From Narrative to Behavioral Shift: An Experimental Pilot Study on Message Framing and Environmental Concern in Electric Vehicle Adoption

Caesarius Haryo Bagaskara[1,*] and Hilya Mudrika Arini[1]

[1] Department of Mechanical and Industrial Engineering, Faculty of Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia

* caesariusharyobagaskarastrt@mail.ugm.ac.id

Abstract. Electric vehicles are an innovation that has potential to reduce environmental impacts in the transportation sector. In Indonesia, the adoption rate of electric vehicles still relatively low, even though the government has issued various incentive policies and conversion support. This study aims to examine the effect of message framing types (positive vs. negative), conversion motivation orientation (environmental concern vs. personal gain), and vehicle type (Battery Electric Vehicle [BEV] vs. Hybrid Electric Vehicle [HEV]) on purchase intention (Willingness to Buy, WTB) and Willingness to Pay (WTP), to switch to electric vehicles. Environmental concern was measured using the New Environmental Paradigm (NEP) scale that has been translated into Indonesian. The study involved 30 conventional vehicle owners as participants. The results showed that framing with a personal gain orientation resulted in a significantly higher response compared to framing based on environmental concern. However, framing has not had a significant effect on WTB, which is thought to be caused by external factors such as the price of electric vehicles which is still relatively high.

Keywords: Message Framing, Prospect Theory, Electric Vehicle Adoption, Willingness to Buy, New Environmental Paradigm.

1 Introduction

1.1 Background and Context

Climate change poses a significant threat to environmental sustainability. Among the primary contributors to greenhouse gas emissions is the transportation sector, which accounts for approximately 29% of Indonesia's total national energy consumption and ranks as the second-largest source of carbon dioxide (CO_2) emissions after coal-fired power plants, reported by Nizam [5]. In response, the Indonesian government issued Presidential Regulation (Perpres) No. 55 of 2019, which outlines a comprehensive program to accelerate the adoption of electric vehicles (EVs). This program includes fiscal and non-fiscal incentives, the development of charging infrastructure, special electricity tariffs, technical standards, and environmental protection measures.

M. Rafieiy et al. (eds.), *Proceedings of the 8th Mechanical and Industrial Engineering Symposium (MIE 2025)*, Atlantis Highlights in Engineering 42,
https://doi.org/10.2991/978-94-6239-687-6_31

The adoption rate of electric vehicles (EVs), particularly the two most prevalent types in Indonesia—Battery Electric Vehicles (BEVs) and Hybrid Electric Vehicles (HEVs)—remains relatively low. In 2023, according to sales data released by Gaikindo, the combined sales of diesel- and gasoline-powered private cars reached approximately 709,414 units. In contrast, BEV sales amounted to only 17,062 units and HEV sales to 52,780 units, showing a substantial gap compared to conventional vehicle sales. Within the Asian context, Indonesia lags significantly behind countries such as Thailand and India, with a domestic adoption rate of just 0.1% as shown at report from McKinsey & Company [4].

1.2 Public Perception and Behavioral Drivers

Based on consumer intention, social media surveys have indicated a potentially positive public attitude toward electric vehicles. A study by Utami et al. [6] found that 79% of tweets expressed support for the transition from conventional vehicles to EVs. Similarly, Farhani and Sutisna [7] reported a recall score of 92.70% for positive sentiment toward electric vehicles. Various studies have emphasized that consumer perception and psychological factors play a crucial role in shaping EV adoption intentions, in addition to technical considerations and government incentives [8, 9]. In the context of electric vehicles, message framing that highlights either environmental benefits or personal gains may lead to different consumer responses depending on individuals' values and motivational orientations [10, 11].

1.3 Theoretical Framework

This research is an initial pilot study aimed at testing the feasibility of an experimental design and analyzing early response patterns to message framing within the electric vehicle context. In this study, framing is examined through the lens of the information presentation hypothesis. According to Kahneman and Tversky [1], individuals tend to exhibit risk-averse behavior when choices are framed as gains, but shift toward risk-seeking behavior when the same choices are presented as losses—even if the outcomes are logically identical.

