Scientific Research Publishing

Open Journal of Social Sciences, 2022, 10, 31-51
https://www.scirp.org/journal/jss
ISSN Online: 2327-5960
ISSN Print: 2327-5952

Study on Factors Impacting on Decision of Choosing Railway to Export Agricultural Products in Vietnam and the Concern about Environmental Element

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How to cite this paper: Tran, T. T., & Ge, Y. E. (2022). Study on Factors Impacting on Decision of Choosing Railway to Export Agricultural Products in Vietnam and the Concern about Environmental Element. *Open Journal of Social Sciences, 10,* 31-51.
https://doi.org/10.4236/jss.2022.104003

Received: March 7, 2022
Accepted: April 5, 2022
Published: April 8, 2022

Abstract

Agricultural products are one of the main export commodities of Vietnam. With the gradually increasing competition of this commodity in the world market, agricultural product manufacturers still depend a lot on the road transport method in transporting this type of goods while the railway has been ignored for too long. This research tried to investigate the factors and their extent that affect exporters' decision to choose a rail transport mode. Additionally, environmental issues are being seriously considered in Vietnam. Environmental factors will also be included to understand its importance in the decision of exporters. The quantitative method is applied in the research and relevant literature reviews are taken as references to conduct the survey sent out to agricultural exporters in Vietnam for data analysis. The binary logistic regression model was applied to the study of 138 samples in Vietnam and the investigation as well as outcomes of the research would generate a practical model to predict the behaviors of agricultural exporters in making decision of using railway in Vietnam.

Keywords

Railway, Vietnam, Agricultural Products, Mode Choice, Environment

1. Introduction

Export of agricultural products has always been a bright spot and strength of Vietnam's economy. As a country with many advantages in the production of many tropical agricultural products, Vietnam is playing an increasingly important position in the world market for agricultural products. These products are

one of Vietnam's important export goods, contributing greatly to the overall export turnover. However, logistics costs for Vietnamese agricultural products are too high, up to 25% of the total value of goods in some items, even much higher than the stages of agricultural production, processing and related businesses (Chi, 2020). This is considered the main reason leading to the reduction of competitiveness of many key agricultural products in Vietnam in potential markets. Additionally, not many businesses choose the railway as a mode of transport for export shipments, although the railway industry has invested in upgrading the quality of wagons, exploiting and transporting self-propelled refrigerated containers recently.

In addition, in term of environmental protection, as to the report of Vietnam Ministry of Natural Resources and Environment, transportation contributes 24.34% of carbon emissions each year. In the transportation sector alone, light cars, trucks and buses account for 44%, 27% and 6% of carbon emissions each year, respectively. Motor vehicles use fossil fuels such as gasoline and diesel; the combustion of fuel leads to the generation of many types of emissions such as SO_2, NO_2, CO, dust (TSP, PM10, PM2.5); even leaking, evaporating fuel when operating, generating VOC, Benzene, Toluene… (Vietnam Ministry of Natural Resources and Environment, 2020) which badly pollute air quality.

Sustainable development is the future orientation of transportation of the world in general and Vietnam in particular; hence, optimal solutions to minimize environmental pollution while reducing the transportation costs should be considered. Meanwhile, Vietnamese government has also released Resolution No. 136/NQ-CP dated September 25, 2020 of the Government on sustainable development and cost reduction in which also emphasized:

- Continue to effectively implement the restructuring of the transport market in a rational way, arrange, innovate, improve the efficiency of the exploitation of the transport system and promote the transport of goods from road to other modes of transport to reduce pressure on road transport, ensure more fuel economy and lower emissions (waterways and railways).
- Implement a project to develop logistics services to optimize transportation time and costs, and reduce fuel consumption; develop the operation of transport exchanges in order to connect the transport network; approach, apply smart traffic technology, green transport technology, reduce greenhouse gas emissions in circulation and transport of goods (Vietnam Ministry of Industry and Trade, 2020).

Recent years in Vietnam, rail transport has not been really focused by domestic companies or has not been fully utilized in the development of the whole supply chain system in Vietnam. Most of the domestic and international import and export goods are still transported mainly by road and sea, and most of Vietnam's agricultural products are exported to China by container transportation. Meanwhile, to transport agricultural products and refrigerated goods, road is still the first choice for shippers due to its flexibility, fast transit time and it is al-

so a traditional method, especially for exports to markets that share a border with Vietnam like China. However, solely depending on road transport also puts Vietnam agricultural products in a less competitive position in the market due to high costs of transportation while railway mode has been neglected for so long. In this research, the transportation of Vietnam agricultural products which are exported to China—one of the main importers, will be investigated.

Transporting containers by train not only costs much less than by road but also causes less harm to environment, yet many agricultural exporters still prefer using whole truck mode. Therefore, in this study, authors will look into other factors which impact on decision of agricultural exporters to use rail or not, and also to study if environmental element has any impact on this decision. There are 8 elements which will be used to evaluate their importance on the exporters' decision including: transport procedures, freight and surcharges, schedule flexibility, transit time, cargo quality insurance, safety and stability, environmental care, distance.

2. Literature Review

2.1. The Dominance of Road Transport

Because of their ability to deliver to most destinations, trucks are the most common vehicles in the transport sector; flexibility, ability to operate on almost any country's roads; speed, especially on short routes; low cost, due to simpler maintenance and handling requirements; and low investment requirements. However, there are inherent disadvantages of using road trucks for transport, such as: susceptibility to traffic in urban environments; accidents or breakdowns due to exposure to poor road pavement or unfavorable weather; limited load capacity for business operations that require the displacement of great quantities of materials over long distances; and high emissions of gases associated with climate change due to fuel combustion (Li et al., 2014; Reis, 2014).

