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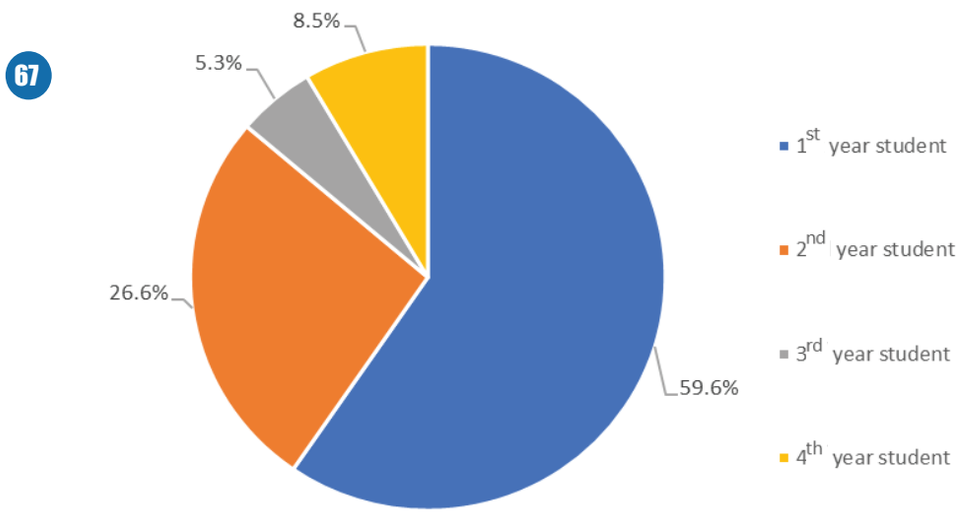

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Impact of cryptocurrencies on financial markets

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Abstract:

Cryptocurrency is no longer an unfamiliar concept. With the development of the digital economy, cryptocurrencies have gradually replaced some functions of traditional currencies. This research aims to measure and evaluate the impact of cryptocurrencies on financial markets by considering their effects on exchange rates, gold prices, oil prices, and stock indices. Data for the analysis were collected on a weekly basis from 1 January 2014 to 28 February 2021. The multiple linear regression model was used to examine the relationships in the research model using the statistical analysis software SPSS 22. The research results indicate that cryptocurrencies have an impact on the financial market. Specifically, the research also identified the inverse effect of currency pairs on cryptocurrencies and the interaction between different cryptocurrencies. Consequently, financial market regulators, especially the agency responsible for monitoring the volatility of cryptocurrencies, exchange rates, gold prices, oil prices, and stock indices, have a basis for devising appropriate plans. From this research, managers can implement policies that enhance financial education and communication to help individuals understand the nature of virtual assets, especially cryptocurrencies, while creating motivation towards accepting cryptocurrencies in Vietnam.

Keywords: **cryptocurrencies, exchange rates, financial markets.**

Classification number: **2.1**

1. Introduction

Cryptocurrency is no longer an unfamiliar concept. With numerous outstanding features, it serves as both a currency in commercial transactions and an investment channel. It facilitates currency agreements between countries, enhancing financial market performance and cross-border remittance services. However, cryptocurrencies alone are insufficient to meet policy goals. Presently, Vietnam has not yet recognised or protected transactions involving this currency [1].

There are various cryptocurrencies worldwide, with Bitcoin and Ethereum being the most popular and widely known. Bitcoin and Ethereum are valuable cryptocurrencies that operate on blockchain technology, promoting a peer-to-peer trust mechanism based on majority node consensus. Another notable cryptocurrency is Libra, which was developed by Facebook with the mission of simplifying the monetary system and financial infrastructure [2]. The Libra Association, based in Geneva, Switzerland, is a non-profit organization overseeing the development of Libra. It ensures the value of Libra through a real asset reserve fund and governs the blockchain's rules. Additionally, other well-known cryptocurrencies include XRP (developed by Ripple) and Litecoin.

As of 3 March 2021, there were 4,476 types of cryptocurrencies with a total market capitalisation of $1,552 billion. The market values of 10 popular cryptocurrencies are presented in Table 1.

Table 1. Market value of 10 popular cryptocurrencies (Updated at 16:00 on 3 March 2021).

No.	Cryptocurrencies	Signal	Current price (USD)	Total market cap (billion USD)
1	Bitcoin	BTC	50,876	949.41
2	Ethereum	ETH	1,591.8	183.10
3	Cardano	ADA	1.25272	40.17
4	Binance coin	BNB	249.63	38.89
5	Tether	USDT	1.001	35.90
6	Polkadot	DOT	38.43	35.20
7	XRP	XRP	0.45113	20.48
8	Litecoin	LTC	193.67	12.95
9	Chainlink	LINK	30.8	12.70
10	Bitcoin cash	BCH	539.27	10.10

Source: https://vn.investing.com/.

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From February 2018 to February 2021, cryptocurrencies such as Bitcoin, Ethereum, and Litecoin experienced significant value changes against the USD (Fig. 1). In February 2018, Bitcoin was priced at only 10,315 BIT/USD, but by February 2021, the value of this cryptocurrency had significantly increased to 45,300 BIT/USD.

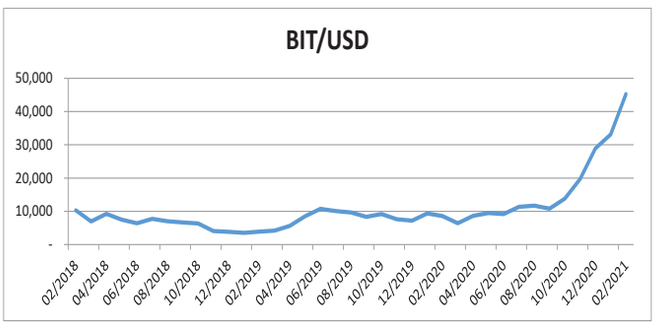

Fig. 1. Price change of Bitcoin between 2/2018-2/2021. Source: https://vn.investing.com/.

Over the course of three years, the value of Ethereum coin also showed a strong increase, rising from 850.85 ETH/USD to 1,418.23 ETH/USD, representing a 66.7% increase compared to the same period in 2018 (Fig. 2).

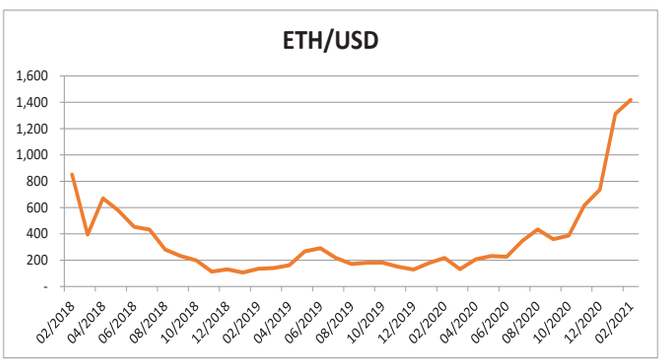

Fig. 2. Price change of Ethereum coin between 2/2018-2/2021. Source: https://vn.investing.com/.

While Bitcoin and Ethereum experienced substantial price increases, the Litecoin cryptocurrency remained relatively stable. In February 2018, the price of Litecoin was recorded as 202,550 LTC/USD, and by February 2021, it had decreased to 165,261 LTC/USD, equivalent to an 18.41% decrease (Fig. 3). At the end of 2018, this currency even hit a low point of only 29,830 LTC/USD.

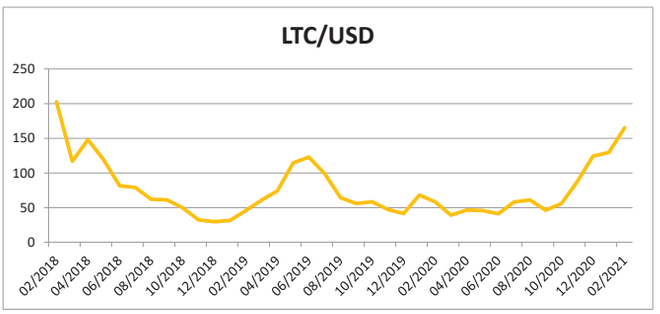

Fig. 3. Price change of Litecoin between 2/2018-2/2021. Source: https://vn.investing.com/.

With the development of the digital economy, cryptocurrencies have gradually replaced some functions of traditional currencies. Blockchain technology-based digital currencies offer high transaction efficiency, low transaction costs, protection against inflation to maintain asset value, and privacy [3].

According to Bloomberg statistics on currency rankings, the USD maintains the top position, although its market share has decreased compared to the previous month. The Euro follows with 37%, while the British Pound remains in third place. The Yen and the Chinese Yuan occupy the fourth and fifth positions, respectively (Table 2).

Table 2. World rankings of the most popular currencies.

Currency rating	Currency	1/2021	12/2020	1/2020
1	USD	38.26%	38.73%	40.81%
2	EUR	36.60%	36.70%	33.58%
3	GBP	6.80%	6.50%	7.05%
4	JPY	3.49%	3.59%	3.32%
5	CNY	2.42%	1.88%	1.65%

Source: Author's analysis on Yuan's popularity for global payments hits five-year high.

Given the uncertain legal status of the digital currency market, the lack of centralised regulatory institutions, the vulnerabilities of anonymous transactions, cross-border circulation, and other characteristics, there is a need to establish a unified global digital currency monitoring system.

Since the beginning of 2013, cryptocurrencies have garnered significant attention in the media and academia due to their highly volatile prices. With the continuous development and increasing popularity of

cryptocurrencies on a global scale, they have had an impact on other commodities in financial markets. This raises concerns about the impact of cryptocurrencies on the value of world currency pairs and financial markets in general. This study aims to measure and evaluate the impact of cryptocurrencies on financial markets by considering their effects on exchange rates, gold prices, oil prices, and stock indices. Additionally, the study will assess the impact of exchange rates on cryptocurrencies and the interactions between different cryptocurrencies.

2. Theoretical basis

2.1. Financial market

The financial market is a large market that encompasses various areas such as money management, insurance, banking, gold, securities, and more [4]. Financial markets provide a platform for buying and selling assets like bonds, stocks, foreign exchange, and derivatives. Businesses and investors can utilise the financial market to raise capital for business development and generate profits through investments.

Based on the influences brought about by financial markets, financial regulators in each country develop strategies suitable for the growth conditions of their respective countries. In financial markets, one of the most discussed issues is the exchange rate, which is usually directly regulated by the central bank. However, there are privately-issued coins in the world, such as the US Liberty Dollar minted between 1878 and 1904, and more recently, the $1,000 bill in 1921. Additionally, the issuance of banknotes of the Hong Kong dollar is managed by Bank of China (Hong Kong) Limited, The Hongkong and Shanghai Banking Corporation Limited (HSBC), and Standard Chartered Bank Limited. In Vietnam, when referring to the financial market, many people immediately think of the stock market, derivatives, capital, insurance, gold, currencies, and commodities.

2.2. Cryptocurrencies

The concept of electronic money, or e-money, is understood in a wide range worldwide. The European Central Bank (ECB) describes a cryptocurrency as the monetary value stored on an electronic device commonly used to make payment transactions to other non-institutional entities. The Bank for International Settlements (BIS) defines electronic money as stored value or prepaid product, in which information about the amount or available value of the customer is stored on an electrical device. In short, cryptocurrency is a digital currency based on cryptographic principles. Cryptocurrencies possess three unique characteristics: they provide anonymity, are independent of a central authority, and provide protection from a double spend attack [5].

Some argue that cryptocurrencies are a special form of information that has economic value unique to their owners. Cryptocurrencies can still serve as a kind of property right, making them assets [6]. In Vietnam, the draft Decree amending Decree No. 10/VBHN-NHNN from 22/02/2019 on non-cash payments recognises and provides a clear definition of electronic money: "Cryptocurrency is the monetary value stored on electronic means paid by customers to banks, foreign bank branches, and payment intermediary providers for making payment transactions. Its corresponding value is guaranteed by the bank. This includes prepaid cards, electronic wallets, and mobile money".

2.2.1. Bitcoin: Bitcoin is a cryptocurrency that operates on blockchain technology. It is primarily traded on online cryptocurrency exchanges. Unlike central banks that can arbitrarily adjust the supply of fiat currencies, the supply of Bitcoin is fixed and cannot be influenced by political decisions [7]. Bitcoin is a form of digital currency not issued by a government or a financial institution, but created and operated on a peer-to-peer computer system [8].

Being a digitally stored virtual currency, Bitcoin carries the risk of being hacked, stolen, having data altered, or experiencing trading suspensions [9]. Bitcoin can prompt financial institutions to update or add existing technologies, adjust fee structures, and enhance services or expertise to track and understand government regulatory issues. Blockchain technology can be leveraged to bring better efficiency to the financial services sector, potentially saving consumers billions of dollars per year [10]. Furthermore, the ability to value Bitcoin and related cryptocurrencies is becoming important for their establishment as legitimate financial assets [11].

2.2.2. Ethereum: Ethereum was introduced by founder Vitalik Buterin in late 2013, and the system was launched in 2015. It is the largest and most established decentralised software platform. As of January 2021, Ethereum has a market capitalisation of $138.3 billion, roughly 19% of the size of Bitcoin [12].

Similar to the Bitcoin blockchain, an Ethereum blockchain is a platform that extends beyond facilitating a single digital currency. The main difference lies in Ethereum blocks, which not only contain block numbers and difficulty levels but also a list of recent transactions and states. Each transaction in the list creates a new state by applying the previous state [13].

2.2.3. Litecoin: After Bitcoin, Ethereum, and XRP, Litecoin is the fourth largest cryptocurrency by market capitalisation. Litecoin works similarly to Bitcoin, but transactions are processed much faster than Bitcoin. This makes Litecoin an attractive alternative coin for currency transactions.

Since more Litecoin can be generated through mining, the price of each Litecoin is cheaper than Bitcoin, making transactions easier. If Bitcoin is often referred to as "gold," then Litecoin is seen as "silver." Litecoin has a lower value than Bitcoin but is easier to access and better suited for regular transactions. The creation and transfer of Litecoin are based on an open-source protocol and are not regulated by any central authority.

2.3. The impact of cryptocurrencies on the financial markets

The significant growth in the quantity and value of cryptocurrencies poses challenges for financial and banking systems, as well as the management of central bank monetary policies aimed at controlling macroeconomic variables such as inflation, interest rates, and exchange rates [14].

Cryptocurrencies can influence the money supply in the market. When the total value of money changes relative to the total value of goods in the market, it affects product prices and consumption. Typically, governments take measures to adjust inflation by reducing output to stabilise prices or increasing prices to restore output. If citizens start using cryptocurrencies instead of the national currency, the demand for the national currency weakens, leading to its devaluation. Increased inflation of the national currency affects even those who do not accept cryptocurrencies [15].

Cryptocurrencies can impact a country's interest rates. A change in the price of a cryptocurrency can affect a country's monetary policy in three main ways: (1) by influencing the central bank's role as the bank for banks, (2) by affecting the central bank's role as the government's bank, and (3) by impacting the central bank's credit control and guidance functions [16].

In the face of threats in traditional cross-border payments, cryptocurrencies are seen as an option in the financial market. Additionally, the popularity and continuous development of gaming services have helped cryptocurrencies become closer to society through service providers, which brings many potential risks.

The regulation of monetary policy for enabling technologies or personal identity influences cryptocurrency adoption and indirectly affects the quality of life [17]. A global currency can also help individuals diversify risk if its returns have a low or negative correlation with other risks [18]. However, cryptocurrencies also carry the risk of promoting illegal activities. The value of virtual currencies is primarily based on the demand for buying and selling the currency itself, posing risks related to high-tech crimes, money laundering, tax evasion, corruption, and financial market risks [19]. Operational risks involve actions that undermine the technological infrastructure and security assumptions of cryptocurrencies [20].

Another challenge arises from the fact that most Fintech providers operate through online platforms, requiring internet access for financial services. This has become the main business model for many providers [21]. The crypto market experiences intense competition as new forms of digital currency emerge, allowing secure transactions over the internet, accessible to anyone with a phone or internet connection, and offering convenience and cost-effective services similar to email. As Bitcoin's value rises against the US dollar, it also gains value relative to other cryptocurrencies [22].

Therefore, it is necessary for digital currency to monitor systems to mitigate the impact of cryptocurrencies on financial markets (Fig. 4).

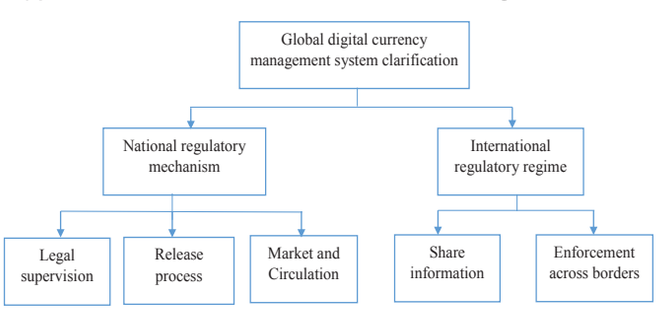

Fig. 4. Digital currency monitoring system [3].

2.4. Previous studies

First, a study by M.L. Erdas, et al. (2018) [23] examined the asymmetric causal relationship between Bitcoin and gold, Brent oil, the US Dollar, the S&P 500 index, and BIST 100 using weekly data from November 2013 to July 2018. The results indicated a relationship between the price of Bitcoin and the S&P 500 Index.

Z. Khamisa (2019) [24] explored the cryptocurrency market in more detail than previous studies, using the latest data and analysing more cryptocurrencies. The author collected data from 4 November 2015 to 31 December 2018, with a sample size of 1154 observations. The dependent variable was the market price of the relevant cryptocurrency in USD. The independent variables were divided into three groups: Market micro structure (Transaction volume, Circulating supply), Financial market (Morgan Stanley Capital International (MSCI) index, Volatility Index (VIX) index, gold price, oil price), and attention (Wikipedia visits). The study utilised the STATA 15.1 statistical analysis tool to conduct statistical analysis, run ordinary least squares (OLS) regression, and apply Cointegration correction model and vector (if cointegration was present). Otherwise, the standard vector autoregressive (VAR) model was used. The research results showed that trading volume was the main driving factor for the market. In theory, cryptocurrencies should perform better the more they are used. However, the results from the model suggested that volume shocks had a negative impact on prices in the long run. Additionally, the study also showed that the MSCI World index and oil price had no relationship with cryptocurrency price performance. However, there were interesting relationships with the price of gold, particularly with Bitcoin, Ethereum, and Monero. Furthermore, the VIX index also showed a relationship in the research model for cryptocurrencies like Bitcoin, Ethereum, and Monero.

Recently, B.Y. Almansour, et al. (2020) [25] examined the impact of exchange rates, including USD/AUD, USD/EUR, USD/GBP, and USD/JPY, on Bitcoin returns from 2014 to 2019 using the ARMA model to estimate maximum likelihood. The results indicated that Bitcoin's returns were not significantly affected by the values of foreign currencies USD/JPY, USD/EUR, USD/GBP, and USD/AUD, with a confidence level of 95%. However, GBP showed significance at a 90% confidence level. The study also suggested the possibility of expanding the investigation of the impact of exchange rates on cryptocurrencies by considering other digital currencies, not just Bitcoin. V.J. Serranía, et al. (2021) [26] discussed the legal issues related to cryptocurrencies in the financial markets and highlighted the potential risks they pose to the financial sector. N. Chiriță, et al. (2022) [27] provided a new perspective on the development of cryptocurrencies and their interaction with other markets, emphasizing their impact on the financial system.

2.5. Research model and hypothesis

Based on the research models of previous studies [23-25] the author constructs a research model to assess the impact of cryptocurrencies on the financial market and examine the interaction between exchange rates and cryptocurrencies. The specific research model is depicted in Fig. 5.

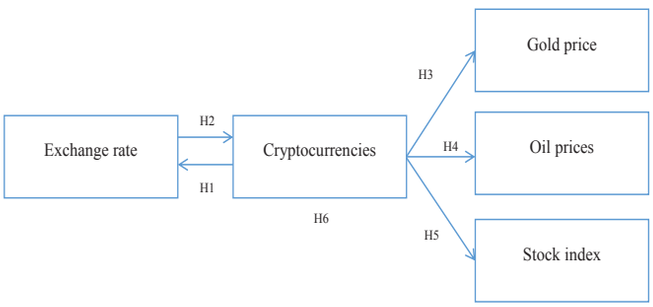

Fig. 5. Research model. Source: Author's research model.

Six research questions were posed in this study:

Research question 1: How do cryptocurrencies affect exchange rates?

Research question 2: Do exchange rates have an impact on cryptocurrencies?

Research question 3: How do cryptocurrencies affect the price of gold

Research question 4: How do cryptocurrencies affect the prices of oil?

Research question 5: How do cryptocurrencies affect stock indices?

Research question 6: Are there any interactions among cryptocurrencies?

Based on the research model, the author sets out 6 research hypotheses as follows:

H1: There is an impact of cryptocurrencies on exchange rates.

H2: There is an exchange rate effect on cryptocurrencies.

H3: There is an impact of cryptocurrencies on the price of gold.

H4: There is an impact of cryptocurrencies on the price of oil.

H5: There is an impact of cryptocurrencies on stock indices.

H6: There is an interplay among cryptocurrencies.

3. Research methods

3.1. Research data

Data for this study was collected from 1 January 2014 to 28 February 2021. Currency pair data in this study is determined on the last day of each week. The research data was sourced from the Investing website (https://www.investing.com/). For detailed information about the research data, please refer to the provided source. The variables in the research model are presented in Table 3.

Table 3. Variables of the model.

	Variable name	Variable details	Signal
1	Cryptocurrencies	Bitcoin	BIT
2		Ethereum	ETH
3		Litecoin	LTC
4	Exchange rate	Australian Dollar	AUD
5		Euro	EUR
6		GBP	GBP
7		Canadian Dollar	CAD
8		Yen	JPY
9		Vietnamese Dong	VND
10	Gold price	Gold price	GOLD
11	Oil price	Oil prices	OIL
12	Stock index	Stock index of the S&P 500	SP500

Source: https://vn.investing.com/.

There are several standard oil prices, such as crude oil and Brent crude. For this study, the Brent Oil Futures index was chosen over Crude Oil WTI Futures, as WTI is the primary global benchmark for pricing and actually has better quality than Brent. Additionally, the chosen currencies include the Australian Dollar, Euro, British Pound, Canadian Dollar, Yen, and Vietnamese Dong. These currencies were selected due to their popularity, with the exception of the Vietnamese Dong, which is the author's native currency.

3.2. Research methods

The author conducted data synthesis using Microsoft Excel software. The relevant variables were included in Pearson correlation analysis to determine the linear relationship between them. Regression analysis was then employed, given the confirmation of a linear relationship through correlation analysis. The Pearson correlation coefficient (r) has a value ranging from -1 to +1. The absolute value of r approaches 1 when the two variables are strongly correlated, while a value of r = 0 indicates no linear relationship between the variables.

Through testing, the author will determine the correlation level between the variables and assess compatibility using ANOVA analysis. If the significance value (Sig.)>0.05, there is no difference in variance, and if Sig.<0.05, there is a significant difference in variance. The multiple linear regression model will be used to examine the relationships in the research model through SPSS 22 statistical software. Moreover, the study will determine the influence of factors through beta coefficients, where a larger beta coefficient indicates a higher degree of influence compared to other factors in the research model.

4. Results and discussion

4.1. Descriptive statistics

The sample used in this study consists of 374 observations collected from 1 January 2014 to 28 February 2021. Descriptive statistics were used to analyse the variables in the study. Table 4 provides a summary of the variables.

Table 4. Summary of variable statistics.

	Sample	Minimum	Maximum	Mean	Std. deviation
BIT	374	209.90	55838.00	5472.9374	7657.41818
ETH	163	83.85	1915.74	376.1767	342.10753
LTC	163	23.610	227.890	80.06805	46.108112
AUD	374	0.5799	0.9424	0.756878	0.0701749
EUR	374	1.0451	1.3914	1.160365	0.0811791
GBP	374	1.1643	1.7160	1.386774	0.1392280
CAD	374	1.0655	1.4540	1.281746	0.0813508
JPY	374	100.22	125.62	110.4347	5.91850
VND	374	21060	23623	22544.34	724.952
GOLD	374	1058.81	2034.62	1351.5279	215.27667
OIL	374	16.94	107.26	56.7114	18.16416
SP500	374	1782.59	3934.83	2523.8835	517.62571

Source: https://vn.investing.com/.

The descriptive reveals the following information about the variables in the research model: Among the cryptocurrency variables, Bitcoin had a minimum value of 209.90 on 18 January 2015, and a maximum value of 55,838.00 on 14 February 2021. Ethereum ranged from a minimum of 83.85 on 9 December 2018, to a maximum of 1,915.74 on 14 February 2021. Litecoin had a minimum value of 23.610 on 9 December 2018, and a maximum value of 227.890 on 11 February 2018.

In terms of the exchange rate variables, the Australian Dollar (AUD) had a minimum value of 0.5799 on 15 March 2020, and a maximum value of 0.9424 on 22 June 2014. The Euro ranged from a minimum of 1.0451 on 11 December 2016, to a maximum of 1.3914 on 9 March 2014. The British Pound (GBP) had a minimum value of 1.1643 on 15 March 2020, and a maximum value of 1.7160 on 29 June 2014. The Canadian Dollar (CAD) ranged from a minimum of 1.0655 on 29 June 2014, to a maximum of 1.4540 on 10 January 2016. The Vietnamese Dong (VND) had a minimum value of 21,060 on 26 January 2014, and a maximum value of 23,623 on 22 March 2020.

For the Gold (GOLD) variable, the minimum market value was 1,058.81 on 22 November 2015, and the highest value was 2,034.62 on 2 August 2020.

The Crude Oil (OIL) variable ranged from a minimum of 16.94 on 19 April 2020, to a maximum of 107.26 on 15 June 2014.

Regarding the S&P500 Index (SP500) variable, the lowest value observed was 1,782.59 on 26 January 2014, and the highest value was 3,934.83 on 7 February 2021.

These descriptive statistics provide an overview of the variable distributions and their ranges throughout the study period.

4.2. Correlation between variables

Table 5 shows the correlation between the dependent and independent variables, the results of the Pearson correlation test indicate that when the correlation between variables has a Sig value <0.05, it signifies a significant correlation. These correlated variables will be used in the regression analysis. Therefore, except for two cases (the correlation between BIT and EUR, and LTC and GOLD), all other variables show a correlation. Hence, these relationships need to be omitted in the multiple regression analysis to ensure higher accuracy.

Table 5. Correlation of variables.

		BIT	ETH	LTC	AUD	EUR	GBP	CAD	JPY	VND	GOLD	OIL	SP500
BIT	Pearson correlation	1											
	Sig. (2-tailed)												
ETH	Pearson correlation	0.850**	1										
	Sig. (2-tailed)	0.000											
LTC	Pearson correlation	0.569**	0.810**	1									
	Sig. (2-tailed)	0.000	0.000										
AUD	Pearson correlation	-0.221**	0.695**	0.674**	1								
	Sig. (2-tailed)	0.000	0.000	0.000									
EUR	Pearson correlation	0.066	0.723**	0.666**	0.825**	1							
	Sig. (2-tailed)	0.202	0.000	0.000	0.000								
GBP	Pearson correlation	-0.316**	0.684**	0.686**	0.770**	0.668**	1						
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000							
CAD	Pearson correlation	0.167**	-0.625**	-0.652**	-0.931**	-0.852**	-0.797**	1					
	Sig. (2-tailed)	0.001	0.000	0.000	0.000	0.000	0.000						
JPY	Pearson correlation	-0.309**	-0.437**	-0.320**	-0.244**	-0.498**	0.112*	0.233**	1				
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.030	0.000					
VND	Pearson correlation	0.485**	-0.585**	-0.690**	-0.828**	-0.551**	-0.879**	0.798**	-0.085	1			
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.101				
GOLD	Pearson correlation	0.680**	0.282**	-0.042	-0.278**	0.071	-0.353**	0.189**	-0.541**	0.451**	1		
	Sig. (2-tailed)	0.000	0.000	0.593	0.000	0.173	0.000	0.000	0.000	0.000			
OIL	Pearson correlation	-0.112*	0.188*	0.400**	0.792**	0.810**	0.617**	-0.843**	-0.330**	-0.560**	-0.239**	1	
	Sig. (2-tailed)	0.031	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
SP500	Pearson correlation	0.821**	0.518**	0.192*	-0.509**	-0.168**	-0.615**	0.410**	-0.294**	0.775**	0.785**	-0.270**	1
	Sig. (2-tailed)	0.000	0.000	0.014	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	

**: correlation is significant at the 0.01 level (2-tailed).

*: correlation is significant at the 0.05 level (2-tailed).

Source: https://vn.investing.com/.

4.3. Research results

To establish an overall model, the F-test in the ANOVA variance analysis table needs to be considered. The results of the F-statistic test, with a Sig value of 0.000 (<0.05), indicate that the multiple linear regression model is appropriate.

4.3.1. Impact of cryptocurrencies on exchange rates: In examining the impact of cryptocurrencies on exchange rates, the following regression results are obtained.

Regression results in Table 6 indicate that the variables AUD, GBP, CAD, JPY, and VND have significance levels (Sig) less than 0.05. Hence, it can be concluded that BIT has an impact on AUD, GBP, CAD, JPY, and VND. Specifically, BIT has a positive impact on CAD and VND, whereas it has a negative impact on AUD, GBP, and JPY. The EUR variable is not considered in the regression results of the independent variable BIT due to the absence of variable correlation. Additionally, there is no issue of multicollinearity as the VIF values for all tests are less than 2.

Table 6. Regression results of the independent variable BIT.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
AUD	-0.000002877	0.000	-0.629	-6.190	0.000
GBP	-0.000003228	0.000	-0.565	-5.430	0.000
CAD	0.0000009923	0.000	0.253	2.121	0.035
JPY	0.000	0.000	-0.793	-5.993	0.000
VND	0.018	0.002	0.876	9.191	0.000

Source: https://vn.investing.com/.

Regression results in Table 7 indicate that the variables AUD, EUR, GBP, CAD, JPY, and VND have significance levels (Sig) less than 0.05. Therefore, with a significance level of 5%, it can be concluded that there is an impact of ETH on variables AUD, EUR, GBP, CAD, JPY, and VND. Specifically, the variable ETH has a positive impact on AUD, EUR, GBP, JPY, and VND; conversely, it has a negative effect on CAD. There is no occurrence of multicollinearity, as the VIFs of all tests are less than 2.

Table 7. Regression results of the independent variable ETH.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
AUD	0.000	0.000	1.146	8.035	0.000
EUR	0.000	0.000	1.012	6.930	0.000
GBP	0.000	0.000	1.012	6.930	0.000
CAD	-0.00005742	0.000	-0.570	-3.406	0.001
JPY	0.003	0.001	0.379	2.041	0.043
VND	-0.576	0.072	-1.066	-7.975	0.000

Source: https://vn.investing.com/.

Regression results in Table 8 show that the significance levels corresponding to the variables EUR, GBP, CAD, and VND have Sig values less than 0.05. Therefore, at a significance level of 5%, it can be concluded that there is an impact of LTC on the variables EUR, GBP, CAD, and VND. Specifically, the variable LTC has a positive impact on EUR and GBP variables, while it has a negative impact on CAD and VND variables. The regression results show that the variables AUD and JPY are not statistically significant in the independent variable LTC. Furthermore, no multicollinearity is observed as the VIFs of all tests are less than 2.

Table 8. Regression results of the independent variable LTC.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
AUD	0.00009111	0.000	0.105	1.145	0.254
EUR	0.000	0.000	0.236	2.586	0.011
GBP	0.000	0.000	0.188	2.012	0.046
CAD	0.000	0.000	-0.334	-3.121	0.002
JPY	-0.010	0.007	-0.175	-1.473	0.143
VND	-1.303	0.343	-0.325	-3.798	0.000

Source: https://vn.investing.com/.

4.3.2. Impact of exchange rates on cryptocurrencies: Next, considering the impact of exchange rates on cryptocurrencies in the research model, we obtain the following results:

Similarly, regression results in Table 9 show that the significance levels corresponding to the variables

GBP, CAD, JPY, and VND have Sig values less than 0.05. Therefore, at a significance level of 5%, it can be concluded that there is an impact of GBP, CAD, JPY, and VND on the variable BIT. Specifically, GBP and VND have a positive impact on BIT, while CAD and JPY have a negative impact. The variable AUD does not show statistical significance. No multicollinearity is observed as the VIF of all tests is less than 2.

Table 9. Regression results of the dependent variable BIT.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
(Constant)	-243048.334	43554.431		-5.580	0.000
AUD	13305.668	13823.047	0.122	0.963	0.336
GBP	20181.948	5183.222	0.367	3.894	0.000
CAD	-27019.303	11367.684	-0.287	-2.377	0.018
JPY	-204.745	65.807	-0.158	-3.111	0.002
VND	11.875	1.084	1.124	10.951	0.000

Source: https://vn.investing.com/.

Regression results in Table 10 show that the significance levels corresponding to the variables AUD, GBP, and JPY have Sig values less than 0.05. Therefore, at a significance level of 5%, it can be concluded that there is an impact of AUD, GBP, and JPY on the variable ETH. Specifically, AUD and GBP have a positive impact on ETH, while JPY has a negative impact. The variables EUR, CAD, and VND do not show statistical significance. No multicollinearity is observed as the VIF of all tests is less than 2.

Table 10. Regression results of the dependent variable ETH.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
(Constant)	-1426.419	4299.952		-0.332	0.741
AUD	4015.310	1452.303	0.472	2.765	0.006
EUR	-665.790	1217.498	-0.085	-0.547	0.585
GBP	2178.152	749.394	0.320	2.907	0.004
CAD	-190.468	991.033	-0.019	-0.192	0.848
JPY	-47.297	8.399	-0.359	-5.631	0.000
VND	0.097	0.151	0.052	0.642	0.522

Source: https://vn.investing.com/.

Regression results in Table 11 show that the significance levels corresponding to the variables GBP, JPY, and VND have Sig values less than 0.05. Therefore, at a significance level of 5%, it can be concluded that there is an impact of GBP, JPY, and VND on the variable LTC. Specifically, GBP has a positive impact on LTC, while JPY and VND have a negative impact. The variables AUD, EUR, and CAD do not show statistical significance. No multicollinearity is observed as the VIF of all tests is less than 2.

Table 11. Regression results of the dependent variable LTC.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
(Constant)	2106.121	608.115		3.463	0.001
AUD	202.497	205.390	0.176	0.986	0.326
EUR	-113.488	172.183	-0.107	-0.659	0.511
GBP	227.391	105.982	0.248	2.146	0.033
CAD	-215.095	140.155	-0.161	-1.535	0.127
JPY	-3.606	1.188	-0.203	-3.036	0.003
VND	-0.072	0.021	-0.287	-3.355	0.001

Source: https://vn.investing.com/.

4.3.3. Impact of cryptocurrencies on gold price: Considering the impact of cryptocurrencies on the price of gold in the research model, the results are as follows:

Regression results in Table 12 show that the significance levels corresponding to the variables BIT and ETH, with Sig values of 0.000, are less than 0.05. Therefore, at a significance level of 5%, it can be concluded that there is an impact of BIT and ETH on the variable GOLD. Specifically, BIT has a positive impact on GOLD, while ETH has a negative impact. The regression results for the dependent variable GOLD do not consider the EUR variable due to the absence of variable correlation. No multicollinearity is observed, as the VIFs of all tests are less than 2.

Table 12. Regression results of the dependent variable GOLD.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
(Constant)	1356.398	23.831		56.916	0.000
BIT	0.029	0.003	1.051	8.934	0.000
ETH	-0.439	0.084	-0.612	-5.202	0.000

Source: https://vn.investing.com/.

4.3.4. Impact of cryptocurrencies on oil prices: Considering the impact of cryptocurrencies on oil prices in the research model, the results are as follows:

Similarly, regression results in Table 13 show that the significance levels corresponding to the BIT and LTC variables, with Sig values of 0.000, are less than 0.05. Therefore, at a significance level of 5%, it can be concluded that there is an impact of BIT and LTC on the variable OIL. Specifically, LTC has a positive impact on OIL, while BIT has a negative impact. No statistical significance was found for the variable ETH. No multicollinearity is observed, as the VIFs of all tests are less than 2.

Table 13. Regression results of the dependent variable OIL.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
(Constant)	47.309	2.001		23.638	0.000
BIT	-0.001	0.000	-0.530	-3.826	0.000
ETH	0.008	0.007	0.205	1.055	0.293
LTC	0.146	0.034	0.535	4.301	0.000

Source: https://vn.investing.com/.

4.3.5. Impact of cryptocurrencies on stock index: Considering the impact of cryptocurrencies on the stock index in the research model, the results are as follows:

Regression results in Table 14 show that the significance levels corresponding to the BIT and LTC variables have Sig values less than 0.05. Therefore, at a significance level of 5%, it can be concluded that there is an impact of BIT and LTC on the variable SP500. Specifically, BIT has a positive impact on SP500, while LTC has a negative impact. No statistical significance was found for the variable ETH. No multicollinearity is observed, as the VIFs of all tests are less than 2.

Table 14. Regression results of the dependent variable SP500.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
(Constant)	2796.724	36.050		77.579	0.000
BIT	0.043	0.004	1.092	12.200	0.000
ETH	-0.187	0.128	-0.182	-1.453	0.148
LTC	-2.141	0.610	-0.282	-3.510	0.001

Source: https://vn.investing.com/.

4.3.6. Interactions between cryptocurrencies: Furthermore, when considering the interaction between cryptocurrencies in the research model, the results are as follows.

Regression results in Tables 15, 16, and 17 show that, with a significance level of 5%, it can be concluded that BIT, ETH, and LTC have an impact on each other. Specifically, BIT has the same impact on ETH and has the opposite effect on LTC. ETH has a positive impact on both BIT and LTC. LTC has the same directional impact on ETH and the opposite impact on BIT. No multicollinearity is observed, as the VIFs of all tests were less than 2.

Table 15. Regression results of the dependent variable BIT.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
(Constant)	4937.900	698.259		7.072	0.000
ETH	29.086	1.682	1.132	17.296	0.000
LTC	-66.310	12.478	-0.348	-5.314	0.000

Source: https://vn.investing.com/.

Table 16. Regression results of the dependent variable ETH.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
(Constant)	-147.210	18.905		-7.787	0.000
BIT	0.022	0.001	0.576	17.296	0.000
LTC	3.580	0.247	0.482	14.497	0.000

Source: https://vn.investing.com/.

Table 17. Regression results of the dependent variable LTC.

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	*Std. error*	*Beta*		
(Constant)	44.322	3.092		14.336	0.000
BIT	-0.002	0.000	-0.431	-5.314	0.000
ETH	0.159	0.011	1.177	14.497	0.000

Source: https://vn.investing.com/.

4.4. Research discussion

Based on the research results, the author concludes that there is an impact of cryptocurrencies on financial markets, including exchange rates, gold prices, oil prices, and the S&P 500 stock index. All the initial

hypotheses can be accepted. Additionally, the study also found a strong interaction between currency pairs (exchange rates) and cryptocurrencies. The summaries of research results are shown in Tables 18, 19, and 20 below.

Table 18. Summary of the results of the impact of cryptocurrencies on financial markets.

	BIT	ETH	LTC
AUD	-	+	X
EUR	X	+	+
GBP	-	+	+
CAD	+	-	-
JPY	-	+	X
VND	+	-	-
GOLD	+	-	X
OIL	-	X	+
S&P500	+	X	-

Source: Author's summary of the above results.

Table 19. Summary of the results of exchange rate impact on cryptocurrencies.

	AUD	EUR	GBP	CAD	JPY	VND
BIT	X	X	+	-	-	+
ETH	+	X	+	X	-	X
LTC	X	X	+	X	-	-

Source: Author's summary of the above results.

Table 20. Summary of the results of the interplay between cryptocurrencies.

	BIT	ETH	LTC
BIT	X	+	-
ETH	+	X	+
LTC	-	+	X

Source: Author's summary of the above results.
Note: +: indicates a positive impact between the two variables; -: indicates an opposite effect between the two variables; X: indicates no effect between the two variables.

The study shows partial consensus with previous studies [23-25]. However, the research results also differ from two studies [24, 25]. Z. Khamisa's study (2019) [24], which attests that there is no relationship between oil prices and cryptocurrency price performance, differs from this study which shows that cryptocurrencies have an impact on oil prices, particularly with Bitcoin having a negative impact and Litecoin having a positive impact. Ethereum aligns with Khamisa's findings. The difference may stem from the data collection time in Z. Khamisa's study, which spanned from 4 November 2015 to 31 December 2018. Additionally, the research methods employed also affect the results. While previous study used the OLS regression model in conjunction with Cointegration and Vector Error Correction Models (VECMs), this study used multiple regression models for implementation [24]. Regarding the study of B.Y. Almansour, et al. (2020) [25], which found that Bitcoin's returns are not significantly affected by foreign currency values except for GBP at a 90% confidence level, this study shows that Bitcoin has an impact on most exchange rate variables (except for the Euro, which was not statistically significant). The difference may be due to the variation in data collection periods, with a study spanning from 2014 to 2019 and this study covering the period from 1 January 2014 to 28 February 2021 [25]. Therefore, the results of this research model remain consistent.

5. Conclusions

The research results demonstrate that cryptocurrencies have an impact on financial markets. The study also reveals the opposite effect of exchange rates on cryptocurrencies, depending on the currency pair. Moreover, there is an interplay between cryptocurrencies Bitcoin, Ethereum, and Litecoin. Financial market regulators, particularly agencies responsible for monitoring cryptocurrency volatility, exchange rates, gold prices, oil prices, and stock indices, now have a basis for developing appropriate plans.

Although cryptocurrencies are not yet recognised as legal transactions and investments in Vietnam, global trends suggest that Vietnam will have access to cryptocurrencies in the future. With measures to encourage non-cash payments, the State Bank has given some opinions on the matter by submitting Decree No. 80/2016/ND-CP on amending and

supplementing a number of articles, Decree No. 101/2012/ND-CP on non-cash payments, and Decree No. 96/2014/ND-CP on administrative sanctions to the Government for promulgation. With the Bank's efforts to amend relevant decrees and regulations, there is increasing momentum towards cryptocurrency adoption. However, strict control and tailored monetary policies in the financial market should be considered based on more specific and in-depth studies.

The relationship between commodity prices such as gold, oil, and stock indices and exchange rate indices can influence the decisions of crypto investors in financial markets. Therefore, there should be measures to enhance financial education and communication to help individuals understand the nature of virtual assets, especially cryptocurrencies. This will enable investors to make informed decisions and avoid falling victim to scams.

This study assessed the impact of cryptocurrencies on financial markets through 374 weeks of data collected between 1 January 2014 and 28 February 2021. Given the rapidly changing nature of the cryptocurrency market, there may have been subsequent developments that could affect the results. Increasing the sample size in future studies would also lead to more accurate findings. Additionally, the impact assessment only focused on four variables: exchange rates, gold prices, oil prices, and the S&P 500 index. There are numerous other factors that cryptocurrencies may affect in the financial market, such as capital flows, the size of the stock market, bank credit, economic growth, inflation, and prices of other commodities like silver, copper, and agricultural products. Future studies could explore these factors to further develop research models. Furthermore, this study only considered three cryptocurrencies: Bitcoin, Ethereum, and Litecoin. Many other cryptocurrencies were not included, such as Cardano, Binance Coin, Tether, Polkadot, XRP, Chainlink, and Bitcoin Cash, and they may have different effects. Therefore, further research is needed to assess the impact of cryptocurrencies comprehensively.

In conclusion, the study indicates that cryptocurrencies have an impact on financial markets. The study also reveals the interplay between cryptocurrencies and exchange rates. This provides a basis for financial market regulators to develop appropriate strategies. Despite the limitations, this study contributes to the research community and serves as a baseline for future studies in this area.

COMPETING INTERESTS

The author declares that there is no conflict of interest regarding the publication of this article.

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Economic valuation from direct use of melaleuca forest at U Minh Ha National Park, Vietnam

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Abstract:

This paper investigates the direct use values of melaleuca forests at U Minh Ha National Park. The market price method (MPM) was utilised to estimate the economic value. A semi-structured questionnaire comprising multiple-choice and open-ended questions was administered to 360 families in 2022 to collect data on the various forest products available locally, the quantity of these products collected, as well as their corresponding prices and costs. The results revealed that the total net benefits that the local people derived from the entire melaleuca ecosystem were US$ 73,022,184 per year, or an average worth of US$ 1,723 per person per year. Most of the local annual income was derived from construction pole harvesting (US$ 57,092,223), followed by wood for fishing boats (US$ 5,792,757) and fish (US$ 6,226,995). The melaleuca ecosystem was significant, contributing an average of 75% to the total annual per capita income for the local people. However, the U Minh Ha melaleuca ecosystems are threatened and predicted to disappear in 118 years if the current extraction rate of wood products (2,204 kg/person/year) remains uncontrolled. This suggests an urgent need for an integrated management plan that incorporates melaleuca preservation, as well as the commercial and local use interests in this area.

