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Communication Strategy of Mangrove Rehabilitation in Muara Gembong, Bekasi District – West Java

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Rici Tri Harpin Pranata[1*], Arif Satria[2], Tri Budiarto [3], Willy Bachtiar[1], Nur Hannah Muthohharoh[2]

[1]Digital Communication and Media, Vocational School of IPB University
[2]Communication and Community Development Science of IPB University
[3]Production Technology and Agriculture Community Development,
Vocational School of IPB University
Jln. Raya Darmaga, Kampus IPB Darmaga, Bogor 16680 - Indonesia
[*]Corresponding author: ricitriha@apps.ipb.ac.id

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Abstract - Environmental communication studies are essential in advancing mangrove ecosystem rehabilitation by facilitating collaboration among diverse stakeholders with varying roles and interests. Grounded in fostering mutual understanding, environmental communication aims to enhance dialogue and engagement in conservation. Therefore, this research aims to analyze: (1) the effectiveness of environmental communication strategies in the mangrove ecosystem rehabilitation and (2) factors that influence the effectiveness of environmental communication of the mangrove ecosystem rehabilitation. This research was conducted in Muara Gembong District, Bekasi Regency, West Java. This research employs quantitative and qualitative methods. This research shows that in developing persuasive communication of the mangrove rehabilitation agenda, the two-way communication model is most effective in fostering an attitude of altruism in preserving the environment. In the digital technology development era, face-to-face communication remains an effective approach for engaging a community with limited access to digital infrastructure and low literacy. Message senders often ignore evaluations to assess the effectiveness of communication. Evaluation by the message sender will encourage improvement and continuity of communication until the expected impact can be achieved.
Keywords: environmental communication; coastal community; climate change; mangroves.

Introduction

Addressing ecological and environmental crises involves a transdisciplinary approach, including the field of communication science. Environmental communication has an important role in disseminating information, increasing public awareness, and engaging stakeholders. Since the 1960s, several global environmental movements have emerged, such as the "Silent Spring Incident" and the "Love Canal Incident," which have significantly increased awareness of environmental issues (Parks, 2017; Tyson, 2020).

Environmental communication is essential to address the escalating ecological and environmental crises, including climate change, which has become a primary threat to the global community (Bayes et al., 2023). Mangrove ecosystem rehabilitation is one of Indonesia's priority strategies for blue carbon-based climate change mitigation, as documented in the *Enhanced Nationally Determined Contribution* (NDC) (MoEF, 2021). This plan acknowledges the role of mangrove ecosystems as a carbon sink and as a greenbelt for coastal areas from ecological crises, which contribute to the coastal communities' welfare. The necessity of mangrove ecosystem rehabilitation is due to the decrease in mangrove forest cover in Indonesia (MoEF, 2022). Given the national commitment and the growth of mangrove rehabilitation initiatives, existing studies have highlighted mangrove management from ecological, political, and community participation aspects (Lukman et al., 2025).

Nevertheless, studies on the environmental communication perspective remain scarce (Yasir et al., 2020). Previous research on the ecological aspect has revealed the carbon stock potential from the mangrove ecosystem (Abdurrahman et al., 2024; Basyuni *et al.*, 2024). While Utami et al. (2024) have reviewed the mangrove management strategies at the national level. Other studies focused on the importance of social participation in mangrove restoration (Listiana & Ariyanto, 2024).

The impact of limited attention to communication aspects in environmental management has been revealed in previous studies. For example, a study by Loureiro et al. (2017) demonstrating the case of solid waste management showed that inadequate information and inconsistent communication between institutions failed to foster trust and hindered public involvement. In addition, other studies have shown that the spread of misinformation and lack of communication undermine cooperation between stakeholders in biodiversity conservation efforts, resulting in actions that inadvertently endanger biodiversity, alienate stakeholders, waste resources, and delegitimize scientific evidence (Ford et al., 2021).

This study contributes to the growing body of literature on environmental communication by examining how communication practices influence behavioral outcomes in mangrove rehabilitation. Environmental communication studies can strengthen mangrove ecosystem rehabilitation with the principle that the goal of humans in communication is to achieve mutual understanding. Therefore, in addition to being an instrument or tool to support environmental management, communication is also an integrated part of environmental management (Flor & Cangara, 2018).