Demand for freight transport services is growing, with major consequences for how best to cope with the need for reliable, scalable, cost-effective, timely and clear door-to-door freight services. Lower levels of inventories and less flexible output capacity build greater dependency on transport services. Trucks dominate short trip lengths and higher value goods, while rail dominates long trip lengths with bulky, low-value products (Florida Department of Transportation Rail Planning & Safety Office, n.d.).

Road transport has increased (often strongly) in most countries, while freight has moved away from rail to road. For example, rail freight's market share has declined steadily across Europe since the 1970s, and particularly in Eastern Europe (Kaack et al., 2018; Islam et al., 2015; Pinchasik et al., 2019). This trend has led to a rise in international transport, mostly preferring road transport, because many centers of production and consumption can only be reached by road.

Almost all freight movements are based on road transport in a wider world sense. For example, the road sector has dominated the European Union as stated

by Colliers International (2016), cargo movement in 2009. For any of the major country members, the road modal share did not drop below 60%. In Germany, this was also the case, even though 12% of cargo moves through inland water mode. In Germany, the cargo market is still dominated by road at 65%. In France, the modal cargo share in the United Kingdom is up 80% - 85%, although Italy's modal share is just over 90%. In France, freight is increasingly transported by road, leading to a number of negative, external consequences such as congestion, pollution and accidents (Jiang et al., 1999).

In reality, shippers are more likely to select the road when they concern more about timely delivery of goods (Zeybek, 2019). Road transport dominates freight transport in the hinterland terminal, with the actual modal share of road transport in domestic freight transport about 60% worldwide (Kaack et al., 2018). Road transport also accounts for 93% of the external transport costs, including injuries, air pollution, climate change, noise, congestion and delay costs, external fuel and electricity production costs, nature and landscape costs (repair costs and conservation steps such as unsealing, renaturation and green bridges), loss of time for non-motorized transport in urban areas, biodiversity losses due to air pollution, and soil and water pollution. As a result of substantial rises in road transport costs and, to a lesser degree, road congestion in recent years, an increasing number of businesses have begun paying more attention to mode choice than before. Despite this, there was obviously an increasing recognition that certain factors beyond the operations of their businesses, such as worsening road congestion and introducing government policies to raise the cost of road haulage, would provide more of an impetus to consider the future of rail (Woodburn, 2003). Additionally, combined with a shortage of drivers and automobiles, the long-term trends towards rising costs of fuel, taxes and road tolls suggest that the road freight sector faces enormous challenges in maintaining its high quality and economic output in future. In addition, end users are increasingly demanding sustainable goods making companies pay attention to the environmental effects of their businesses, including transport.

2.2. Rail Transport

Road mode dominates the inland freight transport due to its low cost on short routes, high speed, flexibility to connect with various geographic locations and sites. However, its negative impact on environment, road accidents, congestion, limited loading capacity are undeniable. Railway, on the other hand, complements those disadvantages of truck mode, but also has its own short comings to put into consideration.

The frequent use for cargo with relatively low value, high volume and/or high density is among transport modes, waterways, roads, and rail transport. These cargoes usually do not need short transport time and special preservation during transportation. Other modes of transport (airway, highway, high-speed rail) may be needed for certain forms of freight, such as high-value, perishable freight, live animals and/or hazardous goods. The need for single-mode transport (or road,

or rail, etc.) would account for a large proportion of the transport of goods at short distances. However, the market for multimodal transport (the combination of air freight transport with trucking or waterway/seaway transport) also accounts for a significant proportion when the transport distance is longer, with a more geographical separation (Phi & Dang, 2020).

Trains do not have the same approach and are not as flexible as trucks, but their characteristics facilitate the transportation of large amounts of materials over long distances, thereby preventing most environmental and traffic problems (Li et al., 2014; Reis, 2014). There is strong consensus that rail is one of the more efficient modes of freight transport and that its use should be promoted, where possible, rather than road use. When concerns are more relevant about the cost of consignments, shippers are more likely to perceive rail favorably. This is because rail shippers are more prone to cost than time.

The biggest concern rail freight facing is its limited geographic reach. The extremely clustered rail network with a small number of high-volume corridors offers access to rail only to broad transport volumes of city-regions and industrial sites. Intermodal rail freight lines link larger cities but do not connect with the small towns along the route. Smaller economic regions where the demand for transport is comparatively small and scattered are typically not served by rail and have road as the only available mode of transport. Given that the accessibility of the rail network is relatively small, pick-up and delivery by diesel trucks to and from rail terminals is necessary (Behrends, 2012).