Keywords: **forest economic valuation, forest livelihood, melaleuca forests, peatland.**

Classification number: **2.1**

1. Introduction

U Minh Ha National Park is one of the three core zones of the Ca Mau Biosphere Reserve, which was recognised by UNESCO as a global biosphere reserve. The melaleuca forest in this area once covered 90,000 hectares of land [1]. Due to forest fires, population resettlement programmes, and the creation of new economic development zones by the government, this forest has gradually shrunk to a mere 50,000 hectares. Today, the national park encompasses only 7,639 hectares in total, with the remaining land being utilised for production forests [1]. However, a variety of plants, animals, and other organisms still survive in the tropical and subtropical environment along the saline coasts in the melaleuca forest in this area. This rich and diverse melaleuca ecosystem provides both direct and indirect values to the ecosystem. Indirect values include environmental functions such as coastline protection, maintaining water cycles, climate regulation, wave mitigation, absorption and breakdown of pollutants, and ecological functions like breeding grounds for aquatic species, biological diversity, and recreational values of natural resources. The direct values encompass nature's products that are consumed directly, or passed through a market, such as fish, shrimp, timber, honey, and construction materials.

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Due to its vital economic role, the melaleuca forest of U Minh Ha is currently under enormous pressure from the growing human demands placed upon it. Population expansion and prosperity translate into increased conversion of natural ecosystems for agricultural, industrial, or residential uses. Additionally, there is a high demand for ecosystem services such as freshwater, fibre, and soil fertility, along with increased pressure on the capacity of natural ecosystems to assimilate waste, and mitigate air and water pollution.

To protect the forest, the U Minh Ha National Park management board has approved the management planning for melaleuca protected areas until 2025, in which the ecosystems and aquatic species are protected in coherence with the livelihood improvement of local communities living in this peatland [1]. However, the conflict between developing the economy and protecting the environment at U Minh Ha is still on the rise. Conserving melaleuca ecosystems and the goods and services they provide involves foregoing certain uses of these ecosystems and the benefits that would have been derived. For instance, the failure to convert melaleuca ecosystems for other uses, such as aquaculture, preserves certain valuable services that the ecosystem may provide more effectively than fish farming, but it also prevents the local people from enjoying the benefits that fish production can offer [2]. To assess the consequences of different courses of action, it is essential to understand how valuable the melaleuca ecosystem is, and how that value is affected by various forms of management. Accordingly, understanding the ecosystem's values is crucial for responding to human demands appropriately.

This paper measures the economic evaluation of U Minh Ha ecosystems. Economic valuation offers a means to compare the diverse benefits and costs associated with natural ecosystems by quantifying and expressing them in monetary units. The results would assist forest users and policymakers in mutually promoting local livelihood and melaleuca protection, so as to optimise the management strategies for the U Minh Ha region.

2. Calculation method

A forest's ecosystem goods and services can be categorised according to how they are used, such as direct use value, indirect use value, option value, and non-use value [3]. However, this study concerns mostly the direct economic values of the forest, whose prices can be observed in the marketplace, and provides direct cash income for the local people. The direct use products and services are monetised to help demonstrate why their survival is important to the local income [4].

Using the following formula explained by A. Malik, et al. (2015) [4], direct use value was estimated by calculating the net income generated by local communities in terms of products extracted directly from the ecosystem, *Direct use value = Gross revenue - Total cost* = $\sum P_i Q_i - C_i$, where P_i: prices of product i; Q_i: amount of product i being collected; C_i: total costs involved in the collection of product i.

In the aforementioned formula, the gross revenue was estimated by calculating the total quantity of all products collected on a monthly basis and then multiplied by the market prices of each. Market prices for all products will be used in the valuation of the ecosystem as there is no data on proportions of products sold in markets to subsistence food. It is assumed that market prices are fixed and not distorted in the short run. Selling some products to tourists, which normally fetches higher prices, was not considered. In the case of unpriced commodities, such as those local people obtained through illegal means, a comparable market value is utilised for valuation purposes.

Total costs include the cost of time spent reaching the forest, harvesting products, and the cost of tools such as axes or knives. Transport costs to commercial centres are not taken into account, as the majority of respondents indicated they sold their products through intermediaries who come and collect them directly from local areas.

Subsequently, the calculation of the annual per capita net benefits is based on the direct use value allocated to each individual. The estimation of total annual net benefits, in turn, involves the multiplication of annual per capita net benefits by the proportion of the population that relies on the forest for subsistence.

3. Data collection

3.1. Study site

U Minh Ha National Park is located in two districts, Tran Van Thoi and U Minh. This park has a total forest area of 7,639 hectares, of which 3,600 hectares are strictly protected and the remaining area is a restoration zone [1]. Additionally, the buffer zone surrounding U Minh Ha National Park encompasses an area of 25,000 hectares of the U Minh forest-fishery, which is renowned for its diverse array of fauna and flora. Notable species include melaleuca, eleocharis, reed, monkey, squirrel, lizard, python, snake, turtle, amphibian, and birds, among others [5]. The acreage of forested land accounted for about 90% of the total area of U Minh Ha National Park (Table 1). However, the area of natural forest has remained in only two communes, Tran Khoi and Khanh An, with an amount of 1,100.6 ha and 753.6 ha, respectively.

Table 1. Description of U Minh Ha National Park.

Categories	Total area	Tran Van Thoi district		U Minh district	
		Tran Hoi commune	*Khanh Binh Tay Bac commune*	*Khanh An commune*	*Khanh Lam commune*
Forested area (ha)	7,639.3	2,694.0	1,037.7	3,340.1	567.5
Natural Forest (ha)	1,854.2	1,100.6	0	753.6	0
Plantation forest (ha)	5,785.1	1,593.4	1,037.7	2,586.5	567.5
Population (person)	60,669	15,069	15,198	16,712	13,690

Source: U Minh Ha National Park, 2018 [1].

The total population of these districts is 60,669 people, with a population density of about 136 people/km^2 [5]. Throughout history, forest resources have served as the primary means of livelihood for a significant proportion of the local population. A preliminary survey conducted recently indicates that approximately 65% of the community relies on the ecosystem for their subsistence.

3.2. Interview design

The sample for this study was chosen based on the characteristics of the households, including their distance from the forests (<10 km) and their reliance on the ecosystem for survival. The strategy was to represent the population of U Minh Ha in terms of the factors thought to have a strong influence on the household economic value. Such factors include the household's income and its perception of odours from the ecosystem. According to our survey, the average household income in the region is 191 $/month (calculated at the exchange rate of US$/VND 23.184) with a standard deviation of US$176. Using a 95% confidence interval and a 10% sampling error, our analysts figured that a sample of 323 homes would be required. The necessary sample size was calculated based on the amount of tolerable error in the sample estimate of mean income, using a standard statistical formula that acknowledges only type I error [6].

$$N = \frac{\partial}{e} Z_{\alpha/2} = \left(\frac{176}{19.1} \times 1.96\right)^2 = 322$$

where *N*: desired sample size; *z*: the 95% confidence interval statistic (1.96) at significance level α = 5%, two-sided test; ∂: standard deviation of income (US$ 176); *e*: acceptable error (US$ 19.1) in the sample estimate of the population (i.e., a 10% error).

To improve the power of the estimation, this research surveys 360 households (1,219 people) instead (Table 2). The survey was undertaken in all 4 communes in the U Minh Ha area (Khanh Binh Tay Bac commune, Tran Hoi commune, Khanh An commune, and Khanh Lam commune) from April 2022 to July 2022. In each commune, 90 households were chosen from various locations of the ecosystem and at various distances to the forests, to provide a representative sample for utilisation of the entire ecosystem. A semi-structured questionnaire with multiple-choice and some open-ended questions was used, in which questions aimed at providing information regarding various uses of the ecosystem,

Table 2. Description of sampled villages surrounding the melaleuca ecosystems at U Minh Ha based on a survey in 2022.

Name of commune	Distance to forest (km)	Average travel time to reach forest by motorbike (min)	Population of 360 sampled households (person)	Total population in 2015 (person)	% population relying on forest for subsistence
Tran Hoi	6	33	395	15,069	67
Khanh Binh Tay Bac	3	20	188	15,198	48
Khanh An	3	17	201	16,712	75
Khanh Lam	8	42	435	13,690	91
Total			1,219	60,669	70.3

Source: Author's calculations.

Table 3. Weight estimation procedure for products collected from U Minh Ha melaleuca ecosystems based on a survey in 2022.

Parameter	Unit	Estimated weight (kg)	Method of estimation
Firewood	Bundle	5	A scale was used to weigh 3 bundles, and an average weight taken
Construction poles	Pole	10	A scale was used to weigh 3 poles, and an average weight taken
Fishing boats	Bundle	30	A scale was used to weigh 3 bundles, and an average weight taken
Charcoal	Bag	90	One bag of charcoal was weighed using a scale. Assuming all charcoal is packed in the same size bag
Honey	Litter	1.44	Means of metric conversion. Assuming a honey density of 1.44 g/ml [7]
Fish	Kg	Kg	Quoted by respondents
Crabs	Kg	Kg	Quoted by respondents
Prawns	Kg	Kg	Quoted by respondents

Source: Author's calculation.

size of each household, amount of products collected, frequency of harvesting, and lifespan of tools used in harvesting, etc. The main output of the survey is summarised in Table 2.

3.3. Data of the products

After collecting data from the interviews for the quantification of various local uses, the number of products collected was converted to one unit (kilograms) for statistical purposes. Table 3 illustrates the procedures undertaken.

Assuming an average of 30 days in a month, the total amount of products collected on a monthly basis for each household was calculated by multiplying the amount of product collected per visit to the forest by the frequency of harvest in a month, and then divided by the number of persons within a household to determine the monthly per capita quantity of forest resources used. Subsequently, the annual per capita extraction rate and the annual extraction rate per commune were calculated by extrapolation.

3.4. Data on the price

For all products, the market price, investigated directly from the market, was used to determine gross income generated, assuming the prices are fixed and not distorted in the short run (Table 4).

Table 4. Extraction costs incurred by harvesting melaleuca products at U Minh Ha based on our survey in 2022.

Product	Market price (US$)	Extraction costs (or cost of tools used in extraction)			
		Harvesting tools	*Average price of harvesting tools (US$)*	*Average life span of harvesting tools (days)*	*Average time spent harvesting (hours)*
Firewood (US$/ton)	3.783	Working knife	19.410	1,800	2
		Axe	28.037	2,520	
		Rope (US$/5 m)	1.294	180	
Construction poles (US$/ton)	2156.660	Working knife	19.410	1,800	2
		Axe	28.037	2,520	
		Saw	176.846	720	
		Chisel	8.195	1,440	
		Hammer	24.155	1,800	
Wood for fishing boats (US$/ton)	1940.993	Working knife	19.410	1,800	2
		Small knife	6.039	720	
Charcoal (US$/ton)	388.198	Working knife	19.410	1,800	3
		Axe	28.037	2,520	
		Lighter	0.216	1	
		Spade	6.901	1,080	
		kiln	647	1,825	
Honey (US$/kg)	35.944	Helmet	3.882	1,800	4
		Smoker	6.039	180	
		Bucket	2.157	1,080	
		Gloves	3.451	720	
Fish (US$/kg)	2.588	Net	21.567	1,080	3
		Canoe (hiring fee US$/day)	25.880	1	
		Floater (hiring fee US$/day)	0.004	1	
Crabs (US$/kg)	15.528	Traps	3.451	150	2
		Bait ($/500 g)	0.431	1	
		Basket	1.725	180	
		Hand net	21.567	180	
Prawns (US$/kg)	5.047	Canoe (hiring fee US$/day)	25.880	1	3
		Basket	1.725	180	
		Hand net	21.567	180	
		Floater (hiring fee US$/day)	0.004	1	

Source: Author's calculation. Note: charcoal production cycle (e.g., wood collection, loading of the kiln, burning and cooling) takes 5 to 10 days according to charcoal producers assessed during the household survey. Assuming that wood is collected during the burning/cooling period, a production cycle of 3 hours was used in the analysis, which is only when the charcoal producer visits the kiln during the burning and cooling phase.

3.5. Data on the cost

The total cost includes the following: (i) The cost of time spent reaching the forest, calculated by multiplying the average time used for reaching the forest (in hours) by the hourly minimum wage rate, and then by the number of trips made per month, where the minimum hourly wage rates are 0.92 US$/hour. The average time used for reaching the forest and the number of trips per month is derived from the interview (Table 5); (ii) The cost of time for harvesting products is derived similarly to the cost of time spent reaching the forest; (iii) The cost of harvesting tools used in extraction was expressed on a daily basis, where the price was divided by the lifespan (in days) of the item (Table 4).

3.6. Data for evaluation of impacts of local direct uses on the ecosystems

Survey questions were also aimed at revealing information on the current threats to the melaleuca ecosystem, and the views of the respondents on the causes of the threats.

4. Results

4.1. Volume of local direct uses

The result reveals that the villagers rely heavily on the ecosystem for their livelihoods. The firewood and construction poles were most utilised with average annual per capita extraction rates of 1,082 and 625 kg respectively (Table 6). Wood for making fishing boats and charcoal were also major uses despite having a lower extraction rate. This reflects a notably high demand for wood from this region. Within this forested region, our further investigation reveals that there are two distinct categories of loggers. The first group comprises individuals from external regions who venture into the area with the intention of procuring valuable logs for commercial purposes. Locals usually report that illegal logging activities are carried out by organised groups, often with the

Table 5. Cost of time spent reaching the forest, hourly minimum wage rate, average time to reach the forest, and number of trips made per month, based on a survey in 2022.

Name of communes	Distance to forest (km)	Average time to reach forest (min)	Hourly minimum wage rate (US$/hour)	Number of trips per month
Tran Hoi	6	33	0.92	3
Khanh Binh Tay Bac	3	20	0.92	2
Khanh An	3	17	0.92	4
Khanh Lam	8	42	0.92	2

Source: Author's calculation.

Table 6. Summary of annual per capita extraction rates for various melaleuca products collected at U Minh Ha in 2022, calculations are based on a sample population of 1,219 persons.

Name of communes	Wood products (kg)				Fishes (kg)			Honey (kg)
	Firewood	*Charcoal*	*Fishing boat*	*Construction poles*	*Fish*	*Crabs*	*Prawns*	
Tran Hoi	356	121	53	15	45	8	2	0.6
Khanh Binh Tay Bac	64	76	55	22	70	6	2	0.5
Khanh An	237	103	91	8	79	8	3	0.7
Khanh Lam	971	59	19	18	167	4	6	0.6
Average annual/capita extraction (kg)	317	91	44	41	82	6	4	1

Source: Author's calculation.

cooperation of some corrupt government officials. The second group consists of local inhabitants who require timber for building fishing boats or as a source of fuel. In the past, deforestation was primarily carried out through the use of axes and machetes, resulting in a relatively low annual loss of forest cover. However, the utilisation of chainsaws today has enabled unlawful loggers to deforest a significant expanse of land within days.

Other forest products such as fish, crab, and prawn play a minor role in terms of quantity of local direct use. Fish extraction records an annual per capita extraction rate of 49 kg per person per year, while prawn and crab contribute only 8 and 2 kg. In recent years, the wetland areas have experienced a notable decline in fish population, primarily attributed to the contamination of agricultural fertilisers and pesticides, as well as the employment of destructive fishing techniques such as the use of small fishing nets and electric shock fishing. Furthermore, the phenomenon of climate change has been observed to result in severe drought conditions downstream, thereby creating an unfavourable environment for the proliferation of fish populations, ultimately leading to a decline in catch.

Another frequent food source harvested from forests is honey, which has been used for many generations in U Minh Ha. Honey has an average annual per capita extraction of about 1.9 kg. Because U Minh Ha National Park is located in Ca Mau Biosphere Reserve, thousands of households in this region have been trained to harvest honey sustainably. However, this activity has been blamed for many bushfire incidents in the region, and many large bushfires have caused multiple direct impacts on the well-being of affected communities and on the survival of species.

Among four communities, Khanh An exhibited the highest annual per capita extraction rate for wood products (3,331 kg). These wood products encompassed firewood, charcoal, fishing boats, and construction poles, with firewood accounting for the largest proportion at 1,671 kg. Khanh An has a high annual per capita extraction rate for firewood because of its high population consumption (16,712 persons) and its favourable proximity to the nearest local market. However, charcoal production was extracted in Khanh An at much lower rates due to its capital-intensive establishment and long production process which pose challenges for market entry. Tran Hoi records the second highest annual per capita extraction of firewood. This could be attributed to its large population living near the forest. Surprisingly, a low annual per capita extraction rate of fish at Tran Hoi is observed (35 kg/person/year), and this is attributed to the unproductive traditional ways of fishing effort. Khanh Binh Tay Bac and Khanh Lam have a similar pattern of extraction rates, with firewood having the largest harvested rate, followed by construction poles, charcoal, and fish. Fishing boats, crabs, and prawns contribute the least to the extraction proportion in Khanh Binh Tay Bac and Khanh Lam.

4.2. Local direct use value

Using the direct market price method, our research found that the total annual net benefit derived from the melaleuca ecosystems by the four communities was US$ 73,022,184 (Table 7). Most of the annual income came from construction poles, contributing US$ 57,092,223 per year (Table 8). Fishing boats provided only one-tenth of that of construction poles (US$ 5,792,757 annually), while firewood contributed the least (US$ 125,000 annually). It is worth noting that fish, crabs, and prawns give lower income, but they are expanding rapidly in this region because they fetch higher prices in the market compared to other products. Their expansion causes high pressure on forest land reservation and the ecosystem.

On average, the local people earn US$ 1,723 per person per year from the melaleuca ecosystem, in which construction poles contribute the highest annual income of US$ 1,347 per person; and fishing

boats and fish contribute US$ 137 and US$ 100 per person per year respectively (Table 7).

Among four communities, Khanh An gains the highest income, in which construction poles contributed the highest proportion (2,058 US$/person/year). Khanh Lam, Khanh Binh Tay Bac, and Tran Hoi have a similar pattern of the source of income. Firewood has nearly a two-fold higher extraction rate than that of construction poles, but its net benefits remain quite low. It is noted that various capacity-building programmes have been carried out by the government to assist local people at U Minh Ha to harvest forest products sustainably, yet their livelihood depends heavily on the forest, forcing them to over-harvest the forest for instant money.

Our calculation reveals that a person who depends entirely on the ecosystem for livelihood would earn US$ 1,723 per year. Considering an average per capita monthly income of US$ 191 earned by most local people, an individual would earn US$ 2,292 per year. Income accrued from the melaleuca ecosystem is therefore important to the community as it contributes an average of 75% of the total annual per capita income.

A sensitivity analysis was undertaken to test whether net income from the ecosystem varied when time changed. The result showed that the melaleuca ecosystem values decreased heavily when time increased. According to the General Statistics Office of Vietnam (1999) [8], the population of four communes in the U Minh Ha area (Khanh Binh Tay Bac, Tran Hoi, Khanh An, and Khanh Lam) is approximately 60,669, of which about 29.7% live in neighbouring towns [9], leaving an estimated 42,650 persons who depend on the melaleuca ecosystem for their livelihood. This study revealed that the average

Table 7. Summary of annual per capita net benefits derived from various melaleuca products collected at U Minh Ha melaleuca ecosystem, results are based on a sample population of 1,219 persons from a survey in 2022.

Name of communes	Wood products (US$)				Fishes (US$)			Honey (US$)	Total annual capita net benefit (US$)	Total annual net benefit (US$)
	Firewood	*Charcoal*	*Fishing boat*	*Construction poles*	*Fish*	*Crabs*	*Prawns*			
Tran Hoi	4	21	130	1,281	63	29	13	70	1,613	16,282,603
Khanh Binh Tay Bac	1	8	81	821	85	30	9	35	1,070	7,802,268
Khanh An	5	35	174	2,058	157	60	28	125	2,643	33,127,491
Khanh Lam	1	27	162	1,228	97	14	3	35	1,566	19,513,295
Average annual/capita net benefit	3	23	137	1,347	100	33	13	66	1,723	73,022,184

Source: Author's calculation.

Table 8. Summary of total net values of melaleuca products at U Minh Ha melaleuca ecosystem, results are based on a sample population of 1,219 persons from a survey in 2022.

Name of commune	Wood (US$)				Fish/shellfish (US$)			Honey (US$)
	Firewood	*Charcoal*	*Fishing boat*	*Construction poles*	*Fish*	*Crabs*	*Prawns*	
Tran Hoi	45,119	213,359	1,317,057	12,937,389	637,653	292,331	129,646	710,049
Khanh Binh Tay Bac	6,713	60,701	590,090	5,987,677	618,372	217,824	63,460	257,431
Khanh An	65,812	443,564	2,176,248	25,798,491	1,965,338	758,128	356,669	1,563,240
Khanh Lam	14,419	341,898	2,014,895	15,294,831	1,208,808	170,132	37,098	431,216
Total net value	125,000	977,848	5,792,757	57,092,223	4,256,919	1,408,773	561,303	2,807,360

Source: Author's calculation.

per capita per annum extraction of wood in the area is about 2,204 kg. As a result, the annual use of wood in the simulation for U Minh Ha becomes 94,001,277 kg. The typical forest density of mature melaleuca is about 6,100 trees/ha [10], while an average melaleuca tree weighs 97 kg according to S.V. Briggs (1977) [11]. For 7,639.3 ha of melaleuca forests, U Minh Ha is currently estimated to harbour 4,520,173,810 kg of wood. Assuming an average production rate for melaleuca vegetation of 3.2 megagram/ha/year [12], and if the extraction rate of wood products remains the same (2,204 kg/person/year) without immediate control measures, all of U Minh Ha melaleuca forest will be depleted in about 118 years.

These community members are aware of the values and threats to the ecosystem [13]. Many have confirmed a reduction in fish catches over the years. This result is consistent with the finding by I.C. Campbell (2012) [14], who discovered that fish species and biodiversity in this region have decreased rapidly over the last few decades. The problem of over-extraction of forest resources may persist, given that the increasing population is exerting more pressure on forest wood products in terms of firewood consumption, which forms the main energy source for household use in nearly all rural homes [15]. The lack of employment opportunities for the youth also contributes to the problem, as most villagers, the majority of whom are young people, have been harvesting products for immediate financial gain for many years.

Ironically, many local people are concerned about losing income generated from the ecosystem once the forest is depleted, yet under the current management of the ecosystem, wood products such as firewood, charcoal, construction poles, and fishing boats are poached by local residents for sale [15]. Given the difficulties in limiting access to the melaleuca ecosystem, it is unlikely that poaching wood products can be prevented [16]. Furthermore, in many instances, illegal logging activities are often carried out by highly organised groups, often facilitated by state officials, who also employ local individuals to undertake risky tasks. In remote areas, forest guards lack the necessary resources, including human, equipment, and financial, to effectively confront these illegal loggers. The illegal exploitation, coupled with land clearance for short-term profitable crops [15], has resulted in the modification of natural capital and the inefficient utilisation of natural resources. Considering the significant value of the ecosystem to the community, it is essential that an integrated management plan be developed to facilitate the coexistence of melaleuca forest conservation and the local livelihoods in the region, thereby ensuring mutual benefit.

5. Conclusions

This research provides insight into the economic evaluation of U Minh Ha ecosystems in order to assist forest users and policymakers in exploiting forests optimally and sustainably. The results reveal that firewood was the least valuable, contributing US$ 178,929 annually but having the highest extraction rate of 1,082 kg/person/year. Most of the annual income came from the harvesting of construction poles, contributing US$ 57,092,223 per year. Fishing boats provided US$ 5,792,757 annually, while fish and honey earned annual incomes of US$ 6,226,995 and US$ 2,807,360, respectively. The total net benefits derived from the entire melaleuca ecosystem were estimated at US$ 73,022,184 per annum or an average value of US$ 1,723 per person per year. The income obtained from the melaleuca ecosystem contributes 75% to the total annual per capita income. With a population of whom 70.3% depend on the ecosystem for their livelihood, all of U Minh Ha melaleuca forests will be lost in about 118 years if the forest extraction rate is not controlled. This high depletion rate suggests an urgent need for an integrated management plan to mitigate the conflict between preservation and local uses in this ecosystem.

COMPETING INTERESTS

The author declares that there is no conflict of interest regarding the publication of this article.

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Travelling, retail activities, trade openness and COVID-19 incidence in Vietnam

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Abstract:

Coronavirus disease 2019 (COVID-19) was first detected in Wuhan, China at the end of 2019; and then quickly spread to become a global pandemic. Vietnam, a country located in Southeast Asia, is also affected by the pandemic. The first case of COVID-19 infection was recorded in the country on 23 January 2020; and by the end of this year, the country reported a total of 1465 confirmed cases of COVID-19. Nevertheless, the disease infection incidence is different among provinces in Vietnam. In this research, we explore the effects of travel, retail activities, and trade openness on the disparities in the spread incidence of COVID-19 among Vietnam's 63 provinces in 2020, utilising cross-sectional provincial-level data. Empirical findings in this research indicate that travel activities and trade openness are likely to exert positive and significant impacts on COVID-19 incidence. In contrast, retail activities appear not to significantly affect the variance in COVID-19 incidence among the Vietnamese provinces in 2020.

Keywords: **COVID-19 incidence, retail activities, trade openness, travelling activities, Vietnam.**

Classification number: **2.1**

1. Introduction

Coronavirus disease 2019 (COVID-19) was first identified in Wuhan, China, towards the end of 2019, swiftly escalating to a global pandemic. Numerous studies have found associations between socioeconomic factors and the spread of COVID-19 [1-6]. However, these studies often utilise cross-national data or focus on data from the United States, China, Europe, or South America.

Vietnam, a Southeast Asian country, has been impacted by the COVID-19 pandemic, albeit to a lesser extent. The first case of COVID-19 was recorded in Vietnam on 23 January 2020, with a total of 1,465 confirmed cases reported by the year's end. Yet, the incidence of COVID-19 varied among the provinces. This paper aims to examine whether travel, retail activities, and trade openness influence the variation in COVID-19 incidence across the provinces, drawing on aggregate data from all 63 provinces for 2020.

Travel and retail activities, which relate to local and tourist mobility and contact, may impact the spread of the virus, as evidenced in research conducted in Chile and China [4, 7]. Additionally, trade openness could facilitate the spread of COVID-19 through import and export-related activities and international transportation, as suggested by cross-country studies [8, 9]. Consequently, these factors could potentially influence the variance in COVID-19 spread among Vietnamese provinces. To the best of our knowledge, there is scant empirical research on this topic concerning Vietnam, thus our investigation seeks to contribute to the existing literature.

The remainder of the paper is structured as follows: Section two describes the data and methodology, section three presents the results, and section four offers the conclusion.

2. Data and method

Employing Vietnamese provincial aggregate data for 2020, this paper investigates the relationship between economic activities, trade openness, and COVID-19 incidence using the following cross-sectional model:

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$$Y_i = \alpha + \beta_1 Travelling_i + \beta_2 Retail_i + \beta_3 Openness_i + \beta_4 Control_i + \varepsilon_i$$

where *i* signifies provinces in Vietnam. The dependent variable, *Y*, represents COVID-19 incidence. Travelling and retail symbolise travel and retail activities in the provinces, respectively. Openness refers to trade openness, while control represents variables encompassing socioeconomic, health, and climate factors potentially affecting COVID-19 incidence. ε denotes the error term.

In this study, the infection rate, computed as the number of confirmed COVID-19 cases per million people, serves as a proxy for COVID-19 incidence. Furthermore, we attempt to use the infection ratio, calculated as the number of confirmed COVID-19 cases in each province relative to the total number of confirmed cases in Vietnam, as an alternate measure of provincial COVID-19 spread disparity. The Ministry of Health of Vietnam (MOH) provides the data on confirmed COVID-19 cases.

It is essential to note the challenges posed by missing or inconsistent data across Vietnam's 63 provincial-level administrative units, particularly for 2020. These constraints limit our choice of proxy measures for provincial travel and retail activities, as well as socioeconomic factors.

Owing to the unavailability of provincial tourist data, we use a proxy for the travelling variable, calculated as local travel turnover per capita. The retail variable is measured by local retail sales of goods and services per capita, while openness is gauged by the sum of exports and imports as a proportion of each province's GDP.

Control variables encompass socioeconomic factors related to COVID-19 contagion, selected based on previous studies [1-7] and the availability

Table 1. Description and data sources of variables.

Variables	Description	Sources
Infection rate	Number of confirmed COVID-19 cases of each province/1 million people	MOH
Infection ratio	Number of confirmed COVID-19 cases of each province/total number of confirmed COVID-19 cases of Vietnam	MOH
Retail	Local retail sales of goods and services/Population	General Statistics Office, Ministry Planning and Investment of Vietnam (GSO-MPIV) and Statistics Office of Vietnamese Provinces (SOVP)
Travelling	Local turnover of travelling/Population	GSO-MPIV and SOVP
Openness	(Import + export)/GDP	Data on provinces' Import and Export are collected from General Department of Vietnam Customs (GDVC). Data on provinces' GDP are collected from SOVP and Reports on the socio-economic situation in 2020 of local governments
Population density	Number of people per square kilometre of each province	GSO-MPIV
In-migration rate	Number of people from different provinces in-migrates to a province per 1,000 population of in-migration province.	GSO-MPIV
Labor rate	Percentage of employed population at 15 years of age and above as compared to population.	GSO-MPIV
Income per capita	Monthly average income per capita	GSO-MPIV
Difference in per capita income	Difference between the highest income quintile and the lowest income quintile on monthly average living expenditure per capita	GSO-MPIV
Mortality rate	Infant mortality rate	GSO-MPIV
Hospital beds	Number of hospital beds per 1,000 people	GSO-MPIV
Doctors	Number of doctors per 1,000 people	GSO-MPIV
PAPI	Vietnam Provincial Governance and Public Administration Performance Index (PAPI)	Centre for Community Support Development Studies (CECODES), United Nations Development Programme (UNDP) and Vietnam Fatherland Front (VFF)
Temperature	Average temperature (°C)	Climate-data.org (based on European Centre for Medium-Range Weather Forecasts Data
Humidity	Average humidity (%)	Climate-data.org (based on European Centre for Medium-Range Weather Forecasts Data)

Table 2. Descriptive statistics.

Variables	Mean	Standard deviation	Minimum	Maximum
Infection rate	14.93929	46.17038	0	354.853
Retail	42.23264	20.59118	11.00702	112.6303
Travelling	0.0621159	0.1529627	0.0000274	0.866607
Openness	11.14961	79.51587	0.021645	632.1544
Population density	521	684.1637	52	4476
In-migration rate	4.755556	9.638511	0.2	62.7
Labor rate	56.06508	4.028373	45.7	64.9
Income per capita	3634.746	1133.592	1737	7034
Difference in per capita income	6.655556	1.973639	3.48	12.66
Mortality rate	15.28889	6.687111	7.6	36.2
Hospital beds	3.553942	1.062711	1.906968	6.400269
Doctors	0.9830839	0.2948754	0.43482	1.894822
PAPI	45.45538	2.138296	40.096	53.29576
Temperature	24.56495	2.136618	19.7	27.41667
Humidity	0.7969577	0.0203085	0.723333	0.835833

Source: Authors' calculation.

of Vietnamese provincial data. These variables include population density, in-migration rate, labour rate, income per capita, and difference in per capita income.

PAPI serves as an additional control variable to account for potential variations in local authorities' response to the spread of COVID-19. Variables relevant to the health system, including mortality rate, hospital beds, and doctors, are also integrated into the model. Lastly, temperature and humidity variables are included to control for potential effects of local climate on COVID-19 incidence.

This research employs 2020 data for all variables, with the exception of the 'doctors' variable. As 2020 data pertaining to the number of doctors in Vietnamese provinces are unavailable (at the time of writing), 2019 data have been utilised instead. Detailed descriptions and data sources for these variables are presented in Table 1. Additionally, descriptive statistics and a correlation matrix for the variables are offered in Tables 2 and 3, respectively.

The correlation matrix in Table 3 reveals that the correlation amongst the independent variables is moderate, thus eliminating the potential for multicollinearity in the regression analysis. The Ordinary Least Squares (OLS) regression method, with robust standard errors, is employed to estimate model (1) in this research.

Table 3. Correlation matrix of coefficients among variables.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Infection rate (1)	1														
Retail (2)	0.246	1													
Travelling (3)	0.3946	0.5822	1												
Openness (4)	0.9423	0.19	0.3513	1											
Population density (5)	0.1229	0.4979	0.6978	0.0792	1										
In-migration rate (6)	0.1186	0.3889	0.1871	0.1277	0.4461	1									
Labor rate (7)	-0.4023	-0.5776	-0.5199	-0.3308	-0.3926	-0.0245	1								
Income per capita (8)	0.2403	0.6848	0.5061	0.195	0.709	0.6483	-0.443	1							
Difference in per capita income (9)	-0.177	-0.41	-0.1959	-0.0942	-0.5046	-0.3114	0.3717	-0.668	1						
Mortality rate (10)	-0.2143	-0.5372	-0.2394	-0.1449	-0.4569	-0.2979	0.3079	-0.7411	0.6093	1					
Hospital beds (11)	0.304	-0.0196	0.1459	0.3412	-0.1207	-0.1689	-0.0788	-0.1271	0.1034	0.1578	1				
Doctors (12)	0.3119	-0.0023	0.2354	0.3378	0.177	0.0219	0.0661	-0.0163	0.1484	0.0768	0.5667	1			
PAPI (13)	-0.0672	-0.0221	0.0286	-0.064	-0.059	-0.095	-0.047	0.0154	0.0125	-0.1087	0.3311	0.0809	1		
Temperature (14)	-0.0666	-0.0427	0.0082	-0.0824	-0.052	-0.1413	0.0465	-0.1158	-0.0397	0.1068	-0.0198	-0.1416	0.1013	1	
Humidity (15)	-0.01	-0.0602	-0.1019	0.0603	-0.0987	-0.0292	0.0683	-0.1647	0.2478	0.1979	0.1277	0.1953	-0.1435	-0.0762	1

Source: Authors' calculation.

3. Results

Table 4 delivers the research's estimation results. In regression (I) of Table 4, 'infection rate' is used as a proxy for COVID-19 incidence, and it is found that the coefficients for the variables of openness to trade and travelling activities are positive and significant at one and ten percent levels respectively. This suggests that both travelling activities and trade openness exert a significant and positive impact on the infection rate in Vietnamese provinces in 2020. Estimation results in regression (I) further demonstrate that retail activities are not significantly correlated with the infection rate. Similarly, other variables of socioeconomic factors and variables of health system and climate appear to have insignificant effects on the disparities in infection rates across Vietnamese provinces in 2020.

In regression (II) of Table 4, 'infection ratio' is employed as an alternative measure of COVID-19 incidence variance amongst provinces in Vietnam in 2020. Estimation results from regression (II) also signify that the coefficients for the two variables of trade openness and travelling activities are positive and significant at the one percent level. This reiterates that travelling activities and trade openness have a significant and positive effect on the spread of COVID-19 among Vietnamese provinces. The coefficients on the variable of retail activities and on other variables in the estimation results are found to be insignificant. This implies that variables relating to socioeconomic factors, the health system, and climate within the model are likely not to have a substantial effect on the disparities in the COVID-19 infection ratio across Vietnamese provinces in 2020.

In summary, the estimation results demonstrate that trade openness and travelling activities have a positive and significant impact on the spread of COVID-19. Conversely, retail activities are

Table 4. The estimation results of effects of travelling, retail activities and trade openness on COVID-19 incidence of Vietnamese provinces in 2020.

	(I)	(II)
Retail	-0.09266	-0.000254
	(0.17183)	(0.000188)
Travelling	43.7896*	0.122755***
	(25.0215)	(0.036229)
Openness	0.49515***	0.000339***
	(0.02868)	(3.22e-05)
Population density	-0.00891	4.82e-07
	(0.00645)	(7.83e-06)
In-migration rate	0.28935	-7.50e-05
	(0.27277)	(0.000337)
Labor rate	-1.24221	-0.000606
	(0.77093)	(0.000716)
Income per capita	-0.00522	6.97e-07
	(0.00535)	(5.63e-06)
Difference in per capita income	-2.43921	-0.001321
	(1.81933)	(0.00167)
Mortality rate	-0.80011	-0.000400
	(0.53576)	(0.000524)
Hospital beds	-1.51218	-0.00331
	(2.35988)	(0.00257)
Doctors	11.4105	0.011596
	(9.6131)	(0.008653)
PAPI	-0.76172	-0.001601
	(1.22006)	(0.001306)
Temperature	0.23954	-0.000813
	(0.89464)	(0.00107)
Humidity	-89.2650	-0.155107
	(171.451)	(0.171146)
Observations	63	63
R-squared	0.912	0.900

Source: Authors' calculation.

Note: robust standard errors in parentheses; ***: denotes significance at the one percent level; *: denotes significance at the ten percent level. Regression (I) employs the 'infection rate' as a measure of COVID-19 incidence, whilst regression (II) utilises 'infection ratio' as an alternative measure. The dependent variables in regression (I) and (II) are calculated from the number of confirmed COVID-19 cases documented in Vietnamese provinces from 23 January 2020 (when the first case of COVID-19 was detected in Vietnam) to 31 December 2020.

surprisingly found to have an insignificant impact on the transmission of COVID-19 amongst Vietnam's provinces in 2020. The significant effect of travelling activities on COVID-19, as discovered in this paper, is in agreement with findings that human mobility has a strong correlation with COVID-19 outcomes, such as those found in studies in Chile and China [4, 7]. Moreover, evidence that trade openness impacts the spread rate of COVID-19 in this investigation aligns with the findings in [8, 9], where countries' levels of globalisation or openness are found to influence the transmission speed of the coronavirus.

4. Conclusions and policy recommendations

This study utilises aggregate data from 63 provinces to scrutinise the effect of travelling, retail activities, and trade openness on COVID-19 incidence in Vietnamese provinces in 2020. To the best of our knowledge, no prior empirical research has been conducted on this subject in Vietnam, which suggests that this research could contribute to scientific knowledge.

Cross-sectional estimation results from our study indicate that travelling activities and provinces' trade openness do have positive and significant impacts on the variation in COVID-19 incidence amongst Vietnamese provinces in 2020. Conversely, retail activities are found to be unlikely to exert a significant effect on COVID-19 incidence variation in these provinces for 2020. The results relating to the significant effects of travel and openness on the spread of COVID-19 suggest that intensive control policies, encompassing early travel restrictions, border and entry control measures, community isolation, and social distancing, should be implemented promptly to curtail the spread of COVID-19 at the initial stage of an outbreak. These policies are particularly beneficial in densely populated nations like Vietnam, which have strong international social and economic ties, in order to minimise case increases in future outbreaks of COVID-19-like pandemics, particularly when no vaccine is yet available [5, 7-12].

Additionally, the negligible impact of retail activities on the spread of COVID-19 in Vietnamese provinces, as discovered in this research, may suggest that Vietnamese authorities propagated and implemented effective control measures to prevent COVID-19 spread in retail and service activities within local communities. This has, to some extent, led to Vietnam's success in controlling the epidemic outbreak in localities in 2020 [11-15].

This research has certain limitations. Firstly, the empirical estimations could provide more insight if the research were to use panel data (e.g., utilising 12 monthly datasets from 63 Vietnamese provinces in 2020) for empirical analysis, as opposed to solely using cross-sectional aggregate data. Regrettably, monthly (and daily) provincial data for almost all variables in the research model are unavailable in Vietnam. Secondly, it would be interesting for the research to further investigate the effect of travelling, retail activities, and trade openness on the spread of COVID-19 in Vietnamese provinces in 2021. However, data on the total number of confirmed COVID-19 cases for each province in Vietnam for 2021 are currently unavailable. Future studies may undertake this subject for 2021 when the data become accessible.

CRediT author statement

Duong Nguyen Minh Huy: Methodology (data and method), Formal analysis, Writing, Editing; Do Anh Duc: Data collection, Writing.

COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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Tracing innovation efficiency: Review and bibliometric analysis

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Abstract:

While "innovation efficiency" has become widespread and intuitive to many over the past few decades, its definition, measurement, and understanding have evolved. This paper offers a review of the economic literature centred on the dynamics of the innovation efficiency concept. We conducted a bibliometric analysis of 5,123 scholarly publications on Scopus to broaden the understanding of innovation efficiency phenomena, complemented by an in-depth science map analysis of 764 publications. We illustrate the accelerated growth of literature in the innovation-efficiency domain in recent years. Despite this significant growth, research in this area remains fragmented, underscoring the need for the systematic approach undertaken in this study. Through the bibliometric analysis, we discerned that the focus of innovation-efficiency-related studies has shifted from internal organisational issues to a comprehensive perspective on innovation, encompassing exogenous elements and external sources of innovation. We delineate three periods in the evolution of central themes within the innovation efficiency domain from 1998-2022: Initial focus on individual firms' performance, progressing to external and network determinants of innovation, and recently, the link between innovation efficiency and green innovation in the third period. We also identified two primary research methodologies: (i) Qualitative surveys and (ii) Quantitative methods using regression analysis, mathematical models, and data envelopment analysis. Scientists, policymakers, and investors can utilise these findings to gain insights into the paramount aspects underpinning research in the innovation efficiency phenomena.

Keywords: **bibliometrix, bibliometrix analysis, economic growth, efficiency, innovation, technology.**

Classification numbers: **2.2, 7**

Highlights

- The perception of innovation efficiency is dynamic.
- Bibliometric analysis is utilised to broaden the understanding of innovation efficiency phenomena.
- Three periods of evolution within the topic of innovation efficiency are identified.
- Innovation efficiency is being increasingly viewed as holistic and associated with sustainability.

1. Introduction

The term 'innovation' has been growing in popularity among economists, policymakers, and business leaders worldwide in recent decades. Innovation is often cited as a driver of technological progress, productivity enhancement, and economic growth, and is crucial for modern governance [1-6]. Whilst seemingly intuitive, the concept of innovation has been challenging to define and precisely measure [7, 8]. Efficiency is a pivotal concept in the innovation domain, as investing in innovation is not a desired activity per se: the outcomes or outputs of the innovation process are paramount for society, hence the emphasis on innovation efficiency. A. Nigg-Stock, et al. (2023) [9] articulated, "*In today's fast-changing world, it is essential not only to be innovative but also to innovate efficiently*".

Innovation efficiency has been the subject of study for some time. The inaugural attempt to explore innovation efficiency dates back to the 1960s when B.R. Mitchell, et al. (1968) [10] introduced the

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idea. Recently, due to the swift advancement and transformative influence of digital technologies, assessing the performance and efficiency of innovation systems has emerged as a focal topic in academic research and policy dialogues, especially considering the development of integrated benchmarking systems in knowledge-driven economies [11-14]. Despite the topic's evident growth in recent years, research in this realm remains disjointed [15, 16]. Therefore, a compelling case exists for this paper to pursue further systematic exploration.

This paper seeks to offer a comprehensive and systematic analysis of research on innovation efficiency. Specifically, we centre on the following research questions: (1) How is "innovation efficiency" characterised, and how has this notion evolved over time?; (2) What methodologies exist to measure innovation efficiency at diverse governance levels?; (3) Which key journals, authors, institutions, and regions are instrumental in this research domain?; (4) What are the principal topics, research trajectories, and evident lacunae in the literature on innovation efficiency, as unveiled through an examination of the prevailing body of work?

We perceive innovation efficiency as a multifaceted and evolving phenomenon. We address the initial two research questions via literature review, augmented by a bibliometric analysis pertinent to the third and fourth questions. Our method encompasses a bibliometric analysis of 5,132 scholarly publications on Scopus to enhance understanding of what innovation efficiency entails and its changing perception over time. Through the bibliometric approach, we scrutinise the trajectory of research on innovation efficiency, delve into the intellectual framework of the topic, and pinpoint emerging trends and gaps in the research domain.

Bibliometric analysis techniques are prevalent in economic and policy research [17, 18]. These methodologies encompass citation analysis, keyword co-occurrence analysis, conceptual structure, and thematic map analyses [19]. Contrary to meta-analysis, where the emphasis is on summarising literature by gauging the direction and intensity of variable relationships, bibliometric analysis concentrates on the social and structural relationships of research components such as authors, countries, and keywords [20].

The remainder of the paper is outlined as follows. Section 2 elucidates the definition and evolution of innovation efficiency and surveys existing literature. Section 3 details the research methodology for the bibliometric analysis. Section 4 presents analysis and discourse, and Section 5 culminates the paper, highlighting its contributions and suggesting avenues for subsequent research.

2. Background: Defining and measuring innovation efficiency

While the term "innovation" has been increasingly used in the literature and policies, there is a lack of consensus on its definition and the measures of innovation.

Academic literature often cites Joseph A. Schumpeter as the pioneer of the modern definition of innovation, the "technical change" in his words under his paradigm of "creative destruction" [21, 22]. In his definition, Schumpeter provided a list of changes such as new products, new production methods, new materials, etc., of which the central feature is novelty, or what is also referred to in the literature as "newness" [23]. More recently, a qualitative survey by S. Singh, et al. (2022) [24], undertaken in search of a consensus definition of innovation, also highlighted "newness" as the most common and critical dimension of innovation.

However, "newness" is a relatively broad and ambiguous concept, which is also challenging to measure. Newness does not encompass the intensity, sources, and results of innovation - important criteria needed to distinguish innovation from other changes in business operations or products.

International organisations and government bodies also define innovation in various ways. It is interesting to observe the evolution of the definition by the Organisation for Economic Cooperation and Development (OECD). The early definition by OECD (2015) [25] was *"... all those scientific, technical, commercial and financial steps necessary for the successful development and marketing of new or improved manufactured products, the commercial use of new or improved processes or equipment or the introduction of a new approach to social service. R&D is only one of these steps."* It is a complex definition tracing the journey from idea or invention to application in practice.

