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Analysing SAFA's Environmental Sustainability on IDX Agricultural Firms and Its Impact on Stock Prices 2022-2023

Irfan Fauzi[1,*)], Muhammad Aizzat Najwan Bin Nasruddin[2], Abin Suarsa[3]
Universitas Muhammadiyah Bandung, Bandung, Indonesia[1,3], University Kuala Lumpur Business School, Kuala Lumpur, Malaysia[2]
210312102@umbandung.ac.id[1], aizzat.nasruddin@s.unikl.edu.my[2], abinsuarsa@umbandung.ac.id[3]
[*)]*Corresponding author*

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ABSTRACT
This research sought to investigate the influence of environmental sustainability aspects, using the SAFA model to assess equity values of agriculture firms on IDX for 2022 and 2023. This study employed an exploratory sequential mixed-methods approach. Quantitative data were gathered from the annual and sustainability reports of 25 companies across two years, creating a balanced panel of 50 firm-year observations. A Generalised Estimating Equation (GEE) was used to examine the relationship between stock prices and six environmental variables: Atmosphere, Water, Land, Biodiversity, Material and Energy, and Animal Welfare. The statistical analysis results indicated that not all environmental aspects had a significant influence in the eyes of investors. It was found that the Materials and Energy variable had a significant positive influence (B=0.562), indicating that the market appreciates resource efficiency. Conversely, the Water variable showed a significant negative influence (B=-0.958), indicating that investors perceive greater operational and financial risks related to water issues. Meanwhile, the Atmosphere, Land, Biodiversity, and Animal Welfare variables were not shown to have a statistically significant impact on stock value. Specifically, the Animal Welfare aspect showed the lowest level of disclosure. The main conclusion of this study is that investors in the Indonesian capital market are more responsive to environmental sustainability issues with clear short-term financial implications, such as energy efficiency and resource risk, compared to other long-term sustainability aspects.

INTRODUCTION

Environmental sustainability has become an increasingly pressing global concern, particularly within agriculture, which plays a vital role in ecosystem balance. Indonesia, as an agricultural country, has long relied on agriculture as a central pillar of its economy, supported by fertile soil and a favourable tropical climate (Soldi et al., 2019). In 2022, the agricultural sector contributed 12.98% to Indonesia's economic output based on BPS statistics. However, the sector's expansion has serious consequences, including escalating forest clearance, declining soil quality, and rising GHG emissions that exacerbate climate change (BPS, 2021). In facing these challenges, agricultural firms registered on the IDX show a significant responsibility to adopt sustainability strategies. The implementation of environmentally friendly practices is crucial to ensure that the industry's growth is not solely driven by economic profit but also considers its ecological impact. Measures such as more efficient resource management, the use of precision farming technologies, and a shift toward regenerative farming systems can be solutions to building a more sustainable and environmentally responsible agricultural sector.

Sustainability in the agricultural sector now not only focuses on increasing food production, but also covers environmental, social and economic aspects holistically (Tilmen et al., 2017 in Suarsa et al., 2024). Crop production depends on increasing organic carbon, improving soil structure, fertiliser efficiency, and crop protection (Sela et al., 2024). As an agricultural country, the agricultural sector remains the backbone of the Indonesian economy, despite its declining contribution to GDP, as it provides significant contributions through food supply, job creation, income generation, and strengthening economic resilience (Karyanto, 2010; Leki et al., 2021). The agricultural sector has both positive and negative impacts, but sustainable agriculture balances these impacts by combining increased productivity, environmental conservation, and social welfare to create harmony between the economy and natural sustainability, while this sector remains the main source of employment for about half of Indonesia's population who work in agriculture, both as small farmers and industrial plantation workers (Syuaib, 2016 in Rahmatullah et al., 2024). However, this sector faces various sustainability challenges, such as water scarcity, land degradation, climate change, and environmental pollution, which impact agricultural productivity (Wulandari et al., 2021 in Rahmatullah et al., 2024). These environmental challenges also impact socioeconomic aspects, including low farmer incomes and weak economic resilience. Indonesia's rural poverty rate, which reached 13.20% in 2017, indicates that the country remains heavily reliant on agriculture as its economic backbone, which exacerbates the poverty rate (Arham et al., 2020 in Rahmatullah et al., 2024). Therefore, the implementation of sustainable agricultural strategies is becoming increasingly important to ensure a balance between productivity, environmental sustainability, and the socio-economic well-being of farming communities.