This study uses a communication perspective to review blue carbon-based climate change mitigation efforts. The objectives of this study are to analyze 1) the effectiveness of environmental communication strategies in the mangrove ecosystem rehabilitation agenda and 2) factors that influence the effectiveness of environmental communication in the mangrove ecosystem rehabilitation agenda.

The focus of this study is to provide insight into how communication can influence individual knowledge, attitudes, and behavior toward mangrove rehabilitation efforts. The indicators to evaluate communication effectiveness can be seen from the people's understanding (cognitive impact), attitudes and opinions (affective impact), and actions or behavior (behavioral impact) (Ricart et al., 2025; Richter et al., 2025). In addition, factors that influence communication effectiveness are measured by assessing the five elements of communication: (1) sender; (2) message; (3) channel; (4) recipient, and (5) impact. (Laswell, 1948; Wilkes-Allemann et al., 2021; Halcovitch & Thibodeau, 2020).

Theoretical Framework

Environmental Communication Strategy

This paper integrates environmental communication with communication strategy to evaluate the effectiveness of mangrove rehabilitation campaigns. Environmental communication uses communication approaches, principles, strategies, and techniques to manage and protect the environment (Flor & Cangara, 2018). Environmental communication involves conveying information about environmental issues, either in the form of environmental knowledge or environmental policies, to the public to increase public understanding, awareness, and participation in environmental conservation efforts (Cox, 2013).

Environmental communication strategies have developed by adopting several theories, including (1) persuasive communication theory designed to encourage behavioral change (Kantola &

Syme, 1978); (2) source credibility theory, which emphasizes that the effectiveness of communication depends on the credibility of the communicator (Kumar et al., 2023), and (3) framing theory, which emphasizes how the packaging of issues affects the audience (Song et al., 2025). These theories generally explain how the designed communication strategy can influence behavioral change. However, Grunig and Hunt (1984) stated that the most important thing in environmental communication is to create a symmetrical two-way communication model that leads to a dialogical process to achieve mutual understanding between stakeholders.

The theory of communication models is based on how information flows. If the flow of information only flows from the sender to the recipient, then it can be called a one-way communication model (Lähtinen et al., 2017). Meanwhile, the two-way communication model involves interaction between both parties and allows for a more proactive approach (Crane & Livesey, 2017). Two-way communication is divided into two categories based on how the response occurs: symmetrical and asymmetrical (Grunig, 1984). Two-way symmetrical communication is characterized by a commitment to listen and respond to stakeholders (Kang & Park, 2017), while in two-way asymmetrical communication, the sender listens to the stakeholders' views but does not make appropriate changes (Roper, 2005; Grunig, 1984). Grunig and Hunt (1984) stated that the two-way symmetrical model is the most effective, focusing on mutual understanding and not one-way persuasion.

The one-way communication model widely used in environmental campaigns is effective only in the short term. It relies on cognitive science, rhetoric, and psychology, but fails to understand the broader context for large-scale social change (Brulle, 2010). The one-way communication model has the disadvantage of a lack of interaction between the sender and the recipient, so the recipient's information needs may not be met. They will not be known, especially if the parties in environmental management conflict with each other.

In environmental communication, the convergence communication model developed by Kincaid (1979) can explain well how two-way communication can more effectively build perceptions and change behavior to preserve the environment (Cangara, 2013; Flor & Cangara, 2018). Dialogue increases community participation in realizing democratic development (Brulle, 2010). A proactive approach can help find solutions to environmental problems that often involve complex needs from various stakeholders. However, one-way and two-way communication designs cannot be separated because, in a broader view and as the communication process progresses, one-way communication may be part of a two-way communication model (Wilkes-Allemann et al., 2021).