1.4 Environmental Concern and NEP Scale

In addition to message framing, environmental concern is considered an important variable in explaining consumers' purchasing intentions. The New Environmental Paradigm (NEP) scale has been widely used to measure environmental concern as a predictor of environmentally friendly consumption behavior [3]. The revised NEP scale, developed by Dunlap et al. [2], consists of 15 items, where odd-numbered statements reflect the New Environmental Paradigm and even-numbered statements reflect the Dominant Social Paradigm (DSP), which contrasts with NEP by asserting that humans have the right to dominate nature. The NEP scale captures both ecological and anthropocentric worldviews, using a Likert scale to assess the degree of agreement among respondents. This scale has been applied in various cross-cultural studies to link

environmental attitudes with consumption behavior, policy support, and preferences for green technologies such as electric vehicles.

In contrast, the 7 even-numbered items represent support for the Dominant Social Paradigm (DSP). The DSP is grounded in the belief that humans have the right to control and dominate nature to fulfill their desires and needs, with the assumption that there are no limits to growth because technological advancement can overcome all environmental challenges. The DSP perspective generally denies the relevance of ecological crises, and therefore tends to be negatively correlated with the NEP.

In this study, the NEP scale was translated into Indonesian using a forward-backward translation method to ensure linguistic and conceptual accuracy. However, the NEP scale cannot be applied uniformly across all cultural contexts. In China, for example, the scale has undergone significant adaptation and validation to maintain its relevance. Wang and Sun [13], argue that the application of the NEP must consider cultural and social dimensions in order to accurately reflect ecological values within each country.

1.5 **Research Objective**

By integrating message framing and NEP levels, this study aims to empirically examine how framing type (positive vs. negative), motivational orientation (environmental concern vs. personal gain), and vehicle type (BEV vs. HEV) interact in shaping Indonesian consumers' willingness to buy (WTB) and willingness to pay (WTP) for electric vehicles.

The study is expected to contribute theoretically to the development of communication strategies based on prospect theory, while also offering practical recommendations for policymakers and industry stakeholders to enhance EV adoption in Indonesia.

2 Method

2.1 Research Design

This study employed a quantitative approach using a mixed experimental design, combining:

A between-subjects design to compare the effects of message framing (positive vs. negative), and A within-subjects design to evaluate participants' responses across different motivational orientations (environmental concern vs. personal gain) and electric vehicle types (BEV and HEV).

This design enables a comprehensive analysis of the interaction effects among variables influencing the intention to adopt electric vehicles. The between-subjects design was chosen for the framing comparison, whereby each participant was exposed to only one type of message frame. This approach was intended to enhance responsiveness to message differences, minimize direct comparison bias, and maintain the naturalness of participant responses.

Conversely, the within-subjects design was applied to the motivation types and vehicle types. Participants were presented with all combinations, allowing them to

naturally compare options as they would in real-life decision-making scenarios. This design choice also helps to control for individual differences, as the same participants respond across all conditions, thereby increasing statistical power and analytical efficiency. Additionally, it allows for a more precise analysis of relative preferences between BEV and HEV within the same individuals.

2.2 Framing Hypothesis and Design Scenario

The framing hypothesis posits that participants will tend to exhibit risk-averse behavior when presented with information in a positive frame, and will lean toward risk-seeking behavior when the same information is presented in a negative frame. To align with the context of transitioning to electric vehicles, the framing conditions in this study were structured as follows:

Group 1: A positive frame was used to describe electric vehicles, while a risk frame was applied to conventional vehicles. Participants were given the choice between a certain outcome (switching to an electric vehicle) or accepting a risk associated with continuing to use a conventional vehicle.

Group 2: A negative frame was applied to conventional vehicles, while a risk frame was associated with switching to electric vehicles. In this condition, participants could choose to take the risk of converting to an electric vehicle or accept a guaranteed loss related to continued use of a conventional vehicle.

In this study, the within-subject component (motivational orientation and vehicle type) was presented in a fixed order rather than randomized. This was done intentionally to ensure that participants could focus on one scenario at a time without cognitive overload or confusion, considering the platform limitations (Google Form) that did not support randomized presentation sequences. We acknowledge that the lack of randomization may introduce potential order or fatigue effects, but the sequential design was chosen to preserve clarity and participant engagement in this pilot study. Previous research suggests that complex stimuli in online survey formats may require structured sequences to avoid misinterpretation, especially when multiple framing dimensions are involved [11,12].

The following is an example of how positive and negative framing scenarios were presented to participants in this study.