Just as the expectation that all freight being transported by rail is irrational, it is also impractical to believe that all freight could be transported by truck. Given that net economic benefits and welfare gains can be achieved by mode shifts from road to rail shipping of goods, how best to incorporate these changes needs to be decided. Little evidence has been discovered to support conventional incentives or taxes to cause mode changes in either mode. Furthermore, it is difficult to decide how these policy changes can achieve mode shift in the light of the data collected. However, considering that certain goods are better or even exclusively suited to one mode or the other, there is a "crossover" category of goods which could be shipped effectively by either mode. Examining product styles and their characteristics offers insight into product niche groups which may well match a change from one shipping style to another (Florida Department of Transportation Rail Planning & Safety Office, n.d.). For long-distance transport, high frequency shipments are favored by both the shipper and the receiver on the railway line, packed shipments, worldwide businesses, industrial goods, and the metal industries. On the other hand, private transportation by truck appears to be preferred for warehouse recipients, shipping in a circuit, small companies, shippers with own vehicle, food industries, and agricultural products. In general, an increase in transport distance and volume of shipments appears to lift the rail and combined transport shares… Combined transportation may be an essential mode for long-distance regional transportation, but for long-distance international transportation, the current standard of combined transportation service

obviously does not meet the needs of shippers and conventional rail transportation plays an important role. Road transportation is the primary mode for short distance transportation and has no competition from other modes. On the other hand, rail, road, and combined transport shares are heavily dependent on distances of transportation over 1000 kilometers. For example, the highest possibility of choosing public road transport takes place at about 700 kilometers, while the option of rail transport exists at 1300 kilometers. Combined transport is dominant if the distance to transport is greater than 1400 kilometers (Jiang, F. et a., 1999). Much of the potential traffic has been described as relatively easily accessible to rail freight operators as long as they are especially able to meet the quality requirements. To become a far more serious competitor to road haulage, rail freight will entail substantial restructuring of either the entire logistics operations of companies within supply chains or far-reaching improvements in the rail industry's capacity to meet the demands put on it. A combination of positive rail attributes and negative road attributes tends to contribute to increased rail usage, rather than exclusively one set of attributes, or the other (Woodburn, 2003).

The main leg of intermodal transport is either conducted by rail, inland water, or short sea shipping, while post and pre-traffic are typically conducted by road. Many countries agreed that modal change is an important way to reduce the negative impacts of road transport. Asian countries also encourage intermodal transportation as a competitive alternative for freight transport. China is funding intermodal transport infrastructural infrastructure projects as part of its Belt and Road Initiative to integrate its international freight transport operations with other parts of the world in a sustainable way. However, because of difficulties in using these services, this growing promotion of intermodal transport may not automatically establish the desired modal shift from road transport. Such problems include uncertainty in the provision of intermodal transport services, insufficient legislation, and lack of incorporation into transport networks (Reis, 2014).

The simulation results suggest that the most efficient modal change strategy for increasing the use of intermodal rail is to increase the frequency of train services and to reduce transit time. Doubling the frequency and reducing the transit time would lift the intermodal rail share from 10.6% to 29.7%. Provision of high-frequency intermodal rail service is important, not only to generate demand, but also to satisfy the demand generated, as a modal change to intermodal rail will create the need for more frequent train departures. Increasing the frequency of train departure may entail high-cost infrastructural investment to increase railway capacity, as passenger transport is also carried out on the same railway. The foremost successful arrangement for modular shift towards intermodal rail within the examined corridor is multiplying the train frequency and lessening transit time 50% depending on the expanded recurrence (Kurtuluş & Çetin, 2020).

Intermodal rail-road transport will be economical over all distances where the

total cost of transport involved is less than the average unimodal cost of road transport. Unimodal road transport, on the other hand, can be profitable as long as its marginal transport costs are less than the average intermodal transport costs. Whatever this might be, competitive mode costs should be smaller than those reflected by the overall competitive cost envelope. By eliminating pre- or post-haulage intermodal transport could be a good alternative to unimodal road transport, also on short- and medium-distance trips (Zgonc et al., 2019). Providing a price-competitive rail service in this corridor has a significant effect on achieving a sustainable mode change from road to intermodal rail transport. To have a lower cost, there is a need to increase demand for the dry port and its capacity to fully leverage economies of scale. A small reduction in the share of road induces a relatively large increase in that of intermodal rail, while a comparatively significant decrease in the share of intermodal transport induces only a slight increase in the share of road traffic. The attribute of transport costs has the greatest effect on the mode of choice and the modal change is more prone to the costs of road transport than the intermodal rail costs (Kurtuluş & Çetin, 2020). Also, throughout the Eastern corridor of Ghana, cost is the most important issue for decision-makers, followed by transit time, dependability and flexibility, and the danger of damage and loss, according to Thompson et al. (2022). In order to prioritize transport mode selection criteria, the largest weightage value was observed, which displays the cost factor, transport time and dependability and flexibility, as well as the potential danger of damage and loss in decreasing order of importance. It suggests that cost is the most important consideration when deciding on a form of transportation (Thompson et al., 2022).

2.3. Rail-Road Intermodal Transportation and Environmental Impact

Both unimodal of whole truck mode or railway have their pros and cons in transportation. However, their disadvantages can be balanced by combining the use of these two modes in freight transport, and the clearest benefit of this rail-road intermodal choice to be seen is to reduce the negative impact on the environment, which many countries and businesses are approaching for the purpose of sustainable development.

A main policy goal for the sustainable development of the freight sector is to reduce the disparity in the growth of the different modes of transport and to move freight to less environmentally harmful modes such as rail (Behrends, 2012). To allow companies and countries in which road transport is the key modal of transport to boost their performance in atmospheric emissions without losing large amounts of money, or taking long periods of time to construct railways, the use of intermodal road-rail can be a short-term solution (Lam & Gu, 2016). Operationally, using existing trucks to supply the nearest existing railway that leads directly or indirectly to the desired destination is the simplest and most preferred way of moving from road to rail, preferably without the need to use trucks again at the end of the long-haul rail (Lam & Gu, 2016).