Effectiveness of Communication Strategy

Communication effectiveness has been conceived in several literatures, referring to the extent to which communication processes accomplish the intended goals and involve mutual understanding (Sheep, 2018; Zhao et al., 2022; Shvelidze et al., 2024). In the case of environmental communication, the intended purpose can be to influence attitudes and behavior (Ricart et al., 2025; Richter et al., 2025). Drawing upon classical models such as Lasswell (1948), "who says what, to whom, through what channels, and what effect", effectiveness can be seen by evaluating whether communicators, messages, channels, audiences, and impacts are aligned to create valuable change (Table 1) (Lasswell, 1948; Halcovitch & Thibodeau, 2020; Wilkes-Allemann et al., 2021). This understanding is consistent with the convergence communication model (Kincaid, 1979) and symmetrical two-way communication (Grunig & Hunt, 1984), which highlight mutual understanding, shared interpretation, and participation among stakeholders.

Table 1. The indicator of effective communication in each element

Elements	Effectiveness indicator
Sender	Credibility (Kumar et al., 2023) Communication skills (Jurin et al., 2010)
Recipient	Socio-cultural and economic characteristics (Lindell & Perry, 2003
Message	Messages are clear, relevant, and tailored to the audience (Zhou et al., 2022)

Channel	Appropriate channels and tools that resonate with the audience (Shvelidze et al., 2024)
Impact	The changes in audience awareness, attitude, and behavior (Ricart et al., 2025; Richter et al., 2025)

First, the message sender is the party delivering the message, which can be seen from whether they have credibility (Kumar et al., 2023) and communication skills (Jurin et al., 2010). *Second*, the message recipient or target audience. Understanding message recipients' social, cultural, and economic characteristics is essential in designing communication strategies (Lindell & Perry, 2003). Cognitive response theory explains that the effectiveness of persuasive messages depends on the thoughts, opinions, or internal responses that arise from the individual receiving the message (Greenwald, 1968).

Message recipients are not always passive but actively process, evaluate, and interpret messages based on their experiences, values, and attitudes (Agusdinata et al., 2024). Message recipients can provide positive responses (support the message), negative responses (reject the message), or neutral responses (do not change their attitude). Thus, understanding the message recipients is valuable for understanding the initial attitudes and perceptions of the audience to develop messages and channels that are appropriate to the audience's characteristics.

Third, message elements relate to communication content designed accurately and relevant to the audience Zhou et al., 2022. Framing theory explains how a message is constructed and influences the audience to understand, interpret, and respond to the message (Goffman, 1974; Cai et al., 2024). This theory shows that communication is done by directing the audience's thinking by selecting specific points of view, words, narratives, or images that emphasize specific issues and ignore other issues (Canto et al., 2023). In environmental communication, framing theory can be the basis for designing messages to be relevant to the target audience; for example, the message "reducing plastic waste will be beneficial for health and the environment" will be suitable for the general public, but the message "developing a circular economy from recycling plastic waste into new economic opportunities" is more suitable for business people (Canto et al., 2023). Thus, message framing in environmental communication is not only to increase audience understanding but also to direct the audience to provide positive responses and actions.

Fourth, the selection of channels is related to the type of media/tools used to convey the message (Shvelidze et al., 2024). There are various types of communication channels, namely: (1) interpersonal/face-to-face communication, this channel is characterized by direct and interactive communication, allowing for direct discussion and feedback (Stevic et al., 2021); (2) mass communication channels, which are characterized by the use of media that reach a broad audience and are often one-way, such as television, radio, newspapers, posters. This channel can quickly spread messages to the broader community (Turow, 2019); (3) Digital communication channels or internet use, such as websites, blogs, social media, videos, and podcasts. Like mass communication channels that aim to spread messages with a broad and fast reach, but these channels still allow for audience feedback and participation (Kovaitė et al., 2020); (4) symbolic and cultural communication channels, characterized by the use of culture, art, and tradition as a communication medium, for example, mural or graffiti art, folk theater, or traditional rituals. This communication is more readily accepted because it is under the local community's values (Hartley, 2012).