2.3 Framing Scenario

Positive Framing, for BEV with reference point environmental concern:

Example : carbon emissions from private vehicles are one of the major contributors to air pollution. On average, private cars produce 4.6 metric tons of CO_2 per year. We should reduce carbon emissions from our private vehicles to maintain cleaner air quality. Which option would you choose from the options below: Electric Vehicle or Conventional Vehicle?

Option 1: Choosing an Electric Vehicle reduces emissions by 1.6 metric tons of CO_2 per year, even under the scenario where the electric power plant still uses non-renewable energy sources, thereby giving a positive impact on the environment.

Option 2:Choosing a Conventional Vehicle, where there is a 1/3 chance that through more efficient fuel innovation or carbon compensation, emissions will reduce by 3

metric tons of CO_2 per year, but there is a 2/3 chance that emissions will only reduce by 0.9 metric tons of CO_2 per year.

Negative Framing, for BEV with reference point personal benefit:

Example : When taking long-distance trips, fuel efficiency becomes important to save expenses. Vehicles are targeted to achieve fuel consumption of up to 30 km per liter, allowing for longer journeys without frequent refueling. You can significantly save fuel during long-distance travel. Which option would you choose from the options below: Hybrid Vehicle or Conventional Vehicle?

Option 1: Using a conventional diesel vehicle is still fuel-inefficient, with an average fuel consumption of 12 km per liter.

Option 2: Using a hybrid vehicle (HEV) has a 1/3 chance of experiencing battery issues, resulting in 9 km per liter, and a 2/3 chance of saving fuel up to 13.5 km per liter, depending on usage.

2.4 Participants

A total of 30 participants were recruited via social media platforms. Inclusion criteria required participants to be private vehicle owners (gasoline or diesel), within the productive age range (between 20 and 55 years), residing in Java, Indonesia, and possessing a basic understanding of electric vehicles. Participants were divided equally into two groups: 15 individuals were assigned to the positive framing condition, while the remaining 15 were assigned to the negative framing condition.

Post-hoc power analysis was conducted using GPower (Faul et al., 2007) for the repeated-measures ANOVA design (within-between interaction). With an assumed medium effect size ($f = 0.25$), $\alpha = 0.05$, and $N = 30$, the analysis yielded a power of 90.3%. This suggests sufficient statistical power for detecting medium effects in the present study design.

Most participants were working professionals living in urban areas of Java, where electric vehicle infrastructure is more accessible compared to other regions. Their monthly income varied, ranging from under 5 million IDR to over 10 million IDR, reflecting a diverse but predominantly middle-class demographic. This profile aligns with the characteristics of the current EV consumer segment in Indonesia, where private vehicle ownership and awareness of EV technology are more prevalent among middle to upper-middle income groups.

2.5 Instruments

New Environmental Paradigm (NEP) Survey to measure participants' environmental concern, the 15-item NEP scale was used, employing a 5-point Likert scale. This scale assesses the degree of ecological orientation and has been widely validated in cross-cultural environmental behavior research.

Message Framing Stimuli : participants were presented with short narrative stimuli representing four framing conditions that combined vehicle type and motivational orientation: Positive framing – Environmental concern; Negative framing – Environmental concern ; Positive framing – Personal benefit; Negative framing – Personal benefit.

The scenarios and choices were adapted from previous studies by Fachrudin [12], Decrinis et al. [11], and Chung & Chon [10].

For each condition, participants answered two key questions.

- Willingness to Buy (WTB): The intention to purchase the presented vehicle
- Willingness to Pay (WTP): The estimated additional amount participants were willing to pay for the electric vehicle, compared to their current vehicle.

3 Result

3.1 NEP Analysis

Correlation analysis revealed that items 4 and 8 had p-values greater than 0.05, indicating that these items were not statistically valid and did not exhibit significant positive or negative correlations. As a result, both items were excluded from the study. Interestingly, as shown in Table 1, items DSP 4, 5, 8, and 14—originally designed to reflect the Dominant Social Paradigm (DSP)—showed positive correlations with NEP scores, suggesting that these DSP items paradoxically reinforced, rather than contradicted, the NEP construct.

In the reliability analysis using Cronbach's alpha, items DSP 6 and 14 were removed to meet the minimum threshold of 0.7. After these exclusions, the Cronbach's alpha increased to 0.854, indicating strong internal consistency and high inter-item correlation across the remaining items.