Freight modal change from road to rail is a possible means of reducing the negative impacts of transport on the environment and on society (Woodburn, 2003).

Rail freight transport decreases gaseous emissions by 92%, decreases PM 2.5 emissions by 87%, and has marginal heavy metal leakage relative to highways. Road transport has substantially higher combined emissions in terms of overall emissions than railways (10 percent of total road transport) and water transport (20% of total road transport) (Spielmann & Scholz, 2005). An air pollution inventory evaluation reveals that road transport accounts for 94.5% of these emissions; railways, on the other hand, is highly productive with a meager 2% CO_2 emission and 1.2% CO emission (Ramachandra & Shwetmala, 2009).

Specific patterns of pollution between intermodal road-only and road-rail operations. This is due to variations in load and combustion efficiency in engine operation (Pinto et al., 2018). As the data in **Figure 1**, the intermodal road-rail has shown a higher propensity to produce NO_x emissions, a category of gasses correlated with smog formation and acid rain caused by the early oxidation of nitrogen in the reduced atmosphere in larger engines. While the intermodal road-rail appears to emit proportionally more NO_x during its service (61.69%), the findings of this case study showed that road-only transport emitted approximately 70% more NO_x in total (399.15 kg).

Despite the high CO composition of road-only emissions, the worst overall emissions were those of overall hydrocarbons (THC), a group of gasses also associated with the greenhouse effect: road-only transport of goods generated 329.30 kg of this pollutant, while the proposed intermodal road-rail emissions would generate 26.85 kg and in terms of CO_2, CO, NO_x, CH_4, hydrocarbons and particulate matter, road-rail intermodal operations can be up to 77.4% less polluting than working exclusively with road transport (**Figure 2**). In addition,

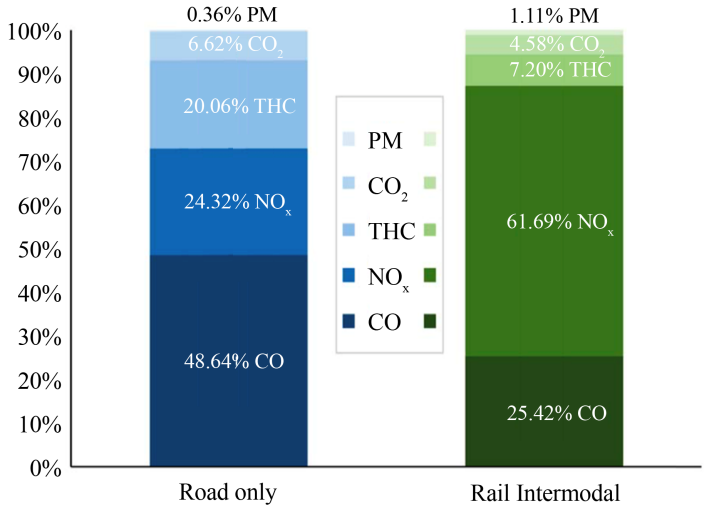

Figure 1. Relative comparison between the compositions of emissions of each modal (Source: Pinto et al., 2018).

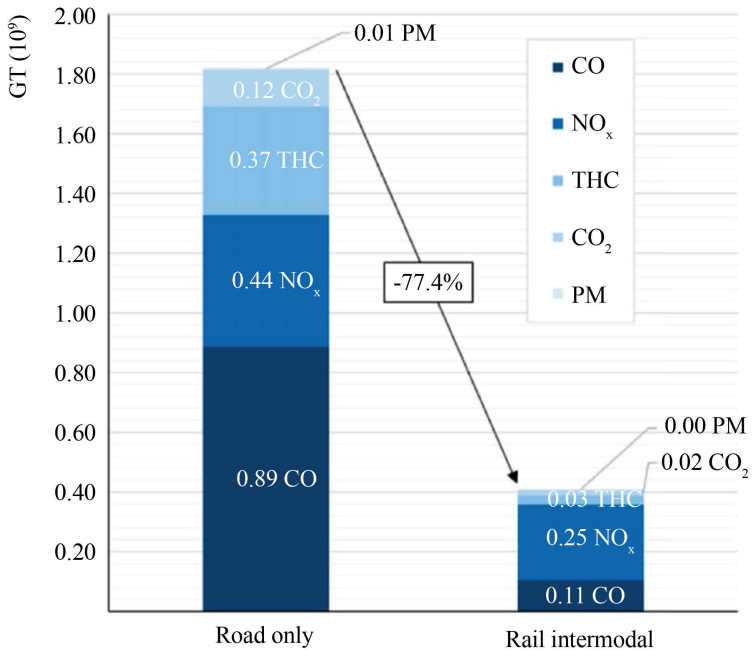

Figure 2. Potential emission reductions from shifting from road-only to an intermodal operation (Source: Pinto et al., 2018).

according to Pinto et al. (2018), the intermodal road-rail operations were up to 43.48% less diesel-intensive than road-only operations compared with current consumption rates. Therefore, intermodal road-rail operations can be a viable tool to help more countries and businesses across the globe contribute to combating climate change. Many countries that rely heavily on road transport have unfavorable rail infrastructure to allow full transitions to rail transport, making intermodal road-rail operations a transitional alternative that could help them achieve their emission reduction targets using their existing infrastructure without unnecessarily jeopardizing substantial long-term investments that could hinder them economically (Pinto et al., 2018).