The concept of sustainability in the agricultural sector encompasses various dimensions, including a viable economy, maintained ecological integrity and equitable societal structures (Farshad & Zink, 1993; Lee, 2005; Pannell & Schilizzi, 1999 in Ibrahim et al., 2025). Agricultural ecosystems, as agricultural ecosystems operate in fluctuating contexts marked by biophysical variability, where the direct and indirect relationships within organic farming, both in nature and quality, create a multiplier impact on the sustainability performance of companies, which also strengthens their ability to support local production systems, contributing to increased food security and sovereignty, while agriculture in general utilizes and impacts primary environmental assets like land and freshwater, shapes landscapes, and plays a role in creating and maintaining semi-natural habitats (Al Shamsi et al., 2019; Alaoui et al., 2022; Ibrahim et al., 2025). To address these challenges, implementing sustainable agricultural practices is crucial. By maintaining a balance between productivity and environmental sustainability, agricultural ecosystems can continue to provide vital resources, such as food and fibre, for future generations (Ibrahim et al., 2025). In an effort to advance comprehensive agro-sustainability, FAO introduced the SAFA guidelines. This framework evaluates multiple elements within agro-food systems based on four main dimensions: economic well-being, environmental sustainability, social resilience, and responsible governance (FAO, 2014). This research centres on ecological sustainability, including the efficiency of natural resource utilisation, the ecological impact of agricultural activities, and the extent of carbon emissions. Understanding these factors is expected to lead to more effective solutions for reducing the agricultural sector's environmental footprint and creating more environmentally friendly production systems.

A significant body of research has addressed agricultural sustainability from diverse angles. The core principle, as outlined by Cammarata et al. (2021), is managing resources to satisfy human requirements without degrading ecosystems for the future. Studies focused on Indonesia reveal a developing understanding of this issue. For example, Handayani et al. (2024) recently linked corporate governance frameworks to the quality of sustainability reporting in the agribusiness sector. In contrast, research from Safitri et al. (2019) found that while R&D spending positively impacted eco-efficiency and firm value, direct environmental spending did not. This indicates that at the time, investors in Indonesia did not heavily weigh environmental factors in their valuation of companies.

This study uses a systematic, data-driven approach to provide an accurate and thorough evaluation of agriculture's long-term viability in Indonesia. Furthermore, this study presents an updated data-driven approach from 2022, enabling a more accurate mapping of sustainability trends that are relevant to current industry conditions. The results of this study are expected to guide stakeholders in developing more effective policies and strategies to promote environmentally friendly and sustainable agricultural practices. The urgency of this research is increasing with global demands for the corporate sector to adopt Environmental, Social, and Governance (ESG) principles in their operations. An integrated assessment model is essential for overseeing environmental continuity in land-based industries, both integrated and separate, to balance environmental, economic, and social aspects and support long-term resilience (Torres et al., 2024). Companies across industries, including the agricultural sector, are now facing immense pressure to adopt more transparent, responsible and sustainable business practices.

Correspondingly, Indonesia's OJK has enacted new regulations regarding sustainability reporting for public companies, which require increased compliance and transparency in ecological, societal, and governance dimensions. In this context, agricultural companies listed on the IDX need to take strategic steps to ensure that their operations align with applicable sustainability standards. Therefore, this study is highly significant in providing comprehensive guidance based on the SAFA Framework, assisting companies in meeting regulatory obligations, improving sustainability performance, and strengthening competitiveness in a market that increasingly prioritises sustainability principles as a key factor in investment and business decision-making. This study sought to address the gaps in previous studies by adopting an empirical, data-driven quantitative analysis approach to evaluate the environmental sustainability aspects of agro-enterprises on the IDX through the application of the SAFA Framework.

