from one of the domestic channels, which is 4%. The NPCI index reveals that the NPCI values for the three channels are below one, namely 0.48 for channel 1 and 0.75 for channels 2 and 3. This suggests that channel 4, when priced at market value, enjoys a safeguarding effect in terms of tradable commodities cost, equal to 62% for channel 1 and 25% for channels 2 and 3. Furthermore, the findings indicate that the EPC coefficients for channels 1, 2, and 3 exhibit values of 0.14, 0.76, and 0.85 respectively, all of which are below unity. This

finding suggests that Channel 4 experiences a lower level of additional value compared to Channel 1 at the prevailing social price, and that inputs are subject to higher taxation relative to outputs. The aforementioned export incentive pertains to channels 1, 2, and 3. Based on the information shown in **Table 3**, it can be seen that the SRP value associated with channel 1 is negative (−0.18). This negative value suggests that there is a flow of net profit from channel 4, which operates at market pricing, to channel 1, which operates at social price and is funded by taxpayers. This finding indicates that a significant portion, namely 18%, of the observed variance may be attributed to the taxation policy implemented to incentivize the export of channel 1. Nevertheless, Channel 4 gets little financial assistance from the government, amounting to around 6% from Channel 2 and 8% from Channel 3 via net profit transfer.

Akter et al. (2003) argue that the Policy Analysis Matrix (PAM) did not sufficiently consider the potential for future modifications to policy indices. In order to assess the influence of fluctuations in FOB prices, tradable costs, domestic costs, and currency rates on competitiveness and policy indicators, it is necessary to do a sensitivity analysis at a significance threshold of 20% in **Table 4** (Yao, 1997; Monhanty et al., 2003).

Table 4. Sensitivity analysis of the Tuong-mango marketing channels.

Indicators	Increase 20%			Decrease 20%		
	Channel 1	**Channel 2**	**Channel 3**	**Channel 1**	**Channel 2**	**Channel 3**
DRC						
FOB price	0.59 ± 0.11	0.48 ± 0.41	0.49 ± 0.52	0.92 ± 0.22	0.75 ± 1.92	0.91 ± 1.58
Tradable cost	0.73 ± 0.17	0.46 ± 2.83	0.66 ± 1.28	0.71 ± 0.12	0.56 ± 0.46	0.57 ± 0.56
Domestic cost	0.86 ± 0.17	0.78 ± 1.06	0.90 ± 2.28	0.58 ± 0.12	0.52 ± 0.71	0.60 ± 1.52
Exchange rate	0.90 ± 0.18	0.82 ± 1.11	0.94 ± 2.38	0.60 ± 0.12	0.54 ± 0.74	0.63 ± 1.58
SBC						
FOB price	1.69 ± 0.25	2.45 ± 1.07	2.56 ± 1.22	1.12 ± 0.16	1.64 ± 0.71	1.71 ± 0.82
Tradable cost	1.38 ± 0.21	1.96 ± 0.88	2.03 ± 1.00	1.43 ± 0.19	2.15 ± 0.90	2.25 ± 1.04
Domestic cost	1.19 ± 0.16	1.77 ± 0.75	1.86 ± 0.86	1.72 ± 0.27	2.42 ± 1.09	2.51 ± 1.24
Exchange rate	1.14 ± 0.15	1.72 ± 0.72	1.80 ± 0.83	1.66 ± 0.26	2.35 ± 1.05	2.44 ± 1.20
EPC						
FOB price	0.11 ± 0.02	0.60 ± 0.04	0.66 ± 0.03	0.18 ± 0.03	1.02 ± 0.26	1.18 ± 0.36
Tradable cost	0.14 ± 0.03	0.79 ± 0.28	0.91 ± 0.23	0.14 ± 0.03	0.71 ± 0.05	0.79 ± 0.04
Domestic cost	0.14 ± 0.03	0.76 ± 0.00	0.85 ± 0.09	0.14 ± 0.03	0.76 ± 0.00	0.85 ± 0.09
Exchange rate	0.18 ± 0.02	1.01 ± 0.12	1.15 ± 0.35	0.11 ± 0.03	0.59 ± 0.08	0.65 ± 0.09
SRP						
FOB price	−0.31 ± 0.07	−0.12 ± 0.13	−0.09 ± 0.14	0.03 ± 0.11	0.32 ± 0.19	0.37 ± 0.20
Tradable cost	−0.16 ± 0.10	0.09 ± 0.18	0.13 ± 0.19	−0.19 ± 0.07	0.02 ± 0.13	0.05 ± 0.14
Domestic cost	−0.04 ± 0.10	0.14 ± 0.19	0.17 ± 0.20	−0.31 ± 0.07	−0.03 ± 0.11	0.01 ± 0.12
Exchange rate	0.02 ± 0.10	0.31 ± 0.18	0.35 ± 0.19	−0.31 ± 0.08	−0.11 ± 0.13	−0.08 ± 0.14

Source: Field survey data in 2022.

Table 4 presents data pertaining to the DRC, SBC, SRP, and EPC scenarios, whereby the FOB price, tradable cost, domestic cost, and exchange rate are subject to a 20% modification in relation to the baseline scenario. The findings suggest that the variables of FOB price, domestic cost, and exchange rate have a more significant influence on SBC compared to tradable cost. On the other hand, DRC demonstrates sensitivity to a 20% alteration in FOB price, tradable cost, domestic cost, and exchange rate. The enhancement of comparative advantage (DRC), benefit-cost ratio (SBC), effective protection coefficient (EPC), and subsidy ratio to producers (SRP) in export channels 1, 2, and 3 is seen when there is a 20% rise in the FOB price and a corresponding 20% reduction in the exchange rate. A modification of 20% in the tradable cost leads to an alteration in the distribution of DRC, SBC, EPC, and SRP. Furthermore, the DRC and the SBC exhibit a favorable transformation when there is a reduction of 20% in domestic expenses. Conversely, a 20% alteration in domestic costs does not impact the EPC. Specifically, the influence of domestic cost on SRP is noteworthy, as a reduction of 20% in domestic cost coupled with a corresponding gain of 20% in FOB price may substantially improve the SRP for export channels 1, 2, and 3.

5. Conclusion

The finding of PAM application show that the government's primary focus was on export channel 1, which included both the output protection policy and the added value policy derived from channel 4. Channel 1 demonstrated a high degree of adaptability to changes in macroeconomic policy, effectively sustaining economic efficiency and international competitiveness across several scenarios. The influence of macroeconomic policies relating to the FOB price and currency rate on the SRP was found to be substantial. Channel 4 has the capability to function independently from government assistance, so signifying its competitive edge within the Vietnamese market, specifically in the context of import substitution. Indeed, the implementation of measures to safeguard marketable inputs contributes to the augmentation of Channel 4's market price. Based on the existing technological advancements, output values, input expenses, and policy transfers, it can be seen that the production and export of Tuong-mango exhibit competitiveness and possess a comparative advantage across three distinct channels. The implementation of the output price strategy serves to incentivize the production and trade of the three export channels.

This demonstrates that the incorporation of quantitative analysis into the policymaking process is a dynamic tool that permits the formulation of agricultural sector objectives, limitations, and coherent policies. This facilitates the gradual adjustment of policies in accordance with economic fluctuations and the predetermined objectives of the tropical fruits and vegetables sector.

Author contributions: Conceptualization, KHVTT and SMV; methodology, PHNN; software, TCN; validation, HVN and AHH; formal analysis, KHVTT and PHNN; investigation, HVN and AHH; resources, SMV; data curation, TCN; writing—original draft preparation, KHVTT and SMV; writing—review and editing, KHVTT and PHNN. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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