Patterson et al. (2008) measured not only the potential for modal changes but also the potential for CO_2 reduction from a modal shift from road to intermodal rail in Canada, CO_2 emissions will still be halved from their current level. In addition, researchers studied the potential for modal changes and pollution mitigation for the inland transport corridor between Laos and Thailand. They announced a very ambitious increase of 0% - 43% in the share of intermodal transport, which would reduce CO_2 emissions by 30% examined possible modal changes and CO_2 emissions from rail transport subsidies in China's inland transport corridor. Allowing longer freight trains, in turn, has a greater impact on modal choice than eco-bonus schemes and increases in road costs, and also produces greater decreases in emissions from the environment. Environmental taxes to road carriers might be an effective policy to increase the usage of intermodal rail since road transport harms the environment more than intermodal transport (Pinchasik et al., 2020).

In a study of countries South East Asia including Singapore, Malaysia, Thailand, Vietnam, Myanmar and Cambodia of analyzing shippers' choice behavior on choosing transport mode through an economic benefit analysis with three platitude factors (i.e. distance, time, cost) and an increasingly important environmental factor (i.e. CO_2 emission), Chang & Thai (2017) stated that as far as CO_2 emissions are concerned, because the government at the time of the interview did not put much effort into this problem in terms of mandatory regulations, CO_2 emissions were not an significant factor in the shipper's choice of mode of transport. However, if the government raises the fine or levy, or imposes a CO_2 emission environmental fee, the shipper will find CO_2 emission as a significant factor and raise its weight. As carriers will usually seek to pass the fine or tax to shippers, using a mode of transport with fewer CO_2 emissions will reduce the fee from the carrier's fine or tax. Some shippers may also emphasize CO_2 emissions because they are national or government-linked entities and must be the role model as mandated by environmental policies of the country (Chang & Thai, 2017).

In the research from literature review, we can summarize that there are many factors affecting the decision of choosing to use rail transport in the transportation of goods including transport costs, flexibility, transit time, type of goods, quality of goods, and one of the important factors that have been focused on in recent years the environment.

3. Methodology

The objective of this research is to study the influence of transport procedures, freight and surcharges, schedule flexibility, transit time, cargo quality assurance, safety and stability, distance, and environmental elements on the decision of Vietnamese exporters for a specific type of cargo which is agriculture and with import market set for China.

An online survey method has been conducted accordingly to collect quantitative data for calculation and finding. The survey includes three main parts. The first part of the survey includes general questions about the companies and individual providing information. The second part is to sort out the location of cargo loading and find out the main markets of export of the companies as well as the main modes of transport they are currently using for transporting agricultural products for export and the frequency of each mode. Finally, in the third part, respondents were asked to evaluate the elements impacting on their decision of choosing railway in agricultural export by rating the importance of each.

The instrument of the survey has been designed using Likert scale in 5 degrees from 1 to 5 to measure respondents' attitude towards the factors of research findings in which 1 is "not important" or "never" in frequency, and 5 expresses "very important" or "frequently" respectively.

The survey was formed by Google Forms online and links have been sent to 230 agricultural exporters from both the North, the Central, and the South of

Vietnam by emails and contacts available on companies' profile page with agricultural exporters filtered out. The survey was also sent to agricultural exporters' forums in Vietnam to increase interactivity and speed of data collection.

Among 230 emails sent out, 17 email addresses were incorrect and returned errors, 112 answers were returned, 38 forms were sent back from agriculture forums. 150 answers were collected in total and questionnaire was closed. The questions used for collecting research data were marked mandatory in order to avoid missing information on data collected. From 150 forms, there are 138 ones are valid with the availability of exporting products to China route. However, the remains can be used to describe general market data.

The results from surveys collected have been summarized and run by Statistical Package for the Social Science (SPSS 22). Since the purpose of the study is to figure out the impact of determined factors on the decision of using rail or not and there are only two separate outcomes of "yes" or "no", the Binary Logistic Regression model has been applied by author to understand to what extend these elements impact on the decision and also with the expectation of utilize the ability of predicting probability of this model into practical use for exporting agricultural products from Vietnam to China.

4. Data Analysis and Findings

4.1. Statistical Summary of Agriculture Export from Vietnam

According to the report of Vietnam Ministry of Industry and Trade for Import and Export in 2020, the top export markets for agricultural and aquatic goods in 2021 were China, the EU, the US, ASEAN, Japan, and South Korea. In 2020, Vietnam's agricultural and aquatic exports to these six destinations reached USD 18.66 billion, or 74.5% of overall exports. In which:

- Chinese market: Exports of agricultural and aquatic products to China totaled USD 6.86 billion in 2020, a decrease of 3.4% compared to 2019.
- US market: Agricultural and aquatic goods exports to the US reached around USD 3.25 billion in 2020, increased 4.6% from 2019. This is Vietnam's largest market for pepper and seafood, and the second largest market for coffee.
- EU market: The EU is Vietnam's third largest export market for agricultural and aquatic products, with export turnover reached USD 2.91 billion in 2020, decreased 4.7% from 2019.
- ASEAN market: Agricultural and aquatic product exports to ASEAN totaled USD 2.76 billion in 2020, an increase of 2.4%.
- Japanese market: Agricultural and aquatic product exports to Japan were USD 1.81 billion in 2020, increased 0.1% from 2019.
- Korean market: Agricultural and aquatic product exports to Korea were USD 1.08 billion in 2020, decreased 1.2% from 2019 (Vietnam Ministry of Industry and Trade, 2021).