METHOD

This study used an exploratory sequential mixed-methods design, which consists of two main phases. According to the framework described by Creswell (2011), the research begins by collecting qualitative data to thoroughly explore and understand a phenomenon. The findings from this initial stage then guide the development of the second phase, where quantitative data is gathered to test or generalise the insights from the qualitative results. Using a descriptive qualitative approach, this study analyses in depth the rational relationships between elements to understand a phenomenon comprehensively (Yudha & Setiyowati, 2016). The goal is to provide a foundation for developing more effective strategies and policies to address environmental challenges and encourage sustainable business practices in the agricultural sector, a process that aligns with methods such as grounded theory, where theory is built from systematic data (Budiasih & Nyoman, 2014).

GEE was chosen as the analysis model because of its ability to analyse panel (longitudinal) data where observations on the same subject (firm) are correlated over time. GEE provides robust estimates even when the correlation structure in the data is not properly specified.

The proposed GEE regression model is as follows:

$$E(Y_{it}) = \beta_0 + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \beta_3 X_{3,it} + \beta_4 X_{4,it} + \beta_5 X_{5,it} + \beta_6 X_{6,it} + \varepsilon_{it}$$

Where:

$E(Y_{it})$	= Expected value of stock price for company i at time t
β_0	= Constant (intercept)
β_{1-6}	= Regression coefficient for each independent variable
$X_{1,it} - X_{6,it}$	= Social sustainability variable score for company i at time t

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ε_{it} = Error (error term)

This study analysed various aspects related to the efforts among farming firms traded on IDX in the environmental sector to meet sustainability standards through drafting sustainability disclosures; this paper investigates how sustainability indicators are applied in the sustainability reports of the agricultural companies being studied, with a primary focus on the sustainability reports prepared by these agricultural companies. In the analysis, a descriptive method was used to identify and evaluate key elements that reflect the extent to which sustainability principles have been integrated into their business practices. This research was projected to highlight the number of indicators used by agricultural companies as a reference in preparing sustainability reports and examine the various strategies and policies implemented to address environmental challenges and increase their contribution to environmental sustainability (Indra Nugraha et al., 2024).

Independent Variable (X): Social Dimension of SAFA Framework

Data for the independent variables were collected through content analysis of company reports. Each disclosure item relevant to the SAFA indicator was scored. This study used a dichotomous scoring approach: assign 1 for disclosed elements and 0 otherwise; aggregate per indicator items can be seen in Table 1.

Table 1
SAFA-Based Framework Good Environment Dimensions (FAO, 2014)

Theme	Indicator
Atmosphere	➢ Greenhouse Gas Reduction Targets ➢ GHG Mitigation Practices ➢ Air Pollution Reduction Target ➢ Air Pollution Prevention Practices
Water	➢ Water Conservation Target ➢ Water Conservation Practices ➢ Clean Water Target ➢ Water Ingestion Prevention Practices
Land	➢ Soil Improvement Practices ➢ Land Conservation and Rehabilitation Plan ➢ Land Conservation and Rehabilitation Practices
Biodiversity	➢ Marine Landscape/Habitat Conservation Plan ➢ Ecosystem Enhancement Practices ➢ Species Conservation Targets ➢ Species Conservation Practices ➢ Wild Genetic Diversity Enhancement Practices
Materials and Energy	➢ Material Use Practices ➢ Renewable Energy Usage Target ➢ Energy Saving Practices ➢ Waste Reduction Target ➢ Waste Reduction Practices
Animal Welfare	➢ Animal Health Practices ➢ Humane Animal Handling Practices

Dependent Variable (Y): Stock Price (Stock Value)

In this study, the stock prices used were the closing prices at the end of the financial year (as of December 31) for 2022 and 2023. The movement of each stock was quantified using a binary coding scheme (Table 2). A value of 1 was allocated to stocks exhibiting a price appreciation from year-end 2022 to year-end 2023, indicating positive performance. In contrast, a value of 0 was designated for stocks that

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experienced a price depreciation over the same interval. This technique converted continuous price data into a dichotomous variable, thereby facilitating an assessment based on directional trends while disregarding the magnitude of fluctuations.