Not surprisingly, this definition posed difficulties in measuring and defining the stages of innovation. In the latest OECD series on instruction for innovation data collection, innovation is defined as "*a new or improved product or process (or a combination thereof) that differs significantly from the unit's previous products or processes and that has been*

made available to potential users (product) or brought into use by the unit (process)" [25]. Comparing the two OECD approaches, we see that the definition has been remarkably simplified and brought back to the essence of Schumpeter's definition - the newness. The latter definition is also centred around the results, which became a focus of several definitions of innovation. For instance, the concept of innovation by the Business Council of Australia in 1993 [26] mentioned "*create added value either directly for the enterprise or indirectly for its customers*" in their definition of innovation.

Innovation efficiency is tied to the concept of productivity. Innovation efficiency improves when, with the same amount of innovation inputs, more innovation outputs are generated, or when fewer innovation inputs are needed for the same amount of innovation outputs. Innovation efficiency can thus be defined as the ability to transform innovation investments into outcomes such as products and profits [9, 27] In these terms, innovation efficiency and innovation productivity are closely related concepts, although not synonymous. Since applied economics research literature uses one to define the other [28, 29], we chose to use both terms as keywords ("innovation efficiency" and "innovation productivity") to ensure we capture the domain fully. While the definition of innovation efficiency seems intuitive, the task of measuring innovation efficiency is not straightforward. Different types of innovation require different investments (inputs) and return different outcomes (outputs), which are difficult to grasp both in theory and in practice. Several approaches and frameworks have been developed in the literature to measure innovation efficiency. They can be broadly categorised into qualitative and quantitative approaches. In this study, we focus on the quantitative approach to assess innovation efficiency.

The two primary quantitative evaluation methods for innovation efficiency are Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA). The SFA method is a parametric and deterministic approach based on economic theory, first presented by D. Aigner, et al. (1977) [30] and W. Meeusen, et al. (1977) [31]. This approach assumes a knowledge production function and uses econometrics to estimate unknown parameters to identify the potential frontier quantitatively.

In contrast, the DEA method is a non-parametric and non-deterministic methodology, first introduced by A. Charnes, et al. (1978) [32]. The distinct features of DEA are as follows: Firstly, it relaxes the restrictions of SFA on a specific production frontier and thus allows uncertainty in the production relationship between input and output variables. Secondly, it uses linear programming techniques to trace the efficiency frontier and thereby avoids the subjectivity of function choice. Thirdly, it accommodates scenarios of multiple inputs and outputs and non-linearity, which is more apt for estimating the efficiency of individual decision-making units. As a result, DEA has long been regarded as the preferred method to measure innovation efficiency in the literature.

The current literature has explored various evaluation methods of innovation efficiency based on DEA methods. Most of the early literature in the field focused on measuring innovation efficiency from a static perspective. This static perspective postulates a single-period framework for the innovation process and leans heavily on single-year analysis. However, static models do not allow for the incorporation of time into the analysis. Several studies have tried to extend these conventional models by dividing the entire innovation process into different production stages, leading to a series of network DEA models. One is to use the Malmquist index. For instance, L. Yun (2011) [33] employed the Malmquist index to evaluate innovation efficiency. Another is the dynamic network DEA models [34-36].

We discussed that innovation is a complex, dynamic phenomenon. However, innovation is also a multilevel concept since firm, regional, and national innovation systems coexist, co-evolve, and interrelate. There are distinct elements in each system. For example, national innovation systems involve mechanisms where co-national innovation systems form the framework for producing a country's innovation, while regions might follow different regimes and exploit innovation inputs differently. As a result, there are multiple quantitative approaches that assess innovation efficiency at the national, regional, sectoral, and firm levels. Literature studying innovation efficiency phenomena at different levels of governance utilises a concept of "innovation performance" to discuss and measure innovation efficiency [9, 37].

At the firm level, organisations apply key performance indicators (KPIs) to show performance and help manage innovation. At the regional level, the traditional approach would be to use indicators such as the number of patents, workforce size, innovative products, and share of research and development (R&D) activity. More recently, however, an increasing number of studies have shifted focus from traditional linear indicators to delineating the diversity of

resources required for innovation, the non-linearity of the innovation process, the varied meaning of innovation, and the innovators' connection to and dependence on global competitive market forces and their immediate socio-economic and institutional environment. Researchers argued that the regional and national knowledge infrastructure, perceived mainly as a mix of universities, research institutes, R&D workers, R&D expenditure, and regional technology policy, is crucial for firms' innovative performance. Digital technologies are also identified as key for innovation at the firm level [38].

One highlight in regional and national innovation studies is the spillover effect. X. Li (2009) [39] analysed innovation at the regional level and concluded that innovation activities are spatially heterogeneously distributed, and knowledge production tends to localise spatially. Other studies also confirmed the spatial agglomeration effect of regional innovation activities [33, 34, 39, 40].

At the national level, the National System of Innovation (NSI) concept emerged at the end of the 1980s [41, 42]. Since then, NSI has attracted interest from both academia and policymakers and become one of the most important concepts to emerge in studies in the domain of innovation efficiency. NSI focuses on the interaction of different stakeholders in the system and analyses how various social, economic, institutional, environmental, and technical factors affect those interactions [43].

The Regional Systems of Innovation (RSI) concept rests on the relationship between technology, innovation, and industrial location [44]. Each region has its assets, strengths, competitive advantages, and capabilities. Studies on regional innovation systems focus on assessing the spillover effect of innovation across regions, and factors that affect regional innovation efficiency [34]. Although many aspects of the NSI approach can be applied at the regional level, the RSI approach differs significantly from the former [45]. The issues commonly explored at a regional level include the relationships between firms, the role of the public sector and public policy, as well as the institutional set-up of industries and sectors of the economy.

Overall, the background study of the literature demonstrates that the concept of innovation efficiency, along with the approaches to measure innovation efficiency, is complex and dynamic. However, the literature is fragmented, and systematisation is required to unveil the specifics of these dynamics. The following bibliometric analysis aims to address this gap.

Having defined innovation efficiency as a focal topic of this study, we also acknowledge its strong connection to the concepts of "innovation performance" and "innovation productivity," which tend to dominate in certain areas of the domain literature. This conclusion will form a basis for shaping the methodology and selection of search keywords for the bibliometric analysis to follow.

3. Data and methodology

The methodology of this study is summarised in Fig. 1 and includes four steps: (i) data collection and cleaning; (ii) performance analysis; (iii) science mapping; and (iv) synthesis of research implications. The detail of our methodology is described below.

Data collection: The data for this bibliometric analysis are sourced from Scopus. Introduced in 2004,

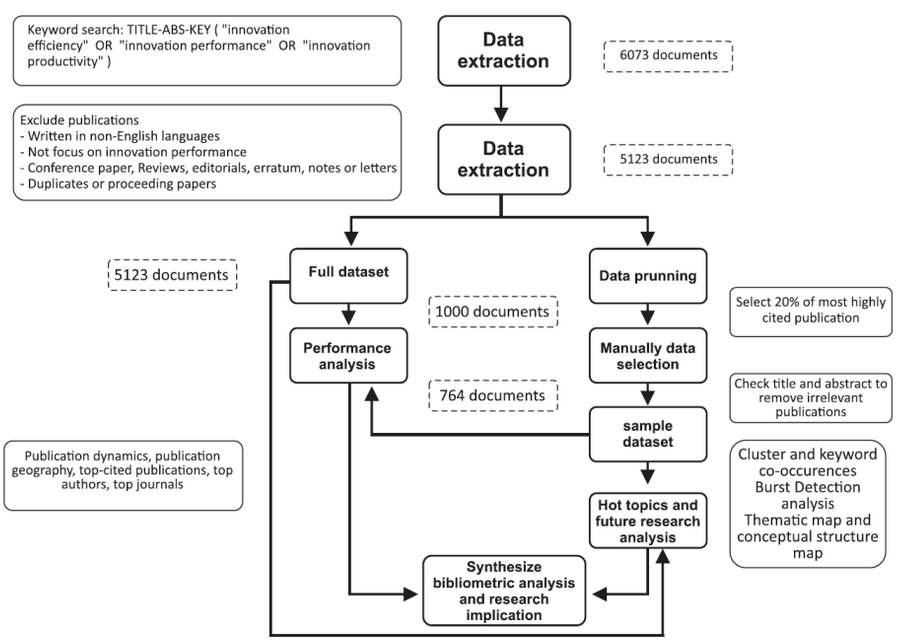


Fig. 1. Methodology framework.

Scopus is amongst the largest abstract and citation databases of peer-reviewed scientific works [46], with comprehensive coverage of disciplines including social sciences and humanities [47]. As of 2020, the Scopus dataset covered approximately 78 million publications from 1969, over 9.8 million conference papers, and 44 million patents. About 3 million new scientific works are added to the dataset each year, sourced from more than 23,000 journals [47].

Based on the literature review, we identified the following keywords for the search - "innovation efficiency," "innovation productivity," and "innovation performance." The search returned 6073 publications between 1995 and 2022. We then performed filtering of the data by document types (only articles were included), language (English only), and source type (only journal). The filtering resulted in 5123 publications.

Based on the approach of Z. Xu, et al. (2021) [48], we further ranked the publications by the number of citations and selected the top 20% of the most cited publications (1000 publications) for analysis. The next step included a manual screening of titles and abstracts of the selected list of publications to verify the selection and remove irrelevant papers from the list. Screening returned 764 publications (Fig. 1).

Bibliometric analysis: Bibliometric analysis is a family of analytical methods within the field of informetric research and research evaluation that allows for quantitative analysis of written publications and investigation of their impact using statistical tools [19, 49]. Bibliometric analysis is increasingly used across research fields (e.g., business [50], environment [51], medicine [52, 53], and engineering [54], among others) and is rapidly advancing with the development of large scientific datasets, availability of bibliometric software such as VOSviewer, Gephi, and the advancement of the analysis methodologies. To conduct the bibliometric analysis, we used the package Bibliometrix in R and CiteSpace program [20]. Bibliometrix allows for performing descriptive analysis on bibliometric datasets [20, 55], while CiteSpace is used to identify citation hotspots, network patterns, and fast-growing topics. Both packages are well-known for effective detection and visualisation of trends and changes in research topics [17].

In this study, the bibliometric analysis focuses on two main aspects:

- Performance analysis - descriptive analysis of the research performance. In this study, a number of indicators are utilised for performance analysis, including influence indicators and productivity indicators such as annual scientific production, top publications by citation, most productive authors' countries, total citation per country, and most relevant sources.

- Science mapping analysis that explores the relationship between research constituents, identifies the intellectual structural connections and their evolution over time [56]. In this study, the following science mapping analysis techniques were used:

+ Conceptual structure map to visualise the topic's conceptual structure using the Multiple Correspondence Analysis (MCA) algorithm [57] to examine the relationship between keywords.

+ Thematic map to plot clusters of keywords in a 2D matrix in which the horizontal axis represents the relevance of keywords and the vertical axis represents the development degree. In this study, more than 500 keywords were considered with a minimum frequency of 5.

+ Co-occurrence-based burst detection (CiteSpace) to find the hotspots or areas of high research intensity over time. Burst detection allows tracking the evolution and decay of research topics over time through identification of ranked lists of word bursts and the time interval in which they occur [17]. Burst detection was conducted with a frequency of not less than ten and burst strength of not less than 2.

4. Analysis and discussion

4.1. Performance analysis

Publication evolution over time: The number of scientific publications on the topic of innovation efficiency has grown almost tenfold between 2008 and 2020 (see Fig. 2), above the growth rate in the total number of academic publications over that period. Whilst the number of papers on the topic was relatively small before 2003, the topic gained momentum as a research interest over 2004-2008 and has been on a steady growth trajectory since 2009 (see Fig. 2). In 2021, despite the impact of the pandemic, we observed the peak in the number of publications. This differs from the decline observed across multiple other research fields and topics during and post-pandemic [58-60].

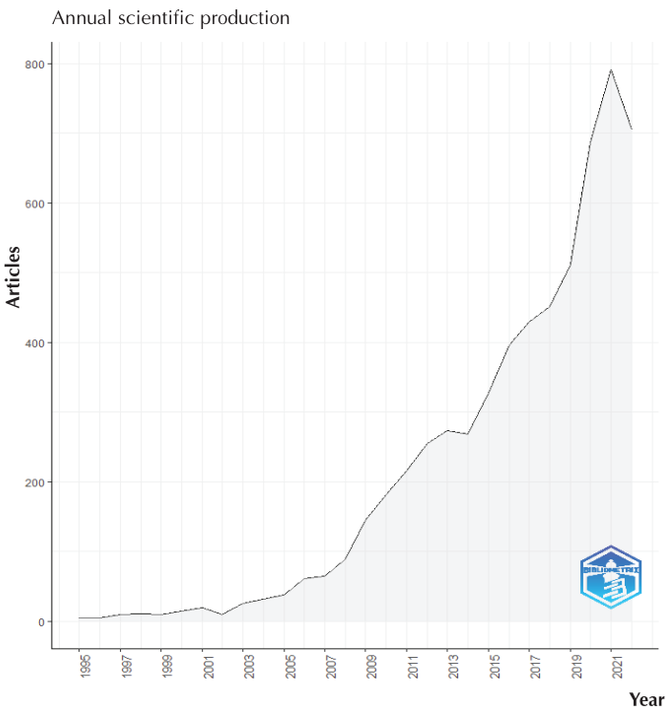


Fig. 2. Annual scientific production of publications on innovation efficiency. Note: The data for 2022 only covers the first nine months of the year.

High-impact research: The top journals by the count of innovation efficiency-focused publications are centred around technology, business management, and innovation. These include highly-ranked journals such as *Research Policy, Journal of Product Innovation Management, International Journal of Innovation Management, Technology Forecasting and Social Change, and Technovation* (Table 1). The most frequently cited outlets include *Strategic Management Journal, Research Policy, Academy of Management Journal, and Technovation.* The former two sources *(Strategic Management Journal and Research Policy)* have more than double the number of citations compared to the rest of the list. This is due to the presence of the most-cited papers on the topic in these journals, such as K. Laursen, et al. (2006) [61], G. Ahuja, et al. (2001) [62]. Over the observed period, the top-cited papers gained between 40 and 66 citations annually, with the outstanding work of K. Laursen, et al. (2006) [61] (Table 1).

The list of journals led by *Sustainability* (Switzerland) accounted for the total number of articles. This outlet outperformed peers only in 2021 as demonstrated by the analysis of source dynamics in Fig. 3. This indicates an increasing interest in sustainability and green technology within the field of innovation efficiency research as we will discuss in detail below.

Geographic distribution of authors in innovation efficiency: As in many fields of science and technology, China dominates the country list by the number of innovation-efficiency-related publications. The number of studies from China is higher than the total number of studies published by authors from the rest of the world. This result is not surprising, given the rates of economic and technological progress in China over the past two decades. Efficient resource

Table 1. Top academic journals and articles in innovation efficiency by publication and citation counts.

Most relevant sources	Articles	Top-cited papers	Total citation	Citations per year
Sustainability (Switzerland)	209	K. Laursen (2006), *Strategic Manage J.*	3604	212.0
Technology Analysis and Strategic Management	104	J.K. Han (1998), *J. Mark,*	1644	65.8
Research Policy	97	G. Ahuja (2001), *Strategic Manage J.*	1354	61.5
International Journal of Innovation Management	92	L. Pittaway (2004), *Int. J. Manage Rev.*	1036	54.5
Technological Forecasting and Social Change	90	N. Rosenbusch (2011), *J. Bus. Venturing*	1028	85.7
Journal of Business Research	86	K. Atuahene-Gima (2005), *J. Mark*	993	55.2
European Journal of Innovation Management	84	H. Li (2001), *Acad. Manage J.*	983	44.7
Technovation	69	Y.S. Chen (2006), *J. Bus. Ethics*	945	55.6
Journal of Product Innovation Management	58	H.F. Lin (2007), *Int. J. Manpow.*	901	56.3
International Journal of Technology Management	50	C.J. Chen (2009), *J. Bus. Res.*	839	59.9

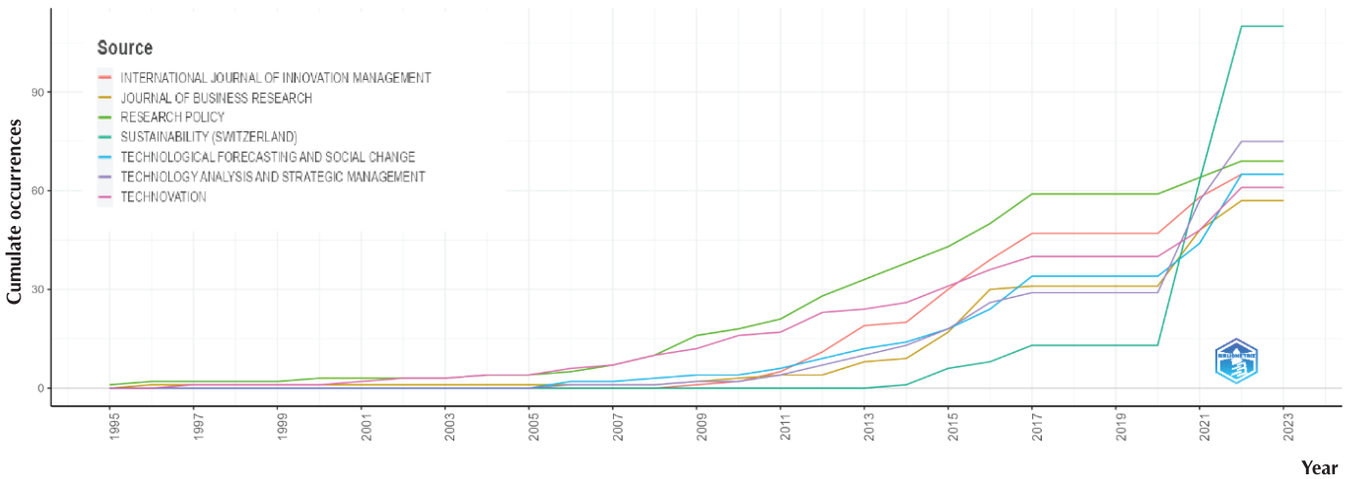


Fig. 3. Cumulative number of papers published by leading outlets per year.

allocation and cleaner production are among the priority objectives of China's government, and technological innovation is the key solution to achieve these objectives. Chinese authors are followed by authors from developed economies, including Spain, the USA, the United Kingdom, and the Republic of Korea (Fig. 4).

Authors affiliated with Chinese institutions also lead the list of author production over time (Fig. 5). Interestingly, the patterns of publications are similar across the top authors, with the first papers published around 2010, followed by at least one paper per year between 2010 and 2022. The number of citations of their papers has been gradually increasing over time.

4.2. Science map analysis

In the following section, we use the top 10% cited publications to analyse the trending topics in the innovation efficiency domain, identify research trends, and gaps.

Conceptual structure of literature in innovation efficiency domain: We performed co-occurrence analysis to identify the connection between keywords. Keywords are marked as co-occurring when they are used simultaneously by authors. Keywords are identified as keywords from author keywords, title, and abstract [63]. Fifty keywords were connected using the MCA as a dimensionality reduction technique. The result is reported in Fig. 6.

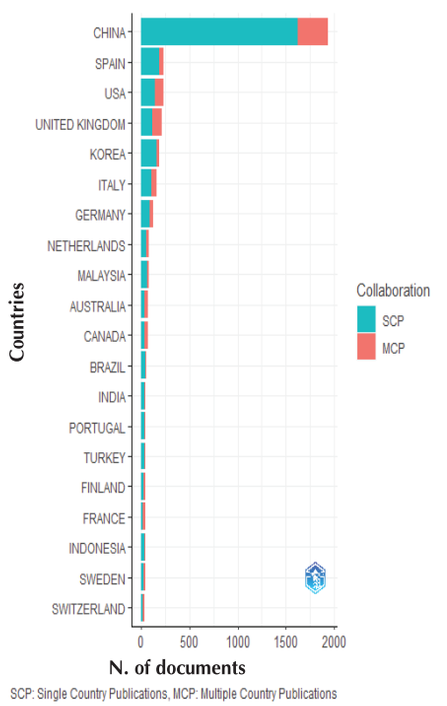


Fig. 4. Publications in the field of innovation efficiency by geographies of authors' affiliations. Notes: SCP: single country publications; MCP: multiple country publications.

The more co-occurrences are observed in the bibliometric dataset, the shorter the distance between words appearing on the map. Bubble sizes represent the frequency that the keywords are used by authors in the dataset. Different colours show different clusters of keywords.

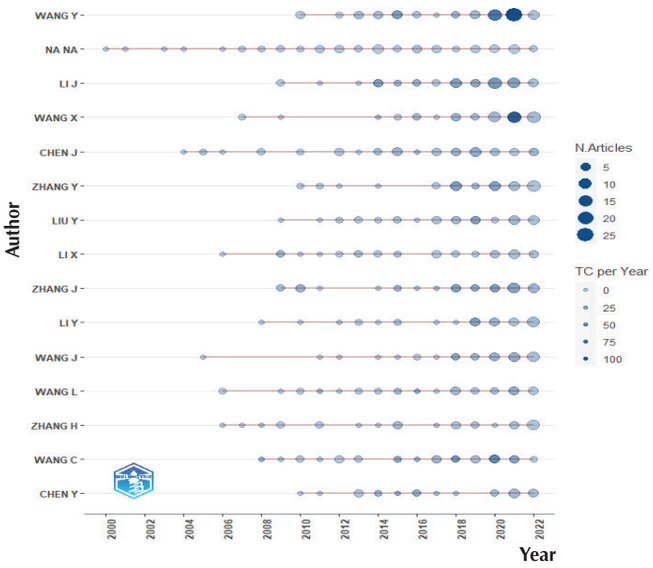


Fig. 5. The top authors in the innovation efficiency domain over time. Note: TC: total citations.

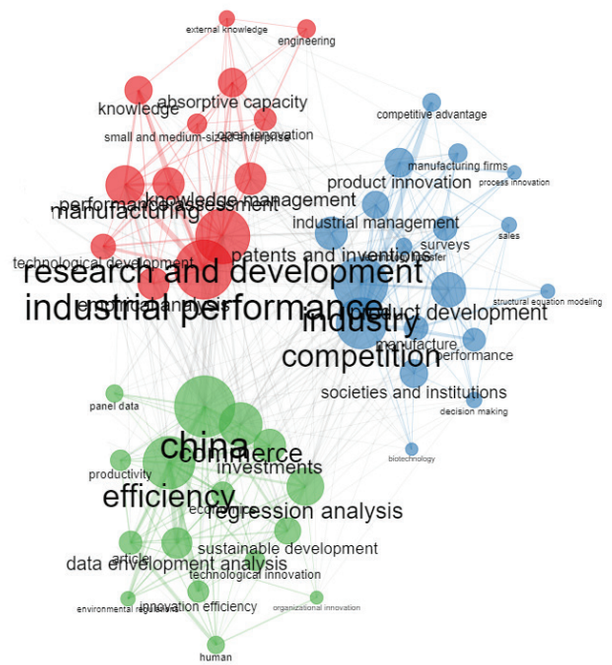


Fig. 6. Co-occurrence network for 10% of the most cited publications in innovation efficiency.

As can be seen, there are three clusters identified:

- Innovation and sustainable development (green) with more research using Chinese data and data envelopment analysis methodology.

- Innovation and research and development (red) with a focus on the manufacturing sector and absorptive capacity.

- Innovation and external factors (blue) with a focus on industrial management, performance, society, and institution.

To provide a more comprehensive analysis of key topics in the domain, we constructed a thematic map as presented in Fig. 7. The leading Eigenvalues algorithm was used for clustering; we also excluded common words (e.g., "innovation," "innovation performance," "article," and "human") to obtain cleaner results.

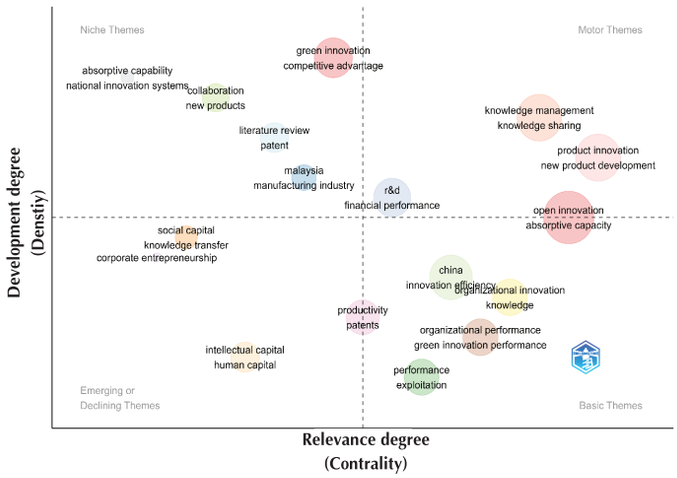


Fig. 7. Thematic map for the top 10% most cited publications in innovation efficiency.

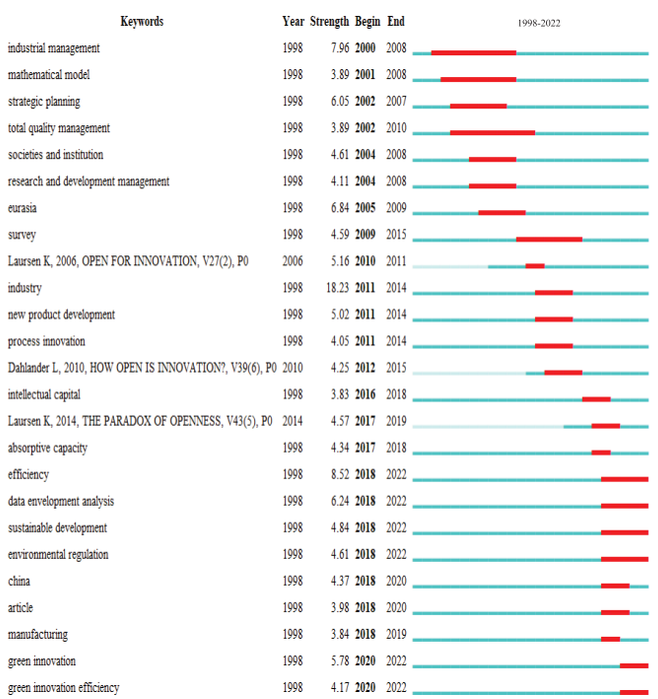
The thematic map has four different quadrants, identified by their centrality (horizontal axis) and density (vertical axis). Centrality measures how a topic connects to others, while density measures the level at which keywords in a cluster connect and thus define a hot topic. As such, the upper-right quadrant includes topics with high centrality and high density (i.e., topics that are well-researched and influential). Themes observed in this area concern knowledge sharing, management, and product innovation. Areas in the lower-left quadrant are either emerging or declining topics, as they have both low centrality and density. These include themes of human, intellectual, social capital and knowledge transfer.

The upper left represents topics that are well developed but do not influence other themes, while the topics of the lower right are weakly established internally yet relatively influential to other topics. As seen in Fig. 7, topics in the lower right quadrant are important and cross-cutting. They have high centrality but low density. In other words, research in these areas is significant to other field topics. However, they are not fully developed and thus

present opportunities for future research. These themes encompass performance-related topics on exploitation, aspects of organisational innovation and performance, and green innovation.

Key topics of research over time: To understand the dynamics of the key topics in innovation efficiency, we performed a keyword burst analysis using CiteSpace software on the 10% of the most-cited publications from 1998-2022, resulting in 764 manuscripts. Keyword bursts are used as indicators of frontier topics or emerging trends; each bar records a keyword, its start and end burst date. Burst detection was conducted using Kleinberg's burst detection algorithm, which can identify sudden increases or "bursts" in the frequency of words used over time. As a result, 25 bursts were determined (Fig. 8). We further performed an analysis of trend topics with the Bibliometrix package, which confirmed and expanded the findings (see Fig. 9).

Through the analysis of methodology-related keywords, we identified two groups of research methodologies used across the domain of interest: (i) qualitative approaches through surveys and (ii) quantitative analysis using regression analysis, mathematical models, and data envelopment analysis. This aligns with the findings of the literature review (Section 2).



Keywords	Year	Strength	Begin	End	1998-2022
industrial management	1998	7.96	2000	2008	
mathematical model	1998	3.89	2001	2008	
strategic planning	1998	6.05	2002	2007	
total quality management	1998	3.89	2002	2010	
societies and institution	1998	4.61	2004	2008	
research and development management	1998	4.11	2004	2008	
eurasia	1998	6.84	2005	2009	
survey	1998	4.59	2009	2015	
Laursen K, 2006, OPEN FOR INNOVATION, V27(2), P0	2006	5.16	2010	2011	
industry	1998	18.23	2011	2014	
new product development	1998	5.02	2011	2014	
process innovation	1998	4.05	2011	2014	
Dahlander L, 2010, HOW OPEN IS INNOVATION?, V39(6), P0	2010	4.25	2012	2015	
intellectual capital	1998	3.83	2016	2018	
Laursen K, 2014, THE PARADOX OF OPENNESS, V43(5), P0	2014	4.57	2017	2019	
absorptive capacity	1998	4.34	2017	2018	
efficiency	1998	8.52	2018	2022	
data envelopment analysis	1998	6.24	2018	2022	
sustainable development	1998	4.84	2018	2022	
environmental regulation	1998	4.61	2018	2022	
china	1998	4.37	2018	2020	
article	1998	3.98	2018	2020	
manufacturing	1998	3.84	2018	2019	
green innovation	1998	5.78	2020	2022	
green innovation efficiency	1998	4.17	2020	2022	

Fig. 8. Top 25 keywords with the most robust citation bursts.

The bar graph in Fig. 8 demonstrates the evolution of key topics within the innovation efficiency domain over time. Fig. 9 depicts trend topics over time, with the length of the bar representing the period in which the keywords emerge, and the size of the dots indicating the frequency of keywords appearing in the sample.

We identified three periods in the evolution of innovation efficiency phenomena: 1998 to 2004, 2005 to 2015, and 2016 to 2022. In the first period, firm-level innovation performance garnered significant attention, with the core topics in the domain of interest being strategic planning, quality management, product design, marketing, and industrial management. This corresponded to the widespread application of quality management tools such as Total Quality Management, Lean, Six Sigma, among others [64]. During this time, attention was given to identifying the interrelation between innovation, business models, and firm performance [65]. The focus of studies centred on internal factors such as technology, capital, personnel, and organisation management [66].

Between 2005 and 2015, the dominant burst terms were open innovation, industry, and new product development. In this second period, the research focus shifted to the inflows and outflows of knowledge and external factors in the innovation process. Researchers delved deeply into the innovation process, which was perceived as a complex activity with various external factors influencing a firm's incentive and ability to innovate, the type of innovation it implements, efficiency, and the outcome of the innovation activities [67]. Some papers also examined elements of organisational culture, such as knowledge sharing in the company [68], team diversity [69], and leadership [70].

During this period, innovation was not viewed as the result of isolated business decisions but as an outcome of a co-creation process with knowledge flowing in and out of the broader economic and social environment. As a result, topics related to open innovation, networking, industrial performance, and competition emerged in the domain. Numerous papers in this literature focused on innovation networks and external spillover effects in innovation [71]. Towards the end of the second period, we noted a surge in research interest in externalities from innovation and the ability to absorb technology

and innovation (absorptive capacity) [61, 72, 73], along with evaluating the innovation performance of a country or a region [44, 74].

From 2016 onwards, the focal point in the innovation efficiency literature turned to sustainability and green innovation, with keyword bursts such as sustainable development, green innovation, and green innovation efficiency [75, 76]. Green innovation merges ideas of innovation and sustainable development, coining terms including environmental innovation and ecological innovation [76]. Examining the green innovation literature more closely, we observed a vast heterogeneity in the definition of drivers or proxies for green innovation. This stems from the variety of academic domains addressing this issue (management, economics, engineering, biology, environmental and ecological studies, etc.), showcasing the heightened interest that this research topic has garnered. This observation aligns with the results of the thematic map analysis provided earlier, placing green innovation among the topics with high potential for future research.

The third period also highlighted an increased use of a quantitative approach to assess innovation efficiency. The favoured empirical analysis method for investigating innovation efficiency was Data Envelopment Analysis. Structural equation modelling was another technique frequently employed to discern how innovation capability affects firm performance.

5. Conclusions

In this paper, we employed bibliometric methods and visualisation software to explore the evolution of research in the field of innovation efficiency. We analysed over 5000 publications in the field and conducted a detailed bibliometric analysis of the 764 most impactful publications in the domain published between 1998 and 2022.

We observed an intensification of publishing in the domain of innovation efficiency since 2003, with no signs of slowing down during and after the pandemic. The analysis demonstrated the dominance of China as a country of affiliation for the authors in the domain, as observed across other research literature domains. We also identified a group of top-cited authors and leading outlets in the domain. The top journals in the innovation efficiency domain focus on technology, business management, and innovation and include *Research Policy, Journal of Product Innovation Management, International Journal of Innovation Management, Technology Forecasting and Social Change, and Technovation.*

Through detailed bibliometric analysis of the 10% top-cited publications, we discovered that the focus of innovation-related studies has gradually shifted from issues internal to organisations to a more holistic view of innovation phenomena, incorporating

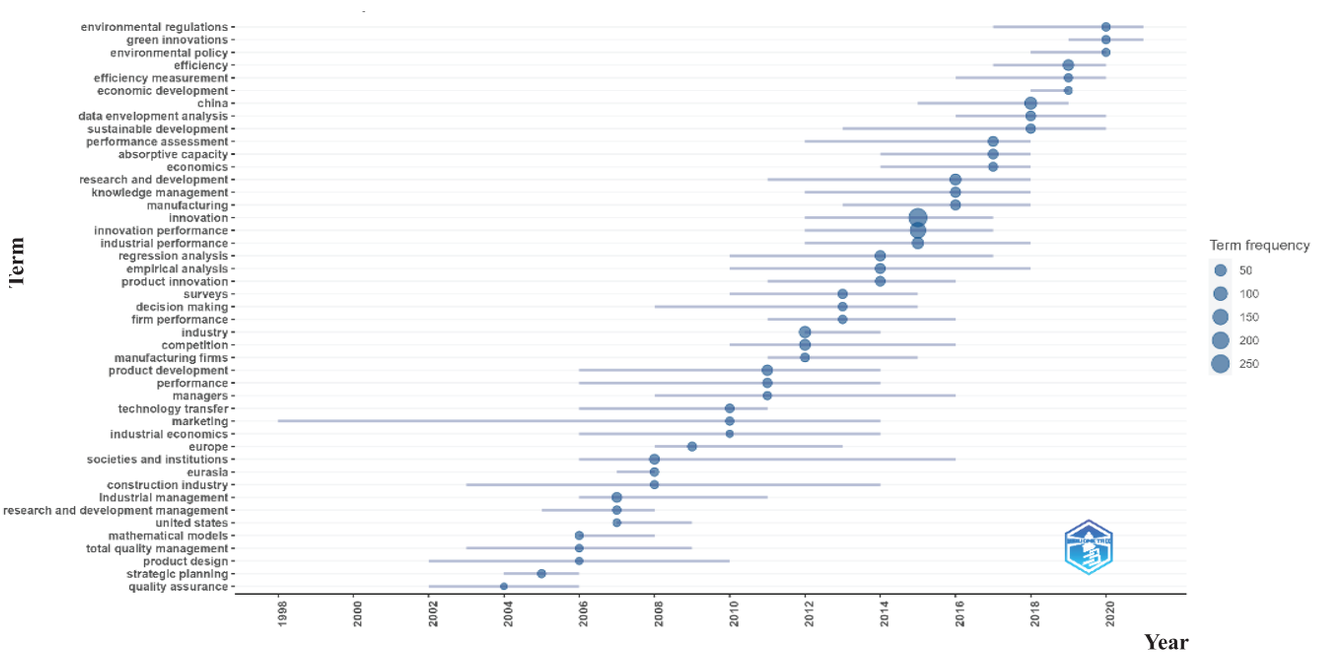


Fig. 9. Analysis of trend topics over time.

exogenous factors and external sources of innovation. Analysis enabled us to identify three periods in the evolution of innovation efficiency phenomena: 1998-2004, 2005-2015, and 2016-2022. In the recent one, green innovation has emerged as a dominant topic in the field with an increasing number of publications using innovation efficiency terms in conjunction with green innovations and in the context of environmental sustainability. Despite the rapid growth in the literature on green innovation within the domain of interest, there remains significant potential for future expansion. This was evidenced by the thematic map analysis. Green innovation and aspects of organisational performance are pinpointed as important for the domain of innovation efficiency literature but are still evolving. The bibliometric analysis, coupled with the literature review, revealed that innovation efficiency is multifaceted, and there is no universally established framework to assess innovation efficiency owing to its complexity. Identifying the appropriate set of input and output variables for the quantitative measurement of innovation efficiency is crucial for the field to progress. More research is needed using microdata with detailed information on innovation inputs and outputs that would allow us to better understand the firm innovation process. Discussing future research, the multidimensional measurement of innovation and innovation efficiency should be studied in a specific local context, taking into account externality and spillover effects, which are critical characteristics of innovation.

This study may benefit researchers, policymakers, and practitioners in several ways. A comprehensive review and the discerned intellectual structure of innovation efficiency via bibliometric analysis might aid scholars in better understanding the concept and applications of innovation efficiency. Policymakers, business, and industry leaders could reflect on the factors that have been discussed to better prioritise investment decisions and work towards enhancing the efficiency of innovation initiatives in their respective organisations and regions.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study is available on request from the corresponding author.

CRediT author statement

Hien Thu Pham: Conceptualisation, Methodology, Validation, Writing; Hoang Giang Nguyen: Data curation, Visualisation, Writing; Alexandra Bratanova: Data collection, Conceptualisation, Methodology, Validation, Writing - Review and Editing; Vu Hoang Dat: Data analyst, Visualisation, Writing.

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COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

ETHICS

No sensitive or personal data was collected or used in the research associated with this article.

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An assessment of the current situation and recommendation of management scenarios for municipal solid waste management in Ho Chi Minh city

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Abstract:

Ho Chi Minh city (HCMC) is currently facing a critical problem of the uncontrollable municipal solid waste (MSW). The most common waste disposal practice in the city is landfilling, but this is not a sustainable solution. From 2010 to 2022, the amount of waste generated has increased annually, from 6,000 tons/day to 9,200 tons/day, with an average growth rate of 6-8% per year. This study calculated the average emission factor of various districts in the city such as districts 1, 3, etc. at 0.83 kg/capita/day and district Binh Chanh, Cu Chi, etc. at 0.73 kg/capita/day and forecasted that the amount of waste will reach approximately 16,100 tons/day by 2050. Currently, 80-90% of collected MSW is landfilled, while only 10% is recycled. Composting and energy recovery practices are rarely used. This paper reviewed the current solid waste practice in HCMC and proposed four management scenarios to develop a sustainable solid waste management system. The first scenario is landfilling, which involves non-segregated waste disposal at the source. The second scenario is recycling, which involves segregating waste at the source for recycling, reuse, and waste reduction. The third scenario is composting, which requires using a mechanical-biological treatment plant for sorting, composting, and producing fuel from waste. The fourth scenario is waste-to-energy, which uses a waste incineration plant to generate energy from waste.

Keywords: **current status, municipal solid waste management, scenario, solution.**

Classification numbers: **2.2, 7**

1. Introduction

Currently, the development of industrialization has led to a surge in urbanization, resulting in the generation of more and more waste to the point of explosion. This problem causes major ecological changes in the direction of harming our planet. Environmental sanitation is a pressing concern in urban Vietnam. The increasing amount of household waste has put pressure on the government to solve the problem of waste disposal as landfills become overburdened. Technical solutions, both domestic and international, are being sought to comprehensively address these pollution sources, which are of interest across all industries and sectors.

While existing technologies such as burying, non-recovery incineration, composting, and recycling, have been suitable solutions in Vietnam in previous years, there is now urgent demand for household waste treatment across the entire country and especially in HCMC. These solutions have not been fully perfected, and secondary sources of pollution (odour control, leachate control, and minimization of landfill areas) have not been completely treated. In addition, landfilling takes up a considerable amount

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of land, wasting a large source of material that could be used for incineration and heat recovery or for generating energy from this process.

Around the world, several solid waste treatment technologies have been implemented such as anaerobic landfills with or without gas recovery and semi-aerobic landfills, which are a widely-used technology and the most popular worldwide [1-3]; composting, which is a waste recycling process based on biodegradation under anaerobic and aerobic fermentation conditions, producing stable and sterilized compost products [4]; burning with and without energy recovery [5, 6]; energy recovery waste incineration, which is a promising technology, especially for developing countries, that turns waste into a usable form of energy [5]; and the production of solid fuels and pyrolysis [5, 6]. Although many treatment technologies have been applied in solid waste management, not all have been successfully implemented [6]. The selection of treatment technology for each locality will depend on an assessment of advantages and disadvantages, site area, operation techniques, economy, and environmental factors. In Southeast Asian countries, where climate conditions are similar to Vietnam, the authors choose integrated treatment solutions in the context of increasing solid waste with economic development. For example, a study in Sepang city, Malaysia, has an organic solid waste composition of 73.2%, with high moisture content in their garbage. The authors suggested that an integrated treatment technology of recycling, composting, and incineration is the best and most suitable alternative for the Sepang area [7]. MSW is considered a renewable energy source in Thailand. Therefore, a study in Bangkok proposed two integrated solutions for sustainable MSW management: the first being composting and gasification in case there are market opportunities for compost products and the second being anaerobic and gaseous decomposition if more importance is given to biogas production and power generation [8]. MSW in the Philippines is treated in three forms: 57% landfilling, 32% incineration, and 11% recycling [9]. MSW in Malaysia is 80-95% landfilling and 5% recycling, while composting and energy recovery are rarely done [10]. The MSW treatment method in Iran is geared towards environmentally sustainable solid waste treatment technologies with segregation at the source, landfill with gas recovery, composting, and incineration for power generation [11].

An assessment of the current situation and a proposal for solid waste management is a topic that attracts the attention of many scholars worldwide. UN-Habitat (2010) [12] showed that the biggest challenges faced by developing countries in solid waste management are the low collection rate and incorrect or unsafe MSW disposal methods. Malaysia has proposed reducing the amount of waste sent to landfills by sorting waste at the source, recycling, and using combustible MSW components as fuel to generate heat for power plants [13]. In a four-year study (2015-2019) on MSW management in Indonesia, the most optimal scenario was when the percentage of waste incinerated for electricity remained constant annually, but the percentage of 3R treatment increased, limiting the amount of waste sent to landfills. This study is highly feasible as Indonesia's waste is similar to Vietnam's, and reducing the amount of waste sent to landfills means a reduction in land investment costs and environmental pollution [14]. A sustainability assessment of the waste management system for Mexico City proposed a sustainable solution of incinerating waste to recover energy. These results confirm that Mexico city's decision to use waste incineration is a sustainable method from environmental, economic, and social aspects [15].

HCMC is the largest city in Vietnam in terms of population and scale of urbanization. It is also the centre of economy, politics, culture, entertainment, and education in Vietnam. The city is facing challenges in which the rate of waste growth is increasing rapidly [16], requiring an optimal waste management strategy. The trend of MSW generation

over the period 2010-2020 shows that MSW is increasing by 3-8% annually [17].

Currently, in HCMC, 69% of MSW management is treated by sanitary landfill technology, 20% is used for composting, and 11% is incinerated, which cannot be a sustainable solution in the future [18]. Combustion helps to significantly reduce the volume, but the cost is high and the impact of discharging non-decomposing organic matter into the environment is unacceptable, therefore this is not a solid waste treatment option. Composting requires a lot of funding, time, and odour release into the surrounding environment. This practical recycling cannot remove all waste, as there will be a significant amount of waste backlog. The task of sustainable waste management is difficult because it requires consideration of the diverse factors mentioned above, namely, the social, economic, technical, and other concerns related to environmental conservation. Integrating waste management strategies that are environmentally friendly, economically affordable, and socially acceptable is an important step.

Since 1998, solid waste management has been addressed by the Party and the State in policies and directives, with Directive 36 of the Politburo-Central promoting the use of clean technology, minimising waste generation, and consuming fewer resources and clean energy [19]. Resolution 41/2002 encourages recycling and the use of recycled products, as well as the collection and treatment of used products [20]. Decree 38/2015 by the Prime Minister on waste and scrap management emphasizes the application of the 3R principles of waste reduction, reuse, and recycling, which play an important role in solid waste management [21]. Decision 491 by the Prime Minister approves the adjustment of the national strategy for integrated solid waste management until 2025, with a vision to 2050. Specifically, by 2025, 100% of solid waste will be source-separated and 100% of the total amount of solid waste will be collected of which 90% will be recycled, reused, energy-recovered, or used for organic fertilizer production [22]. Green growth strategies will be implemented with policies related to natural resource conservation and utilisation, renewable energy use, 3R in place of plastic bags, and sustainable production and consumption [22].