The data collected by authors on the destination markets for agricultural products in Vietnam from 150 exporters in the industry are as following:

In Figure 3, among 150 exporters of agricultural products, 106 answered for agricultural products exported to Asia, accounting for 44% of the total export volume of this commodity, in which, 106 only accounts for 44% because a company can export to more than one market. In second place is the European market with 20% of the total, followed by the US market with 15%. Other small markets such as the Middle East, Latin America, Africa, and others accounted for quite modest numbers.

In the surveys collected, up to 62 out of 150 respondents had high frequency of exporting agricultural products to China, and only 12 respondents had no exports to China. These 12 answer sheets were filtered out of the data for analysis in the next steps (Figure 4).

Among 138 samples collected to analyze, authors have sorted out exporters in 2 groups in which one has main cargo loading locations from the North of Vietnam with 48 answers and the remaining is from the Central and the South with 90 answers. Exporters were asked the choice of transport modes and their frequency; the authors have summarized the following data in Figure 5.

From the above data, we can see that up to 70 respondents with high frequency of using road transport to export agricultural products, account for the highest proportion of all modes of transport. Ranked second is sea transport with 43

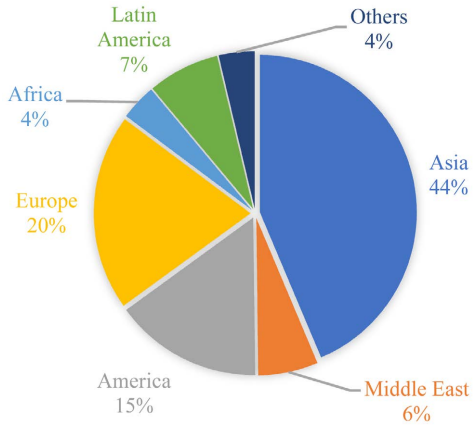

Figure 3. Main import markets of agricultural products from Vietnam (Source: Collected by author).

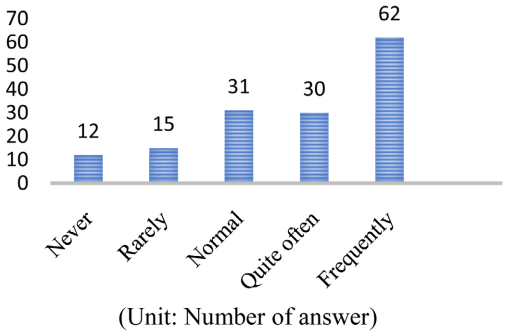

Figure 4. Collected data on frequency of exporting agricultural products to China (Source: Collected by author).

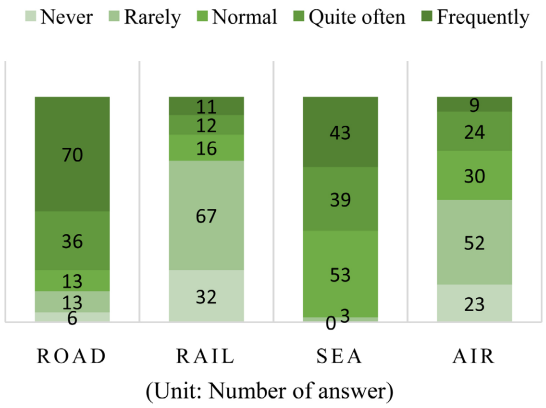

Figure 5. Collected data on main modes of transport used to export agricultural products (Source: Collected by author).

answers of high frequency of mode choice and there is none of exporters who does not use seaway to export their products.

Contrary to that, at the top of the list of not being prioritized as a mode of transport for agricultural exporters in Vietnam is rail transport with 32 answers never used and 67 answers rarely used. This numbers for air transport are 23 and 52 respectively; however, the frequency of choosing air transport is more than that of rail transport. This is to show that agricultural products are exported solely by whole truck unimodal mode.

4.2. Data Analysis of Factors Impacting on Decision of Choosing Railway

Agricultural exporters are asked to rate the importance of the simplicity of transport procedures, freight rate and surcharges, schedule flexibility, transit time, cargo quality assurance, safety and stability, and environment care.

The Cronbach's Alpha test were run in SPSS to test the reliability of the questions with $\alpha = 0.712$ which is acceptable.

In the next step, a preliminary analysis suggested that the assumption of multicollinearity was met with tolerance values are greater than 0.1 and close to 1 which means the independent variables are less dependent (**Table 1**).

No condition index with value greater than 15 which is the threshold for collinearity signal by Belsley et al. (1980) found in **Table 2** of collinearity diagnostics. Additionally, the variance proportions reflect no 2 predictors in the same dimension with value greater than 0.5. Therefore, there are no collinearity problems or dependence among independent variables.

Binary logistic regression was used to examine whether these factors were associated with the likelihood of using rail or not for exporting agricultural products. The model was statistically significant, χ^2 (8, N = 138) = 51.814, $p = 0$ (**Table 3**), suggesting that it could distinguish between those use and not use rail.

Table 4 below showed significant number of 0.104 which is greater than 0.05 in Hosmer and Lemeshow test indicates that a non-significant effect and in that case, it indicates that the model is a good fit of the data.

Table 1. Collinearity statistics.