Fifth, the impact is related to the evaluation of increased awareness, attitude, and behavior changes seen by the message recipient (Zhao et al., 2022; Shvelidze et al., 2024). Evaluation of the impact and feedback from the message's recipient is significant for improving future communication strategies. Evaluation of the impact can be seen from several aspects: understanding (cognitive impact), attitudes and opinions (affective impact), and actions or behavior (behavioral impact) (Ricart et al., 2025). This paper analyzes the extent to which changes in knowledge, attitudes, and behavior of people on the coast of Muara Gembong have occurred after receiving messages about mangrove rehabilitation. This analysis will be beneficial for providing insight into future communication approaches.

Material and Methodology

This research was conducted in Muara Gembong District, Bekasi Regency, West Java, Indonesia. Muara Gembong District has an extensive mangrove ecosystem spread across several areas. Several studies have shown a significant decrease in mangrove areas since the 1970s, but have also experienced an increase in area in the last decade due to various mangrove rehabilitation programs/activities (Nugraha, 2018; Maulani et al., 2021). Therefore, it is important to analyze how environmental communication contributes to increasing the area of mangrove land. This research was conducted during March-December 2023. Data collection in the field was carried out in July and October 2023.

Mixed methods (quantitative and qualitative) were used to collect the required information. Data collection techniques include: (1) a literature study; (2) structured interviews; (3) in-depth interviews, and (4) observation. Informants interviewed in depth were selected intentionally (purposive), i.e., the determination of informants based on specific characteristics, in this case, people with expertise/work related to the issue being studied. Informants include government, private sector, civil society organizations (CSOs), media/journalists, and academics who focus on the issue/scope of mangrove ecosystem rehabilitation. Meanwhile, respondents in structured interviews were selected through simple random sampling techniques and selected from the community living in the coastal area of Muara Gembong District. Respondents selected 54 people from coastal communities in Muara Gembong who had been involved in mangrove rehabilitation communication activities.

Quantitative data were processed using Microsoft Excel and SPSS. Descriptive analysis is presented in graphs and tables, and multiple regression analysis was carried out to identify factors related to the effectiveness of environmental communication. Qualitative data were analyzed through the following stages (Schutt, 2018): (1) documentation; (2) conceptualization, coding, and categorization; (3) analysis of relationships and data presentation; (4) drawing conclusions and reflection.

Result and Discussion

Study Site and Community Profile

Muara Gembong District, Bekasi Regency, with an area of 166.7 km2, is located in the northern coastal area of Java Island. Located between 1-4 meters above sea level, with an average area consisting of land. This district consists of six villages, namely Pantai Harapan Jaya (52.04 km2), Pantai Mekar (15.32 km2), Pantai Sederhana (13.08 km2), Pantai Bakti (36.2 km2), Pantai Bahagia (31.65 km2), and Jayasakti (18.41 km2) (BPS, 2022). The distance of Muara Gembong District from the center of Bekasi Regency is ± 70 km. With a relatively long distance from the business and government centers, Muara Gembong District still faces infrastructure limitations; namely, only 50% of the road infrastructure is well served, as well as inadequate waste, drainage, clean water, and telecommunications infrastructure (Nastiti et al., 2019).

The coastal area of Muara Gembong is a downstream area of the Citarum River Basin (DAS), which is affected by industrial and household waste (Suryono et al., 2021). The Muara Gembong community is highly dependent on natural resources for its livelihood. As many as 49.85% of the population in Muara Gembong work as fish farmers and fishermen. Some people also farm in rice fields in coastal areas, and some provide sea and river transportation services due to the land route being cut off due to abrasion (Asyiawati & Akliyah, 2014). Unfortunately, the community faces livelihood vulnerabilities due to damage to mangroves and water ecosystems. Degradation of the mangrove ecosystem can reduce the quality and carrying capacity of the environment, which has an impact on pond productivity (Nugraha, 2018), while the accumulation of garbage and waste also causes fish deaths and reduced fish stocks (BRPSDI, 2018), as well as increased production costs because fishermen have to go to sea to further places (Saepulloh & Syam, 2019).

These environmental problems are interrelated with other problems, namely poor sanitation, poverty, and low education. Abrasion that worsens the damage to road infrastructure can endanger road users. In addition, when the sea water rises, children are cut off from access to the road to school, so many children in Muara Gembong drop out of school (Ahnanto et al., 2014). Low education makes awareness of environmental health minimal (Aziz et al., 2017). The poverty experienced by the

community causes them to have no other choice but to move, so in the end, the quality of life of the community becomes low.