The proposal of the national strategy on 3R of waste management - reduce, reuse, and recycle, specifies the following issues: (1) Mechanisms to encourage reduction activities; (2) Policy development for the recycling market; (3) Development of appropriate tax structures for the industry; and (4) Mechanisms for establishing a recycling industry [16]. Additionally, the government should consider including the following activities in the strategy: (1) Integrating reduction activities at the source with community-wide efforts; (2) Introducing the concept of sustainable consumption in Vietnam through pilot projects; (3) Introducing clean development mechanisms in Vietnam through pilot projects; and (4) Sharing experiences in waste recycling into compost through associations and social organizations. In addition, recycling and recovery activities need to focus on the following issues: (1) Enhancing the recovery of used products for reuse for the same purpose or finding an alternative use; (2) Reuse mainly focusing on beverage containers and packaging materials, which are circulated through a closed-loop system, e.g., production - circulation - consumption - circulation - production; (3) Encouraging recycling facilities by collecting used products, processing or reprocessing them into original products or creating new products; (4) Effectively implementing reuse and recycling in industrial parks by establishing an information system to exchange waste, or, in some cases, waste that needs to be disposed of in one place can become input materials at another.

Thus, in addition to the decisions and decrees on solid waste management according to 3R, HCMC must have appropriate MSW management solutions. Therefore, the purpose of the paper is to propose solutions for domestic solid waste treatment in HCMC based on the current state of waste management, bringing a certain environmental and economic efficiency to the city.

2. Methods

One of the biggest challenges in this study is the limitation of data. There are many sources of data on the current status of solid waste management in the study area, but they are not continuous over time and space and are not regularly updated. For example, in the HCMC Environmental Status Report for 2019, the data on components and quantities remained the same (citing data from 2010-2015). The data sources are also inconsistent with each other, meaning that data on the same location and at the same time may differ, making it challenging to select and analyse data in this study. Therefore, in this paper, we re-evaluate the current status of MSW management in HCMC, which is the basis for forming the most sustainable and optimal treatment options.

2.1. Method of data collection

The data is collected from the following sources: (1) National State of the Environment reports of the Ministry of Natural Resources and Environment; (2) Environmental Status Report of HCMC Department of Natural Resources and Environment; (3) Environmental report of Urban Environment Company; and (4) the Statistical Yearbook.

2.2. Method of investigation

Determine the number of survey forms: To better understand the situation in the research area and related subjects, the study conducts surveys and field investigations in districts and towns throughout HCMC. Using a survey questionnaire for field investigations is suitable for many subjects and has high accuracy in research. The number of survey questionnaires is based on the total number of households in HCMC (Table 1), calculated using Yamane's formula (1967) [23]:

$$n = \frac{N}{1+N(e)^2}$$

where n: the required number of questionnaires for the survey; N: total number of households (N_{2020}=2,559,817 households); e: expected percentage error (5%).

For example, the study area in Thu Duc city, with 16 urban districts and 05 suburban districts, has 2,559,817 households [24]. Thus, the number of questionnaire samples for the whole study area is 400 votes. With *e* being 0.05 acceptance error, a total of 420 questionnaires were sent out for evaluation.

2.3. Method forecasting

To forecast the total amount of MSW generated in the study area until 2050, this study relies on the forecasted population in the area. The population forecast is estimated using the improved Euler formula:

$$N_{i+1} = N_i + r \times N_i \times t$$

where: N_{i+1}: the current population of the year being calculated (people); N_i: the current population of the city (people); t: the time difference between years; r: the population growth rate, with r=1.02% (2020), r=0.95% (2021-2050).

The amount of generated solid waste from household activities is calculated as:

$$R_{MSW} = N_{i+1}.g.365/1000 \text{ (tons/year)}$$

where R_{MSW} is the amount of generated solid waste during the period being considered (tons/year); N_{i+1} is the population in the period being considered (people); g is the waste disposal standard (kg/capita/day).

The amount of collected MSW is calculated as:

$$R_{collect} = R_{MSW} \times P$$

where P is the collection rate (%/year).

2.4. Method of determination of waste generation

A random 10 households were selected for each district. Carry-out bags for garbage collections were weighed on a scale at the same time the next day for a total of three times a week for one month. After collection, the garbage was dumped on the tarpaulin for sorting, determining the volume of each type of balanced garbage, and recording the results on a prepared form.

A record of the weight of the garbage and the demographic number of each household was used to calculate the waste generation by:

$$\text{Waste generation} = \frac{\text{Household garbage weight}}{\text{Demographics}}$$

2.5. Method of determining waste composition

Sampling in the districts was conducted and 200 kg of garbage was analysed according to Environmental Protection Agency (EPA) (2002) [19]. The method was as follows (Fig. 1):

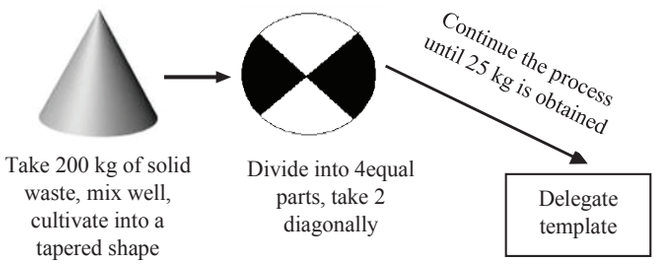

Fig. 1. Solid waste sampling method.

In each district, garbage was collected and sorted 3 days per week over 4 weeks and assessed according to the following equation:

$$\text{Ingredients \% by type} = \frac{Weight\ by\ type}{Total\ waste\ of\ sampling} \text{ x } 100\%.$$

Generally, the entire assessment process for the recommendation of scenarios for MSW management is shown in Fig. 2.

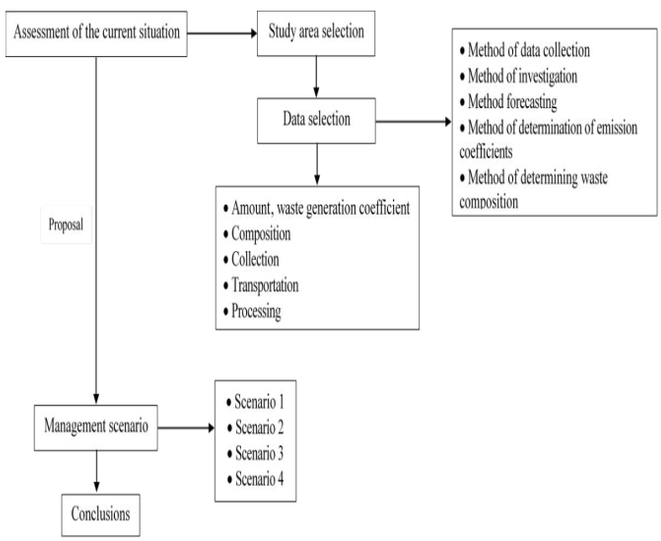

Fig. 2. Overview of the study procedure.

3. Results

3.1. The current status of MSW management in HCMC

The quantity of MSW generated: Based on the survey results from the HCMC Department of Natural Resources and Environment (DONRE) in 2023, the quantity of MSW in the city's area over the years is shown in Fig. 3.

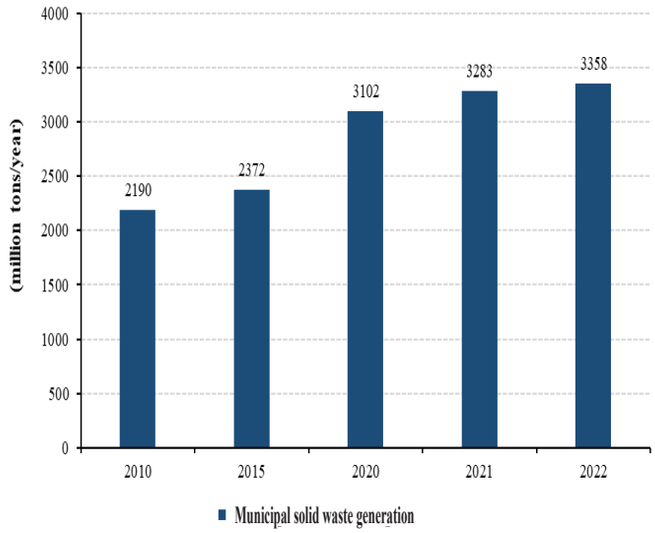

Fig. 3. The quantity of MSW in HCMC over the years. Source: HCMC DONRE (2022) [24].

In terms of scale, the period from 2010 to 2015 saw an annual increase of 2-4% in waste production. From 2015 to 2022, the quantity of waste increased rapidly with an annual growth rate of 6-8%. This situation is attributed to the rapid pace of urbanization and high population density, coupled with the lack of awareness among citizens in waste segregation for reuse and recycling at the source. As a result, the city is facing a rapid increase in waste, which is placing significant pressure on the environment.

The quantity of waste generated in each district and county is determined by weighing the waste from each discharge source. The method for determining the amount of waste is presented in detail in the research methodology section.

From the quantity of waste surveyed from the districts over three days/week carried out for one month, the average volume of waste of each waste

discharge unit generated in a day is also known as the emission factor. The calculation results are shown in Fig. 4.

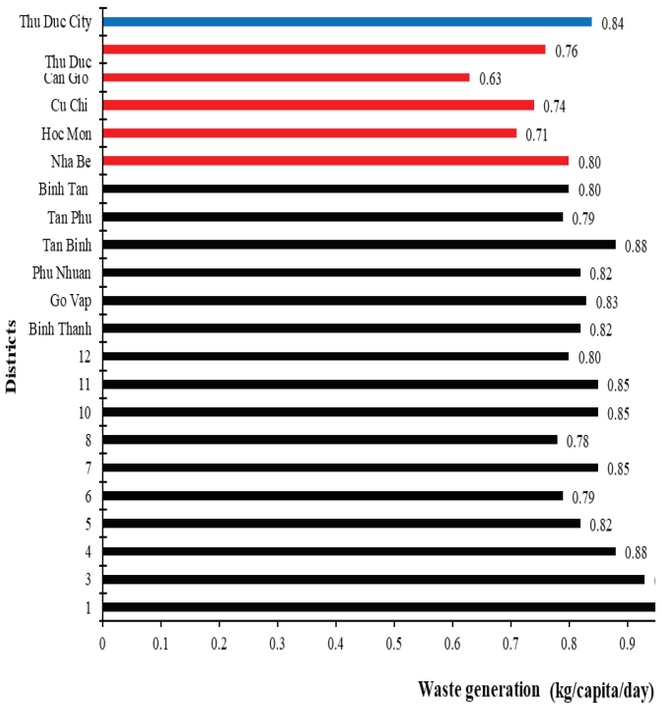

Fig. 4. Waste generation per district. Source: Authors' calculation.

The results of Fig. 4 can be seen that the waste generation of the districts does not have a big difference, an average person is about 0.83 kg/capita/day. However, in the central districts (districts 1, 3, 4, 7, 10, 11, Tan Binh) the waste generation (0.85-0.95 kg/capita/day) is higher than remaining suburban districts (0.78-0.83 kg/capita/day). However, there is a significant difference of about 0.3 kg/capita/day when comparing the discharge levels between the central and suburban districts. Thus, on average, the quantity of MSW discharged is estimated at approximately 0.81 kg/capita/day, and this data is also used as a basis for forecasting future waste generation volume. To compare the waste generation of HCMC to other regions, this study collected inherited information on the waste generation of several cities in the country [16], as shown in Fig. 5.

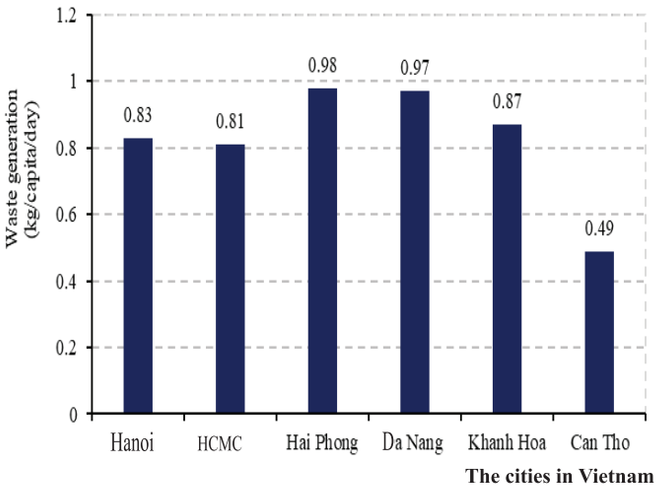

Fig. 5. Waste generation comparison chart of various cities in Vietnam. Source: Authors' calculation.

Based on Fig. 5, HCMC and Hanoi exhibit similar waste generation rates due to similar levels of urbanization and industrialization. Conversely, waste generation in Hai Phong, Da Nang, and Khanh Hoa is high due to the rapid development of industrial parks, coastal urban areas, and tourist destinations that attract a large number of domestic and foreign tourists. Although Can Tho is a large city in the Mekong delta region, its waste generation is relatively low compared to other urban areas. This is because the region's river tourism has not yet fully developed, and many agricultural occupations are under cooperatives. Furthermore, the infrastructure has not yet implemented or upgraded a new highway in the town, and investment in the province remains limited. Thus, the standard of living in Can Tho is not as high as in other cities, which results in a lower waste generation rate.

Composition of MSW: Fig. 6 provides the waste component results for the entire city by indicating the weight ratio of each type of waste to the total weight of the waste. This allows us to determine the percentage ratio of each waste component in HCMC.

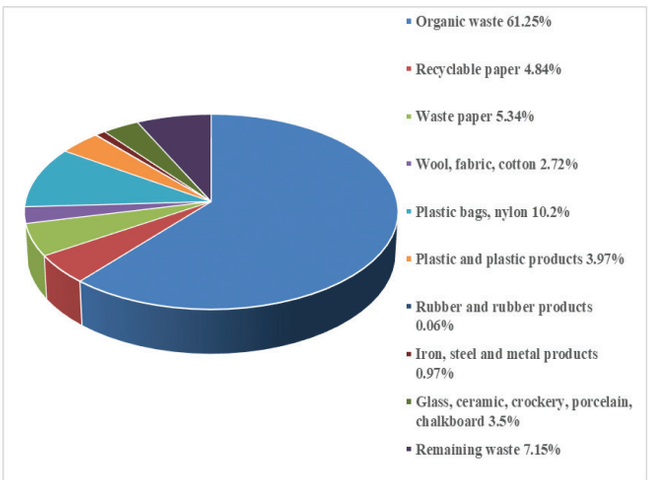

Fig. 6. Solid waste composition in HCMC. Source: Authors' calculation.

The waste composition of the city is diverse and comprises ten different types of waste, with organic waste being the most common due to its biodegradable nature. Other common types of waste include nylon bags and paper. This research categorized the waste components according to Decision No. 12 of the People's Committee of HCMC dated May 17, 2019, which mandates the classification of MSW at the source and proposes effective waste treatment measures. Thus, this work categorizes the waste components into three main types: organic waste group, comprising 61.25% (leftover food and fruit and vegetable peels); recycling, reusing waste group, comprising 31.6% (plastic bags, other plastics, rubber, paper, bottles, and jars); and the remaining waste group, comprising 7.15% (chemical containers, broken fluorescent bulbs, and expired medicines) of the total waste.

The composition of waste in the study area is similar to that of developing countries in the ASEAN region, which is mainly organic waste with an average of over 50% [25]. In Sepang, Malaysia, organic solid waste constitutes 73.2% of the total waste with a high moisture content of 80-95%. Only 5% of waste is recycled, while no energy recovery or composting is carried out [26]. In Indonesia, 60% of MSW is organic waste, followed by plastic (14%), and paper (9%) [27]. The composition of MSW in Thailand is mainly organic waste at 64% of the total waste, paper at 8%, plastic at 17.6%, and metal at 2%. Of the total waste, 17.65% is recycled, 25.66% is sent to landfills, 1.52% is burned, and only 1.82% is composted [28]. Thus, countries with developing economies have a high proportion of organic waste, which is similar in composition to that of Vietnam. Vietnam still treats their waste in the traditional way: landfilling and recovering/recycling of plastics, metals, and paper. Composting technology is suitable for Vietnam's amount of organic waste, however, it is still a waste of resources.

Current status of MSW collection segment: A survey of waste collection and cleaning in districts and towns was conducted by the public sanitation team of the utility service company and community waste collection groups. In 2022, the waste collection rate in HCMC reached 90%. However, like other developing cities, the waste collection rate in HCMC varies by location. Specifically, the collection rate in 13 inner city districts is 100%. Meanwhile, it is 80-90% in 6 outer suburban districts and 70-80% in rural districts [24]. In reality, the amount of collected waste is still low, and most of it is still uncontrolled and not properly disposed of. In fact, the amount of waste collected is still low, mostly from households that do not transfer it directly, but instead leave it out in public waste containers or dump waste into the city's canals. Sometimes, households will self-treat by burying waste in the garden or dumping it in vacant lots in suburban districts such as Cu Chi and Can Gio [16, 24].

Current status of MSW transportation segment: Collection and transportation networks for solid waste are operated by the Urban Environment Company, Public Service Companies, and the Agricultural Transport Cooperative. The network collects and transports MSW from designated points to transfer stations and then to processing clusters located within the city. Although the MSW transfer station system has

been established, most transfer stations are temporary or have not received enough investment to meet environmental protection requirements. They also face difficulties in terms of location, scale, and distance, which affect the surrounding environment.

Current status of MSW treatment segment: Like many cities in Asia, disposal of solid waste in landfills is the predominant form of waste disposal in HCMC. The MSW in the city, after being collected, is brought to four solid waste treatment centres as shown in Fig. 7.

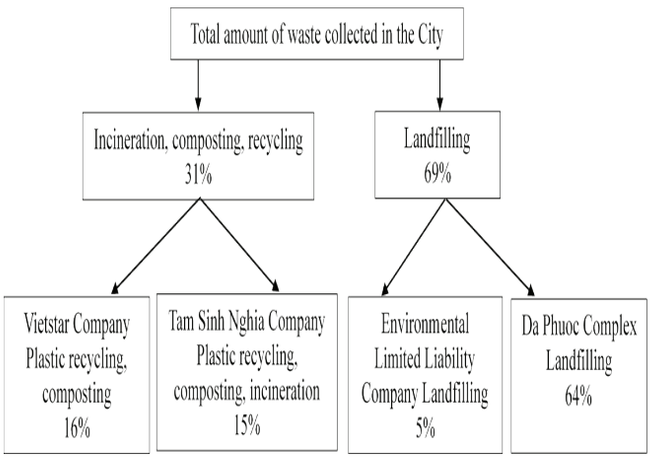

Fig. 7. Solid waste treatment flowchart in HCMC.

Currently, the majority of waste treatment technology in the city comprises landfill (69%), while incineration, composting, and recycling methods account for the remaining 31%. The Da Phuoc landfill is the primary urban solid waste treatment facility, receiving nearly 70% of the total waste. However, according to a survey conducted by the author's team, almost 80-90% of the collected solid waste was sent to landfills, with only 10% being recycled, and composting and energy recovery practices being rare. The reason for this issue can be explained as follows: firstly, the waste is not sorted at the source, resulting in compost product containing impurities, being of low quality, and difficult to consume. Secondly, the construction and operation of a waste incineration power plant are high, while funding sources are limited [29].

3.2. Forecasting the quantity of MSW in HCMC until 2050

Population growth poses a significant challenge in managing the increasing quantity of garbage generated in the city. This study estimated the quantity of MSW that could be generated by 2050, as shown in Fig. 8. Based on forecast data on population growth, GDP forecast increases, and report in the "HCMC solid waste planning 2019", per capita emissions tend to steadily increase at a rate of 0.02-0.03 kg/capita/day [30]. This result is consistent with research from other developing countries such as Malaysia [31] and Thailand [32]. Therefore, the study relies on this data as the basis for forecasting future waste generation.

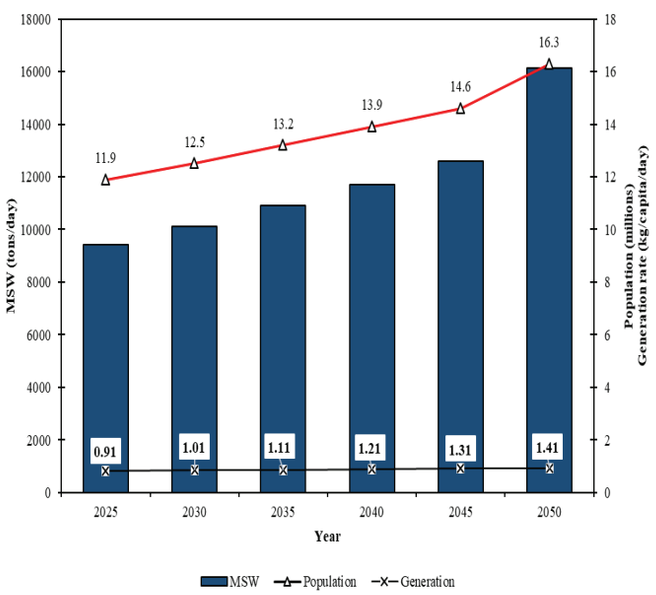

Fig. 8. Forecasting the quantity of MSW generated to 2050. Source: Authors' calculation.

Referring back to Fig. 3, in the year 2022, the total amount of MSW generated is approximately 3.3 million tons/year, which is equivalent to 9,200 tons/day. It is projected that by 2050, the total amount of MSW generated will be approximately 5.8 million tons/year, equivalent to 16,100 tons/day. It can be seen that, along with population growth, the amount of MSW is expected to increase almost twofold compared to the current amount generated as this increase depends heavily on the economic growth rate.

3.3. Proposed management scenarios

To meet the growing demand for waste management in the city due to urbanization, an optimal waste management scenario needs to be chosen. The current waste management model has many limitations, and therefore, a waste treatment planning direction until 2025 and a vision until 2050 have been proposed. To achieve this, advanced and modern treatment facilities are suggested to reduce landfills, conserve land resources, recover energy and biomass, and reduce greenhouse gas emissions. The proposed aim is to reduce the landfill rate to no more than 10% by 2050 [33, 34].

In building a scenario for HCMC, the study relies on integrated solid waste management, which considers the entire waste management cycle, from generation to final disposal. The proposed scenario aims to optimize resource recovery, minimize waste generation, promote sustainable economic development, and reduce the negative impact of waste on communities and the environment. The four scenarios proposed by our research group for a sustainable solid waste management system are based on the principles of integrated solid waste management.

Scenario 1: Non-classification of waste at the source: Scenario one (Fig. 9) is based on the reality in many urban areas, where a significant proportion of waste is sent to landfills, such as Hanoi (89%), Da Nang (90%), and Can Tho (80%). Despite having regulations for waste classification at the source, the proportion of sorted waste is still low. For example, in HCMC, 69% of solid waste is treated through landfilling without being classified at the source, and recycling and material recovery are still informal. Although the city has implemented waste classification at the source, there has been little progress, and most people still mix different types of waste. The landfills in the study area are open-air sites that have leachate treatment but do not collect gas. In this scenario, waste collection units at containers do not sort waste, and transfer stations are used to store and transport waste to landfills.

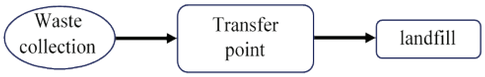

Fig. 9. Waste flow diagram of Scenario 1.

Scenario 2: Waste sorting at the source for recycling, reuse, and waste reduction: Scenario two aims to improve the current waste collection system by sorting recyclable waste at households based on the city's waste classification program, which divides waste into burnable and non-burnable categories (Fig. 10). This sorting method is already used in some localities, such as Can Tho and Hanoi. Under this scenario, all collected waste will be treated at sanitary landfills, and full compliance with environmental regulations will be ensured. By sorting waste at the source, this scenario aims to reduce the amount of generated solid waste and promote recycling and reuse of waste. All waste will be disposed of at sanitary landfills to ensure safe and sustainable waste management practices.

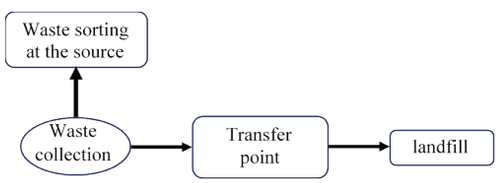

Fig. 10. Waste flow diagram of Scenario 2.

Scenario 3: Mechanical-biological treatment plant for sorting, composting, and producing refuse derived fuel: Scenario three addresses the challenge of managing waste in areas with numerous rendezvous and transit points, which can cause environmental pollution (Fig. 11). Implementing recycling, reduction, and reuse strategies in these areas is particularly difficult. To achieve the 3R goal of waste management, this scenario proposes converting waste into energy in the form of refuse-derived fuel. This scenario combines integrated processing, where a mechanical-biological treatment plant sorts, recycles, and composts waste simultaneously. The waste is sorted and separated into ferrous metals, organic, and inorganic components. The inorganic component, which includes plastic, paper and cardboard, textiles, wood, and rubber, is processed

to remove refuse-derived fuel and used as fuel for incineration or other thermal energy uses. Organic waste accounts for over 70% of the waste and is primarily processed biologically to produce compost. Biogas is the main product in the composting plant.

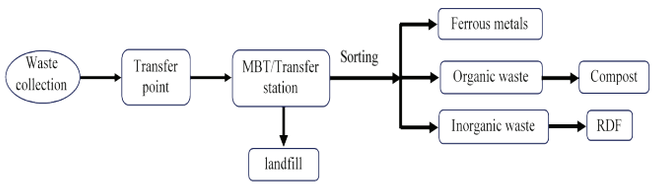

Fig. 11. Waste flow diagram of Scenario 3.

Scenario 4: Incineration plant waste to energy: The treatment of municipal waste has become a challenge for many localities due to overloaded landfills and outdated incinerators that pose environmental pollution risks and health hazards to the community. To address this issue, this study proposes a scenario that involves converting waste into sustainable energy, in line with the city's integrated waste management policy. This approach focuses on high-tech applications and aims to reduce the landfill rate to less than 10% after treatment by 2050, which is consistent with the trend that developing countries are pursuing, as well as international conferences on global climate change such as COP26 in November 2021, where countries committed to reducing emissions and using renewable energy in the future.

Scenario shown in Fig. 12, the waste-to-energy (WtE)/incineration plants include transfer stations where the waste is transported directly to the incinerator for energy recovery with emission control. Eliminating transfer stations will reduce environmental pollution and transportation costs.

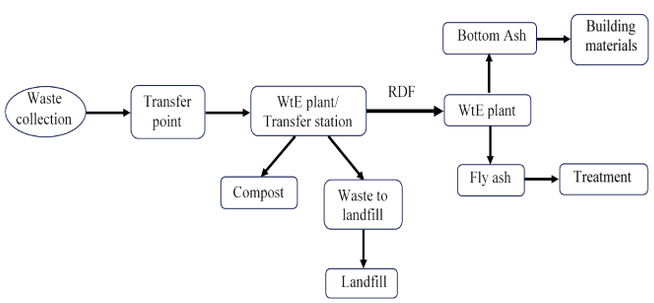

Fig. 12. Waste flow diagram of Scenario 4.

Using four previously proposed scenarios, the research team will establish criteria using the Analytic Hierarchy Process (AHP) in the next study, which is a tool of the Multi-Criteria Analysis method to evaluate scenarios. This evaluation will compare the economic benefits, the impact of waste treatment on the environment, and the social benefits of specific waste treatment scenarios for HCMC. The results obtained from this evaluation will assist decision-makers in selecting a sustainable waste management system.

4. Conclusions

HCMC is a metropolis of Vietnam, characterized by fast-paced economic growth and rapid industrialization and urbanization. However, this continuous development has come at a significant cost to the environment, with serious negative impacts resulting from human activity. The results of this investigation show that the current technology and strategy for managing MSW in HCMC are outdated, with most of the unsorted waste being landfilled, resulting in secondary pollution and consuming a considerable amount of land. The waste collection system is also inefficient, with open-air bins concentrated in residential areas, causing pollution and affecting people's daily lives. Therefore, the city needs to adopt a sustainable solid waste management model, innovate waste treatment technology, recover energy from waste, conserve resources, reduce the land used for waste treatment, limit emissions, and minimise environmental pollution. It is essential to realize that sustainable economic development requires a balance between economic growth and environmental protection.

This study evaluated the MSW management system in HCMC and provided solutions for sustainable solid waste management. Through the survey process, this study calculated the average emission factor of Districts 1, 3, etc. as 0.83 kg/capita/day and the districts of Binh Chanh, Cu Chi, etc. as 0.73 kg/capita/day. Therefore, on average, the estimated amount of solid waste generated per day in the research area is about 0.81 kg/capita/day, which also serves as the basis for predicting the amount of solid waste to be generated in the future. This study proposed four scenarios for effective sustainable waste management, considering the environment, society, and economy.

To find the most optimal technology from the proposed scenarios, the next research direction is to comprehensively evaluate the four scenarios (burying, recycling, composting, and incineration for electricity generation) using an analytical hierarchical process (AHP). This evaluation will involve experts who will provide their opinion on the most optimal technology. The results will assist planners in making informed decisions on waste management strategies, policies, and investments in new waste treatment facilities in HCMC and neighbouring areas.

CRediT author statement

Phuong Giang Le: Data Collection, Writing; Hung Anh Le, Xuan Thang Dinh, and Huu Hai Trinh: Co-authors who provided research guidance.

COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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Suggestions on extended producer responsibility mechanism in Vietnam from international experiences

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Abstract:

Extended producer responsibility (EPR) serves as a policy instrument, ensuring that manufacturers and importers of specific products bear responsibility for their collection, recycling, and disposal once consumed, thereby alleviating the public financial burden of waste management whilst enhancing recycling rates. Registration, an integral component of EPR systems, denotes the identification of obliged manufacturers and importers, and the accumulation of sales data for products subject to EPR. The principal functions of the registry encompass: delineating manufacturers and importers with EPR obligations; reporting aggregated data; and overseeing the adherence of manufacturers and importers in executing their extended responsibilities. This paper encapsulates the experiences of several countries with respect to the organisation and administration of registration agencies for manufacturers and importers of packaging, proffering potential recommendations for Vietnam.

Keywords: **extended producer responsibility, plastic packaging, register.**

Classification numbers: **2.3, 7**

1. Introduction

Recognising the significance of collective efforts to address the global plastic waste crisis, Vietnam has pledged to undertake robust actions towards reducing plastic waste to safeguard its ecological environment. In 2017, Vietnam formally joined 127 countries that approved the United Nations Environment Council Resolution of the United Nations Environment Programme concerning plastic waste and ocean microplastics. On 4 December 2019, the Prime Minister issued Decision No. 1746/QD-TTg, signifying the national action plan on ocean plastic waste management until 2030, and subsequently, on 20 August 2020, Directive No. 33/CT-TTg was released, emphasising the strengthening of plastic waste management, reuse, recycling, disposal, and reduction. Recognising the enhancement of policies and legislation on plastic waste management as one of the priorities, the EPR - the obligation of manufacturers and importers to recycle waste - has been included in the new Law on Environmental Protection (2020). Further, ancillary documents detailing the Law have been promulgated to guide the implementation of EPR for obliged manufacturers and importers.

EPR is an environmental policy grounded in the "Polluter pays" principle, obligating manufacturers and importers of certain products (or so-called obliged producers) to be responsible for the collection, recycling, and disposal of post-consumer products. This not only reduces the public financial burden of waste management but also enhances recycling rates. The adherence to EPR is meaningful and necessary in the current context of Vietnam to

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improve packaging waste management efficacy.

To ensure that the EPR scheme operates transparently and fairly, it is essential to establish a registry of obligated companies. Such a registry would identify these companies, thus curbing non-compliance. Globally, this registry may be managed by a government agency or by obligated companies themselves, albeit under state regulatory supervision. Determination of which companies must register, the data they must provide, and its accessibility, along with specifications on public and confidential data, should be clearly stated in the relevant legislation. Understanding and studying international experiences in operating EPR systems for packaging and the roles and responsibilities of stakeholders in the system will aid the development and implementation of Vietnam's EPR regulations.

EPR, as defined by the Organisation for Economic Co-operation and Development (OECD), is an environmental policy approach in which producers' responsibility extends to the post-use stage of a product's life cycle [1]. EPR mechanisms require producers to assume responsibility for collecting waste products and sorting them prior to implementing disposal measures, ideally recycling. EPR programmes enable producers to fulfil their extended responsibilities by providing the necessary financial support and/or by managing the organisational and operational aspects of recycling waste from local governments, individually or collectively through intermediary organisations, known as producer responsibility organisations (PRO).

EPR mechanisms for end-of-life product management emerged in several OECD countries in the late 1980s as a solution to the mounting volume and complexity of waste management challenges. Based on the "Polluter Pays" principle, EPR policy shifts the burden of managing specific end-of-life products from the public sector and particularly local governments, to the producers. This encourages producers to (re)design their products and packaging to simplify waste management and to avoid potentially hazardous materials.

A study conducted by the OECD (2016) identified over 400 different EPR schemes, most of which are in developed countries [2]. About 90% of existing EPR systems have been implemented in the European Union (EU) and North America. All EU member states have established EPR systems for the four waste streams identified in the EU Directive: packaging, batteries (BAT), end-of-life vehicles (ELVs), and waste electrical and electronic equipment (WEEE). In North America, EPR programmes cover a wide range of products and are primarily designed and implemented at the local, state/provincial levels, with the US leaning towards tools such as deposit-return systems (DRS) and advance disposal fees (ADF). In Latin America and the Caribbean, countries like Chile, Mexico, Brazil, Argentina, and Colombia have gradually introduced their first EPR systems. The current landscape of EPR in Asia varies considerably: advanced economies such as Japan and South Korea have established regulatory EPR systems, while emerging economies like India and Indonesia are beginning to develop EPR programmes. In Africa, EPR and waste management policies are still in the early stages of research and implementation.

As an environmental tool that has been globally applied over the past few decades, EPR obliges manufacturers and importers of products and packaging to assume responsibility for their collection, recycling, and disposal. This not only reduces the financial burden of waste management but also enhances recycling rates. The mandatory implementation of EPR is meaningful and crucial in Vietnam's current context for improving waste management efficiency and alleviating public

budget strain. Simultaneously, EPR serves as a vital tool for realising the goal of developing a circular economy by accelerating efforts towards closing the material cycle and managing resources efficiently and sustainably.

2. International experiences on EPR registration mechanism for plastic packaging recycling

2.1. Overview of the position and role of the EPR registry

Registration is the identification of companies that are obligated to participate in EPR systems and to collect data on sales of products subject to the EPR. This is also a key factor in identifying manufacturers/ importers that are obligated to but do not comply with EPR regulations (called free riders).

Globally, registration is generally handled by public authorities, such as in Finland where paper manufacturers must register with the Pirkanmaa Centre for Economic Development, Transport and the Environment, or by quasi-public bodies, such as with the Alberta Recycling Authority in the Canadian province of Alberta [3]. Conversely, the process can be managed by PROs, entities that execute recycling responsibilities on behalf of producers. An instance of this is the UK, where registration information is collated by PROs (known as Producer Compliance Schemes in the UK) and subsequently forwarded to the Environment Agency or equivalent in England, Scotland, Wales and Northern Ireland [4].

The OECD Guidelines on EPR (2016) defines the purpose of the Registry as providing PROs with the means to collate information required to set fees and to identify free riders. Directive 2002/96/EC of the Council of Europe (EC) on waste of electrical and electronic equipment since 2003 mandates Member States to establish a register of manufacturers and importers to receive registration information and manage data [5].

The registry performs multiple roles, such as identifying manufacturers and importers with obligations within the EPR system, reporting collected data, and depending on its competencies, enforcing compliance where necessary [6].

The register can be operated by a state agency or by an organisation representing companies with obligations. In a scenario where there is only one PRO in the EPR system, this PRO can also carry out the registry function. However, with multiple PROs working concurrently, a separate register is required (e.g., a register in a system with many PROs is called a clearinghouse).

2.2. Examples of EPR register models in some countries

In Germany, the Central Agency (ZSVR in German) is responsible for the registration of packaging product manufacturers, the receipt and verification of data reported by manufacturers, importers (or obliged producers), and PROs, and monitors companies participating in the system. The Central Agency's registration, data reporting and all related activities are free for the first manufacturer/ importer, being funded by approved systems and industry-specific solutions.

Manufacturers and importers are subject to several basic conditions:

- Manufacturers and importers must register with the Central Agency prior to marketing packaging materials.

- Manufacturers and importers must enlist business-to-consumer packaging materials within the EPR system before introducing them to the commercial market.

- At minimum, once annually, manufacturers and

importers must report the volume (total weight) of packaging materials they distribute in the market, accompanied by specifics of the packaging material. Reports must be concurrently submitted to their chosen compliance scheme and the Central Agency.

If a producer fails to register, or registers incorrectly, they may incur a fine of up to €100,000 for each instance of non-compliance. Non-participation in any of the compliance systems could result in a fine of up to €200,000.

In Austria, the packaging registry or clearinghouse, known as VKS, is a non-profit organisation supervised by the Austrian Environment Agency (UBA). VKS's primary role is to ensure equitable competition among all packaging collection and recycling systems active in the market [7]. Its services include handling and analysis of packaging waste, monitoring system participants, maintaining a register of collection points, and distributing information to end consumers. VKS is funded through the fees levied on the responsibility organisations of the producers. The organisation comprises a CEO and five employees, a supervisory board with five members, and an advisory committee with seven members.

In the UK, the activities of the packaging EPR system registry are more limited due to the structure of the tradable credit system. The National Waste Packaging Database (NWPD) operates as a registry within the state Environment Agency. Rather than assigning collection routes, the NWPD's primary function is to facilitate information flow. The NWPD registers manufacturers, certifies recyclers, issues PRN and PERN credits, manages reports, and monitors companies evading obligations (free riders).

In Denmark, the registry (referred to as DPA-System)[1] is managed by the Danish Environment Agency and is financed from the registration fees of manufacturers and importers. DPA-System's responsibilities include: designing and operating statutory producer registers; receiving statutory registrations from all obligated manufacturers and importers; signing up for collective responsibility programmes (PROs); receiving and registering information from local authorities about local collection sites; calculating and collecting statutory fees; receiving volume reports from manufacturers and importers; providing information services to all stakeholders [8]. Organisational structure wise, DPA-System is currently managed by an eight-member executive board approved by the Minister of Environment (2020). It comprises a chairman appointed by the Minister of Environment and seven members introduced from seven typical industry associations. All registered manufacturers and importers must pay a fee to DPA-System. These fees fund the operation of the DPA System. Fees include registration fees, annual fees, and case management and handling fees for special services, if applicable. The fee is set by the Ministry of Environment once a year. Manufacturers/importers do not pay an annual fee for the first year as no reported volumes have been marketed in the previous year. Thus, the number of products of the first year that are put on the market is used as the basis of calculation for the first year and the second year with fees for year 1 and year 2 respectively. Therefore, they do not have to pay twice the annual fee and the first year's annual fee is waived.

In Sweden, from 2021, all packaging producers must register with the Swedish Environmental Protection Agency. The packaging producer must pay an annual enforcement fee to the Swedish Environmental Protection Agency of 500 SEK (Swedish Krone). Producers who delay providing the Swedish Environmental Protection Agency with regulatory information relevant to the previous year

[1]Danish Producer Responsibility.

may be subject to an environmental penalty fee of SEK 10,000.

In the Netherlands, the National (W)EEE Register, an organisation that registers electrical and electronic equipment, is responsible for establishing and managing registrations for discarded electrical and electronic equipment in the country. This organisation is mandated by the government to carry out these tasks in line with the WEEE Directive (derived from the European WEEE Directive). It is an independent organisation, registered with the Dutch Chamber of Commerce and funded by the manufacturers. The Register collects and aggregates data for reporting to the Ministry of Infrastructure and Environment and for monitoring preparation by the Dutch Inspector General for Environment and Transport. The Register provides detailed information on: the total amount of electrical and electronic equipment put on the market in the Netherlands; the total amount of electrical and electronic equipment collected and recycled; the reuse of materials from electrical and electronic equipment; and the results related to the achievement of the recycling targets set out in Annex V of Directive 2012/19/EU.

In Chile, regarding registration, micro companies (defined as businesses whose annual income from sales and services and other business activities does not exceed 2,400 UFD in the preceding year, equivalent to €73,445) are exempt from all obligations under the law; they are not even required to provide information. Small producers (less than 300 kg of packaging/year) are also exempt from EPR liability, but they must provide information about the quantity of packaging they put on the market.

In Korea, the Korea Environment Corporation (KECO), a statutory public organisation, oversees many activities in the EPR chain for all products subject to EPR. These include collecting data on product sales, monitoring and approving recycling results, and administering low-interest loans to small and medium-sized recyclers [9]. Furthermore, KECO supervises the activities of the Korea Resource Circulation Service Agency (KORA), a non-profit organisation established in 2013 from PROs based on the Act on the Promotion of Saving and Recycling of Resources 2013. KORA undertakes support activities for the EPR system, including managing EPR financial contributions from manufacturers and importers to pay for recyclers, supporting and monitoring the recycling process to achieve the required recycling rates, facilitating the resource cycle (collection, sorting, recycling, etc.), searching for markets with recycled materials, supporting initiatives, and raising awareness to achieve the goal of a zero-waste society. In terms of funding, KORA obtains its operating funds from the Korean Recycling Organisation - KPRC, that is, from the contributions of manufacturers and importers [10].

3. EPR policy development process in Vietnam

The development process of the Extended EPR policy in Vietnam began with the integration of EPR regulation within the 2005 Law on Environmental Protection. At that time, the primary impetus for developing the EPR was to devise a financial solution to the environmental degradation caused by informal recycling in craft villages. The regulation stipulated the recall of certain consumer products for recycling and disposal. Subsequently, the Prime Minister's Decision No.16/2015/QD-TTg on the recall and treatment of discarded products was enforced. This law was applied to five categories of products, namely: (i) batteries and accumulators; (ii) electrical and electronic equipment; (iii) all types of lubricants; (iv) tubes and tyres; and (v) end-of-life vehicles. However, the implementation proved to be limited due to the absence of specific regulations, guidelines, and sanctions. In particular, the time

limit for recalling and handling products applied to end-of-life vehicles from 1 January 2018 and the remaining groups from 1 July 2016. However, the actual implementation results are limited due to the lack of specific regulations and guidelines as well as sanctions.

In an effort to rectify the previous limitations, the Law on Environmental Protection 2020 was amended, introducing two articles regulating the responsibilities of manufacturers and importers, these being Article 54 and Article 55. Specifically, regulations on responsibilities for recycling products and packaging of manufacturers and importers (Article 54) and responsibilities for waste treatment of manufacturers and importers (Article 55).

In particular, within the recycling responsibility system, producers and importers have the option to fulfil their responsibility in one of several ways: self-recycling, individual contracts with service providers, authorization of third parties to perform obligations (such as PROs), or by financial contribution to Vietnam Environmental Protection Fund (VEPF).

Regarding waste treatment responsibilities, manufacturers and importers are mandated to make a financial contribution to the Vietnam Environmental Protection Fund. Going forward, it will be crucial to enhance awareness of the EPR among all stakeholders in the packaging chain in Vietnam. This includes management, obligated companies, waste collectors, recyclers (both formal and informal), and consumers of packaged products.

The Ministry of Natural Resources and Environment (MONRE) has subsequently submitted two decrees to the Government for approval: Decree 08/2022/ND-CP, which elaborates on a number of articles from the Law on Environmental Protection, and Decree 45/2022/ND-CP, which details sanctions for administrative violations in the field of environmental protection. Furthermore, MONRE has promulgated Circular No. 02/2022/TT-BTNMT, providing implementation details for certain articles of the Law on Environmental Protection, including the regulations to guide the extended responsibilities of manufacturers and importers for products and packaging.

4. Some suggestions for EPR implementation in Vietnam

International experience indicates that countries employ various management approaches for EPR programmes across different product types. Despite the diversity in approach, the primary state management functions within the EPR system typically encompass policy formulation and assessment, operation, stakeholder consultation, producer registration, certification of PROs, fee collection and disbursement, coordination of service provision, monitoring of manufacturers, PROs, recyclers, localities' technical and financial performance, and ensuring enforcement.

The roles of stakeholders in a typical EPR system can be summarised as follows: public agencies that formulate, implement, and assess policy, as well as monitor and certify participants; PROs that organise and manage the collection and recycling of discarded products on behalf of manufacturers and importers; registries or clearinghouses that collect data and allocate service delivery space (usually when there are multiple competing PROs); waste management companies and local governments providing collection and treatment services; and in developing economies, the prevalence of the informal recycling sector.

It is crucial to encourage and involve the participation of consumers and communities in promoting sustainable behaviour, particularly through waste segregation at source and the selection of eco-friendly products. The efficacy of the entire

system largely hinges on waste collection from the household level or equivalent, ideally sorted waste from recyclable and organic sources.

In EPR systems where multiple PROs compete, an intermediary coordinating organisation is necessary to ensure that collection is conducted where needed, prevents only valuable waste from being collected, and ensures that competing PROs do not duplicate service coverage, collecting end-of-life waste from the same service area or collection points. Clearinghouses are typically independent non-profit organisations, or occasionally government agencies, that help to resolve unforeseen issues arising from competition amongst PROs. Clearinghouses can also act as registries by collecting data from manufacturers or service providers, offering proprietary data management mechanisms, or identifying evasive producers ("free riders"). Additionally, in certain EPR systems, ancillary activities such as outreach, waste prevention initiatives, related research and development, anti-litter campaigns, and so on may be assigned to clearinghouses [11].