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	0.754	0.244		3.093	0.002		
	Procedures	−0.036	0.043	−0.077	−0.837	0.404	0.625	1.601
	Freight & Surcharges	0.170	0.054	0.295	3.145	0.002	0.606	1.650
	Schedule Flexibility	−0.172	0.049	−0.322	−3.497	0.001	0.628	1.591
	Transit Time	−0.071	0.047	−0.134	−1.531	0.128	0.701	1.427
	Cargo Quality Assurance	−0.153	0.049	−0.275	−3.138	0.002	0.696	1.437
	Safety and Stability	0.096	0.048	0.185	1.975	0.050	0.608	1.645
	Environmental Care	0.008	0.036	0.019	0.214	0.831	0.703	1.422
	Loading Location	0.167	0.078	0.177	2.139	0.034	0.784	1.276

a. Dependent Variable: Use rail or not (Source: Collected data processed in SPSS by author).

Table 2. Collinearity diagnostics.

Collinearity Diagnostics[a]											
Dimension	Eigen value	Condition Index	Variance Proportions								
			(Constant)	Procedures	Freight	Schedule Flexibility	Transit Time	Cargo Quality Assurance	Safety & Stability	Environmental Care	Loading Location
1	8.380	1.000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.376	4.721	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.63
3	0.090	9.630	0.00	0.01	0.00	0.02	0.03	0.01	0.00	0.71	0.09
4	0.042	14.093	0.01	0.63	0.00	0.00	0.13	0.07	0.00	0.03	0.05
5	0.033	16.048	0.00	0.01	0.12	0.00	0.12	0.29	0.29	0.04	0.00
6	0.028	17.325	0.00	0.03	0.00	0.48	0.20	0.05	0.25	0.05	0.05
7	0.019	20.738	0.00	0.19	0.01	0.42	0.00	0.52	0.38	0.01	0.00
8	0.016	22.705	0.10	0.09	0.85	0.00	0.30	0.01	0.06	0.06	0.02
9	0.016	23.157	0.88	0.04	0.01	0.07	0.23	0.05	0.01	0.08	0.16

a. Dependent Variable: Use rail or not (Source: Collected data processed in SPSS by author).

Table 3. Omnibus tests of model coefficients 1.

Omnibus Tests of Model Coefficients 1				
		Chi-square	df	Sig.
Step 1	Step	51.814	8	0.000
	Block	51.814	8	0.000
	Model	51.814	8	0.000

(Source: Collected data processed in SPSS by author).

The model explained between 31.3% (Cox & Snell R square) and 45% (Nagelkerke R square) of the variance in the dependent variable and correctly classify 86.2% of cases (Table 5 and Table 6).

As shown in Table 7, Freight, Schedule Flexibility, Cargo Quality Assurance, Safety and Stability, and Loading Location, but not Procedures, Transit Time, and Environmental Care significantly contributed to the model. By this, the removal of each among Procedures, Transit Time, and Environmental Care have been tested to compare one by one model. The final result showed that even though the p-value of these 3 elements is greater than 0.05 which did not significantly contribute to the model, only Procedures can be removed from the model but not Transit Time and Environmental Care since the removal of these 2 independent variables will cause to the significant shortage of information of the model.

The results for new model after removal of Procedures is as described from Tables 8-11 as following.

Converted the result from Table 12, the Freight and Surcharges odds ratio of 2.791 suggests that the more important this factor is for exporters, 2.791 times likely they will choose to use rail.

Table 4. Hosmer and Lemeshow test 1.

Hosmer and Lemeshow Test 1			
Step	Chi-square	df	Sig.
1	13.235	8	0.104

(Source: Collected data processed in SPSS by author).

Table 5. Model summary 1.

Model Summary 1			
Step	−2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	112.516[a]	0.313	0.450

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than 0.001 (Source: Collected data processed in SPSS by author).

Table 6. Classification Table 1.

Classification Table[a] 1					
Observed			Predicted		
			Use rail or not		Percentage Correct
			Not Use	Use	
Step 1	Use rail or not	Not Use	97	2	98.0
		Use	17	22	56.4
Overall Percentage					86.2

a. The cut value is 0.500 (Source: Collected data processed in SPSS by author).

Table 7. Logistic regression predicting the likelihood of using rail to export agricultural products to China from Vietnam 1.

Variables in the Equation 1									
		B	S.E.	Wald	df	Sig.	Exp (B) or OR	95% C.I. for EXP (B)	
								Lower	Upper
Step 1[a]	Procedures	−0.230	0.327	0.498	1	0.481	0.794	0.419	1.506
	Freight & Surcharges	1.057	0.368	8.271	1	0.004	2.878	1.400	5.917
	Schedule Flexibility	−1.413	0.425	11.030	1	0.001	0.243	0.106	0.560
	Transit Time	−0.418	0.307	1.862	1	0.172	0.658	0.361	1.200
	Cargo Quality Assurance	−1.214	0.369	10.798	1	0.001	0.297	0.144	0.613
	Safety and Stability	0.746	0.341	4.788	1	0.029	2.109	1.081	4.116
	Environmental Care	0.146	0.246	0.350	1	0.554	1.157	0.714	1.875
	Loading Location (1)	1.314	0.621	4.476	1	0.034	3.721	1.101	12.569
	Constant	2.659	1.752	2.303	1	0.129	14.285		

a. Variable(s) entered on step 1: Procedures, Freight, Flexibility, Transit Time, Cargo Quality Assurance, Safety and Stability, Environmental Care, Loading Location (Source: Collected data processed in SPSS by author).

Table 8. Omnibus tests of model coefficients 2.