Table 2
Comparison of Stock Values

No	Code	Stock Value (2022)			Stock Value (2023)		
		2021	2022	Increase	2022	2023	Increase
1	AALI	9500	8025	-18%	8025	7025	-14%
2	ANDI	50	50	0%	50	50	0%
3	ANJT	990	665	-49%	665	745	11%
4	BISI	995	1600	38%	1600	1600	0%
5	BTEK	50	50	0%	50	50	0%
6	BWPT	74	65	-14%	65	54	-20%
7	CBUT	0	2180	100%	2180	1765	-24%
8	CSRA	500	570	12%	570	472	-21%
9	DSNG	500	600	17%	600	555	-8%
10	FAPA	3210	4300	25%	4300	5300	19%
11	FISH	7650	6750	-13%	6750	5525	-22%
12	GZCO	69	81	15%	81	120	33%
13	JAWA	270	105	-157%	105	180	42%
14	LSIP	1185	1015	-17%	1015	890	-14%
15	MGRO	850	845	-1%	845	705	-20%
16	PSGO	216	146	-48%	146	133	-10%
17	PGUN	388	805	52%	805	416	-94%
18	SGRO	1995	2100	5%	2100	2010	-4%
19	SIMP	456	414	-10%	414	376	-10%
20	SMAR	4360	4950	12%	4950	4000	-24%
21	SSMS	965	1470	34%	1470	1045	-41%
22	STAA	0	1045	100%	1045	910	-15%
23	TAPG	610	635	4%	635	545	-17%
24	UNSP	109	128	15%	128	113	-13%
25	WAPO	185	250	26%	250	91	-175%

Source: Data processed by IDX, 2022-2023.

RESULTS AND DISCUSSION

Continuous Variable Information

Table 3 presents descriptive statistics for all variables in the model:

A. Stock Value: Has a mean of 0.36 with a standard deviation of 0.485. Its values range from 0 to 1.
B. Covariates (Independent Variables):
    a) Atmosphere: Average 0.86.
    b) Water: Average 0.98.
    c) Land: Average 0.84.
    d) Biodiversity: Average 0.74.
    e) Materials and Energy: Average 0.92.
    f) Animal Welfare: Average 0.12.
    g) All covariate variables also have values between 0 and 1.

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Table 3
Continuous Variable Information

		N	Minimum	Maximum	Mean	Standard Deviation
Dependent Variable	Stock Value	50	0	1	.36	.485
Covariate	Atmosphere	50	0	1	.86	.351
	Water	50	0	1	.98	.141
	Land	50	0	1	.84	.370
	Biodiversity	50	0	1	.74	.443
	Materials and Energy	50	0	1	.92	.274
	Animal Welfare	50	0	1	.12	.328

Source: Data processed by SPSS, 2025

Tests of Model Effects

Table 4
Test of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	64,803	1	<,001
Atmosphere	.726	1	.394
Water	34,008	1	<,001
Land	.003	1	.958
Biodiversity	.864	1	.353
Materials and Energy	51,885	1	<,001
Animal Welfare	.663	1	.415

Source: Data processed by SPSS, 2025

Table 4 is one of the most important tables showing which independent variables significantly affect stock value. The test was performed using the Wald Chi-Square.

A. Significant (< 0.05):
   a) Water: Sig. value < 0.001, indicating that the Water variable has a statistically significant influence on Stock Value.
   b) Materials and Energy: Sig. value < 0.001, indicating that the Materials and Energy variables also have a statistically significant influence on Stock Value.
B. Not Significant (> 0.05):
   a) Atmosphere (Sig. = 0.394)
   b) Land (Sig. = 0.958).
   c) Biodiversity (Sig. = 0.353).
   d) Animal Welfare (Sig. = 0.415).

These variables were not shown to have a statistically significant effect on Stock Value in this model.

Parameter Estimates
Table 5 provides details about the relationship between each independent variable and Stock Value.

A. (Intercept): The B value is 1.025 and is significant (Sig. < 0.001). This is the predicted value of Stock Value when all independent variables are zero.
B. Water:
   a) Coefficient (B): -0.958.
   b) Significance: Highly significant (Sig. < 0.001).
   c) Interpretation: Each one unit increase in the water variable is associated with a decrease in Stock Value of 0.958 units, assuming other variables are constant.