In terms of position and role, the establishment of the National EPR Council and the Vietnam EPR Council Office has emerged from the necessity for an organisation to operate the extended responsibility system of producers effectively, as well as in line with practices in countries that have implemented EPR mechanisms. This is especially relevant for setting recycling rates, registering with manufacturers and importers, identifying non-compliance cases, developing and managing databases from producers, and supporting related activities such as information dissemination, research funding, and more.

With the registry model, after examining and analysing relevant experiences, it is apparent that the clearinghouse model performs two principal roles: one as the registration agency for producers and PROs, and the other as the coordinator of information and activities when there are multiple competing PROs. This model is popular and offers numerous advantages for effectively implementing the EPR system, particularly with packaging, as well as with other product streams. Therefore, the establishment and organisation of the Vietnam EPR Council Office should align with the role and function of the clearinghouse as seen in the aforementioned countries (Fig. 1).

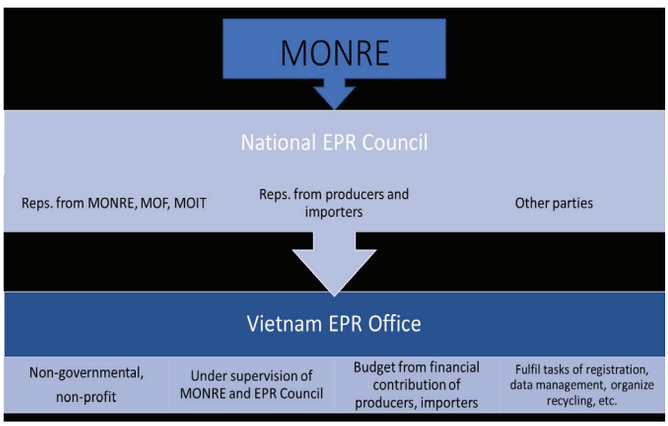

Fig. 1. Proposed model of the National EPR Council and EPR Office.

The Vietnam EPR Council Office will perform several functions including the collection of registration information, the collation of data from producers, PROs, and other necessary parties, coordinating system operations and identifying producers evading their obligations (free riders) for handling violations. Furthermore, based on its roles and duties, the Vietnam EPR Council Office will execute its responsibilities to support and propose to the National EPR Council and specialised management agencies (notably, the MONRE). It will undertake tasks such as receiving, synthesising, and organising the verification of applications from agencies and organisations wishing to receive financial support for waste recycling, collection and treatment activities. It will also submit these to the EPR Council, notify and sign support contracts with agencies, organisations receiving financial

support, and organisations that support recycling and waste treatment for manufacturers and importers. Additionally, it will execute related activities such as propagating awareness, research, cooperation with relevant domestic and foreign units and organisations. These are also functioning many registries or clearinghouses globally are currently overseeing.

5. Conclusions

EPR is an environmental policy designed to ensure that manufacturers and importers of products into the domestic market take responsibility for the collection, recycling, and disposal of their products when they become waste. This thereby reduces the financial burden of waste management while increasing recycling rates. Mandatory EPR implementation is significant and necessary in the current context of Vietnam, to enhance waste management efficiency and reduce the strain on public budgets.

The establishment of the National EPR Council and the Vietnam EPR Council Office stems from the need to create mechanisms to effectively operate the extended responsibility system of producers. Countries around the globe have already implemented EPR mechanisms, particularly in the setting up of the system for registering manufacturers and importers, identifying cases of non-compliance, developing and managing a database from the producers, and supporting other related activities such as propaganda, information dissemination, financial support for recycling and waste treatment. Their experiences suggested invaluable lessons to Vietnam on developing the EPR scheme in general and registration in particular.

COMPETING INTERESTS

The author declares that there is no conflict of interest regarding the publication of this article.

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Students' preferences for attributes of a B1 English level course: A conjoint analysis

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Abstract:

The increasing demand and requirements of the recruitment market towards foreign languages, especially English, has prompted many universities in Vietnam to consider English certificate as one of the mandatory conditions for students to be graduated. This has increased the demand for English courses. This study aims to ascertain students' preferences and willingness to pay for attributes of a B1 English level course. Through an experimental approach, we conducted a survey among students enrolled at An Giang University (Vietnam National University, Ho Chi Minh City). The findings indicate that the most significant attribute influencing student preferences for an English course is the reputation of the foreign language centres offering the course, followed by the tuition fee, assurance policies for learning outcomes, and foreign teachers. Additionally, the course duration, availability of free materials, and proximity of the language centre to the student's residence are also important factors affecting student interests. Based on these results, several implications are suggested for foreign language centres to develop effective marketing strategies aimed at attracting learners.

Keywords: **B1 English level course, conjoint analysis, preferences, student.**

Classification number: **3.2**

1. Introduction

It has been widely acknowledged that one of the aims of education is to meet societal and professional requirements. Within the context of global integration, foreign languages, particularly English, are indispensable tools for university graduates. Many organizations now require candidates to possess a certain level of foreign language proficiency, which varies depending on the specific job position.

In response to the growing demands of the labour market, university graduates must acquire a certain level of English proficiency, as dictated by the regulations of their respective universities. For instance, An Giang University mandates that students obtain a foreign language certificate at level 3 (e.g., a B1 English level certificate) or higher, as defined by the Common European Framework of Reference for Languages (CEFR), in order to be eligible for graduation and receive a university degree. Consequently, there is a substantial demand for English language training courses at this level.

Recognising this need, numerous foreign language centres in An Giang province have begun offering B1 level English courses. These courses possess various attributes aimed at attracting learners. Understanding which attributes of the English course are crucial to learners is essential for foreign language centres in

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designing effective course policies and incorporating these key attributes in their communication strategies to engage students. Conjoint analysis (CA) has been widely used to explore customer preferences for the attributes of products or services [1-3]. However, few studies apply the CA method to elicit students' preferences for the attributes of a B1 level English course in Vietnam in general and in An Giang province in particular.

Therefore, this research aimed to identify the attributes of an English course that learners prefer. The study's findings provide valuable insights for foreign language centres, enabling them to understand the crucial aspects of a B1 English level course from the learner's perspective. This understanding can guide the centres in formulating effective policies to attract and engage students in their courses.

2. Methodology

This study employed a conjoint-type experiment to collect data on customer preferences regarding the attributes of an English course. Initially, the researchers carefully selected the attributes and their respective levels for the course. The determination of these attributes and levels was based on the following steps: (1) consideration of the course attributes offered by prominent foreign language centres in An Giang province, and (2) conducting group discussions with relevant customers, including students and potential learners. The outcomes of these group discussions revealed that customers demonstrated a keen interest in factors such as the prestige of the foreign language centres providing the course, followed by the tuition fee, assurance policies for learning outcomes, and the quality of foreign teachers. A summary of the attributes and their corresponding levels for the B1 English level course is presented in Table 1.

Table 1. The attributes and levels of each attribute of a B1 level English course.

No.	Attribute	The level of the attribute		
1	Duration (50 minutes per period)	30 periods/course	40 periods/course	60 periods/course
2	Tuition fees	VND 2,000,000	VND 3,700,000	VND 4,500,000
3	Prestige of foreign language centre (1 star: bad, 2 stars: average, 3 stars: good)	1 star/3 stars	2 stars/3 stars	3 stars/3 stars
4	Distance to the centre	≤2 km	>2 km	
5	Policies to ensure output for learners	No	Learners can re-study for free if they do not pass the test for B1 level certificate	
6	Teachers are foreigners	No	Yes	
7	Document fees	Free	VND 50,000	

Source: Authors' calculation.

After identifying the attributes and their corresponding levels, we proceeded to design various course options. These options resulted in a total of 432 possible combinations of attribute levels (432=3332222). Evaluating all of these options would have been challenging for participants. Hence, we employed a fractional factorial design using the SPSS software [4] to create an orthogonal design. The outcome of this orthogonal design was 16 options, each representing a unique combination of attributes at different levels.

To gather data on students' preferences for the B1 English level course within a CA study, we conducted an online survey. The questionnaire consisted of two parts. In the first part, participants were instructed to carefully evaluate the 16 options mentioned above and rate each option using a 5-level Likert-type scale (1: strongly unfavourable, 5: strongly favourable). The second part of the questionnaire focused on collecting demographic information about the participants. In total, 188 students from An Giang University participated in the survey.

Based on the participants' evaluations of the design options, the authors employed the CA method

to estimate the part-worth utility value assigned by the participants to each level of the attributes. This estimation was carried out using the following model [5]:

$$U = \alpha + \Sigma_{i=1}^{m}\Sigma_{j=1}^{n}\beta_{ij}X_{ij}$$

where U is the total utility of the participants for an option, α is a constant, β_{ij} is the part-worth utility for level j of attribute i, m is the number of attributes, n is the number of levels of attribute i, and X_{ij} is the j level of attribute i [5].

3. Results

According to the data presented in Fig. 1, approximately 60% of the participants in the survey were first-year students (academic year 2021-2022), while second-year students (academic year 2020-2021) accounted for 26.6% of the sample population. These students are of particular significance as they are the primary focus of Decision No. 656/QD-ĐHAG, issued on 27/5/2020 by the Rector of An Giang University, which outlines the English language proficiency requirements for university students. The decision stipulates that students must attain a B1 English level certificate or its equivalent in order to obtain a university diploma.

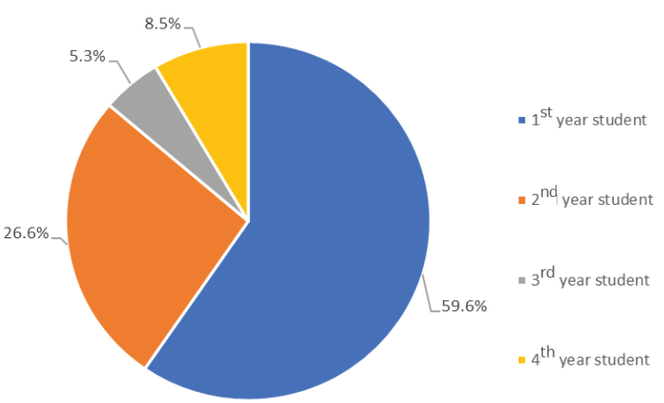

Fig. 1. Participants' information. Source: Authors' survey on information of the participants.

The participating students expressed that they are currently dedicating less time to English language learning. It is important to note that none of the students in the sample has possessed a B1 English level certificate yet. Consequently, the majority of students acknowledged the need for further training and have been seeking English language courses at foreign language centres.

Table 2 presents the results of the CA model. Part A of Table 2 demonstrates the goodness of fit of the model, as indicated by Pearson's R and Kendall's tau statistics, which reveal a correlation between observed preferences and the estimated model. Part B of Table 2 displays the estimated part-worth utility for each level of the attributes in a B1

Table 2. Results of the conjoint analysis.

Part A			
(Correlations[a])		***Value***	***Sig.***
1	Pearson's R	0.969	0.000
2	Kendall's tau	0.933	0.000
Part B			
Attributes	***Attribute levels***	***Part-worth utility***	***Std. error***
Teachers are foreigners	Yes	0.104	0.031
	No	-0.104	0.031
Document fees	VND 50,000	-0.059	0.031
	Free	0.059	0.031
Policies to ensure output for learners	Yes	0.136	0.031
	No	-0.136	0.031
Tuition fees	VND 4,500,000	0.191	0.038
	VND 3,700,000	0.382	0.076
	VND 2,000,000	0.574	0.113
Duration	60 periods/course	-0.072	0.038
	40 periods/course	-0.145	0.076
	30 periods/course	-0.217	0.113
Prestige of foreign language centre	1 star/3 stars	0.291	0.038
	2 stars/3 stars	0.582	0.076
	3 stars/3 stars	0.873	0.113
Distance from the student's residence to the centre	2 km	-0.047	0.063
	>2 km	-0.093	0.125
Constant		2.571	0.151

Note: [a]: Correlations between observed and estimated preferences.
Source: Authors' calculation.

English level course, as derived from Model (1). The findings highlight that the combination of attributes consisting of a foreign teacher, provision of free materials (i.e., documents), assurance policies for learning outcomes, a tuition fee of VND 2,000,000 per course, a course duration of 60 periods, a highly rated prestige of the language centre (3 stars), and a short distance (≤2 km) between the student's residence and the language centre, yields the highest utility for the course (U=2.571-0.047+0.873-0.072+0.574+0.136+0.059+0.104=4.198).

The research results, as depicted in Fig. 2, highlighted that the most crucial attribute influencing student preferences for a B1 English level course is the prestige of the language centre that offers the course. Following closely in importance is the attribute of tuition fee, accompanied by the assurance policies provided by the centre to learners, among other attributes.

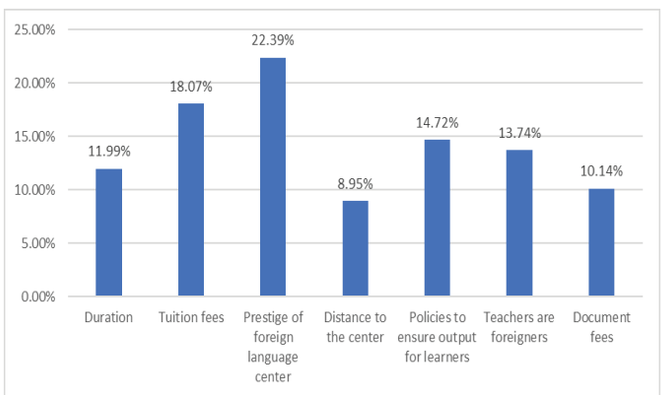

Fig. 2. The importance of the B1 English level course's attributes.
Source: Authors' calculation.

Furthermore, the estimated part-worth utility value obtained from Model (1) provides insights into the monetary value of utility. Specifically, each unit of utility corresponds to VND 6,527,000 [=(VND 4,500,000-2,000,000)/(0.574-0.191)]. This information allows us to determine the additional amount of money students are willing to pay when considering trade-offs with other attributes of the course. For instance, learners demonstrate a willingness to pay an additional VND 1,775,000 [=(0.136-(-0.136))*6,527,000] for a language centre that provides assurance policies, and a premium of VND 1,357,000 [=(0.104-(-0.104))*6,527,000] for a centre that employs foreign teachers.

The findings also indicate that students are willing to pay an extra VND 300,000 [=((-0.047)-(-0.093))*6,527,000 VND] for a course at a language centre located within a 2 km radius of their residence. In-depth interviews further support this, with more than 60% of students expressing a preference for studying near their homes to facilitate travel. Consequently, foreign language centres aiming to attract a larger number of learners should consider establishing small or medium-sized centres in residential areas, as opposed to establishing a single large language centre.

The estimated part-worth utility value derived from model (1) can be utilised to forecast the market share of student preferences for each option of B1 English level courses offered by different language centres [5]. In order to predict students' course choices, the authors employed a maximum utility model. This model assumes that individuals will select the option that provides them with the highest level of utility, and the market share of these choices can then be calculated.

To conduct the simulation, the authors developed two scenarios. The first scenario (Part A, Table 3) serves as the reference and comprises three options: three B1 English level courses offered by three language centres (referred to as Centre A, Centre B, and Centre C) in An Giang province. The second scenario (Part B, Table 3) introduces a simulation in which Centre C (i.e., option 3) offers learners assurance policies for learning outcomes and employs foreign teachers, while simultaneously increasing the tuition fee from VND 2,000,000 to VND 3,700,000. The attributes of the other options remain unchanged.

Table 3. Market share simulation scenarios.

Part A - References scenarios			
Attribute	*Option 1 Centre A*	*Option 2 Centre B*	*Option 3 Centre C*
Tuition fees (VND)	4,500,000	3,700,000	2,000,000
Duration	60 periods/ course	40 periods/ course	30 periods/ course
Prestige of foreign language centre	3 stars/3 stars	2 stars/3 stars	2 stars/3 stars
Distance from student residence to the centre (km)	2	2	2
Teachers are foreigners	No	No	No
Document fees	Free	Free	Yes
Policies to ensure output for learners	Yes	Yes	No
Part B - Simulation scenarios			
Tuition fees (VND)	4,500,000	3,700,000	3,700,000
Duration	60 periods/ course	40 periods/ course	30 periods/ course
Prestige of foreign language centre	3 stars/3 stars	2 stars/3 stars	2 stars/3 stars
Distance from student residence to the centre (km)	2	2	2
Teachers are foreigners	No	No	Yes
Document fees	Free	Free	Yes
Policies to ensure output for learners	Yes	Yes	Yes

Source: Authors' calculation.

Market share simulation results for both scenarios are presented in Table 4. In the reference scenario, Option 1 emerges as the dominant choice with a market share of 62.80%. Option 3 follows with a market share of 21.50%, while Option 2 captures 15.70% of the market. These findings closely align with the actual market shares of the foreign language centres offering B1 English level courses in An Giang province. In the simulation scenario, the results demonstrate that despite a substantial 1,700,000 VND (85%) increase in tuition fees, Centre C manages to significantly increase its market share by 14.9 percentage points, rising from 21.50 to 36.40%.

Table 4. Market share simulation results.

The service providers	Option 1 Centre A	Option 2 Centre B	Option 3 Centre C
Current actual market share (%)	64.17	10.83	25.00
References scenario market share (%)	62.80	15.70	21.50
Simulation scenario market share (%)	52.10	11.40	36.40

Source: Authors' calculation.

4. Conclusions and implications

This study utilised the CA method to ascertain students' preferences for attributes of a B1 English level course. The findings highlight several key attributes that significantly influence student preferences, namely the reputation of the language centre, tuition fees, assurance policies for learning outcomes, presence of foreign teachers, course duration, availability of free materials, and proximity to the student's residence.

Based on these results, several implications can be drawn to assist foreign language centres in developing marketing strategies to enhance competitiveness and attract learners. Firstly, it is crucial for a B1 English level course to encompass attributes that strongly resonate with and influence the interests and choices of learners, with the reputation of the language centre being of utmost importance. Centres should strive to improve teaching programs and the quality of instruction, thereby creating genuine value for learners and fostering positive word-of-mouth promotion. Secondly, the provision of assurance policies for learning outcomes is vital, as it instils confidence in learners when selecting a foreign language centre. Thirdly, the inclusion of foreign teachers is recommended to attract more students. Lastly, it is advisable for foreign language centres to continually monitor and adapt their course attributes in response to competitors' strategies, thereby enhancing competitiveness.

The paper does have certain limitations that should be considered for future research. Specifically, expanding the survey scope to encompass a wider

geographical area would enhance the generalisability of the research results. In summary, this research represents an initial and significant effort in providing insights into the preferences of customers (students) regarding a B1 English level course.

5. Suggestions for further studies

Based on the research results and an limitations, several future research directions are proposed. Firstly, expanding the survey scope to cover the entire country would yield more comprehensive and generalisable findings. Additionally, extending the research duration to maximise the sample size would ensure more representative analyses.

This research serves as a baseline and an important step towards gaining a deeper understanding of the decision-making process and preferences of customers (students) when selecting a B1 English course. It provides preliminary insights into the psychological factors influencing customers' decision-making processes. However, to apply these results to real-life cases, further practical studies are necessary, which can build upon the foundations established by this study.

CRediT author statement

Tran Chi Kiet: Literature Review, Data Collection, Data Analysis; Doan Vinh Thang: Literature Review, Methodology, Data Analysis, Writing Manuscript.

COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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Digital literacy of Vietnamese human resources

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Abstract:

The comprehensive digital transformation taking place across all aspects of global and Vietnamese societal life is both objective and inevitable. The successful execution of this transformation necessitates the development of appropriate digital human resources. Digital literacy has emerged as a paramount competence of the 21st century. Despite the qualifications and skills of Vietnam's human resources, digital literacy remains limited. The demand for digital literacy is substantial and represents an urgent requirement for Vietnam in its pursuit of establishing a digital government, society, and economy. This paper explores facets of digital literacy, analyses the current state of digital literacy amongst Vietnamese human resources, and, based on this analysis, proposes recommendations and solutions to advance the digital literacy of Vietnamese workers.

Keywords: **digital literacy, digital transformation, human resources.**

Classification numbers: **3.2, 7**

1. Introduction

The world is experiencing dramatic changes, signifying the advent of a new era strongly influenced by digital transformation. Digital transformation is the driving force of the fourth industrial revolution, wherein digital technology moulds global society and future economic activity. At its core, digital transformation is a process that induces significant changes in an object's properties by integrating information, electronic equipment, and communication technology, and enabling online connections [1]. This process demands an organised approach, a clear plan, and the involvement of all stakeholders, both internal and external to the organisation. This is often termed a digital transformation strategy, designed to swiftly and creatively harness the potential and impacts of emerging technologies [2].

Digital transformation is the process of change associated with the application of digital technology across all facets of human social life [3]. Physical assets are progressively transitioning into digital assets. Human resources within organisations and businesses are significantly affected as job roles continuously evolve and decision-making becomes increasingly reliant on the management of knowledge and skills. The operation of organisations and businesses is heavily influenced by social networks and mobile technology. Digital literacy opens opportunities for the expansion and redefinition of business markets. Digital transformation fundamentally changes entities by creatively applying digital technologies along with key resources and capabilities, thereby completely improving an entity and redefining its value to stakeholders [4]. Human resources play a pivotal role in this process. Consequently, to successfully implement digital transformation, it is essential to develop human resources possessing digital literacy.

In the digital era, evolution of production technology leads to daily shifts in jobs, with the disappearance and emergence of roles demanding new expertise and skills. A report from the International Labour Organization (ILO) indicates that Vietnam is the most affected country within ASEAN in terms of labour and employment due to digital transformation, with 70% of workers in basic occupations being impacted [5]. Thus, digital literacy is a crucial factor for achieving future success in study, research, and career development [6]. The need to develop human resources with digital literacy is an urgent requirement for Vietnam to effectively execute the national digital transformation.

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2. Digital literacy and the importance of digital literacy in the new era

2.1. Digital literacy

The term 'literacy', as per the Cambridge English Dictionary, refers to the ability to read and write. The range of concepts it describes have evolved and diversified over time, particularly in recent decades, as 'skill-based literacies' have developed in response to increasing information complexity and emerging technologies. These concepts imply critical thinking in evaluating information sourced from mass media, such as television, radio, newspapers, magazines, and the internet [7].

To navigate the complexities of the current information environment, a comprehensive and sophisticated form of literacy is required. It should encompass all skill-based literacies but should not be confined to them or any particular technology or set of technologies [7].

The term "digital literacy" was initiated in the 1990s by several authors to denote the ability to read and comprehend hypertextual and multimedia texts. R. Lanham (1995) [8] proposed one of the earliest conceptual definitions, arguing that the term "literacy" had expanded its semantic reach from "the ability to read and write" to "the ability to understand information"; however, it is presented. He emphasised the multimediated nature of digital information, asserting that digital literacy involves being skilled at deciphering complex images and sounds, as well as the syntactical subtleties of words [8].

Digital literacy incorporates Information & Communication Technologies (ICT)/computer literacy, information literacy, technological literacy, media literacy, communication literacy, visual literacy, network literacy, e-literacy, digital competence, among others [9].

In the context of the fourth industrial revolution, with the robust development of science and technology, digital transformation is increasingly becoming an inevitable trend worldwide, including Vietnam. For the successful implementation of digital transformation across all sectors-digital government, digital society, and digital economy-corresponding human resources equipped with digital literacy are required.

UNESCO defines digital literacy as the ability to use digital devices, communication applications, and the internet to access and manage information. It enables individuals to create and share digital content, communicate, and collaborate, and effectively and creatively solve problems in life, study, work, and general social activities. At a basic level, digital literacy is demonstrated through the ability to use digital devices and online applications. At an advanced level, it involves utilising digital technologies to enhance competence and adaptability in career fields, such as those in the information and communication technology sectors. Technologies such as artificial intelligence (AI), machine learning, big data analytics, blockchain..., change skill requirements, thereby influencing capacity building and skill development within the workforce in the digital economy. Digital literacy is a blend of computer capacity, information technology (IT) capacity, information capacity, and communication capacity [10].

The World Bank (2020) [11] report stipulates that digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate, and create secure and relevant information. According to this report, the digital skills framework for the workforce generally comprises seven competencies-operating software and equipment; knowledge of data and information; communication and collaboration; digital content creation; safety; problem-solving; career-related competencies-each at four proficiency levels (basic, intermediate, advanced, and highly specialised).

Digital literacy represents a fundamental ability to use computers confidently, securely, and effectively, inclusive of software proficiency [12]. It is also interpreted as the capacity to utilise digital technology and communication tools to access, manage, analyse, and evaluate information; to construct new knowledge; and to communicate with others, thereby effectively participating in society [13]. Furthermore, digital literacy incorporates life skills, which extend beyond the ability to use technology, information, and communication devices, and incorporate the capacity to socialise, learn, and develop attitudes and critical, creative, and inspiring thinking as digital competencies [14].

Building upon the comparison of international competency frameworks, and referencing Facebook's

We Think Digital courses and the content of the Introduction to Information Competence module, the VNU University of Social Sciences and Humanities (under Vietnam National University, Hanoi) has proposed a digital literacy framework model comprising seven competency groups with 26 standards. These include: (1) Operating equipment and software; (2) Information and data mining; (3) Communication and cooperation in the digital environment; (4) Digital safety and security; (5) Digital content creation; (6) Learning and developing digital skills; and (7) Utilising digital competence for the profession.

Table 1 shows that, corresponding to each capacity is a description of the capabilities to be achieved. The specific competencies described in each group mainly focus on applying technology into practice through attitude, empathy, critical thinking, problem-solving, and innovation. This competency framework has been widely consulted by training institutions in Vietnam to build digital literacy development programs, with the goal of helping learners acquire the necessary skills and knowledge to study, work and communicate positively and securely in the digital environment.

Digital literacy encompasses a combination of behaviours, expertise, know-how, work habits, personality traits, and key insights, incorporating not only technical skills but cognitive skills and soft skills as well.

2.2. The importance of digital literacy in the new era

Technological advancements such as cloud computing, AI, big data, internet of things (IoT), along with the catalytic impact of the COVID-19 pandemic, have introduced new work trends like telecommuting and virtual work. According to McKinsey and Company (2021) [16], the post-COVID-19 trend suggests that approximately 20%-25% of workers in developed economies could work remotely for three or more days a week. As per S. Weston (2021) [17], by 2030 up to 75% of jobs will necessitate advanced digital skills, which greatly influences the workforce.

To meet the demands of work in the digital era, equipping new capacities, especially digital literacy, is considered a vital issue for the workforce. As most jobs will be digitised, the ability to use digital technology will be a requirement of almost every profession, with the digital industry becoming a key player in the economy.

According to Microsoft's report (2020) [18], between 2020 and 2025, there will be approximately 149 million jobs related to new technologies created, with 98 million jobs associated with software development, 23 million linked to data and cloud computing roles, and about 20 million jobs connected to AI, machine learning, data analysis. This suggests a transformation in the global workforce, and workers must equip themselves with new skills, particularly digital skills, to meet the new demands of the labour market if they wish to avoid unemployment.

Table 1. Digital literacy framework of human resources.

No	Capability group	Ability description
1	Operating equipment and software	Identify, select, and use hardware devices and software applications to identify and process data and digital information in problem-solving.
2	Information and data mining	Identify individual information needs; implement strategies to find, locate, and access information; evaluate news sources and their content; store, manage, and organise information; and use information ethically and legally.
3	Communicating and collaborating in a digital environment	Interact and communicate through digital technology and practise digital citizenship. Manage your digital identity and reputation in the digital environment. Use digital tools and technologies to collaborate, design, and create resources and knowledge.
4	Digital safety and security	Protect devices, content, personal data, and privacy in the digital environment. Safeguard your health and spirit. Recognise the impact of digital technology on social well-being and social inclusion, and the impact of digital technologies and their use on the environment.
5	Digital content creation	Create and edit digital content. Transform and combine information and digital content into existing knowledge. Understand the licensing and copyright systems involved in the digital content creation process.
6	Learning and developing digital skills	Identify opportunities and challenges in the online learning environment. Understand personal needs and preferences as a digital learner. Promote open access and information sharing. Recognise the importance of lifelong learning for personal growth.
7	Utilising digital capabilities for your career	Operate digital technologies in specific career contexts. Understand, analyse, and evaluate data, information, and digital content specific to professional practice. Practise innovation and entrepreneurship in a digital environment.

Source: VNU University of Social Sciences and Humanities (2021) [15].

Table 2. Survey on the role of digital competence.

Year	Author	Name survey	Object survey	Main conclusion
2019	J. Abel-Koch, et al. [19]	European Small and Medium Business Survey: Going Digital	2586 businesses with 20249 employees in Poland, France, UK, Spain, Germany	The lack of digital literacy amongst employees in the enterprise and external labour market is a significant obstacle for businesses in all five countries
2019	M. O'Loughlin, et al. [20]	Global Digital Skills Survey	Information technology experts of organizations around the world	19% of businesses have applied digital technology and changed business processes, yet employees and business processes have not adapted in time
2020	BrainStation [21]	Survey on Digital Literacy	Unknown	83% of those surveyed believe their level of understanding of data in the organisation is medium and low, and that this deficiency has adversely affected the success of the organisation

Source: [19-21].

In Table 2, the survey results show the lack of understanding about the digital literacy of employees is one of the major obstacles for businesses, especially in the context that businesses are in the process of applying digital technology and changing business processes [19-21].

According to estimates by A. Cameron, et al. (2019) [22], by 2035, about 15% of all jobs in Vietnam will be automated and up to 38.1% of current jobs in Vietnam could be transformed or relocated due to the impact of automation by 2045. This implies that a significant proportion of Vietnamese workers will risk unemployment if they are not upgraded or equipped with new skills, especially digital capabilities. The World Bank report (2021) [23] suggests that the Vietnamese economy will lose about 2 million jobs by 2045 if no solution is found to bridge the gap between supply and demand in terms of human resources for digital transformation.

It can be concluded that digital literacy is one of the important competencies of the 21st century and an essential capacity in the context of digital transformation, encompassing not only the ability to use IT but also the soft skills needed for adapting to the changing labour market

3. Guidelines and policies of the Communist Party of Vietnam and the Government on improving digital literacy of human resources

Digital transformation is a vital requirement for development; thus, Vietnam cannot afford to remain detached. Over the recent years, Vietnam has been amongst the pioneering countries advocating for a national digital transformation programme to meet the nation's developmental requirements in the new era. In this context, the digital literacy of human resources has been identified as a pivotal factor for successful digital transformation. The Communist Party of Vietnam and the Government have hence developed and issued a series of strategic documents to enhance the workforce skills in adapting to the Fourth Industrial Revolution's trends of digitisation and automation. The policy emphases include:

Prime Minister's Decision No. 681/QD-TTg (June 4, 2019), "On promulgating a roadmap for the implementation of sustainable development goals until 2030". The objective is to notably augment the number of workers with skills aligned with labour market demand. By 2025 and 2030, the proportion of trained workers will be 70 and 75% respectively; the percentage of workers with IT skills will be 80 and 90% respectively [24].

The 12th Politburo's Resolution No. 52-NQ/TW (September 27, 2019), "On a number of guidelines and policies to actively participate in the fourth industrial revolution". Clause 5, Section III addresses human resource development policy: "Overall review and reform of educational and training contents and programmes towards developing accessibility, creative thinking and adaptability within a continually changing and evolving technological environment" and "Innovation in teaching and learning methods based on digital technology application; assessment of enterprises for the quality of IT university training" [25].

Prime Minister's Directive No. 24/CT-TTg (May 28, 2020) "On promoting and developing skilled human resources, contributing to improving labour productivity and increasing national competitiveness in the new situation". This directive "encourages enterprises to recognise, recruit, employ, and pay wages and salaries to employees based on skills and practical capacity; prioritise workers who have been trained or have national vocational skills certificates as prescribed by law" [26].

Prime Minister's Decision No. 749/QD-TTg (June 3, 2020), approving the "National Digital Transformation

Programme to 2025, with orientation to 2030". The goal is to reach the dual objective of developing a digital government, digital economy, digital society, and forming Vietnamese digital technology enterprises with global reach by 2030 [27].

Prime Minister's Decision No. 1486/QD-TTg (October 1, 2020), on "Vietnam Labour Skills Day" is aimed at inspiring the domestic community to support labour skill development, thus contributing to enhancing productivity, labour efficiency, and national competitiveness [28].

Prime Minister's Decision No. 2289/QD-TTg (December 31, 2020), promulgating the "National Strategy on the 4th Industrial Revolution to 2030". It proposes regulations to "evaluate workers' skills in relation to the requirements of the fourth industrial revolution and suggest solutions and policies to enhance the skills of the workforce"; "Building retraining programmes for workers to transition into jobs requiring new skills of the fourth industrial revolution" [29].

The 10-year socio-economic development strategy for the period 2021-2030 emphasises four central needs for Vietnamese human resources: (i) Technical human resources, (ii) Digital human resources management, (iii) Management level human resources: technical management, business management, public/social management, and (iv) Human resources for social care. Based on these, the Government issued Decision 176/QD-TTg promulgating the Programme to support the development of the labour market until 2030. This Programme aims to lay a solid foundation for the synchronous development of labour market factors, contributing to the effective mobilisation, allocation and usage of resources for socio-economic development; transforming the labour structure towards modern development and ensuring the connection between the domestic labour market and the regional and global labour market.

Prime Minister's Decision 146/QD-TTg (2022) [30] approves the Project "Raising Awareness, Popularizing Skills and Developing Human Resources for National Digital Transformation to 2025, Orientation Towards 2030". The project recognises: "Digital skills universalisation is the key for people to access digital knowledge and skills to participate in the digital transformation process, opening up opportunities to access digital services on an equal basis, contributing to an inclusive digital society. Human resource development is key to effective and sustainable digital transformation, helping to successfully realise the goals of the National Digital Transformation Programme to 2025, with a vision to 2030" [30]. Thus, it is critical to enhance the quality and efficiency of training and development of human resources for digital transformation across each industry, each field, and each locality.

4. Assessment of digital literacy of Vietnamese human resources

4.1. Availability of digital information

Vietnam possesses a robust infrastructure essential for the development of digital human resources.

The Vietnamese Government advocated for nationwide internet connectivity in 1997. Although Vietnam was slower to adopt the internet compared to other nations, since 1997, it has become one of the world's fastest-developing countries in terms of internet connectivity. Thanks to the comprehensive broadband infrastructure across the country, internet connectivity is ubiquitous, ranging from urban areas to rural communities, from plains to mountains, borders and islands. Consequently, the IT competency of the majority of Vietnamese citizens has significantly improved.

The advent of the internet prompted societal transformations. Technological penetration began shaping an application-based economic system, altering societal structure. The escalating internet usage also bridged merchants, consumers, and families. The emergence of smart cities, particularly those adopting IT; the advent of the 4th industrial revolution characterised by comprehensive digitisation, including product and service digitisation, customer engagement digitisation, and productivity enhancement through digitisation; public services becoming faster and more efficient; all these factors contributed to the rise of the digital generation (the generation with technological capabilities).

According to the Digital Economy Index report surveyed by the Financial Times and Omdia, published at the end of November 2022, Vietnam ranked second for the world's fastest digital economic growth rate (12.3%) in 2022 (just behind India), third fastest in the world (10.3%) in 2023 (after Mexico and India), and is predicted to top the global growth rate of the digital economy from 2022 to 2026 [31]. Furthermore, in the 7th Southeast Asian e-Conomy SEA digital economy report,

announced by Google, Temasek, and Bain & Company on October 27, 2022, Vietnam's internet economy reached USD 23 billion in 2022 and is projected to reach USD 49 billion in 2025. This is the fastest growth rate in the region, and Vietnam's internet economy is anticipated to expand rapidly, potentially reaching a record level of USD 120-200 billion by 2030 [31].

By January 2023, Vietnam had 77.93 million internet users, constituting an internet usage rate of 79.1% of the total population, the 12th highest in the world and the 6th in Asia. Over 70 million people used social networks, predominantly YouTube and Facebook (ranked 7th out of 10 countries using Facebook and one of the 10 countries with the highest number of YouTube users worldwide). The prevalence of social networks in Vietnam continues to grow, showing no signs of slowing down [32]. This robust infrastructure provides Vietnam with the opportunity for swift digital economic transformation and stimulates the demand for digital human resources.

Another influential factor impacting the digital literacy of human resources is a country's economic, social, and educational status. In Vietnam, rapid economic growth has transformed it from one of the world's poorest countries into a lower-middle-income country. Consequently, the general education level in Vietnam has improved. This is evidenced by Vietnam's high scores in the Program for International Student Assessment (PISA) in 2012, 2015, 2018, and 2022, where Vietnamese students' learning outcomes far exceeded many countries in the Organisation for Economic Cooperation and Development [33].

Since 2006, the Vietnamese Government has advocated for the socialisation of IT dissemination across society, encouraging domestic and foreign organisations and individuals to participate in many forms of IT training. Policies have been enacted to enhance computer literacy and the application of IT in all fields of study, promote online distance learning for all types of training, and recognise the legal value of diplomas and certificates in an online learning environment. Most educational institutions have started using open-source software in their training activities.

Informatics is taught effectively and efficiently at all educational levels. In general education, it is an elective subject at the primary and lower secondary levels, and compulsory at the high school level. The development of applied informatics learning programmes according to knowledge modules allows for flexible and practical application to many levels, incorporating new technology content, and actively using open-source software in IT curricula at all levels. Throughout the implementation process since 2006, the education sector and society as a whole have recognised the importance of Informatics, and the percentage of Informatics training in primary and lower secondary schools has been rapidly increasing.

Figure 1 provides data on elementary, middle, and high schools that teach Informatics. In 2006, the percentage of primary schools and junior high schools that taught informatics was very low (7.1% in primary schools and 30.5%) in junior high schools. However, with a high growth rate for many years, by 2020, the percentage of schools that teach informatics will be quite high: 72.4% for primary school and 89.3% for lower secondary school level. For the upper secondary level, the rate is relatively stable, close to 100%.

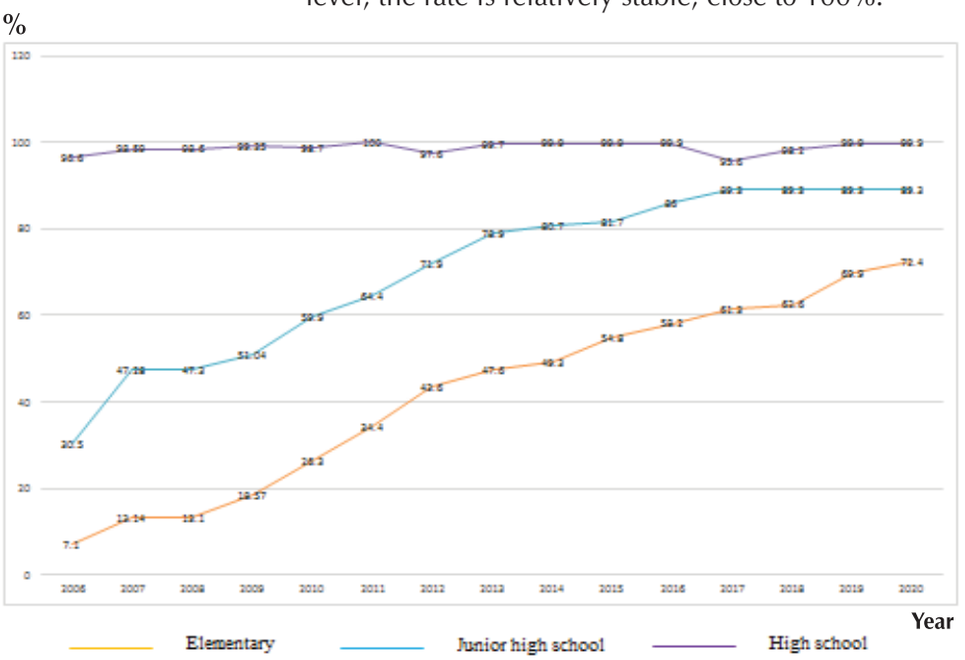

Fig. 1. Percentage of high schools that teach informatics. Source: Author compiled from Vietnam ICT Index (year 2006 to 2020) of Office of National Steering Committee for Information Technology and Ministry of Information and Communications.

One significant factor influencing the digital proficiency of human resources is the extent of IT training. In Vietnam, as of 2020, 158 universities and 442 colleges and vocational schools offer IT courses. For the academic year 2020-2021, the combined enrolment target for university courses in IT, electronics, telecommunications, and information security is 82,085 students. The annual number of university and college students specialising in IT and communications is estimated to be over 50,000. Vocational schools in IT are projected to produce around 12,000 graduates annually [34].

Table 3 provides the number of universities, colleges, vocational schools, and enrolment targets for IT majors from 2010 to 2020 and demonstrates the reality of IT enrolment is quite high.

Table 3. Number of universities, colleges, vocational schools, and enrolment targets for IT majors (2010-2020).

Year	College and University block		College, vocational secondary school	
	College and University number	*Enrolment targets (students)*	*College, Vocational secondary school number*	*Enrolment targets (students)*
2010	277	60,332	186	66,631
2011	290	64,796	113	32,632
2012	290	65,501	143	25,527
2013	290	67,518	228	24,569
2016	250	68,883	204	18,311
2017	131	48,631	412	67,673
2018	149	51,114	412	67,662
2019	158	68,435	442	52,424
2020	158	82,085	442	56,838

Source: Ministry of Information and Communications (2014-2021) [35-40].

In 2020, actual enrolment rates in universities and colleges were high, reaching 84%, and 68.27% for colleges and vocational schools [40]. The number of IT graduates has been steadily increasing each year, with the graduation rate reaching 93.88% (around 64,000 individuals) in 2016. For vocational schools, the graduation rate stands at 52.4%, equating to approximately 9,600 people [36].

To enhance the quality of education, universities and colleges focus not only on investing in material and technical facilities and educational reform, but also on enhancing the professional qualifications and English proficiency of the IT teaching staff. Numerous universities have policies to attract overseas Vietnamese scientists and international IT experts for participation in training and scientific research. This involves promoting high-quality training associations, exchanging lecturers and experts with foreign countries, and encouraging experts and technicians with professional experience in enterprises to participate in training IT human resources.

Since 2017, the Ministry of Education and Training has endorsed a strategy that permits universities and colleges to provide IT training according to specific mechanisms. This entails dedicating 30-50% of the course time to practical study and work experience, directly under the tutelage of enterprise experts. The educational institutions work closely with IT enterprises during the training process to improve students' practical skills and their applicability in real-world settings. Universities are required to publicise the employment rate of their graduates (12 months post-graduation) on their websites and report these figures to the Ministry of Education and Training. Training institutions are encouraged to offer training according to the orders of businesses and societal needs, and to foster links between user facilities and IT human resource training institutions. As a result, there has been a substantial number of students and graduates in IT, a portion of whom have met the high requirements for working and conducting research within the IT industry.

Despite the high number of IT training institutions, the quality of training is inconsistent. A handful of institutions have the necessary capacity, equipment, and training methods to meet international standards, while the majority do not meet societal requirements. Students aspiring to secure employment in large companies or specialise in IT often need to attain additional international certifications in programming and network administration, improve their foreign language skills, and enhance their soft skills.

The link between enterprises and training institutions remains weak, and Vietnamese IT enterprises have not actively collaborated with universities and colleges in IT training and career

orientation. Although the Government has encouraged partnerships between enterprises, universities, and research institutes to develop IT human resources, the reality falls short of expectations. The collaboration between training institutions and enterprises is still nascent. The current cooperation is largely one-sided, with schools needing enterprises to increase practical training, while the latter does not yet fully recognise the schools as a stable source of quality labour.

4.2. Digital processing capacity

The quality of human resources in Vietnam has shown significant improvement. Despite lower levels of public spending on health, education, and social protection, Vietnam's human capital index continues to surpass the average of countries with comparable income levels. Among the countries in the East Asia - Pacific region, Vietnam is one of the top performers on the human capital index. According to the United Nations Development Programme's Global Human Development Report 2020, Vietnam's Human Development Index (HDI) for 2019 was 0.704, ranking 117th out of 189 countries and territories [41]. From 1990 to 2019, Vietnam's HDI increased by more than 48%, moving from 0.475 to 0.704. Vietnam's 2019 HDI score of 0.704 exceeded the 0.689 average for developing countries but fell short of the High Human Development average of 0.753 and the 0.747 average for countries in East Asia and Africa Pacific. As per the General Statistics Office, the proportion of trained workers in Vietnam increased from 40% in 2010 to 65% in 2020. The percentage of workers aged 15 years and older in employment with training has progressively increased from 15.4% in 2011 to 24.1% in 2020 [41]. Therefore, the prevalence of high-quality human resources in Vietnam has been steadily increasing, with some industries, such as medical, mechanical, technology, and construction, reaching regional standards.

Vietnam's human resources have significant advantages, primarily comprising young, hard-working, progressive workers. The population is large and has a relatively solid background in mathematics and IT. The quality of labour has been gradually improving over the years. Trained labour has, to an extent, met the requirements of enterprises and the labour market. The technical workforce has steadily mastered science and technology, undertaking most complex work positions in production and business. Therefore, these factors provide favourable conditions for meeting the technical, technological, and operational requirements of the labour market when transitioning to the digital economy [42].