Table 1. Correlatiom Test Results

Code	Item	Pearson's R	P value
DSP 1	2	-0.382	0.037
DSP 2	4	0.319	0.086
DSP 3	6	0.634	< .001
DSP 4	8	0.104	0.586
DSP 5	10	-0.551	0.002
DSP 6	12	-0.372	0.043
DSP 7	14	0.582	< .001

3.2 Framing Analysis

Given the small sample size and non-normal distribution of the data, the framing hypothesis was tested using the Mann-Whitney U test to directly compare the positive and negative framing groups, in line with prospect theory. The results indicated a significant difference in risk-averse scores between the two groups ($U = 203.000$, $p < 0.001$). The Mann-Whitney U test results at Figure 1 showed that participants who received positive framing had significantly higher risk aversion scores than those with negative framing. This indicates that framing significantly influences risk preferences. The visualization results using error bars and raincloud plots also support this finding, where risk aversion scores in positive framing were consistently higher. These findings

suggest that respondents were more likely to avoid risk and choose the safer option when information was presented in a gain frame, while loss-framed messages encouraged more risk-seeking behavior, such as a higher willingness to switch to electric vehicles.

A significant difference was also found in NEP scores between participants exposed to positive versus negative framing. Participants in the positive framing condition generally exhibited higher NEP profiles, while those in the negative framing condition tended to have lower NEP scores. In the combined analysis, participants were categorized as environmentally concerned or unconcerned based on the overall NEP average. In separate within-group analyses for each framing condition, participants were grouped according to the average NEP score within each specific framing group.

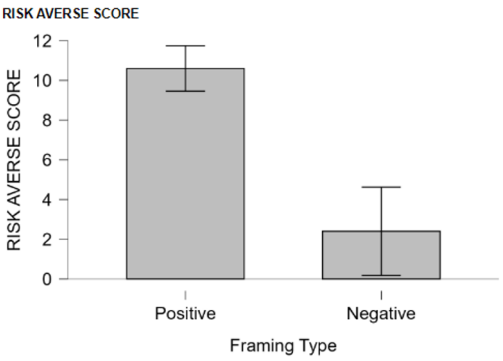

Fig. 1. Mann-Whitney U test results.

Based on the results of the repeated measures ANOVA with two within-subject factors (Framing Type and Vehicle Type), it was found that the framing variable had a significant effect on participants' responses. Specifically, as as shown in table 2, the test of the main effect of Framing Type (environmental concern vs. personal gain) yielded $F(1, 28) = 4.797$, $p = 0.038$. Since the p-value was less than 0.05, it can be concluded that there was a statistically significant difference between the environmental and personal gain framing conditions.

The analysis further revealed that Framing Type had a significant main effect mentioned in table 3, with personal gain framing producing higher participant responses compared to environmental concern framing. In contrast, Vehicle Type, environmental concern level (as measured by NEP), and message valence (positive vs. negative) did not show significant main effects.

Table 2. . Repeated Measure ANOVA Test Results

Cases	SSQ	df	Mean Sq	F	p
Vehicle Type	0.006	1.000	0.006	0.722	0.403
Framing Type	0.022	1.000	0.022	4.797	0.038
Vehicle X Framing Type	0.003	1.000	0.003	0.526	0.475

Table 3. Descriptive Analysis Mean response score

Vehicle Type	Framing Type	Mean
BEV	Environmental	0.492
BEV	Personal Gain	0.528
HEV	Environmental	0.501
HEV	Personal Gain	0.518

These findings suggest that personal, benefit-oriented message framing is more effective in shaping consumer responses to environmentally friendly vehicle options than environmentally driven messaging, particularly among individuals with lower levels of environmental concern.

3.3 Assumption Testing and Data Transformation

The assumption of normality was not fully met, and violations of homogeneity of variance were detected in two conditions. To address these violations, a logarithmic transformation was applied to the data. This transformation was intended to normalize skewed distributions, reduce the influence of outliers, and improve variance homogeneity, making the data more suitable for further analysis.

3.4 Willingness to Buy Analysis

The Generalized Linear Model (GLM) indicated that environmental concern had a positive, yet statistically non-significant, effect on willingness to buy (WTB) electric vehicles ($p = 0.232$). This suggests that individuals who are environmentally conscious may be more inclined to purchase electric vehicles, although the effect is not strong enough to significantly influence purchasing decisions.