Omnibus Tests of Model Coefficients 2				
		Chi-square	df	Sig.
Step 1	Step	51.321	7	0.000
	Block	51.321	7	0.000
	Model	51.321	7	0.000

(Source: Collected data processed in SPSS by author).

Table 9. Model summary 2.

Model Summary 2			
Step	−2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	113.009[a]	0.311	0.446

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than 0.001 (Source: Collected data processed in SPSS by author).

Table 10. Hosmer and Lemeshow test 2.

Hosmer and Lemeshow Test 2			
Step	Chi-square	df	Sig.
1	5.440	7	0.606

(Source: Collected data processed in SPSS by author).

Table 11. Classification Table 2.

Classification Table[a] 2					
Observed			Predicted		
			Use rail or not		Percentage Correct
			Not Use	Use	
Step 1	Use rail or not	Not Use	92	7	92.9
		Use	17	22	56.4
Overall Percentage					82.6

a. The cut value is 0.500 (Source: Collected data processed in SPSS by author).

Table 12. Logistic regression predicting the likelihood of using rail to export agricultural products to China from Vietnam 2.

Variables in the Equation (2)									
		B	S.E.	Wald	df	Sig.	Exp (B) or OR	95% C. I. for EXP (B)	
								Lower	Upper
Step 1[a]	Freight & Surcharges	1.027	0.369	7.723	1	0.005	2.791	1.353	5.758
	Schedule Flexibility	−1.498	0.416	12.956	1	0.000	0.224	0.099	0.506
	Cargo Quality Assurance	−1.191	0.367	10.558	1	0.001	0.304	0.148	0.623
	Safety and Stability	0.701	0.335	4.377	1	0.036	2.016	1.045	3.887
	Loading Location (1)	1.374	0.614	5.009	1	0.025	3.949	1.186	13.151
	Transit Time	−0.440	0.308	2.050	1	0.152	0.644	0.352	1.177
	Environmental Care	0.123	0.243	0.255	1	0.613	1.131	0.702	1.821
	Constant	2.479	1.733	2.045	1	0.153	11.926		

a. Variable(s) entered on step 1: Freight, Flexibility, Cargo Quality Assurance, Safety and Stability, Loading Location, Transit Time, Environmental Care (Source: Collected data processed in SPSS by author).

The Schedule Flexibility odds ratio of 0.224 with negative value −1.498 suggests that the more important this factor is for exporters, 0.224 times less likely they will choose to use rail (not use).

The Cargo Quality Assurance odds ratio of 0.304 with negative value −1.191 suggests that the more important this factor is for exporters, 0.304 times less likely they will choose to use rail (not use).

The Safety and Stability odds ratio of 2.016 suggests that the more important this factor is for exporters, 2.016 times likely they will choose to use rail.

The Loading Location odds ratio of 3.949 suggests that if the exporters have loading location in Central or South of Vietnam which has further distance to the destination, 3.949 times likely they will choose to use rail.

The analysis is limited since an inspection of standardized residual values revealed that there were 3 outliers (Std. Residual greater than 2.5) which were kept in data set.

The binary logistic regression equation could be converted as following:

$$\ln\left(\frac{P}{1-P}\right) = 2.479 + 1.027a - 1.498b - 1.191c + 0.701d + 1.374e - 0.440f + 0.123g$$

in which:

P: probability of choosing to use rail

a: The importance of Freight and Surcharge

b: The importance of Schedule Flexibility

c: The importance of Cargo Quality Assurance

d: The importance of Safety and Stability

e: Loading Location

f: The importance of Transit Time

g: The importance of Environmental Care

5. Conclusions

Numerous studies on railway intermodal transportation have been undertaken to investigate shippers' behaviors on modal choice between railway and road based on transit time, quality, distance, flexibility, types of cargo, freight, and environmental benefits when choosing rail-road intermodal over whole truck in transportation. Referring to those studies, the research has managed to examine the behavior of Vietnamese agricultural exporters on choosing rail over road as the main leg.

The results of this study have shown that agricultural products exported from Vietnam to China largely depend on road transport while rail transport accounts for a very small proportion. Moreover, the exporter's choice to use rail transport depends on many factors. In particular, the methodology applied in the research has pointed out that schedule flexibility has the greatest influence on shippers considering using railways, especially for agricultural products because of the seasonality of this item; and then followed by the transportation distance, the quality assurance of goods, the rail freight, and the safety and stability of using rail transport. Surprisingly, simplicity in the procedures handling seems to have no relation to the decision to use rail of agricultural exporters. Transit time might not significantly contribute to the model, but it reflects that the more important transit time will be, the less likely exporters will choose to use rail to export their cargo. In addition, while government of Vietnam has increasingly release policies regarding minimizing the negative impact on the environment in transportation and encouraging manufacturers to choose a less harmful transport modes rather than solely depend on whole truck, and also with studies showing the benefits of changing to intermodal rail-road does less harm to environment, agricultural exporters are still on the side of prioritize to care about other factors. To conclude, while flexibility, distance, goods quality reservation, freight, and stability in decreasing order have most influence on decision-makers in choosing to use railway, transit time and environmental factors did not show

an affirmation about their impact on this modal choice for the case in Vietnam.

There are still limitations in this study due to the outliers in the data set, and the reliability of predict potential of the model is still remained with the confounding variables. The collected samples are limited in term of scale; also the in-depth investigation on the other possible factors which might also impact on the decision such as current technology updates of Vietnam railway and its limited capacity is not yet included. Those factors also leave a room for new research directions for the future studies.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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