However, the quality of Vietnam's human resources remains somewhat constrained: The country lacks a significant number of methodically trained, high-quality workers to meet the requirements of true experts in vital economic sectors such as finance, banking, insurance, energy, mechanical engineering, information and telecommunications, environment, and international law [43]. As per the World Bank's assessment, the quality of human resources in Vietnam only scored 3.79 out of 10 points, ranking 11th out of 12 surveyed Asian countries. South Korea reached 6.91 points, India 5.76 points, and Malaysia 5.59 points. Many indicators of Vietnam's human resource quality remain subpar compared to developed countries in the region [43]. Workers without professional and technical qualifications also constitute a significant proportion of the labour force.

Workers lacking professional and technical qualifications make up a substantial proportion of the labour force.

Table 4 shows that the labour force without technical qualifications accounts for a high proportion with 79.7% in 2015, by 2021, although the rate has decreased, it still accounts for 73.9%. The trained labour force comprises roughly one-quarter of the country's total labour rate. As of the first quarter of 2023, the nation had approximately 38.1 million untrained workers [44]. This poses a considerable challenge for employees as production activities are becoming increasingly automated, necessitating workers to adapt to technological advancements, particularly in the context of an evolving business environment.

Vietnam's labour productivity remains somewhat limited: Over the years, Vietnam's labour productivity has seen notable improvement in both value and speed. Nevertheless, it still lags behind that of other Southeast Asian countries.

Table 4. Professional and technical qualifications of employees, 2015-2021 (unit: %).

Targets	2015	2016	2017	2018	2019	2020	2021
No technical qualifications	79,7	79,1	78,3	78,0	77,2	76,0	73,9
Primary	5,0	5,0	5,4	5,5	3,7	4,7	6,8
Professional range	4,0	3,9	3,8	3,8	4,7	4,4	4,1
College	2,7	2,8	2,9	3,2	3,8	3,8	3,6
University and above	8,6	9,2	9,6	9,7	10,6	11,1	11,7

Source: Synthesised data from the "Vietnam Labor and Employment Survey" of the General Statistics Office.

Table 5 shows the labour productivity of Vietnam compared to Southeast Asian countries. Although there has been an improvement in recent years, Vietnam still holds the 8th position in the region, behind Singapore, Brunei, Malaysia, Thailand, Indonesia, Philippines, and Laos. In 2019, Singapore's labour productivity was 11.5 times higher than that of Vietnam.

The lower education levels of the workforce can be considered a contributing factor to Vietnam's relatively low labour productivity within the region. In 2020, the workforce with a secondary school diploma or higher made up 61.2% of the total number of employees. Conversely, the number of workers who have graduated from high school or higher, or possess professional and technical qualifications, accounted for only 38.8% [41] (Fig. 2).

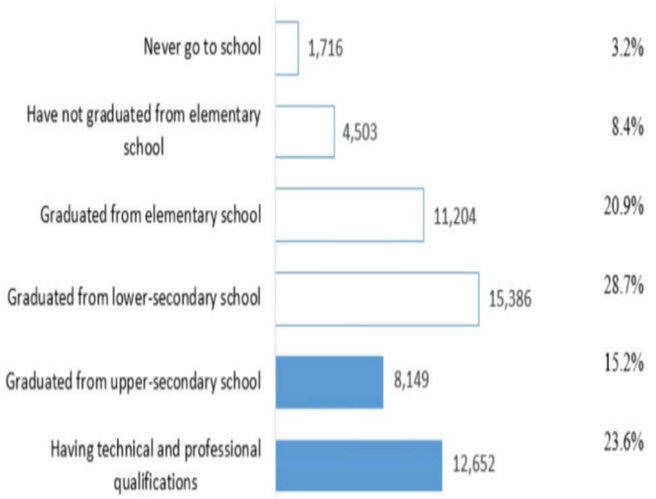

Fig. 2. Vietnam's labour force by education level (unit: thousand persons). Source: General Statistics Office (2020) [41].

Moreover, the digital literacy of Vietnamese human resources remains underdeveloped: According to the Global Competitiveness Index 4.0 (GCI 4.0) 2019, Vietnam currently ranks 67th out of 141 countries on the GCI 4.0 index, yet only 93rd in terms of skills, representing the lowest ranking among the thirteen indicators [45]. Consequently, inadequate skill levels can be seen as a hurdle for Vietnamese workers in the 4.0 job market and an impediment to Vietnam's journey towards global integration in the future.

Table 5. Labour productivity of Vietnam compared to other Southeast Asian countries (unit: USD in GDP PPP).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Singapore	136.243	139.918	141.219	145.405	146.818	147.417	151.030	156.376	160.348	159.680
Brunei	147.354	150.119	149.045	143.778	138.331	136.813	133.030	134.309	129.057	133.209
Malaysia	48.813	49.061	49.750	49.865	51.467	52.986	54.641	56.625	57.841	59.364
Thailand	25.028	24.542	26.268	27.448	28.014	28.956	30.174	31.586	32.523	33.502
Indonesia	18.360	19.033	19.033	20.488	21.166	22.034	22.851	23.303	24.013	24.425
Philippines	14.955	15.016	15.805	16.582	17.102	17.877	18.690	20.379	21.202	21.832
Lao PDR	9.843	10.362	10.911	11.498	12.083	12.677	13.285	13.920	14.507	14.887
Viet Nam	8.833	9.214	9.547	9.851	10.299	10.933	11.559	12.216	12.859	13.817
Myanmar	6.689	6.999	7.446	8.007	8.572	9.091	9.774	10.584	11.036	11.548
Cambodia	4.818	4.999	5.393	5.847	6.160	6.475	6.656	6.959	7.368	7.774
Timor-Leste	7.831	8.094	8.393	8.361	8.524	8.560	8.632	8.018	7.704	7.741

Source: ILO (2019).

In terms of the digital skills scores for the Asia-Pacific workforce, Singapore and Malaysia are the two frontrunners, while Vietnam's standing is relatively low in comparison to other regional countries [45].

Figure 3 shows the digital skills scores of the workforce in some Asia-Pacific countries, with Vietnam scoring quite low compared to other countries, reaching 46.1 points in 2019, behind many countries in the region.

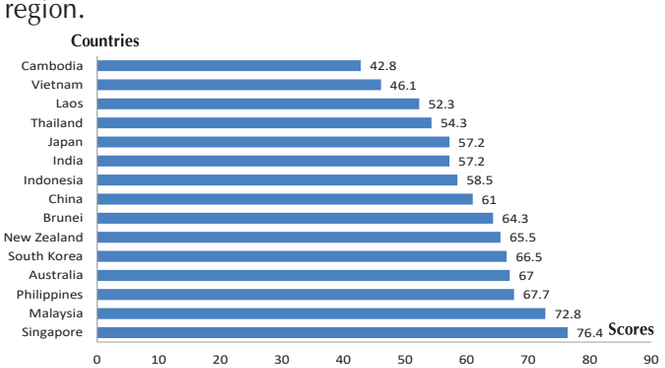

Fig. 3. Digital skills scores of the workforce in some Asia-Pacific countries. Source: World Economic Forum (2019) [45].

According to the Global Talent Competitiveness Index (GTCI) report, compiled by the Adecco Group, Google and INSEAD, Vietnam is ranked 96th out of 132 countries on the GTCI 2020. This signifies a drop of five places compared to 2019 and nine places compared to 2018. The disparity between Vietnam and other high-income countries in terms of digital capabilities, especially AI, is markedly expanding. Digital literacy represents a significant gap between training and corporate needs within Vietnam's human resources. The advent of AI necessitates the training of new skills for the workforce.

As for Vietnam's IT human resources: In the early '90s, Vietnam's IT human resources were scarce in both research and training as well as implementation and application. Notably, the core IT workforce, possessing profound knowledge and command of key technologies, appeared sporadically and fragmented. The number of professional staff working in the IT field was minimal, with no alignment or coordination towards a unified goal to create synergy. Universities only trained a small number of students in IT-related fields. However, after implementing the "National Program on IT" in 1995, the number of IT human resources began to grow. Following the investment and development from the Party and State, by 2019, the total number of IT industry employees reached 1,055,000 [39], exceeding one million for the first time, thereby achieving the goal of having one million IT human resources by 2020 one year ahead of schedule.

However, current IT human resources do not yet meet labour market demands. According to a Vietnamworks forecast, the country presently lacks about 400,000 IT workers and needs to supply 78,000 new employees annually [46]. The demand for recruiting in this sector increases as the Government pushes digital transformation and technology 4.0, and as new IT businesses emerge, leading to heightened competition for human resources. Although the demand for IT human resources is immense, domestic IT human resource training institutions have not met societal development needs, particularly in the training of high-quality engineers. Currently, only about 27% of IT workers meet the requirements; the remaining 72% need additional training for at least three months [34]. Hence, in terms of the quality of human resources, we have not yet achieved the set target.

Furthermore, digital transformation, which encompasses three main pillars: building a digital government, developing the digital economy, and forming a digital society, requires a large IT workforce with profound expertise in digital technology and digital skills. At present, there is a severe shortage of human resources for digital transformation across all three pillars in Vietnam. The digital transformation demands a substantial number of human resources trained in new and specialised areas such as AI; big data; cloud computing; IoT; virtual reality/augmented reality (VR/AR); blockchain; 3D printing, but very few training institutions offer these new majors. Most universities, colleges and vocational schools providing IT training to meet the requirements of digital transformation face challenges due to a lack of teaching staff; unstandardised training programmes and contents; and inadequate facilities and practice rooms for research training.

IT enterprises have not collaborated closely with state management agencies and training institutions in the training of IT human resources. Some businesses, while having affiliate programmes with training institutions that accept interns and support jobs for students after graduation, tend to focus only on the most promising students, neglecting long-term development, leading to output imbalance.

Compared to the global stage, the IT capacity of Vietnamese human resources has yet to be adequately recognised.

Table 6 shows, Vietnam's telecommunications standing is primarily assessed via the ICT Development Index published by the International Telecommunication Union. The index is evaluated based on three criteria: accessibility to ICT services (40%), utilisation of ICT services (40%), and ICT skills (20%). Regrettably, Vietnam often finds itself positioned at the lower end of this ranking. Out of the three assessed criteria, the index of ICT skills of human resources is consistently the weakest. According to ITU data from 2017, Vietnam ranks 108th out of 176 countries worldwide and 6th among 11 ASEAN countries (behind Singapore, Brunei, Malaysia, Thailand, and the Philippines). The ICT skills index shows a continued lag compared to previous years and holds a low position globally, ranking 113/176 in 2017.

Table 6. ICT ranking of Vietnam by a number of international indicators (ranking results/total countries).

Year	Assessment by the International Telecommunication Union		Assessment by the United Nations	Assessment of the World Economic Forum
	ICT Development Index	*Skills of ICT Human Resources Index*	*E-Government Development Index*	*Networked Readiness Index*
2001	-	-	-	74/75
2002	107/154	95/154	-	-
2003	-	-	97/173	-
2005	-	-	105/191	75/115
2007	92/154	102/154	-	-
2008	86/154	105/154	91/192	-
2009	-	-	-	70/134
2010	94/166	109/166	89/190	55/133
2011	-	-	-	55/138
2012	81/161	101/161	83/190	83/142
2013	-	-	-	84/144
2014	-	-	99/193	-
2015	102/167	108/167	-	85/143
2016	-	-	89/193	79/139
2017	108/176	113/176	-	-
2018	-	-	88/193	-
2020	-	-	86/193	85/148

Source: Author's compilation from Ministry of Information and Communications (2019b) and International Telecommunication Union (2007-2017) [47-53].

In 2020, Vietnam's E-government ranking was 86 out of 193 countries (23 out of 47 in Asia and 6 out of 11 in Southeast Asia), improving by 2 places compared to 2018. However, within the component indices (Human Resources Index, Telecommunications Infrastructure Index, Online Services Index, Electronic Participation Index, Open Government Data Index), the Human Resources Index occupies the lowest ranking, placing 117 out of 193 countries.

Additionally, the World Economic Forum determines the Networked Readiness Index of countries based on the evaluation of ICT readiness and exploitation, focusing on three primary factors: environment for ICT development (policy, infrastructure, political stability), ICT readiness (of citizens, businesses and governments) and ICT usage (by individuals, businesses and governments). In this regard, Vietnam maintains a relatively low average global ranking, placed 85 out of 148 countries in 2020. Consequently, the digital literacy of human resources remains a weak point for Vietnam.

5. Discussion

The preceding analysis indicates that, given the inevitable trend of digital transformation, it is exceedingly important and urgent to upgrade both knowledge and skills, particularly in digital literacy for human resources. Enhancing the quality of human resources not only facilitates job stability for employees, but also contributes to improving labour productivity, reducing costs, bolstering competitiveness for Vietnamese enterprises, and increasing income to attract foreign investment. The construction of a high-quality workforce prepared for digital transformation primarily requires close cooperation and coordination between the Government, training service providers, employers, and the workers themselves.

The Government has a significant role in forming a legal framework as well as establishing digital infrastructure for digital transformation and digital capacity development for the workforce. In addition, the Government can plan budgets and support policies for businesses, particularly small and medium-sized enterprises in the digital transformation process, as well as provide training and upgrade digital skills for workers. Through online training portals, the Government and

stakeholders can establish short and long-term training programmes and courses, permitting businesses and workers to utilise them for free. The Australian portal, SkillFinder, which connects the workforce and SMEs with digital skills training, serves as a good example. This platform offers thousands of digital competency training courses designed and developed by leading technology enterprises (AWS, IBM, Microsoft, Google...). In Vietnam, there exists a Digital Citizen platform (https://www.congdanso.edu.vn/) offering training courses on digital skills, soft skills, entrepreneurship skills..., supported by Google and Microsoft corporations. However, these have not been widely promoted for employees and citizens to access. Furthermore, policymakers need to develop solutions to enhance the flexibility of the labour market, allowing workers to transition jobs easily in accordance with their professional skills.

Training service providers must attract highly qualified human resources to instruct, train, and disseminate digital skills. Strong application of digital technology in training digital skills, such as online learning, and sharing digital resources in teaching and learning, is essential. Additionally, training units need to collaborate with experts in technology training and professionals currently employed at reputable technology enterprises to stay abreast of new technology trends and design courses in line with practical needs and technological standards.

For businesses, it is necessary to clearly identify the digital literacy requirements to equip employees in alignment with their strategy, business model, and digital transformation orientation. They should then offer training options, upgrade skills for the existing workforce, as well as recruit new workers with appropriate professional skills. Strengthening connections with the Government, regulatory bodies, and training service providers should also be prioritised.

Workers need to enhance their initiative and adaptability. With the rapid development of digital technology, a range of digital skills training courses are freely available through online training portals such as Digital Citizen of Vietnam, Vietnam Digital 4.0 Launchpad - a Google initiative supporting Vietnam, AWS Skill Builder by AWS, or Google Digital Garage. Vietnamese workers, particularly Generation Z, forecasted to constitute one third of the working-age population by 2025, can master the process of cultivating and upgrading their digital skills to adapt to the ever-increasing demand for digital workers in the labour market.

It can be affirmed that the development of human resources, especially those with high-quality labour skills closely linked with the development and application of science and technology, is considered a strategic breakthrough. This is a key decisive factor for restructuring the economy, transforming the growth model and competitive advantage, and ensuring rapid, effective, and sustainable development. Amid international integration and the Fourth Industrial Revolution, the emergence of new technology, automation and numerous development trends profoundly affect the labour market, changing the job structure and setting new requirements for labour skills. The higher the skill level of employees, the faster the application of modern scientific and technological achievements will assist enterprises in exploiting resources effectively, innovating business models, improving labour productivity and competitiveness. Consequently, in the context of implementing digital transformation, apart from technology and capital investment, human resources with digital capabilities become a crucial determinant for the sustained growth and success of enterprises.

6. Conclusions

Digital transformation is becoming an inevitable trend in the process of the Fourth Industrial Revolution and this process is taking place strongly in many countries around the world. Vietnam is also in the process of digital transformation, which requires Vietnam to prepare a human resource with commensurate digital literacy to adapt and master technology in the fields of socio-economic life.

In Vietnam, many studies show that the Vietnamese workforce has many limitations in terms of digital literacy. Therefore, to succeed, Vietnam needs to especially improve the digital skills of its workforce, otherwise, we will not achieve the expected success, which is a shortcut, and many Vietnamese workers will not be able to find jobs through the process of digitisation.

In that context, Vietnam needs to act sooner and more drastically to solve the current problems of labour for digital transformation, to supply enough in quantity, and to meet the increasing quality requirements of employees in the enterprise.

The study of the digital literacy of Vietnamese human resources is one of the bases for training and fostering digital capabilities for employees. Digital literacy needs to be included in the curricula at all levels of education, with many different levels of access, and regularly survey and evaluate the digital capacity of human resources based on digital competency frameworks corresponding to specific target groups.

COMPETING INTERESTS

The author declares that there is no conflict of interest regarding the publication of this article.

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Standards of independence and impartiality in the context of international commercial arbitration

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Abstract:

In this day and age, international commercial arbitration is widely regarded as an effective alternative dispute resolution mechanism, voluntarily chosen by a majority of parties. However, a pertinent question arises: why do an increasing number of international businesses prefer international commercial arbitration over national courts to resolve commercial cases? Apart from the efficiency and convenience that international arbitration provides, the arbitrator's professional ethics play a crucial role in maintaining the credibility and legitimacy of the process. Therefore, to bolster parties' trust in international arbitration, it is imperative to uphold the requirement of independence and impartiality of arbitrators throughout the arbitration procedure. Specifically, the arbitrator plays an important role in giving effective awards in the arbitral proceeding. Hence, each arbitrator is required to be independent and impartial so that the arbitrator's award is not questioned on the ground of lacking fairness. Furthermore, in order for the appointment process to operate smoothly, the independence and impartiality of arbitrators will be challenged in the relationships with the parties or the parties' lawyers.

Keywords: **impartiality, independence, international commercial arbitration.**

Classification number: **6**

1. Introduction

According to the United Nations (UN), one of the essential aspects of the rule of law is the independent administration of justice [1]. This obligation is a recognized principle in European arbitration law [2]. Clearly, adjudicators have the responsibility to remain independent and impartial in their adjudicative functions. The independence and impartiality of arbitrators stem from their obligations to the parties in an arbitration agreement, wherein the parties are free to select their own arbitrator, and these arbitrators must maintain their independence and impartiality in settling the dispute. However, in cases where arbitrators violate any of these obligations, they will be removed from the dispute, and the award will be annulled.

Furthermore, to ensure equal footing in arbitration proceedings, the majority of states require the arbitration mechanism to guarantee that independence and impartiality are not affected by external factors, maintaining "neutrality and distance" from the parties involved. Nations will accept arbitration as an alternative dispute resolution system only if this obligation is strictly enforced. Recognizing the importance of this obligation in arbitration proceedings, this paper aims to address two main questions: Firstly, what are the standards of independence and impartiality in the context of international commercial arbitration? Secondly, what are the common challenges in the appointment of an arbitrator? To answer these questions, the paper will primarily rely on desk research, particularly through academic papers and legal journals in the field of commercial arbitration.

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2. Basic concepts

Although the concepts of "independence" and "impartiality" may seem similar at first glance, it is essential to clarify their significant differences. Surprisingly, many arbitration laws or rules lack a precise definition of these terms. Various national arbitration laws attempt to regulate the "independence" and "impartiality" of arbitrators in different scenarios. For instance, the new Swedish arbitration law [3] as an example, Section 8 provides a list of instances in which the required "impartiality" is required, but it is still insufficient. Similarly, Article 34 of China's arbitration law [4] outlines circumstances under which an arbitrator must withdraw from the arbitration due to a lack of independence or impartiality. These circumstances include situations where the arbitrator "is a party or a close relative of a party or of a party's representative" or "has some other relationship with a party to the case or with a party's agent which could possibly affect the impartiality of the arbitration". In the Law on Commercial Arbitration of Vietnam, Article 4 unambiguously requires that "Arbitrators must be independent, objective, and impartial and shall observe the law". Moreover, both Codes of Ethics and rules on the nationality of the sole arbitrator or chairman[5] address the fundamental concepts of "independence" and "impartiality". Nevertheless, it is evident that despite these guidelines, the lack of clarity surrounding these concepts has led to varying interpretations of their actual content. Besides, according to the Law on Commercial Arbitration of Vietnam, Article 4 also provides clearly that "Arbitrators must be independent, objective and impartial and shall observe law". Last but not least, the content of the basic concepts of "independence" and "impartiality" are covered in both Codes of Ethics as well as the rules on the nationality of the sole arbitrator or the chairman [5]. However, it is not difficult to realize that regardless of these guidelines, the ambiguity of these concepts has resulted in varying viewpoints on their actual content.

2.1. The concept of "impartiality"

Impartiality refers to the arbitrator's ability to maintain a stance free from bias or predisposition towards any of the parties or the issues in a given dispute [6]. Given that impartiality involves not only a subjective standard but also a state of mind, it becomes challenging to definitively ascertain whether this standard is genuinely met or merely perceived. In general, arbitrators' impartiality is characterised by their ability to carry out their functions without practical bias, thus mitigating significant challenges that may arise during proceedings. Consequently, arbitrators view their impartiality as a duty rather than a privilege [7].

However, arbitrators still grapple with distinguishing between impartiality and neutrality, a distinction governed by the AAA Code of Ethics [8]. In certain arbitrations, appointed arbitrators are not explicitly required to be neutral. This, however, does not imply that arbitrators may compromise their impartiality. Rather, it suggests that, depending on the legal, social, or cultural context, arbitrators may align themselves with the appointing party to fulfil their role as party-appointed arbitrators when parties come from diverse nations. Thus, a lack of neutrality can be tolerated as long as it does not interfere with impartiality [9]. For instance, the arbitrator's nationality is a contentious issue. Some argue that if the arbitrator shares the same nationality as one of the parties, it may imply bias. Conversely, others contend that the arbitrator's nationality does not affect their impartiality; instead, it may even have positive implications. For instance, the shared nationality could enable the arbitrator to serve as an interpreter and facilitate communication with the party in the event of the arbitrator's award being accepted [5]. Besides, the Model Law [10] outlines that the arbitrator's nationality should not be a decisive factor in preventing them from serving as an arbitrator in the arbitration, unless the parties agree otherwise [11].

2.2. The concept of "independence"

The concept of independence requires that arbitrators have no relationships or connections with any of the parties, whether current or past, direct or indirect [6]. Independence is not related to an arbitrator's state of mind, but rather to their positions or relationships with the parties, including social and financial aspects. Unlike impartiality, "independence relates to the lack of relations with a party that might influence an arbitrator's decision. Impartiality, on the other hand, concerns the absence of bias or predisposition toward one of the parties [12]". Therefore, independence is evaluated as an objective test.

The lack of independence can be influenced by various factors, such as the relationship between the arbitrator's law firm and a party or a witness party. Notably, a longstanding connection between the arbitrators' law firm and the counsel's law firm often raises concerns about the arbitrators' independence. However, the assessment of arbitrators' independence should consider the timing and extent of the relationship between arbitrators and counsels, as well as their law firms. When the counsel's law firm handles only a few unrelated issues to either party, or when both the arbitrator and the counsel do not act on behalf of their law firms participating in the proceedings, the arbitrator's independence should remain unaffected [13].

A particular challenge to independence arises when an arbitrator is appointed to resolve the same matters in different cases. While familiarity with the issue may save time and money, it can also lead to biases in later arbitration proceedings due to preconceived arguments. Consequently, some arbitrators may lose their objective judgment and independence when evaluating crucial facts in subsequent arbitrations.

Moreover, if one of the parties is a state, a state entity, or a person employed by a government entity, the arbitrator's independence may be called into question. Generally, apart from judges and law professors, most employees lack the necessary independence, as they may not possess the required training or practical experience to serve as arbitrators. This concern may arise in arbitration proceedings involving disputes between directors of state-owned enterprises and other state entities.

While "impartiality" and "independence" are interrelated, an arbitrator can be impartial but not entirely independent and still qualify. However, an arbitrator who lacks impartiality despite being independent must be disqualified. Therefore, the gold standard in selecting party-appointed arbitrators in arbitration proceedings must prioritize impartiality [14].

3. The importance of "impartiality" and "independence"

3.1. Ethical ground

It has been argued that every legal action contains a moral component, emphasizing the significance of fairness, independence, and impartiality of judges and arbitrators in the proceedings. In society, arbitration is considered one of the most ethical institutions for resolving labour-related issues, with arbitrators holding the ethical authority to discern what is correct, beneficial, or detrimental [15].

While disputing parties have the freedom to choose their arbitrators in the arbitration process, this does not grant them the right to interfere with the judicial process or compromise the ethical norms of arbitrators. Therefore, to ensure the fairness of arbitration proceedings, both "impartiality" and "independence" are essential criteria, as "impartiality is needed to ensure that justice is done, independence is needed to ensure that justice is seen to be done" [5].

3.2. Party expectations

The primary purpose of arbitration is to expedite the resolution of international disputes and promote the globalization of world trade. As such, parties

Arbitrators have a duty to sign a written statement of independence before their appointment.

involved in arbitration hope for fair, prompt, and cost-effective settlements. However, if an arbitrator exhibits bias, these expectations can be shattered. An unfair award not only inflicts moral harm but also damages the confidence of the community, particularly the parties engaged in the arbitration [16]. To uphold the reputation of arbitration, the process must be built upon parties' trust, which necessitates arbitrators' adherence to professional ethics and the integrity of the arbitral institution itself as an alternative dispute resolution mechanism.

3.3. International recognition

International arbitration awards typically carry greater international recognition compared to judgments rendered by national courts. To uphold and secure the legitimacy of arbitration awards worldwide, judicial independence is crucial. Arbitrators are required to possess both intellectual qualifications and the moral integrity of a judge, enabling a fair and effective arbitration process. However, a common challenge faced by international commercial arbitration is the lack of authorities to regulate arbitrators' conduct [17]. This shortcoming may be exploited by some arbitrators, leading to awards made in an "ethical no man's land" [17], resulting in a decline in the international recognition of the arbitral institution.

4. Common challenges of an arbitrator's appointment

The number of challenges in arbitration has increased in recent times, mainly because parties are increasingly unwilling to accept arbitrators lacking independence or impartiality. For instance, doubts may arise about an arbitrator's independence or impartiality if they fail to disclose relevant relationships, leading to legitimate concerns. Consequently, such challenges can cause delays,

escalate the cost of arbitration proceedings and appointment processes. This paper will explore several challenges in the context of arbitrator's appointments to better understand how to contest decisions effectively.

4.1. Relationship between the arbitrator and the parties

The existence of a relationship between the arbitrator and the parties can arise in various circumstances. *The IBA Guidelines on Conflicts of Interest in International Arbitration* [18] *(the IBA Guidelines)* delineate certain scenarios wherein arbitrators may be disqualified due to their connections with the parties. Notably, a prominent example is when "the arbitrator has a significant financial or personal interest in one of the parties, or the outcome of the case"[1] [18], In such cases, the arbitrator's appointment will be challenged. For instance, in an ICSID case [12], an arbitrator served as a non-executive director of an investment bank. During the appointment process, concerns were raised that this bank had invested in a project involving two of the claimants. The arbitrator contended that she had no knowledge of the investment and was not involved in any business decisions in her capacity as a non-executive director. Consequently, she was deemed fully independent from the disputing parties. Therefore, it is essential to qualitatively consider and evaluate the alleged relationship between the arbitrators and the parties to accurately determine whether it raises concerns about the arbitrators' independence and the subsequent arbitration awards.

Another form of relationship can arise based on the arbitrator's advice provided to one of the parties. *The IBA Guidelines* also furnish specific examples of this connection, wherein the arbitrator regularly offers legal advice or expert opinions to the parties or their affiliates[2] [18]. If this advisory role leads to "the arbitrator or his or her firm derives significant financial income therefrom"[3] [18], it may impact the outcome of the arbitration proceedings.

4.2. Relationship between the arbitrator and the parties' lawyers

The appointment of an arbitrator may face challenges when a relationship exists between the arbitrator and one of the parties' counsels. Several factors determine whether such a connection exists between the parties' lawyers and arbitrators. *The IBA Guidelines* highlight this issue, with paragraph 2.3.3 of the Waivable Red List specifically addressing an arbitrator's relationship with the parties' lawyers, particularly when they work in the same law firm. Additionally, if the arbitrators "have been appointed on more than three occasions by the same counsel"[4] [18], or the same law firm, it indicates a relationship with one of the counsel.

However, not all connections raise reasonable doubts about the arbitrator's independence and impartiality in the minds of the parties. For instance, in the case of Tesco v Neoelectra Group [19], the Lyon Court of Appeal refused to annul the award made by the French Court, even though doubts were raised about an arbitrator's independence and impartiality due to a professional relationship with Neoelectra's counsel. Notably, this relationship existed before the lawyer started working at the law firm, and it was clarified that the lawyer functioned in the dispute as a self-employed individual rather than on behalf of her law firm. Consequently, this connection was unlikely to raise doubts among the parties.

Moreover, when the arbitrator and counsel both belong to the same barristers' chambers, questions may arise about their potential relationship. In such cases, *the IBA Guidelines* emphasize the necessity of disclosing any challenge when "the arbitrator and

[1]The IBA Guidelines, para 1.3 of the Non-Waivable Red List.

[2]The IBA Guidelines, para 2.1.1 of the Waivable Red List.

[3]The IBA Guidelines, para 2.3.1 of the Waivable Red List.

[4]The IBA Guidelines, para 3.3.8 of the Orange List.

another arbitrator, or the counsel for one of the parties, are members of the same barristers' chambers"[5] [18] as this can serve as a clue to determine the connection between the arbitrator and the parties' lawyers.

4.3. Related proceedings for challenges

In practice, parties often fail to agree on a specific procedure for challenges, leading to the submission of challenges directly to party autonomy. Consequently, proceedings for challenges are governed by the provisions of the Arbitration Rules and the Arbitration Laws.

Rules of the arbitration rules: Typically, a challenge proceeding requires the parties to submit a reasoned application to the institutional arbitration, which is then open to comments from the other parties and the arbitration tribunal. If the challenged arbitrator does not voluntarily resign, and the parties cannot agree on a replacement arbitrator, the institutional arbitration must make a decision. For instance, under *the LCIA Arbitration Rules*[6] [20], if all other parties agree in writing to the challenge within 14 days of receiving the application, the LCIA Court will "revoke the appointment of that arbitrator"[7] [20]. Similarly, according to the UNCITRAL Rules, a written agreement on the challenge must be sent to all parties and all members of the arbitration tribunal within 15 days. If the other party does not agree to the challenge and the challenged arbitrator does not withdraw, the decision on the challenge will be determined by an appointing authority. Consequently, decisions made by the institution or the appointing authority are final, even if the challenge is rejected.

Provisions of the arbitration laws: Most arbitration laws provide challenge procedures when the parties do not agree on a tailored challenge procedure. For instance, *the UNCITRAL Model Law on International Commercial Arbitration* [10] (*the Model Law*), stipulates that if the parties fail to agree on a procedure for the challenge, they must continue with the arbitration proceedings, even if they are aware that the challenged arbitrators lack necessary independence or impartiality [21].

Moreover, Article 13(3) of *the Model Law* allows the challenging party to "continue in the arbitral proceedings and make an award" in the case a request is pending. This provision aims to prevent delays and dilatory tactics when a challenged arbitrator is conducting the arbitration proceedings. However, some arbitration laws may restrict a party from continuing court challenge proceedings until the arbitrator proceedings are completed. Consequently, the court may only address the independence and impartiality of arbitrators at the post-award stage.

4.4. Prior proceedings and previously expressed opinion

The Model Law specifies that "an arbitrator may be challenged only if circumstances exist that give rise to justifiable doubts as to his impartiality or independence" [22]. For example, in the case of National Grid PLC v Republic of Argentina [23], the respondent expressed concerns about a specific statement that could cast doubts on the arbitrator's independence and impartiality. However, challenges based on an arbitrator's prior publication of opinions on an issue do not always result in a challenge being upheld. In an ICSID case [24], it was argued that if an arbitrator has previously expressed a general opinion on a legal issue also present in the current arbitration, it does not necessarily create conflict problems. Moreover, establishing bias solely based on a previously published opinion is insufficient, as professional arbitrators consider the facts and arguments presented by the parties in the specific case.

[5]The IBA Guidelines, para 3.3.2 of the Orange List.

[6]The LCIA Arbitration Rules (effective October 1, 2020).

[7]The LCIA Arbitration Rules, Article 10(4).

5. Disclosure obligations

In the realm of international arbitration rules, disclosure plays a pivotal role in determining an arbitrator's independence. It is incumbent upon arbitrators to diligently disclose any pertinent facts that may impact their impartiality and independence during the arbitral process [6]. In particular, *the Model Law* regulates the disclosure obligations as follows: if the person is appointed as an arbitrator, "he shall disclose any circumstances likely to give rise to justifiable doubts as to his impartiality or independence" [22]. Similarly, the ICC Arbitration Rules [25] stipulate that prospective arbitrators must not only sign a written statement of independence before their appointment but also provide written disclosure of any issues that "might be of such a nature as to call into question the arbitrator's independence in the eyes of the parties" [26]. The Secretariat then shares this information with the other parties involved.

In practice, when a person is appointed as an arbitrator, they informally disclose relevant facts and circumstances to the prospective clients. If the potential party accepts the arbitrator based on the argument that these facts do not compromise their independence, the arbitrator will formalize the disclosure in a statement sent to both parties. As such, when arbitrators have fulfilled the requirement of disclosing all issues that could affect their independence and impartiality and there are no objections, any subsequent challenge to the arbitrator based on these circumstances is rendered void.

6. Conclusions

Undoubtedly, international commercial arbitration has emerged as an increasingly vital mechanism in the dispute settlement system. Parties are increasingly recognizing its advantages, such as neutrality, confidentiality, and cost-effectiveness compared to litigation in national courts. However, this system necessitates decision-makers to ensure unwavering independence and impartiality throughout the arbitration proceedings.

The preservation of arbitrators' independence and impartiality stands as one of the fundamental tenets of international arbitration. As a result, several arbitration laws and rules include provisions to safeguard the independence and impartiality of arbitrators' awards, thereby upholding the ideal of a neutral arbitrator in resolving disputes in the realm of international commercial arbitration.

COMPETING INTERESTS

The author declares that there is no conflict of interest regarding the publication of this article.

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Rubber industry in Southern Vietnam (1954-1975): An economic dimension

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Abstract:

This paper examines the significance of the Statistical Yearbook of Saigon's government in providing a comprehensive overview of the rubber industry in Southern Vietnam in the period 1954 to 1975. Prior to 1945, rubber plantations played a crucial role in the economy of French Indochina. After the French left Vietnam following the Geneva Agreement in 1954, the Saigon government endeavoured to take control of the rubber industry. However, due to the war and the incompetence of Southern Vietnam's officials, the rubber industry in the region experienced instability during the period 1954 to 1975. Consequently, the Saigon government struggled to control and develop economic activities. This paper contends that despite these challenges, the rubber industry remained pivotal in Saigon's economy after 1954. This claim is supported by the expansion of rubber plantations, the industry's contribution to Southern Vietnam's exports, and its impact on the overall economy and society.

Keywords: **agricultural reforms, French influence, rubber plantations, Saigon, Southern Vietnam.**

Classification numbers: **7, 8.1**

1. Introduction

Together with the French exploitation in Indochina, rubber cultivation was introduced in Southern Vietnam, quickly becoming a pivotal agricultural product in Vietnam's economy during the first half of the twentieth century. Recognizing the significance of the rubber industry in Southern Vietnam's society and economy, both the French colonial government in Indochina (1897-1945) and the Saigon regime (1954-1975) acknowledged its importance. Consequently, when the French army withdrew from Vietnam in 1954, the Saigon government deployed various strategies to manage this industry and replaced French influence with Vietnamese and Chinese stakeholders in rubber plantations. However, between 1954 and 1975, significant plantations saw minimal changes, as French bourgeoise maintained their positions within the Republic of Vietnam (RVN)'s economy, working with the same personnel and managers until the early 1970s. Failing to eliminate French influence in the rubber economy, the Saigon government turned to supporting large plantations to increase commodity production for foreign demand and generate revenue for the RVN. This paper maintains that despite political movements, French investors and major firms continued to play a significant role in Southern Vietnam after 1954. Additionally, the paper emphasises the rubber industry's position in Southern Vietnam's economy, providing specific details regarding its cultivated lands, production, exports, and contributions to the region's economy.

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Findings from this analysis gain new insights into the rubber industry in Southern Vietnam in the period of 1954-1975, complementing previous research that primarily focused on labour struggles and French control of rubber economy before 1945. By presenting a clearer understanding of the RVN's economy, this paper proves valuable for historians studying Southern Vietnam under the Saigon regime. It also serves as a helpful reference for educators teaching Vietnamese history, especially in economic courses that cover French and American investments and their influence on the RVN. Furthermore, it contributes to the historical narrative of Vietnam's rubber industry, one of the country's most significant and profitable sectors. Business professionals in the rubber industry can also draw lessons from this analysis to enhance their work.

2. Literature review

Rubber has long been closely connected to Vietnam's society and economy since the early 20th century, garnering considerable attention from scholars investigating the development of the rubber industry in Southern Vietnam and its role in Vietnam's pre-1975 economy. Regularly, Vietnamese scholars primarily focus on studying this subject during the French colonial period (1897-1945), as rubber was considered a significant contributor to the colonial economy. However, due to difficulties in accessing and utilizing French primary materials, studies on the rubber economy before 1945 have been scarce in Vietnam. Notably, D.V. Vinh's *100 Years of Rubber in Vietnam* published in 2000 [1], stands out as a prominent work in this area. This work provides a comprehensive overview of rubber, spanning its early days in Vietnam to the modern period, including the origins of rubber in Vietnam, the rubber economy during the French colonial period, and particularly the rubber labour movement throughout the twentieth century. Another noteworthy publication edited by D. Phong (2005) [2], titled *History of Vietnam's Economy 1945-2000, Vol. 2: 1955-1975* offers further insights into Southern Vietnam's economy, encompassing the products and value of the rubber industry. This study situates the rubber industry within a broader context of Southern Vietnam's economy to highlight its role in the Republic of Vietnam's economic landscape. The majority of other works concentrate on the daily lives of rubber labourers, their struggles, and their contributions to Vietnam's revolution. This focus is evident in studies such as Nguyen Hai Trung's *The Rubber Hell,* Tran Xuan Tri's *Rubber Plantation in Cochinchina: An Escape for a Poor Life or a Path to The 'Hell on Earth' of Vietnamese Workers?* as well as other works such as *History of Movement of Rubber Labor in Dau Tieng Plantation (1917-2010)* and *History of Movement of Vietnam's Rubber Labor (1906-2000)*. Numerous other studies delve into labour movements in various rubber plantations in the provinces of Binh Long, Dong Nai, and Binh Duong. These works indicate that previous Vietnamese scholars have mostly focused on the role of rubber labourers in Vietnam's revolution, paying little attention to economic and social contributions of the rubber industry. Recently, the Vietnam Rubber Group published a narrated book titled *History of Rubber in Vietnam, Vol. 1: 1897-1975* [3]. This book partially supports previous research by providing additional information about the rubber economy in Southern Vietnam during the period 1954-1975, drawing from Vietnamese, French, and English primary sources. However, this work mostly offers descriptive accounts of events related to rubber plantations, the rubber industry, and the rubber labour movement, without delving into the attempts and role of the Saigon government in controlling the RVN's rubber industry or the dominance of French plantations in Southern Vietnam's economy.

Foreign scholars have also made significant contributions to the study of Vietnam's rubber industry in the twentieth century. French scholars, in particular, possess distinct advantages due to their access to and utilisation of primary materials on this subject. However, their focus primarily lies on the

period from 1897 to 1945 when rubber plantations were owned by the French. Colonial historians show great interest in rubber plantations during the French colonial era, exploring topics such as the role of rubber in French Indochina's economy, the daily lives of workers, and their movements for social and political change. Several famous articles and books on these subjects include "Le prolétariat des plantations d'hévéa au Vietnam méridional: Aspect social et politique (1927-1937)" [4], "La situation des plantations d'Hévéas dans le monde de 1939 à 1948" [5] and "Des plantations colonials à la production socialiste: La 'vietnamisation' de l'hévéa (1956-1975)" [6]. In contrast to research on the RVN's rubber industry, historians tend to focus more on Southern Vietnam's land reforms and the Saigon government's efforts to replace French influence while forging closer ties with the American economic system from 1954 to 1975. Particularly noteworthy is M. Aso's work, "Profits or people? Rubber plantations and everyday technology in rural Indochina" [7] and *Rubber and The Making of Vietnam: An Ecological History, 1897-1975* [8]. Aso argues that the Saigon regime endeavoured to "Vietnamise" the rubber industry after 1954 by improving technologies and transforming the lives of workers to gain control over this industry. M. Aso's comprehensive book covers all aspects of the rubber industry and provides a general overview of its development under the Saigon regime [6]. He can be regarded as a key foreign scholar who extensively studied RVN's rubber from 1954 to 1975. However, it is important to note that in this book, the author places more emphasis on the role of rubber in the Vietnam War, particularly in relation to both sides of the conflict -RVN and DRV - rather than providing detailed information about the development of the rubber industry under the administration of the Southern Vietnam's government.

In addition to the aforementioned studies, this paper aims to delve deeper and provide more detailed data to precisely illustrate the developments within the rubber industry in Southern Vietnam from 1954 to 1975. Rather than merely describing the state of the rubber economy in Southern Vietnam, it seeks to highlight its characteristics, examine the Saigon government's attempts to gain control over this profitable sector, and explore the influence of French rubber plantations within the rubber system. By scrutinizing Vietnamese documents, this paper endeavours to contribute additional knowledge to the neglected aspects of previous studies on Vietnam's rubber industry in the twentieth century.

3. Methodology

To depict the development of the rubber industry in Southern Vietnam (1954-1975) and argue its role in the RVN's economy, this paper primarily relies on the collection and analysis of specific and primary information obtained from the Statistical Yearbook of Saigon's government during the specified period. It is noteworthy that the RVN's government diligently recorded economic activities, clear and precise data on the rubber industry each year. Utilising a quantitative methodology, the author analyses the gathered data relating to the rubber industry. Furthermore, information from RVN documents is compared with data from various sources. These methodological approaches enable the paper to present a comprehensive picture of Southern Vietnam's rubber industry from 1954 to 1975, incorporating specific data that has not been previously examined in earlier studies.

4. Factors affecting the rubber industry in South Vietnam (1954-1975)

The rubber industry in South Vietnam can be divided into two different periods: a period of robust development from 1954 to 1964, followed by a decline in the late 1960s and early 1970s. The differences between these two periods were influenced by various external and internal factors, including both political and economic reasons.

Firstly, the rubber industry was directly impacted by changes in international rubber prices and consumer trends. the environment for the rubber industry was quite favourable in the 1950s, leading to significant production achievements. However, the price of natural rubber declined substantially from 1958 to 1963, dropping by half during the period 1960-1963 to reach just $476/tonne [9, 10]. Furthermore, between 1960 to 1967, the price of rubber products continuously decreased from $0.71 to $0.37/kg [8]. As profitability decreased, rubber producers reduced fertilization, limited new tree planting, and focused only on exploiting existing plants. Additionally, alongside falling price, there was a reduction in global demand for natural rubber, resulting in limited markets for South Vietnam's rubber. Starting from 1960, as the production of synthetic rubber surpassed that of natural rubber worldwide, many countries began shifting towards using synthetic alternatives instead of importing natural rubber. For example, between 1966 and 1968, North America supplied 49.8% of the world's synthetic rubber, significantly reducing the United States' demand for South Vietnam's natural rubber products [11]. These conditions restricted the expansion of larger rubber plantations in Southern Vietnam during the period of 1954-1975.

Secondly, in effort to replace French-owned estates in the rubber industry, Ngo Dinh Diem encouraged Vietnamese middle and small holders to increase rubber cultivation through the Land Development Plan (LDP). He also issued Decree 414-KT and Government Decision 287-KT to establish the Rubber Cultivation Development Fund (RCDF) and subsequently the National Agricultural Credit Bureau (NACB), which provided loans to planters [10]. Diem aimed to raise 90,000 ha of rubber plantations. By 1959, the Saigon government had established 12 "dinh điền" zones with 84 small farms. In 1963, there were 18 districts across 22 provinces, encompassing 208 small plantations [12, 13]. These policies contributed to the expansion of rubber cultivation, particularly for especially for middle and small plantations, while impeding the growth of French-owned estates with large plantations.

Thirdly, Southern Vietnam's rubber industry suffered significant damage during the American war. In 1958, the forces of the Democratic Republic of Vietnam (DRV) attacked the Dau Tieng plantation with the aim of gaining control over rubber firms in Southern Vietnam [14]. Starting in 1961, the Saigon regime implemented the "Strategic Hamlet Program," which compelled labourers and farmers in RVN villages to relocate to hamlets built by the government in order to sever their connections with the National Liberation Front for South Vietnam (NLF) and the DRV's armies. This policy resulted in a shortage of labour in most middle and small plantations. From 1965, the Battle of Dong Xoai disrupted all economic activities in the Thuan Loi and Phu Rieng plantations in the province of Phuoc Long. The Dau Tieng and Ben Cui plantations in Binh Duong came under control of the DRV's army and ceased operations in October 1965. Following the Tet Offensive in 1968, the RVN's military forces attacked rubber plantations in the Southeast regions and locations near the Cambodian border to eradicate hidden bases of DRV soldiers. As a result, a significant number of rubber cultivations suffered damage. In 1968-1969, 34,000 ha of rubber were left uncultivated and unexploited. For example, in the province of Long Khanh, 45.7% of rubber estates were abandoned, the Dau Tieng Plantation decreased from 9,200 ha of cultivated land to 2,500 ha, and 35% of plantations owned by the SIPH (*Societe Indochinoise de Plantations d' Heveas*) were damaged [10]. These challenging conditions had a detrimental impact on the development of Southern Vietnam's rubber industry and resulted in a diminished contribution of rubber to the RVN's economy and society, particularly from the late 1960s.