Regarding Framing Type, the full model produced a non-full-rank warning, indicating predictor redundancy or multicollinearity. Due to multicollinearity warnings in GLM, the four framing conditions were simplified into two composite scores for exploratory purposes. While this approach is not commonly used, it was chosen to simplify the model after redundancy (non-full-rank) concerns were identified. However, composite score has potential to reduce the clarity of interpretation. Further studies are recommended to analyze these two dimensions separately or use other methods such as interactions in a factorial model. This adjusted framing variable also did not show a significant effect on WTB across various models (all p-values > 0.05).

Although parameter estimates suggested differing directional effects between environmental and personal gain framing depending on the Vehicle Type (HEV vs. BEV), these patterns were not statistically strong enough to draw firm conclusions. This indicates that emotionally or socially charged messages may not be sufficient to increase EV purchase intention in the absence of other supporting factors.

3.5 Willingness to Pay Analysis

The analysis of Willingness to Pay (WTP) data showed that most participants were willing to pay an additional cost for both HEVs and BEVs. However, GLM results

revealed that none of the predictor variables—framing, vehicle type, or environmental concern—had a statistically significant effect on WTP ($p > 0.05$ in all models)

As shown in Figure 2, boxplot visualizations revealed that Willingness to Pay (WTP) for Hybrid Electric Vehicles (HEVs) tended to be higher and more varied compared to Battery Electric Vehicles (BEVs). The median WTP for HEVs was above that of BEVs, and the distribution range was wider, including extreme values up to IDR 500 million. In contrast, WTP for BEVs was concentrated in a lower range, with no significant outliers. These findings suggest that current consumers are more inclined to value HEV technology higher than BEVs, both in terms of perceived value and actual willingness to pay.

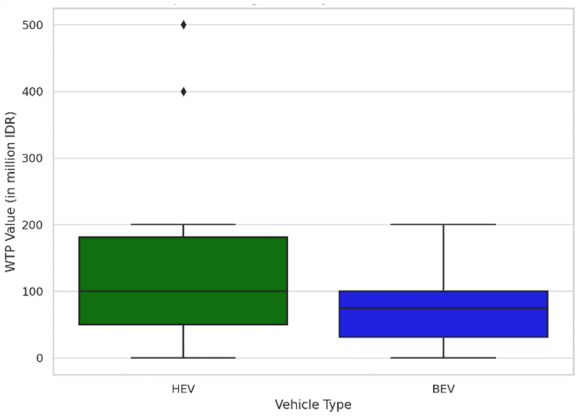

Fig. 2. Boxplot of Willingness to Pay (WTP) for HEV (left) & BEV (right). Y-Values are expressed in million IDR.

3.6 **Additional Factors**

Additional factors cited by respondents are presented in Chart at Figure 3 Frequency analysis of these factors indicates that the most dominant reasons influencing vehicle purchase decisions were environmental friendliness and car price.

Respondents identified environmental impact and car price as the primary motivation for switching to electric vehicles. Interestingly, after-sales service and concerns about electricity power plant sources were also frequently mentioned (each cited by 5 participants). These responses suggest that consumers still perceive after-sales support for EVs as inadequate and remain concerned that Indonesia's electricity grid is still largely powered by fossil fuels, which reduces the perceived environmental benefit of switching to EVs. Other considerations, such as fuel efficiency, engine performance, and safety, were mentioned less frequently but still reflect important aspects of the decision-making process.

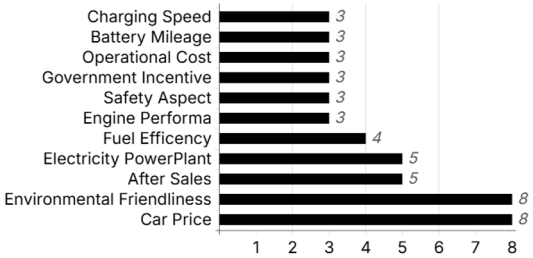

Fig. 3. Frequency chart of mentioned reasons

4 Discussion

4.1 NEP-DSP Misalignment

In the NEP segment, several items representing the Dominant Social Paradigm (DSP) unexpectedly showed positive correlations with the NEP construct. For instance, if items 2 and 12 were not reverse-scored, the Cronbach's alpha increased significantly. This suggests that respondents treated these items as though they were NEP-oriented rather than DSP-oriented. It is likely that participants either misread the questions or that the negative phrasing in the translated items did not clearly convey DSP ideology, which may be due to translation ambiguity or cultural interpretation. This implies that the DSP items require revision and adaptation of terminology in Indonesian context. The idea of 'managing nature' might be perceived as stewardship rather than domination, leading to unexpected responses. Future research should refine the DSP items to better reflect the intended anthropocentric orientation.