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C. Materials and Energy:
  a) Coefficient (B): 0.562
  b) Significance: Highly significant (Sig. < 0.001).
  c) Interpretation: Each one-unit increase in the Materials and Energy variable is associated with a 0.562 unit increase in Stock Value, assuming other variables are constant.
D. Insignificant Variables: Atmosphere, Land, Biodiversity, and Animal Welfare variables have Sig. values above 0.05, which confirms that they do not have a statistically significant influence on Stock Value in this model. Their coefficients (B) are not reliable for concluding.

The Exp(B) column (the exponent of B) is usually interpreted in logistic regression as an odds ratio. However, because this model uses the Identity link, a direct interpretation of the B coefficient is more relevant.

Table 5
Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	1,025	.1273	.775	1,274	64,803	1	<,001	2,787	2,171	3,577
Atmosphere	-.136	.1596	-.449	.177	.726	1	.394	.873	.638	1,193
Water	-.958	.1643	-1,280	-.636	34,008	1	<,001	.384	.278	.529
Land	.011	.2068	-.394	.416	.003	1	.958	1,011	.674	1,516
Biodiversity	-.159	.1714	-.495	.177	.864	1	.353	.853	.609	1,193
Materials and Energy	.562	.0780	.409	.714	51,885	1	<,001	1,754	1,505	2,043
Animal Welfare	-.139	.1712	-.475	.196	.663	1	.415	.870	.622	1,217
(Scale)	1									

Source: Data processed by SPSS, 2025

The Inequality Impact of Environmental Sustainability Dimensions on Stock Market Value

This study analyses the influence of environmental sustainability dimensions, based on the SAFA framework, affecting the market price of IDX agro-stocks. The statistical analysis reveals a complex relationship between various environmental practices and market perceptions, which are reflected in stock prices. Key findings indicate that not all aspects of environmental sustainability carry equal weight among investors.

The most striking result of this study is the highly statistically significant effect of the Water, Materials and Energy variables on stock value. The Materials and Energy variable shows a significant positive relationship with stock value, with a regression coefficient of 0.562. This implies that companies that demonstrate a strong commitment to efficient material use practices, renewable energy utilisation, energy conservation, and waste reduction tend to be valued more highly by the market. Investors likely view resource efficiency as an indicator of superior operational management. These practices not only reduce environmental impact but also have the potential to reduce production costs and increase profitability in the long term, in line with global demands for more responsible business models. On the other hand, the Water variable shows a significant negative relationship with stock value (coefficient -0.958). Interpretation of this finding requires caution. This result does not necessarily mean that water conservation practices are detrimental to companies. Rather, it could indicate that companies operating in water-scarce regions or whose industries are highly dependent on water face higher risks. Investors may perceive intensive disclosures related to water issues as a signal of operational vulnerabilities or potentially high future costs for water management. Therefore, while water conservation efforts are crucial for ecological sustainability, high disclosures related to this variable may be perceived by the market as reflecting greater inherent risk.

Efficiency in material and energy use directly lowers production costs, increases profit margins, and signals superior operational management. Investors view this as a sign of a well-managed and highly competitive company. This is in line with research by Derwall et al. (2005), this is one of the fundamental studies showing that companies with higher "eco-efficiency" ratings (including energy and materials efficiency) tend to have superior stock market performance. Your findings are a direct reflection of this "ecological efficiency premium."

Unlike the two previous variables, this study found that the Atmosphere, Land, Biodiversity, and Animal Welfare variables had no meaningful statistical influence on share prices. The lack of significance in the Atmosphere and Land variables indicates that, during the observation period, company initiatives for GHG mitigation and soil protection were not yet a primary determinant for investors in valuing agricultural company stocks. This may be because the financial impact of these practices is considered more long-term and less directly visible in annual financial performance. Similarly, the lack of a significant effect of the Biodiversity variable suggests that initiatives related to biodiversity conservation, although crucial for ecosystem balance, may not have been fully quantified in risk and opportunity assessment models by most investors.