Furthermore, each type of plantation had its own reasons for the reduction in rubber planting and

production. For instance, French-owned firms were affected by the French army's withdrawal from Vietnam in 1954-1955, a lack of financial assistance, and the Saigon government's policies aimed at developing small rubber farms to replace their position. In contrast, middle and small farms, as well as governmental plantations, faced challenges such as a shortage of skilled labour and management, inadequate technical support, and limited investments in comparison to larger operations.

5. Rubber areas

Under the Saigon regime, rubber plantations in Southern Vietnam can be categorised into 4 types: large-scale plantations (more than 500 ha, primarily owned by French estates), middle-sized plantations (ranging from 100 to 499 ha), small plantation (under 100 ha, newly established and owned by Vietnamese individuals), and "dinh điền" or new plantations created under Saigon's Land Development Program (LDP) with government support. After 1954, all French plantations under 500 ha were transferred to Vietnamese planters (Fig. 1). However, the French retained control over significant firms with sizes exceeding 500 ha, therefore maintaining their dominance in Southern Vietnam's rubber industry [8].

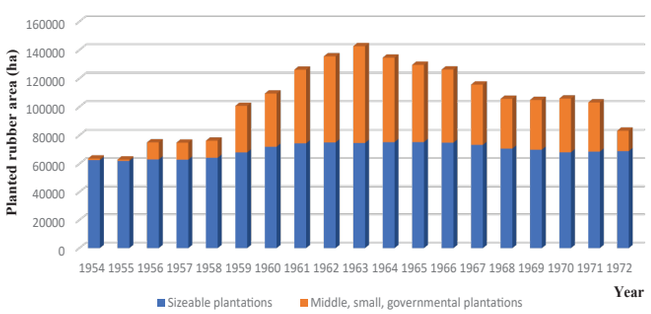

Fig. 1. Planted rubber area in hectares from 1954 to 1972. Sources: [8, 15-17].

Rubber cultivation experienced rapid growth from 1959 to 1964, reaching its peak at 134,700 ha, more than double the cultivated area in 1954 (63,000 ha) [9]. The number of plantations also increased, from 270 (in all sizes) in 1959 to 304 in 1960 and 335 in 1961. This indicates that Ngo Dinh Diem's policies promoting new tree planting were relatively effective during this earlier period. However, despite its substantial area, rubber accounted for only 3% of all cultivated lands in the RVN, with rice fields holding the top position. In 1954, rice fields covered 1,572 million ha, which was 25 times greater than rubber areas (62,731 ha) [15]. By 1965, rice fields had expanded to 2.4 million ha, surpassing rubber plantations by a ratio of 18 to 1 [18]. By 1972, due to the detrimental effects of the war, rubber land had dwindled to only 83,000 ha, in stark contrast to the 2.7 million ha of rice fields [17].

Rubber cultivation was primarily concentrated in Southeast Vietnam, particularly in the provinces of Binh Duong, Binh Long, and Long Khanh, while the Tay Nguyen region made a relatively small contribution with "dinh điền" and small-scale plantations. For example, in 1954, provinces Bien Hoa and Thu Dau Mot collectively accounted for more than 51,000 ha (out of the total of 62,731 ha) of the RVN's rubber, while Tay Nguyen had only 1.021 ha [15]. In 1965, with the completion of the LDP, rubber land in Tay Nguyen increased to 15,590 ha (12.3% of the total), but it still paled in comparison to Southeast Vietnam, which held 87.7% of the rubber plantations [18]. In 1972, despite the damages inflicted by the war, this region continued to maintain its advantage with 79,200 ha (95%), while plantations in other regions significantly reduced, surviving with only 4,100 ha [17]. In summary, regardless of the prevailing conditions of war or peace, Southeast Vietnam, particularly with its French-owned estates, consistently played a major role in the rubber industry of the RVN.

Large plantations were the leading contributors to the RVN's rubber industry (Fig. 2). From 1954 to 1958, they accounted for about 90% of the total rubber area. However, as the Saigon regime provided support for the developments of middle-sized, small, and "dinh điền" plantations, the land occupied by

large firms diminished to 66% by 1960. This ratio increased slightly to 66.5% by 1969, but large plantations still remained the primary holders of rubber land [17]. In 1972, as middle-sized and small estates were damaged by war, the area of sizeable plantations increased to 86%. As M. Aso argued, the biggest beneficiaries during this period were the large planters, most of whom were French bourgeoisie, as they expanded their cultivated land from 64% in 1943 to 82% in 1970 [8, 19]. In contrast, middle-sized farms maintained a size of 206-207 ha each, while small farms experienced a reduction in size from 21 ha to 9 ha/each [19].

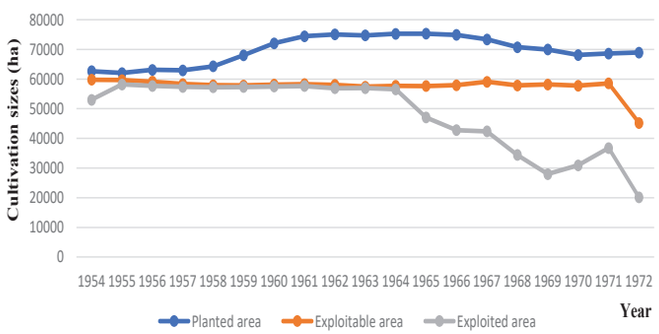

Fig. 2. Cultivation sizes (in hectares) of large plantations in Southern Vietnam from 1954 to 1972. Source: [17, 18, 20, 21].

The area of large plantations increased from 1955 to 1964, reaching nearly 80,000 ha, but experienced a decline in the late 1960s and early 1970s. Approximately 500 ha were newly planted in 1955-1956, and during the period of 1960-1965, new plantations exceeded 1,000 ha annually. Between 1955 and 1963, a total of 16,882 ha were planted with new rubber trees [9]. However, due to the impact of the Tet offensive, there was limited new rubber land in 1968-1969. From 1970 to 1972, more than 1,000 ha of rubber were planted, but the survival rate was low due to the ongoing war [19]. The exploitable land consistently accounted for around 85-90% of the total planted areas, except in the early 1960s when a significant number of trees were newly planted and had not yet reached tapping age. Interestingly, before 1965, the gap between exploited and exploitable plantations was minimal as that period experienced little impact from the war and was peaceful for rubber production. However, in the late 1960s, the exploited land only represented 50% of the exploitable plantations, declining further to 44% in 1972 due to the war (20,100 ha out of a total of 45,200 ha) [17].

This paper argues that despite the efforts made by the RVN's government to control the rubber industry and promote the involvement of small holders as replacements for the large French estates, these attempts were unsuccessful. The French continued to wield significant influence in the rubber economy, and the majority of rubber lands from 1954 to 1975 remained unchanged in comparison to the previous period [22]. In 1954, the estimated size of French-owned large plantations stood at 63,752 ha [10]. By 1962, the land area occupied by large plantations had increased to 73,850 ha, with 78% of the rubber trees having been planted prior to 1954 [23]. New rubber plantings between 1955 and 1962 accounted for a mere 22% of the total. This figure not only underscores the prominent position of French-owned firms but also serves as one of the reasons for the decline in the RVN's rubber production, as the existing rubber trees had aged and their productivity had become limited. Around 35% of rubber trees were over 30 years old, while 22% of newly planted areas, which were under 7 years old, were still awaiting tapping. The deterioration of rubber plantations became more pronounced in the 1970s. Trees over 40 years old (planted before 1930) constituted 33.2% of the rubber cultivation, while rubber trees aged 35-40 years accounted for 11.6%, and those aged 27-36 years (planted during the period of 1936-1945) represented 24.3%. Thus, in 1972, a staggering 69.1% of rubber cultivation in Southern Vietnam consisted of trees that were over

27 years old, having been planted during the French colonial period [12].

By 1963, French firms still retained ownership of plantations and factories, valued at $100 million. Twenty-three French-owned plantations occupied three-quarters of the rubber lands and accounted for 90% of rubber exports in South Vietnam, valued at $30 million [6]. There were ten prominent French factories in the RVN's rubber economy, namely, *Plantations des Terres Rouges (PTR), Societe Indochinoise de Plantations d'Heveas (SIPH), Les Caoutchoucs du Donai (LCD), Societe des Caoutchoucs d'Extreme-Orient (CEXO), Ste des Plantations et Pneumatiques Michelin, Ste des Heveas de Tay Ninh, Ste des Plantations d'Heveas de Xuan Loc, Les Caoutchoucs de Phuoc Hoa, Compagnie des Hauts Plateaux Indochinois (CHPI),* and *Societe des Plantations de Cau Khoi (SPCK)*. Together, they possessed 29 large plantations in the Southeast region, covering 71,200 ha (95.3%), and yielding 64,200 tonnes of rubber products (93.1%) [14]. *Plantations des Terres Rouges* (PTR) alone was valued at 925 million piasters and held the five largest plantations, encompassing lands, rubber plants, and a manufacturing factory. In 1971, most of the exploited rubber land belonged to French-owned plantations. The PTR and CEXO factories exploited a total of 14,690 ha out of the 15,120 ha in Binh Long. In Long Khanh, French factories occupied 7,984 ha out of 8,070 ha. In Tay Ninh, they exploited 3,570 out of 4,340 ha. In Binh Duong, the *Michelin* factory operated in 1,410 out of 1,550 ha. In Phuoc Tuy, the ratio was 700 out of 1,160 ha, and in Phuoc Long it was 340 out of 550 ha [10].

"Dinh điền" plantations in the Tay Nguyen region were established and expanded in the late 1950s and early 1960s to compete with the French-owned plantations. Between 1957 and 1963, the RVN's government constructed 13 large "dinh điền" in provinces of Kontum, Pleiku, Daklak and some provinces in the Southeast region. By 1964, an additional 31,408 ha had been planted across 11 provinces. However, the survival rate was disappointingly low, standing at only 41.2%. For instance, in Binh Duong, 1,337 ha were planted, but only 50 ha survived. In Phuoc Tuy, all 294 ha of rubber plantations perished. In the Tay Nguyen region, only 50% of the newly planted rubber survived until 1964 [10, 24]. Several factors contributed to this low survival rate, including a shortage of experienced labour, unsuitable weather and land conditions, and the adverse effects of war. This reality highlights the failure of Ngo Dinh Diem and the RVN's government in replacing the French plantations and underscores the continued influence of French bourgeoisie in the RVN's rubber economy.

6. Rubber production

From 1954, the RVN actively promoted the exploitation of various types of rubber products due to the high profitability this industry offered to both private companies and the government. The rubber production in Southern Vietnam experienced a significant increase after 1945, rising from 12,000 tonnes to 71,500 tonnes by 1963, which amounts to a nearly sixfold growth in just 18 years. The peak production year was 1961, with 78,140 tonnes [1, 9, 17]. However, after 1962, production began to decline, reaching a low point of 13,000 tonnes by 1965 [18]. With the direct involvement of American soldiers in the anti-American resistance war, rubber production continued to decrease, averaging nearly 40,000 tonnes annually from 1965 to 1968, and dropping to less than 30,000 tonnes after the Tet Offensive in 1968. This decline was a result of the attacks by American and RVN soldiers on all rubber plantations located around Saigon and in the Southeast region, aiming to destroy the military bases of DRV and NLF soldiers. By 1974, rubber production had plummeted to a mere 20,000 tonnes,

marking a fourfold reduction compared to the peak output in 1961. This indicates a gradual decline in rubber production from the early 1960s to the early 1970s. According to the World Bank, during this period, the RVN's rubber supply averaged around 21,000 tonnes of rubber per year. Despite the potential for substantial profits in Southern Vietnam's economy, RVN's rubber played a minor role in the international market. In the 1950s and 1960s, the three Asian countries of Malaysia, Indonesia, and Thailand accounted for 80% of the world's natural rubber supply, with other countries such as India, Sri Lanka, Liberia, and Nigeria contributing 12%. The RVN's share was only around 3%, placing it in fifth position within the global rubber system. However, its contribution diminished sharply over time, dropping to 3.5% in the period 1955-1957, 1.6% in the period 1965-1968, and a mere 0.6% from 1972 to 1974 [11].

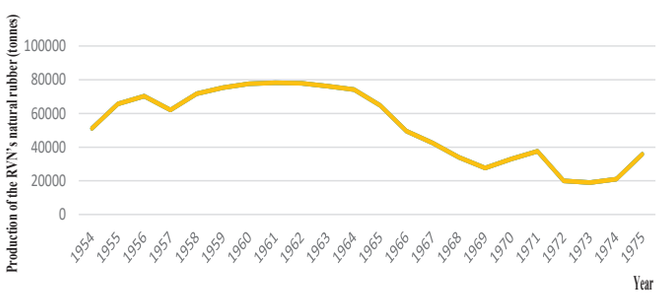

Fig. 3. Production of the RVN's natural rubber in tonnes from 1954 to 1972. Sources: [1, 9, 15, 17, 18, 25].

The main argument presented in this paper is that the large plantations owned by French bourgeoisies made the greatest contribution to Southern Vietnam's economy, surpassing that of small and middle-sized plantations, as they accounted for about 85% of the RVN's rubber output. In 1954, these large plantations produced 50,345 tonnes, which increased to 68,000 tonnes in 1960, representing 88.3% of the total RVN's rubber production (Fig. 3). Furthermore, in 1961, their contribution reached a staggering 90.8% [14, 15]. Despite a decline in production during the early 1960s, the large estates still maintained control, accounting for 86.8% in 1965 [18]. Even in 1967, although their actual production was significantly reduced to 39,414 tonnes out of a total of 42,000 tonnes, the large plantations continued to contribute 93% of the RVN's natural rubber output. It can be argued that American and RVN's soldiers avoided damaging the French-owned rubber estates due to their high profitability, while targeting the middle-sized and small plantations, which were predominately owned by Vietnamese individuals and served as hidden bases for DRV and NLF soldiers. Moreover, these smaller plantations lacked the financial and technological support provided by the RVN government. Additionally, the new "dinh điền" plantations experienced a mortality rate of over 50% between 1957 and 1963, and the surviving plantations yielded low output. As a result, from 1954 to 1965, the combined production of all small and middle-sized plantations amounted to approximately 6,000-9,000 tonnes annually, which was less than one-sixth to one-seventh of the output of the large plantations [26, 27].

From 1954 to 1965, Tay Nguyen could only supply around 1,000 tonnes annually, while the Southeast provinces produced more than five times that amount. Remarkably, in the years 1954-1955, the Southeast provinces contributed more than 50,000 tonnes, whereas the Tay Nguyen region produced more than 700 tonnes. By 1965, Tay Nguyen's output decreased to less than 700 tonnes, while rubber firms in the Southeast region saw a significant increase, producing 80 times more rubber than Tay Nguyen [18]. In particular, in 1971, Tay Nguyen produced a mere 200 tonnes due to the destruction caused by the war [17]. Among the Southeast region's rubber industry, Binh Long and Binh Duong provinces stood out, occupying 50% of all rubber lands and contributing significantly to the overall production. Binh Long ranked first, averaging an output of 24,000

tonnes in the 1950s and 1960s. However, by 1968, its yield had declined to 18,000 tonnes, with 99.5% originating from large plantations. Long Khanh secured the second position, but its production continuously decreased, reaching only 8,600 tonnes in 1968.

Fig. 4. Different types of production from large size rubber estates, in tonnes, from 1954-1972. Source: [17, 18, 21].

Various types of rubber products were produced in Southern Vietnam, with natural products comprising the majority while processed goods remained limited (Fig. 4). Smoked sheets stood out as the most significant product, accounting for around 60-70% of the annual output. Other crepes, including ordinary, flat bark, and sernamby, held the second position, representing 33.2% in 1959 and 30% in 1960. Sole crepes had the smallest contribution, especially in 1968 with 62 tonnes and 78 tonnes in 1972. With the involvement of multiple factories in the processing industry, RVN was able to offer a wider range of rubber products, such as tires and tubes for bicycles and motorcycles, sandals, and mattresses. Notably, not only French-owned planters but also Chinese and Vietnamese companies participated in this lucrative economy. In 1965, there were 47 firms in Saigon engaged in rubber exportation, although most of them were small enterprises [14]. Additionally, in 1974, there were two Chinese and Vietnamese-owned two firms in Bien Hoa, along with 20 large enterprises and 110 small organizations in Saigon [28].

Table 1. Bicycle tire and tube production (in units) in the RVN from 1967 to 1968. Source: [29].

Factory	Tire		Tube	
	Year 1967	*Year 1968*	*Year 1967*	*Year 1968*
Michelin	1,254,260	1,144,805	1,254,883	1,333,914
Dutaco	408,638	364,627	310,833	362,514
Filanco	49,100	41,275		
My Hanh	11,726	180		
Duc Loi	826	800		
Liandrat	0		390,341	320,500
Dong Ich	0		37,160	10,486
Viet Tan	0		21,150	6,203
Pham Hiep	0		200	
Total	**1,711,998**	**1,550,707**	**1,956,057**	**2,021,458**

As shown in the Table 1, both French and Vietnamese factories involved in the rubber industry, specifically in the production of tires and tubes for bicycles and motorcycles. Among them, French firms held a prominent position, with the Michelin factory taking the lead. Established in 1953, the Michelin factory alone produced over 70% of all rubber products. There were also 30 medium-sized factories engaged in sandal production, but only the Bada factory, owned by a French holder, was able to produce high-quality products using modern technology. In the late 1960s, rubber factories primarily catered to military demand [24]. However, the RVN's rubber processing industry was still in its early stages, and Saigon continued to import technologically advanced rubber commodities.

7. Exportation and rubber's role in RVN's society and economy

The majority of rubber production in the RVN was dedicated to exports, with only a small portion being consumed domestically. In 1960, a mere 2,000 tonnes were allocated for local demand, while nearly 78,000 tonnes were earmarked for foreign

markets [25]. Exportation experienced a sharp increase, reaching 27,503 tonnes from 1954 to 1961. However, starting from 1962, rubber exportation witnessed a rapid decline, with figures falling below the 1954 levels after 1966 due to the impact of low global natural rubber prices and the ongoing war situation [2]. Notably, the years 1969-1970 marked the lowest point in exported rubber weight, with just over 20,000 tonnes. The RVN's contribution to the global natural rubber market dwindled from 3% to 0.6% in the 1970s, which was considerably low in comparison to neighbouring countries like Malaysia, Indonesia, and Thailand.

Similarly, the value of rubber exports followed a pattern of increase from 1954 to 1961, but then experienced a continuous decline until 1971. In 1957, although the RVN exported only 79,950 tonnes of rubber, it generated a value of 1.7 billion piasters, reaching its peak. In the subsequent years, the value of rubber exports declined, although it was still higher than that of 1954. For instance, in 1959-1960, it exceeded1.6 billion, and in 1961, its value decreased to 1.53 billion, despite the highest weight of exports at 83,403 tonnes. This decline in value was attributed to the drop in international natural rubber prices to $526 per ton. Interestingly, except for a few specific years, including 1954 (the year of governmental transfer), 1965 (with direct American involvement in anti-American resistance war), and the period of 1968-1971 (marked by the negative impact of the Tet Offensive), the value of rubber exports remained consistently high, surpassing one billion piasters [14]. The lowest year was 1970, with a value of 708 million piasters. In 1973 and 1974, the value increased again, reaching over $13 million and $14.4 million, respectively, as RVN's planters exploited and exported both new production and existing stockpiles [30].

Remarkably, the types of rubber exportation from the RVN were quite diverse, with an increasing presence of processed commodities alongside crude and natural ones. In 1956, the list of exported commodities included both natural and manufactured rubber products such as bicycle tires, mattresses, and sandals. However, the volume of manufactured rubber was minimal and insignificant, with 22 tonnes in 1957, 10 tonnes in 1958, 4 tonnes in 1960, and nearly zero in other years of the 1950s and 1960s [18]. In 1968, RVN's exportation of manufactured rubber was limited to bicycle tires only [21]. In contrast, the RVN had to import 5,000 to 6,000 tonnes of manufactured rubber to meet its domestic economic demand. It was not until 1972 that 1,662 tonnes of manufactured rubber goods were exported, with a value of 30.8 million piastres [17]. These data show that the RVN mainly exported natural rubber during this period, despite efforts to improve the rubber industry. Natural rubber, therefore, contributed significantly to export revenues, such as 1.225 billion out of a total of 1.227 billion piastres in 1966 and 612.2 million out of 612.6 million piastres in 1967 [20].

Rubber also made a substantial contribution to the RVN's economy by providing numerous jobs in plantations and factories for Vietnamese workers and their families. In some provinces, large plantations employed and supported the livelihoods of up to 50% of the local population. In 1958, there were 14,044 workers in rubber estates, and within two years, this number nearly tripled, with workers spread across 304 plantations [22]. By 1961, 335 rubber firms employed 41,045 workers, accounting for 67.2% of the workforce in all types of plantations, including rubber, tea, coffee, and more [11, 25]. In 1963, 445 rubber plantations provided employment for 41,217 individuals, representing 68.5% of the total plantations' workforce. This included 17,925

skilled workers, 12,379 unskilled ones, 9,944 part-time workers, 8 professional employees, and other officials and managers [18]. The rubber industry also generated additional demand for supplies, housing, education, and healthcare. In 1960, the RVN had 160 factories in the rubber industry, and this number increased to 197 industrial and commercial firms by 1966 [17]. These enterprises yielded considerable profits, amounting to 551 million piastres in 1957 and rising to 645 million in 1961 [10].

The rubber industry was a significant source of revenue for the Saigon regime, as it contributed various types of taxes, including export tax (70%), land tax (6%), business income tax (10%), consumption tax (3%), general tax (6%), and other taxes (5%). The export tax was raised from 3% in 1954 to 12% and then to 40% in 1960 [9]. As a result, the government's income from exported rubber taxes also experienced a rapid growth, from 48.1 million piastres in 1956 to 161.6 million in 1961-1962, which represents an increase of more than threefold in just five years [15, 31]. In 1963, the value of exported rubber reached $33.5 million, with the government collecting $13.4 million or 500 million piastres (40%) in taxes, while private factories gained a profit of 230 million piastres [14, 25].

Due to the lucrative nature of the rubber industry, the RVN government prioritised investments in profitable rubber plantations and made efforts to avoid damaging them during the war. When the rubber industry faced difficulties due to both internal and external factors, the government reduced the export tax from 40% to 20% in 1970 to incentivise traders to engage in rubber exploitation [4]. Prime Minister Tran Van Huong issued Decrees and Instructions to halt the destruction of rubber plantations after the Tet Offensive in 1968 [32]. In 1970, the Saigon government developed a plan with two main objectives: 1) to cultivate 30,000 ha of uncultivated land and improving plantation technology to achieve an annual production of 70,000 tonnes within the next five years, and 2) to plant 50,000 ha with an annual production of 100,000 tonnes [28]. A rubber conference held in late 1973 aimed to enhance the competitive ability of Southern Vietnam's rubber industry, with key targets of producing 38,130 tonnes, exporting 11,360 tonnes, and generating $42.7 million [1].

Rubber production consistently accounted for around 50-75% of the RVN's total export value from 1954 to 1972, despite rubber plantations occupying only 3% of cultivated land (Fig. 5). Among the various rubber products, smoked sheets RSS1 held the highest value. In 1957, American economist Sheldon Tsu argued that rubber would surpass rice as the RVN's most important export. From 1956 to 1960, rubber consistently contributed over $40 million to the total export value of the RVN ($60-80 million), while rice only generated $3,000 in 1956 [33]. In 1959, rubber accounted for 62% ($46.5 million) and in 1960, approximately 57% of the RVN's total exported value, while rice fields covered 11% of RVN's cultivated land (170.85 km^2) but contributed only $27 million, with industrial products exporting a mere $4 million [25, 33]. In 1965, rubber generated 901 million piastres, representing 76.21% of all exportation, which was more than 13 times higher than the contribution of rice exports (11.05%). Other agricultural goods such as meat products, tea, coffee, and fruit accounted for 10.10% of the total export value [10]. Even in the late 1960s, despite a reduction in rubber exports, it still provided $24 million, while industrial products contributed only $1 million, as rice and other food types were not allowed for export [33]. In 1970 and 1971, rubber still represented 70% of the RVN's total export value, but in 1972, due to the war, it dropped to 36% (1.5 billion piastres), falling behind the value of fish, crustaceans, and seafood products (1.6 billion

piasters) [17]. Consequently, from 1954 to 1975, rubber held the leading position as the main exported commodity of Southern Vietnam's economy, although its prominence decreased in the early 1970s.

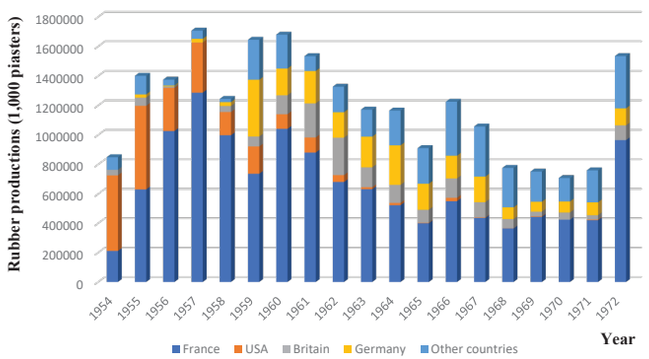

Fig. 5. The RVN's rubber export markets by value (units in 1,000 piasters). Sources: [15, 17, 18, 23].

The market for the RVN's natural rubber encompassed more than 20 countries, including Denmark, Taiwan, Poland, Greece, the United States, Japan, Algieri, Morocco, French West Africa, Switzerland, Spain, Sweden, Mexico, Cuba, and Finland. However, the main markets were France, Britain, West Germany, and Japan. Among these, France emerged as the leading consumer of the RVN's rubber. With the exception of 1954 when the United States imported a significant amount of Vietnam's rubber, France consistently held the highest position in subsequent years. This market regularly accounted for over one billion piastres annually, while other markets contributed around 80-90 million piasters per year or less [15, 23]. The lowest point for French importation occurred in 1954 when France only imported 12,669 tonnes (22.6%), valued at nearly 200 million piastres. The highest year was 1957 when France imported 55,364 tonnes (72.8%) valued at 1.28 billion piastres out of the total 1.7 billion piastres of rubber exportation. However, starting from 1964, the amount of money from France declined sharply as the price of natural rubber decreased, and other markets such as Japan and Italy made greater contributions. By 1972, French importation accounted for only 30% of the RVN's total rubber exports.

Interestingly, despite America's attempts to replace the French-owned plantations, it had a negligible contribution to the RVN's rubber exportation. Prior to 1960, America was the second-largest market for the RVN's rubber products. However, its contribution declined rapidly after 1961, with only seven tonnes imported in 1972 and zero tonnes in 1970. This decline can be attributed to America's development of technology for producing synthetic rubber, which reduced its demand for natural rubber. Since 1960, global production of synthetic rubber exceeded that of natural rubber, leading many countries to prioritise using synthetic goods instead of importing natural rubber [11]. West Germany emerged as a replacement for America's position in the 1960s, along with Britain, both of which played a significant role in the RVN's rubber exportation during that period. However, in the 1970s, Italy, Japan, and Singapore became prominent importers of rubber from Southern Vietnam. Remarkably, from the late 1960s, other markets also contributed significantly to Vietnam's exportation, with their share increasing to 25% in 1965, 35.6% in 1968, and reaching a peak of 68% in 1972 [12].

8. Conclusions

Rubber industry held a significant role in both the colonial economy of French Vietnam and Southern Vietnam from 1954 to 1975, impacting various aspects such as social, economic, political, and military affairs. This position was evident not only in the numbers related to area, production, exportation, and value, but also in the treatment of rubber plantations by the Saigon government, the French bourgeoisies, and even the DRV. Both Southern

and Northern Vietnam recognised the fundamental importance of rubber plantations as military bases for their armies and a vital financial resource for their economies. The policies of the RVN, including the establishment of "dinh điền" and the encouragement of middle-sized and small rubber farms, were attempts to replace French owners in controlling the rubber economy in South Vietnam, as this industry offered substantial profits in all circumstances. Even rice, the most significant agricultural product, lost its influence compared to rubber.

Rubber became the leading exported product, helping the RVN mitigate its trade deficit. The activities of the Saigon regime, such as the establishment of the Vietnam Institute for Rubber Research (IRCV) and financial support provided to planters, facilitated the cultivation and efficient exploitation of rubber plantations. In 1958, Decree 287-KT enabled 100-ha plantations to receive a loan of 3 piastres per kg of exported rubber with an annual interest rate of 2% [1]. The exchange rate for sales in Saigon steadily increased, enabling rubber companies to accumulate more piastres for investment in rubber tree utilisation and labour wages. Prior to June 18th, 1966, the exchange rate was $1 USD to 35.35 piastres. From 1966 to October 5th, 1970, it was 80.80, and then it rose to 277.75 piastres. In 1971, the rate fluctuated from 277.75 piastres to 404, and then 414.10 piastres per $1 USD. In 1973, it sharply increased to 500 piastres [17].

Southern Vietnam, however, failed to replace the French role in rubber industry, and the government had to support sizeable plantations and rubber factories to maximise profits from this sector. Aso argues that there was a lack of small holders in Vietnam's rubber system prior to 1954, and Ngo Dinh Diem's early policies aimed to "Vietnamise" rubber estates by encouraging small farms and establishing new "dinh điền". However, Saigon faced challenges due to the shortage of professionals and skilled managers to oversee the entire rubber industry. The RVN's projects in the Tay Nguyen region proved unsuccessful, with a significant number of rubber trees dying and only minimal output being generated. While there were some developments in processing and manufacturing rubber goods, their impact remained limited. Due to the financial demands of the Vietnam War, Saigon had no opportunity to support French-owned firms in rubber exploitation and the exportation of natural rubber. This indicates that the large French-owned plantations consistently held the key position in Southern Vietnam's rubber industry as it supplied about three-quarters of the production and exportation. The power of the French bourgeoisie and the United States' investments also underscored the fact that the RVN was heavily reliant on external factors and still in the early stages of development as an economy.

COMPETING INTERESTS

The author declares that there is no conflict of interest regarding the publication of this article.

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Stories of the Indian descendants as revolutionaries in Vietnam

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Abstract:

This paper focuses on the Indian descendants who are acknowledged in mainstream records as contributors to national and democratic revolutionaries. Relying on archival documents and ethnographic notes collected from the author's research at National Archival Centre II, the Archive Centre of Ho Chi Minh city People's Committee, and at the Indian temples and mosques in Ho Chi Minh city in the years from 2013 to 2014, this paper constructs narratives of the Indians' personal experience about Vietnamese revolutionaries. Rather than aiming at a comprehensive description of these Indian individuals with heroic details, this paper includes fragments of their life stories, which are diverse and temporary, as collected largely from the author's ethnographic research and sometimes from journalistic and administrative writings. The way of telling specific and particular experiences of the Indian descendants supporting Vietnamese nation-building is significant in bringing up vivid and particular portrayals of this population. That potentially forms lively, immediate indicators of historical and cultural connections between India and Vietnam.

Keywords: **Indian descendants, supporters of Vietnamese national and class revolutions, Vietnamese nation building.**

Classification numbers: **8.3, 9.2**

1. Introduction

In official records of both Vietnam and India, Indians in Vietnam exclusively include those who have migrated to Vietnam as various bilateral commitments between the two countries since the early 1990s. Specifically, the Ministry of the Non-Resident Indians and Person of Indian Origin Division of the Ministry of External Affairs still characterizes the community of Indians in Vietnam as workers: they "enjoy reasonably good economic status", [1]. This definition highlights the role of young Indian businesspeople and professionals, who present an emerging India and its enterprise and energy [2]. Correspondingly, the term "Indian Community" in Vietnam, as revealed in the document titled "India - Vietnam Relations", refers to "the Indians living in Vietnam, primarily to promote trade and business interactions". This community "is vibrant, law-abiding, well-educated and prosperous", including professionals working in Indian and multinational companies; and they retain strong family, cultural, and business ties with India" [1].

Such a way of identifying Indians in Vietnam does not count *historical* records and the *actual* presence of Indians who are the descendants of those who, since the second half of the nineteenth century, migrated from French-British India to Indochina - Vietnam, Laos and Cambodia. These Indian descendants have been in Vietnam for generations and many of them have participated in the democratic and national revolutions of Vietnam. Some of them have Vietnamese citizenship while their identity card carries the note "Indian ethnicity". Some of the Indian descendants retain Indian citizenship. Many Indian descendants

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earn their living through impermanent and low-income jobs such as mobile selling, motorbike taxi, costume jewellery polishing and selling, and halal meat servicing. This paper focuses on the Indian descendants who are acknowledged in mainstream records as contributors to national and democratic revolutionaries. Relying on archival documents and ethnographic notes collected from the author's research at National Archival Centre II, the Archive Centre of Ho Chi Minh city People's Committee, and at the Indian temples and mosques in Ho Chi Minh city in the years from 2013 to 2014, this paper constructs narratives of the Indians' personal experience about Vietnamese revolutionaries. Rather than aiming at a comprehensive description of these Indian individuals with heroic details, this paper includes fragments of their life stories, diverse and temporary, collected largely from the author's ethnographic research and sometimes from journalistic and administrative writings [3]. The way of telling specific and particular experiences of the Indian descendants supporting Vietnamese nation-building is significant in bringing up vivid and particular portrayals of this population. This potentially forms lively, immediate indicators of historical and cultural connections between India and Vietnam.

2. Female wounded soldier

One of the fragments of the Indian descendants' life stories belongs to Mrs. Bibi. She is a wounded soldier, who is recognized by the Vietnamese government to be a supporter of the Vietnamese revolution and nation-building. At the time I first met her in the summer of 2013, she was 82 years old. In days around July 27 - the Martyr and Wounded Veteran Memorial Day of Vietnam - in 2014, I visited Mrs Bibi more often, observing the Vietnamese government's appreciation of revolutionary contributors like Mrs. Bibi. Staying alone in an old and tiny room of the impaired collective building at Le Thanh Tong street, Mrs Bibi tended to speak unstoppably. As her habitus was apparently constructed since the time being a state-recognized citizen, Mrs. Bibi constantly endeavoured to perform as an old ideal female veteran. She narrated that her father was a "Bombay silk businessman" in Hanoi and married a Vietnamese woman from Hai Duong, a province of northern Vietnam. Her mother died when she was two years old. Due to her father's business, she moved from area to area. Her father then married a "Bombay woman[1]". "It was boring to death imprisoned in a house as my father constantly did business afar for months. My stepmother was beautiful and nice, but she kept quiet all the time. It was very boring staying at home", Mrs. Bibi's face turned stagnated when she told me this detail. But she looked energized again when she recalled stories of what she called "revolutionist activities" (hoạt động cách mạng, Vietnamese).

She recited her "revolutionist activities" in the tone of a child who was curious about the outside world, different from the world of the house that her father forced her to stay in all the time while he had to travel afar for a long time frequently. For her, taking the "revolutionist activities" was also a chance for her to escape from classes. Her female teacher, whose husband was a high leader of the Party-led revolutionary movement in Saigon, asked her to bring letters and weapons hidden in baskets to her husband at a secret base. According to Bibi, it is her Western figure that helped to contribute to her easy completion of the revolutionary tasks that were assigned by her teacher. She could help secret cadres pass the security posts easily because no one could think that a western feminine girl could be involved in anti-French action. Bibi recalled that she was acquainted with a French official who treated her

[1]The research author thinks this detail needs to be treated not as a historical fact but as a segment of her memory, which must be imaginative. In other words, the term "Bombay" occurs more as a form of Mrs. Bibi's fantasy about her so-called Indian origin than as a noun of precise geographical location as in administrative maps. The perception of separate countries "India" and "Pakistan" did not exist in India until 1947 with the Partition.

as though she was his daughter. Thanks to this close relationship, she could go to his house, freely take food and fruits, and it also made it easier for her to pass security checks even when she was secretly keeping confidential documents inside her belongings. She was a polyglot. She could communicate in French, Chinese, Thai and Cambodian. Later, she learned to even speak English.

It was her fun to run around the Saigon streets, slipping in tree and grass bushes and swimming in leech-filled damps to bring the basket to the secret soldiers. She kept freshly and happily smiling when she recalled memories of those days. Her father and her brothers could not recognize her when she came back home from school because her face and her body were covered with black mud and other strange substances that were often used at the time to confuse French securities. She adored her female teacher because she did not force her to study as her father expected; instead, she taught Bibi how to make a special cake inside which weapons could be kept. Mrs Bibi repeated her stories about her female teacher as the saviour of her lonely childhood. Her father was absent from home for his business with the supposition that the female teacher he chose for his daughter would teach her how to become a traditional Hanoian girl. He did not know how bored his daughter was at home with the stepmother who was always quiet. However, his absence was a good condition for her to freely enjoy "playful games" that were guided by her teacher - a secret communist at that time. She enjoyed the wild trees and damps of Ong Co Field where the secret base of communists was located. She enjoyed staying at her teacher's house, lying on the cold ground although she had a luxury bed at home. Mrs. Bibi's mouth opened widely and freshly recalled her naughty childhood with the entertainment of sneakily stealing her fathers' clothes and food to give to people in the secret base.

One day in the year 1950, the young girl was wounded in a sudden attack by French soldiers at Ong Co Field. Her father brought her to France for treatment which lasted a year, given that he did not know her involvement with the communist base located in the Field. He thought his daughter's wound was an accident while she happened to play on the field. Although cured, Mrs. Bibi was permanently disabled forty-one percent.

Being granted the certificate of a wounded veteran, Mrs. Bibi's involvement in the national revolutionary appears in numerous journalistic and literary depictions writings including *The People* newspaper, *Ho Chi Minh Committee of The Vietnamese Fatherland Front*, news *Liberating Saigon*, *Youth News*, and Ho Chi Minh Television [4-7]. They depict the young Bibi as an example of a young Vietnamese who plays the role of "the vanguard force" in nation-building and defence in different national struggles. The July 28, 2010 issues of *Liberating Saigon News* Highlights Grand Bibi's sacrifices for the Vietnamese nation at her very young age:

At the age of thirteen, being far away from her father and staying with her adopted mother (the female teacher), she happily followed the Viet Minh [communist cadres]. Bibi followed her adopted mother in taking revolutionary activities in outlying areas of Gia Dinh city... Bibi instructed cadres on how to get in and out of Saigon - Gia Dinh. She supplied chemical substances, food, cloth, and many other goods for the revolution [5].

Vuong Liem is a high-profile socialist writer. He uses words such as "Viet Minh", "revolutionary activities", "cadres" and "revolution" to name Grand Bibi's thoughts and activities. These details aim at constructing an image of Grand Bibi as an ideal citizen who supports the leading Party of Vietnam. In a more lyrical and emotional narration of her past, Dang Thi Tu, a high-rank female police officer in Ho Chi Minh city, also interprets Bibi's unmarried status as her devotion to the Vietnamese national revolution. In Tu's narration, the image of Grand Bibi completely conforms to familiar discourses of the Party about the history of the national struggle:

"I visited her one day at the first-floor apartment located at 277 Le Thanh Ton street, Ben Thanh ward, district 1, Ho Chi Minh city. She welcomed me happily. She smiled, revealing the wrinkled skin of a seventy-seven-year-old childless and husbandless woman. She committed her whole life to the revolution, the party, and the ideology of Ho Chi Minh (...) Answering my question on what she learned from Uncle (Ho Chi Minh), she said that she "learned humanity and sacrifice... He sacrificed his whole life for the freedom and liberty of the Nation and for the Happiness of the People. Following him, I abided by the Party. I give up parts of my blood and body for it without regrets. Completely absorbed with the revolution, my greenness passed by without notice" [8].

In a similar way to the way of Dang Thi Tu, Thanh Thuy highlights Grand Bibi's involvement in the Revolution in her publication in the August 31, 2010 issue of *News Column, The Communist Party of District 1* (Ho Chi Minh city Communist Party). As described in this article, Bibi has never thought of herself as a foreigner... Vietnamese blood flows strongly within her body... The [first Indochina] War happened. Her family drifted to the southern part of the land. Her happy childhood nearly stopped when her mother got sick and passed away; her father got married to another woman. However, it was fortunate for her that she had an adopted mother - her wonderful second mother. This woman taught her during her elementary school years and filled the motherless child's unfortunate fate with the grand love of an ideal mother. One thing that she was not expecting was that her adopted mother was an underground communist soldier. Due to her love for her adopted mother, she occasionally helped her bring food, letters, documents, and news to some cadres without knowing that she was gradually stepping into the revolutionary road [9]. Answering the author's question on why she became a communist revolutionary, she simply answered: "I love my mother, so I love the revolution".

As seen in documents of the 4th Congress, the Party continued encouraging Vietnamese authors to erect inspiring models of "loyal, resourceful and extremely brave mothers and women", who "side body and soul with the entire nation to fight the enemy and build a new life" [10]. The portrait of Mrs Bibi in official Vietnamese history is the portrait of the brave youth who sacrificed lives for the national struggle of Vietnam.

3. Martyr, secret agent, and political imprisoner

Velousamy, often called Big Bi, is a nationally recognized revolutionary martyr. On the wall, above the only window of the Indian temple Subramaniam Swamy located at Nam Ky Khoi Nghia street (Ho Chi Minh city), hangs a rectangle glass frame that keeps a certificate inside. It is the National Acknowledgement of Your Contribution, which is normally granted to citizens who died for the national cause. The name that occurs in the certificate, as written, is "Nguyen To Lien (Velou Sa My)". The following notes in the certificate include more details about this martyr: He is a member of a suicide team. He lived in the Duc Nghia ward, Phan Thiet district, Binh Thuan province. He was acknowledged "for being sacrificing his life in the anti-colonial French resistance on May 1, 1945". The certificate was signed by Prime Minister Phan Van Khai on January 29, 2007, which was fifty-seven years after his sacrifice.

Velousamy was born to the family of an Indian man with English citizenship and two Vietnamese wives - two blood sisters. His father, named V.R.M Ramassamy, was usually addressed by local people "Cha Chop" because he looked like an Indian person and he usually had an appointed peak leather hat. He settled in Phan Thiet province, Southern Vietnam, in 1926. Members of his family worked as tax collectors in Phan Thiet's markets and ran the business of curry foods at the house 26 Le Van Duyet (present-day 26-28 Nguyen Thi Minh Khai, Da Kao ward, district 1, Ho Chi Minh city). His son, Velousamy, had English citizenship and was

knowledgeable of French. He was hired to work as a waiter at the pub Chez les Manchots managed by a French military official. Then, revolutionary cadres recruited him to exploit news from French officials and soldiers, who came to the pub frequently. Velousamy, called by a Vietnamese comrade as Big Bi, was killed by pro-French Vietnamese soldiers when a photo of him taken with a member of the Suicide Team was found in an attacked revolutionary base [11].

The July 13, 2007 issue of *Tien Phong* revealed that Big Bi's family permitted the Viet Minh officials to dig a secret vault in their house in Phan Thiet province. His aunties took turns guarding and cooking for Viet Minh soldiers. These twin sisters self-assigned their responsibility of throwing unwanted soil and dirt in a cellar near Ca Ty river, helping the soldiers to complete the secret tunnel [11]. Volume 213, March 1994, of *Phan Thiet News* published a reflection about Big Bi; the author of this reflection is Tran Ngoc Trac, the former president of former Thuan Hai province and the former ideological supervisor of Big Bi. The reflection is full of ideological terms, which impressed the audience with Big Bi's loyalty to the Vietnamese nation:

Big Bi was enlightened by the communist revolution early. He was admitted to the Team of Teenage Suicide Communists... He was an intellectual youth who was passionate about books, letters, and arts performances, and was knowledgeable of English and French; he had revolutionary enthusiasms and impetuous patriotisms in the blood of his body [11].

Big Bi's attachment to the Vietnamese nation such is expressed with emotionally strong words as "revolution enlightenment", "patriotism", "impetuous", and "enthusiasm". As a consequence, the Indian descendant incurs a model of "brave Vietnamese young persons" who sacrificed their lives for the nation's cause.

Another Indian descendant who performs his loyalty to Vietnam is Cao Van Tay (Moritam). He was the only Indian descendant who received a Vietnamese citizenship decree that was signed by President Ho Chi Minh and who held many high governmental positions in Vietnam [12]. In the National Archive Centre 3, there was a file including ten documents related to the application for Vietnamese citizenship of Cao Van Tay. The documents have dates of issuing starting from February to June 1959. Unfortunately, these documents have not yet been deconfidentialized, which means they were not yet open for public access. The only information about this character was the decree by President Ho Chi Minh issued in December 1959 and the surface information gathered from the title of the unpublished file. Other small bits of information about this person are from the archive of Binh Duong Province.