4.2 Purchase Intention vs Actual Intention

In this study, the Framing Type (positive vs. negative) was strong enough to significantly influence consumer preferences toward electric vehicles. However, it did not produce a statistically significant effect on Willingness to Buy (WTB) or Willingness to Pay (WTP). Although framing may have influenced respondents' perceptions, it did not translate into actual purchase intentions.Other factors may play a more dominant role at this stage—such as the high price of electric vehicles and the overall low WTP observed among respondents. However, if respondents already possess the intention to adopt, it is possible that they may eventually convert to electric vehicles in the future.

4.3 Practical Implications for Communication Strategies

The finding that personal gain framing was more effective than environmental concern framing has practical implications, particularly for governmental institutions such as the Ministry of Transportation and the National Research and Innovation Agency (BRIN), which are actively promoting EV adoption. Public campaigns should emphasize tangible personal benefits—such as fuel cost savings, tax incentives, and

maintenance convenience—rather than relying solely on long-term ecological messaging. This personal gain-framing strategy can also be adopted by automotive companies in developing countries, where environmental concern tends to be lower among the general population. The study also provides empirical support for the development of behavioral nudges based on Prospect Theory to promote the adoption of green technologies in the transportation sector.

4.4 Limitations and Recommendations for Future Research

Nonetheless, the limited sample size and relatively small number of participants per condition may have constrained the statistical power of the analyses. This increases the possibility that certain real effects, particularly in complex interactions, were not detected as statistically significant. For example, environmental concern showed a positive relationship with WTB, but this was not statistically significant ($p = 0.232$). This indicates that while environmentally conscious individuals may be more inclined to purchase EVs, the effect was not strong enough in this dataset to influence actual buying decisions. Despite the lack of statistical significance, the direction of the effect suggests a meaningful trend that warrants further investigation in studies with larger sample sizes.

Additionally, this study did not include a manipulation check to verify whether participants correctly perceived and understood the framing conditions (positive vs. negative, or personal gain vs. environmental concern). Although the scenarios were carefully designed in accordance with prospect theory principles, this limitation could affect the interpretation of the findings. Future research is advised to incorporate a manipulation check to validate participants' framing perception and ensure the robustness of the experimental manipulation. Although this study did not formally test NEP as a moderator, future work should explore whether environmental concern levels modulate the impact of message framing on EV adoption intentions.

References

1. D. Kahneman, A. Tversky, Econometrica 49, 263–291 (1981).
2. R.E. Dunlap, K.D. Van Liere, A.G. Mertig, R.E. Jones, J. Soc. Issues 56, 425–442 (2000).
3. J. Jansson, M. Marell, A. Nordlund, J. Environ. Psychol. 52, 166–177 (2017).
4. McKinsey & Company, Electric Vehicle Outlook Southeast Asia, Report (2022).
5. Nizam, Transportation and Emission Report, Ministry of Transportation, Indonesia (2020).
6. A. Utami, H. Prasetyo, S. Rahmawati, Social Media Sentiment toward EVs in Indonesia, (2020).
7. N. Farhani, D. Sutisna, Twitter Recall Analysis on Electric Vehicle Sentiment, (2024).
8. T. Widiawati, F. Rachma, R. Setiawan, J. Sustainability Studies 14, 33–45 (2022).
9. A. Ibrahim, S. Kurniawan, D. Mahendra, Asian J. Consumer Research 11, 78–91 (2022).
10. H. Chung, J. Chon, Energy Policy & Behavior 27, 100–112 (2024).
11. M. Decrinis, L. Bertolini, A. Russo, Transportation Research Part D 109, 103398 (2022).
12. Fachrudin, Risk Communication in Environmental Decision Making, Master Thesis, UGM (2005).
13. H. Wang, J. Sun, Ecological Indicators 125, 107519 (2021).