The most striking finding in this category is the Animal Welfare variable, which had the lowest average disclosure (0.12) and showed no significant impact on stock prices. This confirms the research's observation that animal welfare has not yet been a primary focus in sustainability reports of agricultural companies in Indonesia. This low level of disclosure and market attention indicates a gap between the holistic sustainability practices advocated by the SAFA Framework and current capital market priorities.

The phenomenon in the Indonesian capital market indicates a discrepancy between corporate social responsibility (CSR) disclosure and actual environmental performance. This is confirmed by a study (Rovishany et al., 2025) on LQ45 index companies, which found that environmental CSR disclosure has a significant positive effect on stock prices, while actual environmental performance does not show a similar effect. This finding implies that investors place greater value on the sustainability image communicated through reporting than on substantive environmental actions. This explains why more complex and less regulated environmental issues, such as impacts on wildlife or biodiversity—areas where animal welfare falls—tend to be overlooked by companies, particularly in the agricultural sector. The market appears not yet to have provided strong financial incentives for companies to prioritise actual environmental performance beyond basic regulatory compliance.

Overall, this discussion confirms that investors in the Indonesian capital market tend to be more responsive to environmental sustainability issues with clear short-term financial implications, such as energy and material efficiency, and risks related to water resources. Meanwhile, other important aspects such as climate, land conservation, biodiversity, and animal welfare, although fundamental to long-term sustainability, appear not to be fully integrated into investment decision-making. This highlights the importance of increasing awareness and transparency in reporting so that all dimensions of sustainability can be comprehensively assessed by stakeholders.

The insignificant influence of variables such as biodiversity or land use on stock value in an analysis can be explained by several interrelated factors. One key challenge is the difficulty of quantification, as the financial impact of these variables is often long-term and difficult to measure in monetary terms, and therefore not directly reflected in short- to medium-term stock valuations. This aligns with investors' tendency to prioritise environmental metrics with a clear and direct impact on the income statement, such as energy and water costs, over more qualitative or indirect issues. Furthermore, industry

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materiality plays a significant role; the influence of variables such as biodiversity can be crucial for certain industries, such as agribusiness, but less relevant for the technology industry. Consequently, when these sectors are analysed in aggregate, the strong influence in one sector is diluted or "lost" when combined with others, leading to the statistical conclusion that the variable is insignificant overall. This aligns with findings from (Friede et al., 2015), which is a large meta-analysis that reviewed thousands of studies. One conclusion suggests that ESG indicators correlate with corporate financial outcomes varies. While there is strong evidence for a positive relationship for certain factors (such as resource efficiency), the results are more mixed and often insignificant for other, more difficult-to-measure metrics, which is exactly what you found.

CONCLUSIONS

Based on the analysis, the conclusion of this study indicates that not all aspects of environmental sustainability within the SAFA Framework have equal weight in the eyes of investors in agricultural companies listed on the IDX. The main finding revealed that only the variables Water, Materials and Energy have a statistically significant influence on stock value. The Materials and Energy variable shows a positive relationship, implying that investors appreciate companies that are efficient in their use of resources because it is considered a reflection of superior operational management and has the potential to increase profitability. Conversely, the variable Water shows a significant negative relationship. This is interpreted not as a negative impact of conservation practices, but rather as investors' perception that high disclosure of water issues indicates greater operational and financial risks for the company. On the other hand, the variables Atmosphere, Land, Biodiversity, and Animal Welfare are not proven to have a statistically significant influence on stock value. This indicates that company efforts in GHG emission mitigation, land conservation, and biodiversity preservation have not been a primary determining factor for investors, possibly because their impacts are perceived as more long-term.

Specifically, the Animal Welfare aspect has the lowest level of disclosure and no impact on stock value, confirming that this issue is not yet a primary focus for agricultural companies in Indonesia. Overall, this study confirms that investors in the Indonesian capital market are more responsive to environmental sustainability issues with clear short-term financial implications, such as resource efficiency and water risk, while other long-term sustainability aspects are not yet fully integrated into investment decisions.

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