In the book *History of The Commando Force in Saigon From 1954 to 1977* (2013), Cao Van Tay is noted as 1 out of 58 intelligent official-leaders in Saigon: "Cao Van Tay (Ba Coc) - Leader of Special Work Agency (work of intelligence and espionage, 1948)" [13]. In the archived document, mentioned above, the list of those "going to B battle site" stored at the National Archive Centre 3, was born in 1925 in My Phuoc district, Thu Dau Mot province [14]. In the personal record, also archived in this Centre, filled on April 10, 1959, for the question about family background, he responded "poor class in the city". His father used to work as a security guard and worker for some companies and his mother was a wandering seller. This document also includes details that Cao Van Tay suffered in "imperial prisons"; he was persistent when he did not surrender enemies even in the context of being imprisoned. His political view - communist alliance - was "consistent", as described.

Cao Van Tay had worked on the side of the Vietnamese communists since he was a teenager in the early years of post-revolution. Under the alias, he was one of the founders of groups of secret agents

advocating for communism in South Vietnam in the 1940s. He led the intelligence agency of Saigon - Cho Lon formed in 1946 in response to the ambition of the French to set up southern Vietnam as its autonomous region, separating it from the northern region. The agency had the first name "Special Work Agency" and later the Information Agency to avoid being watched by the French. As an intelligence agent of the Communist-led Secret Task Agency in southern Vietnam, Moritam travelled and visited agricultural institutions throughout India and Burma from 1948 to 1953, searching for some special fungus that could destroy entire rubber tree fields of French colonizers in the region. With knowledge of Khmer, Chinese, Russian, English, and French languages, he could complete his tasks in the international milieu. When going to the B battle in North Vietnam during the war, Cao Van Tay worked as a governmental specialist of Asian relations in the Department of Foreign Affairs in Hanoi. North Vietnam government distributed him a house at Ly Nam De street, famous for being the residence place of military officials and high-ranking governmental officials. When he returned to Saigon in 1975, he continued holding important positions in charge of ethnic minority issues.

Another Indian descendant who was involved in the Vietnamese revolution that is recorded in Vietnamese history is Nam Ha. He acted as an underground intelligence of North Vietnam working and living in Saigon[2]. His Indian identity helped him get through many security checks while he was active in Saigon. He was a "political prisoner" imprisoned in "imperialist prisoners". He was listed in the book that lists political prisoners living in district 10 [13]. He was captured in 1966 by Republic Government police and sentenced to 15 years in jail. He suffered severe torture at the General Police Station in Saigon and the Prison Con Son until he was released in 1971. After 1975, while all of his relatives fled to France, Nam Ha worked for the Vietnamese government, particularly the Department of Personnel of district 10 until he retired.

4. Supporters of the contemporary Vietnamese government

This part of the paper focuses on the individual Indian descendants who formed as strong supporters of the recent Vietnamese government in its effort for national hegemony and socialist goals. The first case is a family of Muslim Indian descent living in Ho Chi Minh city. These descendants, at the time of research in 2013-2014, were in charge of managing an Indian mosque in this city. As told by Zen, a member of this family, his maternal grandfather was a "pure Indian". He came to Vietnam to do textile business with his older brothers. Later on, he changed to the job of dispatching and processing goats for meat. At that time, he married a Vietnamese girl. Zen also mentioned that his paternal grandmother was also a "pure Indian." He worked as a helper in a French family. She followed this French family to Vietnam, met and married a Pakistani. Zen is the third generation of his racially mixed family.

Noticeably, members of this family of Indian descent actively participated in Party-led functions and organizations. Jaytune, the youngest sister of Zen, was born in 1985 and is a member of the Fatherland Front. She particularly advocated for ethnic minority ties. As told by Jaytune, she often took part in trips organized by the Fatherland Front to other provinces to promote the ethnic unification of Vietnam. She said that this monthly program was to ensure the participation of representatives of every ethnic group in Ho Chi Minh city in functions of cultural exchanges. At her home, above the table on the right side of the room where the Jaytune family usually invites their guests for tea, there are photos of her in traditional Muslim dress. In this photo, she was bowing her head down and shaking the hands of a national president.

[2]No document about his Indian name and Indian background was found. Information about his background was provided by his close friend, a famous historian and translator of Vietnam. Details of this informant was omitted intentionally by the paper's author.

Jaytune's father and brother, who were in charge of the Indian mosque, also performed as supporters of the Vietnamese government. At the centre of the administrative office of the mosque, there are photos in which her father and brother are shaking hands with the president in one voting day. The photos were placed on the top of the glass cupboard that was hanging on the wall. They are at a position opposite to entering the door so that people can see them immediately when they step into the room. The photos do not have any notes indicating the time and space of the event. The only existing note reveals that the photos were taken when the president met with the representative of voters in the district. Five other photos were of the meeting of the mosque members with some politicians from India. These politically meaningful photos were treated solemnly: they were encased in a gilded frame of 20x30 cm and covered by glass. They were placed prominently and easy for public eyes to access. They were all hung on top and outside the glass cupboard. In one section of the cupboard, revolutionary books occupy the centre position. At the corner of the section is a book about Ho Chi Minh, entitled Ho Chi Minh, a national liberation hero and world cultural celebrity. Next to it on the right is Heroes living forever at the age of 20, talking revolutionary heroes of Vietnam. On the left a book about the anti-American resistance war of Southerners, entitled *The South*, 21 years of resistance against the US. In these books are photos of Ho Chi Minh and revolutionary soldiers. Lying at the bottom of the sections were two other books about the histories of the Communist Party and Ho Chi Minh. These Indian descendants also demonstrate their allegiance with the main political ideology and the mainstream histories of the Vietnamese state by way of showing their concern over the Parcel Island issues. These Indian descendants display in the mirror cupboard many mainstream publications and souvenir items that highlight the island's belonging to Vietnamese land historically.

The second case is Mr Ba, in charge of Sri Thenday Yutthapani Temple. Mr Ba's father was a "pure Indian" born to a rich Indian family who settled in the area presently called Tan Binh district of Ho Chi Minh city. They had moved to Saigon when Mr Ba was 7 years old. They once had a farm of cows in Dong Nai province. When they moved to Saigon, their property grew to include the entire road, presently called Truong Minh Giang (district 1). They constructed a number of houses for release[3]. Mrs Tuyet, his sister, recalled that she used to follow her grandmother as she went to every house on that street to collect rental fees at the end of each month. In Tuyet's memory, her mother did not have a good relationship with her parents-in-law. The marriage of her parents was not permitted by her Indian grandparents because her mother came from a poor Vietnamese family. When Mr Ba was only three months old, the Indian grandparents took him to their family to take care of him, ignoring her mother's begging to keep the child. They wanted to make sure that their grandson did not become influenced by the culture and knowledge of the so-called low Vietnamese class. They proposed a so-called western education to him. Every day, in their own car, they drove him to western schools to study English. Under the South Vietnam government, his father worked for the Vinatexco and Vinafilco factory, established in 1959 by a large shareholder named Ly Long Thanh, a Chinese businessman. Twice a week, her father was asked to come to his parent's house to teach Mr Ba French. Her mother, in her early time of being the daughter-in-law of this powerful Indian family, had to learn how to make spicy cakes and curry bean meals every Sunday morning. In Tuyet's memory of her mother's narration, her grandfather was the one who took the responsibility to teach all the daughters-in-law about Indian foods. Every day, he worked from 7 am to 4 pm. Back to his house by 4:15 pm, her father took two cans of water from the

[3]Informal interview with his son, August 8, 2013.

village dwelling. One can be placed in the bathroom for his wife and children to bathe. The other one was stored to wash the family's belongings. According to her, her Indian father was the nicest man.

Under the management of Mr Ba, Sri Thenday Yutthapani temple is more engaged with national projects. Before 1975, Sri Thenday Yutthapani temple was a place exclusively of these rich, powerful Indians[4] who were members of Association of Overseas Indians. Commoners were strictly kept away from the temple. As a memory from Grand Sam, one Indian descendant, he did not dare to go to Sri Thenday Yutthapani temple. Her husband, a Vietnamese historian, recalled that two policemen always stood at two sides of the temple gate. They looked threatening and would stop any Vietnamese and other tattered people from going close to the temple. The retired old man, living nearby in the Sri Thenday Yutthapani temple, recalled in his childhood time long rows of luxurious houses opposite the temple on Ton That Thiep street, which used to be places of small banks of Indians. He showed me the unchanging white houses where rich Indian families once stayed. He pointed me to the white corridors, white curtains, and small milky-coloured windows saying that they were typical of Indian houses in his time. He particularly remembered that Indians set up desks on the pavements opposite to the temple. His uncle went to borrow money from the Indians several times. Whenever there were money borrowers, the Indian quickly ran into the temple and went out with some amount of money. Nevertheless, with the democratic revolution after 1975, the Indians' control of this temple ended. Mr Ba's father and Mr Ba, with their Indian background, were assigned to be in charge of managing the temple. Mr Ba made an effort to make the temple a significant contributor to national projects that aimed at clearing hunger, alleviating poverty, taking care of wounded soldiers, and performing gratitude for revolutionary martyrs. At every homeless-soul day (July 15 according to the lunar calendar), his pagoda distributed rice and soya bean to poor people and took care of old people. In a proud voice, he talked about his latest donation to the community, which is the successful construction of a house of gratitude in Can Gio district. The temple also provides scholarships for poor students with high achievement in studying. Mr Ba explicitly and proudly shared his function in the temple as the bridge connecting the state and believers. As a member of the Fatherland Front, he was able to convey his believer's state policies. Around the table where Mr Ba sits, there are certificates acknowledging his contributions to national projects. There are also frames of his merits for his excellent participation to support his district community.

Mr Ba's alliance with national projects is also seen in his language use. He constantly transplanted nationalist statements into his conversations with me. Mr Ba's conversations are filled with vocabulary and terms often appearing in officials' meetings. His conversations are filled with mainstream political vocabularies such as governmental levels and brotherhood and collective group. He constantly identified himself as part of the Vietnamese nation although he is still carrying an Indian passport. "Although I brought my passport of India when I was 15 years old, I lived in this country; I followed Vietnamese laws and traditions. Therefore, this is my hometown". For this man, it is his great love for this country that he is in charge of the temple Loving for the country was performed as the supreme truth. This man presented himself as a loyal citizen of Vietnam. More than that, he behaved not as a Vietnamese citizen, but also with Vietnamese ethnicity with the use of the word "my hometown". For him, although

[4]There is no record saying that Subramaniam Swamy temple used to be headquarters of Indians' trading activities. Nevertheless, records about the two other Hindu temples, Marimman and Sri Thenday Yutthapani temple, were not only religious centers but also head-quarters of money-lending and commercial activities of groups of Indians before 1975 [15].

he holds an Indian passport, his intimacy and his passion fall into Vietnam[5].

In conforming to the government's policy of promoting the India - Vietnam relationship, Mr Ba also attempts to function as an authentic Indian guru of the temple. In the early 1980s, the government revitalized the Indian temples to serve the religious practices of coming Indian expats. Ho Chi Minh city Television 2002 made a film documentary about three Indian temples in Ho Chi Minh city. In the DVD version of the film, provided by Mr Ba, the narrative concludes with the necessity for the state to govern these temples to ensure their function as religious centres of current Indian expats: "The heritages like this one do not only stamp a national history of old Saigon but also function as a worshipping place for Indians in present-day Ho Chi Minh city" [7]. For specific Sri Thenday Yutthapani, Ho Chi Minh city's People Committee issued decision number 99/QD-UB in 1976, making it a memory house of the Vietnamese - Indian relationship and a museum of artifacts that indicate cultural and artistic ties between the two nations as well as a place for Indians to visit and worship on the occasion of festivals. Mr Ba acted as a respected Indian intellectual as he could speak both English and French. According to him, he could read the classic Indian language. He wore an Indian dress when he prayed. His appearance was typical Indian according to the Vietnamese imagination. He wore a walrus moustache curling down to his under his chin and had curly black hair. He looks serious and is mostly quiet. Mr Ba continuously reconstructed and decorated the temple with the most authentic Indian figures, according to his knowledge. He asked his son, who had businesses with Indian companies, to buy Indian photos, statues, and building materials from India for the temple. There are a number of large photos of famous Indian figures, including R. Tagore, hanging on the walls of the temple. If asked when these photos were placed there, Mr Ba would answer it was hundreds of years ago, even unmemorable. This way of blurring time must aim at constructing an Indian authenticity of this temple. In the documentary film, produced by Ho Chi Minh city Television in 2002 about three temples in Ho Chi Minh, Mr Ba and his family members attempt to seriously perform Indian rituals. In the scene about Sri Thenday Yutthapani temple, there are both overseas Indians, who were new Indian migrants and Indian descendants. They attend a ritual function led by Mr Ba. The overseas Indian performs the ritual of receiving God's gift that is handed down by Mr Ba. The camera lens focuses on the moment when Mr Ba gives him a plastic bag of an apple and a candle stick. The other person who is recorded closely was an Indian woman, who dresses nobly and wears a costly wallet. She also receives sacred water from Mr Ba. She applies the water to her hair and drinks the remaining. All relatives of Mr Ba were dressed neatly, quietly standing and observing the ritual. Mr Ba's cousin, a twenty-two-year-old man, carefully watches the hand moves of another overseas Indian man when he receives the holy water. His eyes moved up and down, right, and left following the Indian man's gesture of receiving and treating the holy water granted by his uncle. Beside her son, Mrs Tuyet, looked anxious, observing the ritual quietly. She seems not to dare to move and is too weak to breathe, fearing to break the solemnity of the ritual. It is apparent that although these Indian descendants might not master the so-called authentic Indian ritual, they make much effort of following it and making it to serve the religious beliefs of the overseas. Doing so, they contribute to developing the relationship between the two nations.

5. Conclusions

As mentioned earlier, this paper does not aim to provide comprehensive portrayals of the Indian descendants who have actively participated in the political, social, and cultural lives of the Indians in Vietnam. Instead, it includes fragments of stories of these individual Indian descendants that are

[5]An informal interview on July 25, 2014.

temporally and spatially specific and particular. It focuses on their personal experience about and with national projects, and how they lived within them and in them. Such a way of identifying Indian descendants provides a more dynamic indicator of connections between Vietnam and India. This is particularly the case, given that most scholarship about connections between the two nations focuses on cultural aspects that largely demonstrate the spread of Indian culture over Vietnam among other Asian lands [16-19]. The stories of the individual Indian descendants in Vietnam provoke a new way of addressing historical links and interactions between Vietnam that include diverse groups of Indians in Vietnam, and counts on various sources of written and orally transmitted accounts as well as of ethnographic research.

COMPETING INTERESTS

The author declares that there is no conflict of interest regarding the publication of this article.

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Trauma, sexuality, and identity in *The Lover* by Marguerite Duras and *Burning Grass on The Field* by Doan Minh Phuong

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Abstract:

This paper examines the relationship between sexuality and trauma in two works, *The Lover* by Marguerite Duras and *Burning Grass on The Field* (*Dot co ngay dong,* in Vietnamese) by Doan Minh Phuong. Using trauma studies as a critical perspective to compare the two works, we focus on the relationship between sexuality and trauma, analyse the construction of identity of traumatized characters, and clarify the role of sexuality in such a process. Juxtaposing a newly released Vietnamese literary work, *Burning Grass on The Field* next to the well-known novel *The Lover* is also expected to reveal more meaning for the seemingly asymmetrical works. This can be seen as our effort to blur the division between the so-called classics and the other, contributing partly to decolonizing human literature.

Keywords: **Dot co ngay dong (in Vietnamese), sexuality, The Lover, trauma, trauma studies.**

Classification number: **9.2**

1. Introduction

Since Sigmund Freud's pioneering studies on the concept of trauma, there have been many research works on trauma, which lay a strong foundation for the development of trauma literature [1, 2]. Cathy Caruth has followed discussion on trauma studies and pointed out specific aspects of trauma studies, including the temporal nature of trauma, the relationship between trauma and reality and the abilities to interpret and understand trauma [3].

As a result of the two World Wars spanning over thirty years and significant changes in modern life, there was *a lost generation* that suffered many physical and mental injuries. Accordingly, literature and research on trauma have become popular, mainly focusing on collective trauma such as war trauma or trauma of genocide. In Vietnam, trauma literature has only been considered since the Doi Moi period in 1986. Abandoning ideal heroism, Vietnamese literature raises scepticism towards wars and their consequences, viewing them as reasons for trauma. Besides, research on trauma literature approaches narratives from different perspectives. However, trauma studies have not been applied as a tool to compare *The Lover* by Marguerite Duras and *Burning Grass on The Field* by Doan Minh Phuong. Therefore, re-reading *The Lover* and *Burning Grass on The Field* from the perspective of trauma studies is our contribution to delve into the layers of meaning of a novel that has been well-known for over 40 years (since 1984) in correlation with a newly released work (in 2020).

In M. Duras's *The Lover*, the protagonist's mental trauma was caused by several issues, including

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material deprivation, struggles between French and Vietnamese cultures, and being victimized by a colonial system. Additionally, her Chinese lover is also a typical traumatized character. In terms of social status, his colonial background made him inferior to his lover. In their relationship, he was taken over by the girl and then abandoned by her. Each character has their own trauma, so reading this work from the perspective of trauma studies can help one to understand more aspects of trauma in literature.

While M. Duras is a French author writing about her experiences in Vietnam, Doan Minh Phuong is a Vietnamese writer who immigrated to Germany at the age of 21. Like M. Duras, Doan Minh Phuong's childhood memories have directly affected the creation of fractured and traumatized characters. Therefore, *Burning Grass on The Field* could be seen as an author's *mimesis* of broken memories.

Using trauma studies as a critical perspective to compare *The Lover* and *Burning Grass on The Field*, we aim to focus on the relationship between sexuality and trauma, analyse the journeys of constructing the identities of traumatized characters, and clarify the role of sexuality in such journeys. Moreover, placing the newly released Vietnamese literary work, *Burning Grass on The Field*, next to the well-known novel *The Lover* is expected to reveal more meaning for the seemingly asymmetrical works. This is also our effort to blur the division between so-called classics and the other works, contributing partly to decolonizing human literature.

2. What is trauma?

Conceptually, the term trauma can be understood in many ways, and the definition of trauma is dynamic and changes over time. According to the *Oxford Learner's Dictionaries* (2023) [4], trauma is defined from two angles. Firstly, it is understood in the medical context, referring to injuries to the human body. Secondly, trauma is defined from a psychological point of view as "a mental condition caused by severe shock, stress, or fear, especially when the harmful effects last for a long time" and as "a very frightening or upsetting experience". Meanwhile, in the *Vietnamese Dictionary* (2003) [5], trauma is defined as "a state of injury in a body part affected from outside". Thus, the term trauma is understood both as physical and mental injuries. The latter, focusing on mental damage, can be seen as a psychoanalytic or psychological concept. Within the scope of this analysis, we use trauma from a mental and psychological perspective to clarify some issues mentioned in the introduction.

As a relatively commonly used term in humanities and social sciences, the connotation of the term trauma is continually being explored and deepened. In S. Freud's work (1961) [6], trauma is understood as "experiences of pain". Specifically, he defined trauma as "an event so overwhelming that it cannot be processed normally at the time of its occurrence, so that its memory is effectively blocked but returns to haunt the victim until it is appropriately confronted and dealt with". This has greatly influenced many trauma studies, including the classic work of trauma criticism, *Unclaimed Experience: Trauma and The Possibility of History,* by C. Caruth (1991) [7].

Freud made the point of *belatedness* (*Nachträglichkeit* in German). Accordingly, trauma is not only what happens at the time of the traumatic event. Trauma is also the return of events that are beyond human tolerance. *Belatedness* refers to the return of trauma through an individual's recalling of what happened. In other words, trauma can delay its onset and arrive with flashbacks that occur when people revive memories of events that crossed the threshold. However, in order to recall or revive

memories of those traumatic events, Freud refers to a second event, which occurs after the first event that caused the trauma. This second event takes the form of the first event. At this point, the victim once again has to go through the old experiences and it is during this experience that the trauma returns with the victim's clear awareness of suffering. Freud also emphasized that "trauma does not reside in the original event; rather, it is constituted in a conjunction of two events, neither of which is trauma itself" [6]. This means trauma exists in recollection. It itself does not cause pain, but the act of repeated remembrances causes someone to fall into a state of distress.

Realizing trauma in the form of memory also emphasizes the relationship between trauma and memories as well as the effects of trauma on each other. As C. Caruth (1991) [7] explained, trauma is "the repeated *possession* of the one who experiences it" and "the traumatizing event and the intrusive repetition of the event via dreams and hallucinations". Thus, the awareness of trauma persists through the recall of memories that have been disrupted by the human consciousness.

In the article "The awakening pains", H.P. Tuan (2012) [8] used the phrase "wailing wounds" to refer to the fact that mental injury will always try to remind us of the certain existence of trauma that has not been forgotten. The calls or cries of trauma are also a form of belated return of trauma that connects with unrecognized memories. From there, it reminds us of forgotten pain that seems to have fallen into the subconscious.

In his writings about the relationship between memories and trauma according to A. Barneby's analysis (2018) [3], S. Freud (1961) [6] suggested that when a shocking memory is blocked, it becomes a trauma. The trauma itself does not originate solely from an overwhelming event; rather, it surfaces when the awareness of that trauma is triggered. After experiencing pain, people often avoid or delay accepting the fact that they persevered through tough times with terrible experiences. As a result, their trauma, hurt, and pain may be forgotten, even though they continue to expand day by day. In other words, trauma can be likened to a ghost that occasionally resurfaces to remind traumatized individuals of their traumatic experiences. However, to recover from personal trauma, victims need to separate trauma from the places and times that the traumatic events occurred, which constitutes the first context of trauma. Thereby, traumatized individuals become aware of their trauma only after the traumatic event has already occurred.

Trauma can be seen as a remarkable event in a person's life that alters their perception of the world and themselves. Traumatic experiences occur so suddenly and so overwhelmingly that it disrupts the linear progression of human maturation. At that time, trauma plays the role of a turning point, affecting all later development in a person's life. In *Beyond The Pleasure Principle*, Singmund Freud (1961) [6] wrote that trauma "lead[s] to a traumatic neurosis the protective shield against stimuli is broken through and excessive amounts of excitation impinge on the mental apparatus". Trauma directly or indirectly reveals the "secrets" deep in the subconscious. At that time, perception is changed, memory is interrupted, and identity is corrupted. Furthermore, because trauma can be triggered by events in the community, it has ripple effects beyond the individual level. By reconstructing the identity of each individual, trauma can redefine the identity of an entire group over a given historical era. This capacity to transform the appearance and nature of a society on a large scale underscores the profound impact of trauma.

The above-mentioned discussion on trauma leads us to determine the following characteristics:

First, the term trauma can refer to both physical and mental injuries caused by events beyond human tolerance. Trauma can be caused by various reasons, resulting in both individual and collective trauma.

Second, trauma can serve as a marker of one's life history or even shape one's history. However, it is a history that individuals may struggle to fully comprehend. Trauma creates cognitive fractures that block an individual's ability to understand or accept his or her own history.

Third, trauma may not surface immediately following the extreme event, but it may resurface later through flashbacks. Trauma exists through remembering the traumatic event. Trauma comes back again and again in human life like long, nagging cries to remind us of the existence of a broken and painful past.

Fourth, trauma can be confined to the oblivion of consciousness, resurfacing delayed and belatedly, but trauma cannot be erased or ignored. Trauma cannot be alleviated or forgotten until individuals face it to thoroughly explain and heal it.

Last but not least, trauma is a milestone that shapes memories and alters the future by reconstructing human identity. Trauma contributes to creating new identities. When entire communities experience the same trauma, not only are individual identities changed, but the collective identities of the community are also reconstructed.

3. Trauma and sexuality in Marguerite Duras's *The Lover* and Doan Minh Phuong's *Burning Grass on The Field*

Both Duras and Doan Minh Phuong were born in the twentieth century and grew up experiencing exile, and to some extent, the traumas of their times. These experiences served as inspiration, driving forces, and materials for writing. M. Duras (1914-1996), whose real name was Marguerite Germaine Marie Donnadieu, was a French novelist known as a multi-talented woman in writing and filming. The most remarkable period in her life was probably her first 18 years when she lived in Indochina, particularly in Vietnam. There, she was influenced by the culture and lifestyle of the indigenous people, which is reflected in her vivid memories of the Saigon and Cho Lon areas. As the author herself admitted in an interview for the weekly *Le Nouvel Observateur*: "I cannot explain but feel that my place of birth, where I spent my young times, becomes a brighter and brighter present to the end of my life, as if it were my destiny, as if it is distant part of my life that created my whole life". All of these experiences were vividly expressed, particularly in her later trilogy of novels, including *The Lover*, which chronicles her life in Vietnam.

Duras's extremely complicated journey into adulthood, associated with the colonialism, made her deeply aware of the contradictions that existed in colonial society. Witnessing the war from within Europe gave her a more profound and multifaceted perspective of the human tragedies during wartime and post-war. Therefore, most of her works exploit the human condition of trauma. The author writes about trauma from the perspective of someone who has not only observed but has also lived with trauma. Most of all, her stories show a deep understanding of trauma from within. Thus, Duras's writings about trauma include not only portray pain, but also create a forum for trauma to speak out.

While Duras was a young French woman who reluctantly grew up with the people of Indochina, Doan Minh Phuong could be considered as an active immigrant. Doan Minh Phuong was born in Saigon, then immigrated to Germany to reunite with

her family at the age of 20. For Duras, returning to France was a repatriation, but for Doan Minh Phuong, going to Germany was a diasporic journey. Similar to Duras, Doan Minh Phuong's childhood and adolescence were very tough, surrounded by the constant fire of war during the first 20 years of her life. She then left her hometown and lived in exile in a foreign country. Hence, Doan Minh Phuong's works always feature trauma characters who have lost and long for their homeland. This leads to Doan Minh Phuong's common theme, which is the search for memories and identities of "no-home-men".

Considered as the most successful work of Duras's career, *The Lover* won the 1984 Goncourt Prize and placed Duras into the ranks of the most important writers of the twentieth century. *The Lover* centres around a love story of a fifteen-and-a-half-year-old white girl and her twenty-seven-year-old Chinese lover. Duras exploits three relationships around the main female protagonist: the mother-daughter relationship, the sexual affair, and the colonizer-colonized relationship. The author portrays a series of human pain and trauma during the colonial period, which was a collective trauma. The novel highlights the childhood trauma of a child who grew up in a dysfunctional family where violence threatened her safety, and her voice was not heard or recognized. It also touches on the pain of a wife who had lost her husband, a mother who was desperate for money but still obsessed with her white identity while trying to hide her inferiority, weakness, and helplessness. The novel explores the shame of a "non-white" man with his white lover and the failure of love against the power of money. *The Lover* thoroughly expresses the human feelings of loneliness, alienation, and uncertainty of identity. The characters are constantly placed in a situation of being the "other" in their world. The contrast between self and the other is reflected in the characters' appearances, dialogues, and social status, all being unable to find themselves in the world outside. Thus, the characters become marginalized, trying to connect to the world while being deeply aware of their own lonely world. It is how the "wailing wounds" were created in *The Lover*.

Similar to *The Lover*, Doan Minh Phuong's *Burning Grass on The Field* is also about a tragic love that has placed the protagonist "I" floating in the middle of life, where she is abused, imprisoned, raped and eventually turns to prostitution. She meets another victim, Quyen, a deaf and mute girl in a brothel who was raped by her own father. Then, the characters' lives intertwine with each other's sufferings, love, and empathy, with love being a cross-cutting theme connecting the disjointed stories, the author touches on the common pain of humanity. First of all, *Burning Grass on The Field* is about the arduous and painful journey that one has to go through to find oneself. In addition, the novel is about a person's fragile fate as they face the absurd and brutal power of the ruling class, as well as the pain that a person must experience to protect their ideals and conscience from power and violence. Finally, *Burning Grass on The Field* recreates the process of overcoming the traumatic memories living of the victims. In this way, Doan Minh Phuong also demonstrates an important characteristic of trauma: it exists in the very event that caused pain, but more than that, trauma returns in the victim's recollection. To overcome trauma, victims must face persistent pain to continue to exist.

In conclusion, both *The Lover* and *Burning Grass on The Field* are epitomes of a world of trauma. The two works contain the manifestations and characteristics typical of trauma while vividly portraying the effects and sequelae of trauma on

each character's life. Above all, these writings about trauma show the characters' awareness and efforts to overcome trauma. In the following sections, we will focus on other aspects of the relationship between sexuality and trauma to clearly express their effects on one another, including how sexuality can be both an origin of trauma and play an important role in the journey to construct identity.

3.1. Sexuality is the origin of trauma

Focusing on the love story of a French girl with a wealthy Chinese young man in Saigon, *The Lover* revolves around a colonizer-colonized relationship built on mutual interests of money and love. In this relationship, the girl holds power as evident from the following passage, "it depends on her alone" [9], and decides whether the relationship will continue. In contrast, the Chinese lover is destined to be "under her control" from the beginning. Despite being poor and needy, the French girl prevails in the love affair while the young man only has money as a weapon to protect himself. This pushes the Chinese lover to suffer due to his uncontrollable desire for love from the white girl.

The Chinese lover's suffering is expressed through his weakness and helplessness when he could not win the love from the white girl. At the beginning of their relationship, he is aware of the only reason he can approach the white girl. He says: "You only came here because I'm rich" [9]. Then, his obsession with never receiving the girl's love becomes his persistent fear of losing her forever. "He lives in terror lest I meet another man. I'm never afraid of anything like that. He's also afraid, not because I'm white, but because I'm so young, so young he could go to prison if we were found out" [9]. Just like that, his fear, insecurity, and inferiority in turn are expressed through painful bursts of tears and pain, which sometimes cannot be hidden. "He moans, weeps. In dreadful love. And, weeping, he makes love. At first, pain, and then the pain is possessed in its turn, changed, slowly drawn away, borne toward pleasure, clasped to it" [9]. In the very moments of love and pleasure with the white girl, the Chinese lover experiences his pain. The stronger his infatuation is, the deeper his sense of the smallness of his body, position, and status. "The skin is sumptuously soft. The body. The body is thin, lacking in strength, in muscle, he may have been ill, maybe convalescent, he's hairless, nothing masculine about him but his sex, he's weak, probably a helpless prey to insult, vulnerable" [9]. He is lonely and miserable in his own love.

Similarly, in Doan Minh Phuong's *Burning Grass on The Field* (2020) [10], sexuality is the origin of trauma for both female characters, May and Quyen. First of all, the first traumatic event, considered a milestone of May's life, was her reluctant separation from G, her lover. However, the following events sink her into immense pain. After G's arrest, May lives alone in their house and is attacked by V, a director who wants to completely bring G down and banish G from life.

"It was a man. I don't remember if I bolted the door inside. Anyway, the man, by the door or the window, is already inside my house. I sat on the bed, clutching my knees and staring at the door frame leading to the outside room. I am unusually awake. The world has abandoned me, there is nobody to call, no god to ask for protection.

[...]

I had just put my hand on the doorknob when a strange man's hand grabbed the top of my wrist, threw the scarf around my neck, pushed me into my room and shoved me to the ground, where I folded the duvet under my bed to make a place to sleep. The man twisted the scarf around my neck with

one hand - causing me to use both hands to try as hard as I could to remove the sash from my neck to breathe - and with the other hand to tore my shirt, unbuttoning a row of buttons and tearing a half of the shirt on the right side" [10].

The unexpected meeting between May and V, at first glance, looks like a sexual assault and abuse case. V broke into May's private house, performed violent acts, suppressing and humiliating her. May was attacked by surprise, deprived of her ability to defend herself, and received absolutely no help from anyone. Although he did not rape her, his act was still the act of sexual abuse and assault. Being attacked physically and mentally, May became a victim of sexual trauma. May's unspeakable shock, humiliation, and silence are manifestations of the outburst of trauma. Her trauma even interrupts her perception of pain, leaving her alone with emptiness, helplessness, and a broken consciousness. "I do not scream, not because I could not be heard but just because I do not know how to do so, how to make the cry escape from my throat to go outside. [...] and I know, every feeling, if I have a feeling, becomes a disgrace, the presence of the body and the sensations it carries are disgraceful" [10].

After this event, May became "something like a lover or V's wife for seventeen months, or two years if the time she was brought to Elysia, then to the brothel at Huyen Tran street was counted" [10]. In the brothel at Huyen Tran street, May becomes a prostitute: "What is prostitution, you know? It is the interruption. There's not a single thing I know about myself left" [10]. At the age of thirty-two, May was forced to receive guests in a brothel, and each time she experienced what she calls "an agreed-upon rape". "The man and I were both deceived by our instincts, his instinct to ejaculate and my instinct to protect my ovary. When there is a conflict the strong side wins, and here power is represented by money, he pays five hundred thousand, he wins, I get five hundred thousand, I lose. So a rape becomes a deal" [10].

When being raped, May felt dislocation, ruin, collapse, and especially death. As she envisioned "prostitution" as an "interruption", her receiving guest was trauma that broke the victim's life. A life that was torn in half, before and after the trauma. At the moment she began to have sex with the guests, her life was broken into two pieces and every atom was broken; the only thing left was death. The author forgoes describing painful feelings and goes straight to death as a way of showing the serious state of her trauma. Trauma occurs and changes the character's life forever, bringing her straight to a state of life that is not as good as death.

The fact that May was attacked and then sexually assaulted made her a typical trauma victim. May's trauma is not described physically, but mentally. She had no scratches or wounds, only had a sharp and clear sense a disintegrating inner vitality. The trauma pushed the character to her limit, separating her from the past and her old self to a state of ignorance.

The characters in *The Lover* and *Burning Grass on The Field* demonstrate sexuality as an origin of trauma, a spark that burns and destroys characters' lives. Love, sex, abusive words, and violent behaviour can all become sources of pain and hurt. Sexuality becomes an origin of trauma when it is not associated with pure love at the beginning of the relationship. With the Chinese lover, his relationship with the white lover was built on the basis of love-money interests. Similarly, the fact that May was sexually assaulted and abused is considered an act of indirect revenge of her lover's

opponent. All of this places the characters in a state of trauma where they are tormented and made to suffer by love, deviance, and bad desires.

3.2. Sexuality plays role of creating identity

Identity is defined as "the characteristics, feelings or beliefs that make people different from others" (*Oxford Learner's Dictionaries*). According to M. Bamberg, et al. (2022) [11], "*identity* connotes (personal) characteristics that are embraced as stemming from a sense of temporal continuity (i.e., a particular contour of temporal change), and those characteristics distinguish this person or entity from (vis-à-vis) other entities in terms of generalizable membership categories". This also implies that identity is made up of countless unique characteristics of an individual, including gender and sexual instinct. Biological gender, sexual orientation, and sexual needs are all involved in the construction of identity. Being aware of one's own sex life also shapes who we are. Beginning with the most basic self-knowledge, people can seek, change and define themselves.

In the process of constructing identity, sexuality can be directly or indirectly involved in shaping identity. In particular, when sexuality is placed in relation to trauma, it has clear and important effects on how people perceive themselves. Studying two cases of *The Lover* and *Burning Grass on The Field* through the lens of trauma studies, we realize that sexuality plays a particularly important role in constructing identity, which is shown specifically in two aspects. Firstly, sexuality is the origin of loss of identity. At the same time, sexuality contributes to creating identities.

When viewed through the lens of trauma studies, the experience and recollection of sexual trauma can result in individuals being tormented and tortured by painful obsessions. In H.P. Tuan's article (2012) [8], "The awakening pains", he refers to this human condition as "wailing wounds", meaning that pain cannot be relieved and people must experience and bear their pain over time. When attempting to set aside the pain of dealing with trauma, individuals may deny that they experienced traumatic experiences. This also means that when the characters deny their past, they contribute to the formation of their identity. In such a case, a self without past, recollections, or memories forms an empty self. In this way, people can lose their identities due to their painful sexual experiences.

In *Burning Grass on The Field*, Doan Minh Phuong built a world of ignorant characters. Their names and figures were all blurred with illusory space and time, which signifies their lost identities. As an example, the character May continuously questions her identity. Being sexually abused interrupts her life and damages her identity. When she was in Elysa, she felt humiliated and lonely:

"I gradually lost consciousness of the world and inside of me, gradually lost my memory, emotions, anticipation, grievances, loneliness and desires.

[...]

Once, I found myself getting out of my body, somehow, I stood back to the wall opposite the painting with blue light. I saw silhouettes of people nearby standing, lying, sitting, or some sort of person among them; and there must have been me in those shadows, eating, sleeping, making love, or doing nothing, in front of the painting was emitting a faint blue light, like a calm sky. I easily blend into that sky, calmly, but it's not peace. A sky without space, and time, something is very wrong. But even that falsehood is not discernible and unnoticed by any consciousness" [10].

May was sexually abused by V, turned into his sex object for seventeen months, and then imprisoned in Elysia to become a prostitute. This series of events undoubtedly turned the character

into a victim of sexual trauma. May was not only traumatized physically but also mentally. She lost the consciousness of her existence, seeing herself as a shadow with a naked, small, and wounded body. As a result, the pieces that create human identity such as "memory, emotions, anticipation, grievances, loneliness and desires" left May. In other words, she no longer knew who she was.

Similarly, in *The Lover*, the Chinese lover also experiences loss of identity due to sexual trauma. However, unlike May, his trauma is the result of failing to control his desires. It is apparent that the Chinese lover has particularly strong feelings for the French girl. This emotion results from the passionate and burning desire for a lover from an inferior status. Consequently, he is tormented by overwhelming lust, combined with the cruel realization that he would never be able to obtain the love he desires. This is the origin of the character's psychological trauma.

To the girl's family members, "he does not cease to exist but he's no longer anything to me. He becomes a burned-out shell [...] My lover's denied in just that weak body, just that weakness which transports me with pleasure. In my brother's presence he becomes an unmentionable outrage, a cause of shame who ought to be kept out of sight" [9]. As for the character himself, he was also aware that she came to him because he was rich and "he knows already she'll never love him" [9]. While he existed faintly in the eyes of the girl, he had no name and no defined identity. Gradually, the Chinese lover struggles with his identity, increasingly doubting himself, grappling with several labels such as "not white" and "a Chinese guy, ugly and sickly".

Since sexuality contributes to creating an individual's identity, their perception of themselves can be affected when they are sexually violated. While this experience can negatively impact the process of identity creation, sexuality can also be involved in the search for human identity or as a healing therapy for traumatized victims.

In Marguerite Duras's *The Lover*, sexuality plays an important role in the creation of identity of the character "I". The story begins when she enters puberty, preparing to explore the world and to find the self. While her body and mind do not seem ready for adulthood, curiosity about herself prompted her to commit to fiercely and enthusiastically exploring her identity. She began with the first and most basic understanding of herself, which was the awareness of her "white" identity, namely, about her beauty with braids, skin, "childish breasts", and "the face of pleasure I still don't know the smell of". Through her monologues, the reader finds that one of her first senses of self is the sense of sexuality. From her first meeting with the Chinese man, she knew and understood that she liked him. Until they began their relationship, she always knew that she wanted him. Even before any sexual experience, the girl was aware of her deep desire: "You didn't have to attract desire. Either it was in the woman who aroused it or it didn't exist. Either it was there at first glance or else it had never been. It was instant knowledge of sexual relationship, or it was nothing. That too I knew before I experienced it" [9].

It is worth mentioning that before her understanding of sexuality and instincts, the girl was not portrayed clearly. Initially, her identity was formed by defaults as a white girl and the daughter of a teacher at an all-girl's high school. The portrait of "I" was compared both to other white women and to indigenous girls in Vietnam. This difference makes the character see herself as "the other". Because, compared to other white women, this poor, sickly, fifteen-and-a-half-year-old girl who grew up in the colony was not actually a member of

the white group. As for the local girls in Sai Gon or Sa Dec, she was clearly different even though she grew up in the same place as them.

Moreover, the character's upbringing reflects her initial identity. She was born into a French family living in the colony and grew up in poverty. Her father died early, her mother was always sad and miserable, and the two older brothers were prone to violence. Within her family, she was not her mother's beloved child as she was not called by name but referred to as one of the "two younger children". The only child in her mother's eyes was the drug-addicted and sadistic eldest brother. While growing up in this family, "I" was deprived of the sense of self, her own uniqueness, and even her clothes were reworked from the mother's old ones. Before she knew what she wanted, it was already determined what she would become: "My mother is a teacher and wants her girl to have a secondary education. 'You have to go to high school.' What was enough for her is not enough for her daughter. High school and then a good degree in mathematics. That was what had been dinned into me ever since I started school. It never crossed my mind I might escape the mathematics degree; I was glad to give her that hope" [9]. At first, she struggled with becoming *the other*, always longing for acceptance and living her mother's dream. These childhood experiences could be viewed as a form of childhood trauma, creating gaps in the character's perception of herself. However, this trauma also becomes a great motivation, compelling the character to search for her identity. Her experiences with sexuality were her first steps in her journey.

Thanks to her love story with a wealthy, young Chinese man, the protagonist gained a new perspective of herself through the awareness of her power over her lover. Most importantly, she became conscious of her independence. In her relationship with her Chinese lover, "from the first moment she knows more or less, knows he's at her mercy" [9]. She realized that she could control him and make him love and suffer for her. Right after their first sexual encounter, she knew "that the time has now probably come when she can no longer escape certain duties towards herself. And that her mother will know nothing of this, nor her brothers. She knows this now too. As soon as she got into the black car, she knew she's excluded from the family for the first time and forever. From now on they will no longer know what becomes of her" [9]. This sexual relationship was a milestone on her journey of maturation and identity shaping. This event marked a turning point for a teen girl to become a woman. In such a moment, she knew that she no longer belonged to her mother and followed her dream of having a master's degree in mathematics. She became herself, with a secret, private life, experiencing suffering and loneliness. In that moment, the character's identity was formed at will, which was the self she searched for and wanted to manifest.

In *Burning Grass on The Field*, sexuality is also used by Doan Minh Phuong as a tool for the character to discover her identity. However, when Duras considers sexuality as the key to liberating the main character's identity, in *Doan Minh Phuong's* works, sexuality helps the character find her new identity after experiencing trauma. In this novel, May's quest for identity was formed by recalling and reinforcing sexual memories.

In *Burning Grass on The Field*, May is both the main character and the narrator, and she is concerned with numerous questions, including the question of identity. In the beginning, May expressed her concerns about identity with

existential questions: "Who are we, what can we bring to the people here and what can we bring back for ourselves?" [10]. The character always searched for herself through others and never saw her "own face". May also doubted herself: "I'm in the border area, I'm still here and just a single accidental touch could push me into a place that is no longer real, I will no longer exist". She was aware of her fragile existence and her weak fate: "This life will never be real. Life is not real; it is just before and after the circle of abstract and illusory links" [10]. May's journey of chasing love, running away from pain, and searching for identity makes up the rest of the novel.

May's first love story with G gave her a sense of completeness and fullness. Love and memories of G were what kept her alive: "All I remember was not about himself but my feeling about him. Those feelings have become a part of my life and shaped who I am" [10]. Through her interactions and connections with G, May captured her spiritual world. During the years she spent in Elysia and brothels, May clung to love with G to nourish her soul. The never-real conversations between her and G and the illusions of G's eyes watching her helped May continue to live and fight for her own decaying body. Her identity was constructed through love and memories of love. Indeed, the feeling of love contributed to forming her identity and kept her alive.

However, May's identity was not stable or solid. Her soul always seemed to be waiting to step out of her body whenever she was tormented by trauma. In these moments, she looked for a new identity through Quyen's story. May and Quyen shared an invisible, voiceless love that was rooted in empathy and harmony. Therefore, through Quyen, May saw herself as someone bothered by her traumatic memories and past. Both of them were traumatized people who had been raped and forced into prostitution. While traumatic events disrupted May's memories and awareness of her life, pushing her into a state of losing her identity, it was Quyen's life that helped her look back and recall her memories. Thereby, Quyen and May's affection for Quyen became the catalysts for May to create a new identity. That is why, even though she had mentioned death before, May was still alive at the end of the novel.

4. Conclusions

Trauma literature and trauma studies are both widely studied, most of which focused on collective trauma caused by historical events, while individual trauma was overlooked. Additionally, research on the relationship between sexuality and trauma only considers sexuality as a means to postpone or delay trauma.

The two case studies of Marguerite Duras's *The Lover* and Doan Minh Phuong's *Burning Grass on The Field* explore the role of sexuality in shaping human identity. Firstly, sexuality can help individuals raise their own awareness about their ego, a complex but unique self that is waiting to be manifested. Sexuality can also awaken vitality within each individual, reviving a person's faith in themselves. Moreover, sexuality can heal trauma and help individuals face their past, accept themselves, and construct a "new me".

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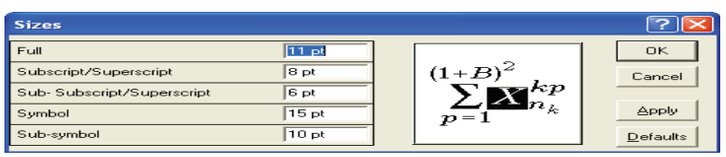

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[2] G. Dosi (2000), *Innovation, Organization and Economic Dynamics*, Edward Elgar, 720pp.

[3] Asia Program Area (1975), "The agricultural situation in the Far East and Oceania: Review of 1974 and outlook for 1975", *Foreign Agricultural Economic Report, No.105*, https://ideas.repec.org/p/ags/uersfe/145966.html, accessed 15 August 2022.

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