Mangrove Changes in Muara Gembong

Nugraha (2018) showed from Landsat imagery that there was a significant decrease in the area of mangrove forests of around 55% over 42 years (from 1,829.88 ha in 1976 to 825.93 ha in 2018), with an average rate of decline of around 23 ha/year. From 1998 to 2008, there was a slight increase of 2.6%, but it was not enough to restore the function of the mangrove ecosystem in Muara Gembong. Meanwhile, the Study (Maulani et al., 2021) completes the analysis of changes in the mangrove area in Muara Gembong in the period 2009-2019, which shows that there was an increase in area of 1,017.75 ha (66%) and a decrease in area of 275.37 ha. In addition, mangrove areas remained unchanged from 2009 to 2019, covering an area of 255,057 ha.

From the results of the analysis of coastline changes, three villages in Muara Gembong experienced the most severe abrasion, namely Pantai Bahagia Village (-15.46 meters/year), Pantai Sederhana (-5.86 meters/year), and Pantai Bakti (-3.76 meters/year) (Nugraha, 2018). Coastal abrasion has caused part of the Pantai Bahagia Village (1,034 ha or 32.7% of the village area) and Pantai Bakti Village (579 ha or 16% of the village area) to sink (Wibisono, 2022). As a result of coastal abrasion, people have lost their homes and access to education, and the impact has spread to a decline in the economy and psychological shocks (Ahmad, 2017).

Several driving factors have reduced mangrove areas in Muara Gembong, including land conversion into ponds, rice fields, gardens, and settlements (Suryono et al., 2021). Land conversion into ponds has been the main factor causing mangrove damage since the 1970s, when the pond area increased by 31% (3,461.76 ha in 1976 to 4,521.24 ha in 2018) (Nugraha, 2018). The opening of ponds was not only by local people but also by immigrants who saw the high potential of the pond business (Maulani et al., 2021).

The state's economic policy at that time encouraged the exploration and exploitation of natural resources, including encouraging increased productivity of aquaculture. All those driving factors led to a change in the status of mangrove land use from production forests, as stated in Bekasi Regency Regional Regulation No. 12/2011 concerning the Bekasi Regency Spatial Planning Plan for 2011-2031. On the other hand, various mangrove rehabilitation programs and activities have contributed to a significant increase in mangrove area in the period 2009-2019 (Maulani et al., 2021), including (1) ecotourism development in Pantai Bakti Village and (2) ecotourism development in Pantai Mekar Village on the initiative of Perhutani's collaboration with PT. Pertamina EP Asset Tambun Field. During the data collection of this research, a company also ran a mangrove planting program in Muara Gembong District, namely PT Nippisun, which planted 5,000 mangrove seeds on October 14, 2023.

Environmental Communication Strategy in Mangrove Rehabilitation

This study shows that various stakeholders initiate education programs/activities and increase awareness of mangrove rehabilitation in Muara Gembong District, including (1) Government (Ministry of Agriculture, West Java Provincial Government, Bekasi Regency Government, Office, Provincial BPDAS, Navy, and Bahagia Village Government); (2) Civil Society Organizations/CSOs (*Rumah Laut Mekar, Kapera, KIH Bakti Pesisir Hijoh*, Mangrove Activist Community/*Komunitas Pegiat Mangrove*); (3) Private (PT Patria, CV Trindo, Lippo Group, Epson, Pertamina); and (4) Academics (IPB, Unisma, Trisakti, University of Indonesia, Undip, UNJ, Bhayangkara University, SMA).

Figure 1 shows that respondents have received messages about mangrove conservation/rehabilitation from CSOs and academics, respectively, as many as 39.6 percent, the government (37.7%), the private sector (26.4%), and the mass media (9.4%). Of the sources/message senders that respondents have received, the source/message sender that respondents most remember is CSOs (30.2%).

Figure 1: Percentage of respondents by the source of the message they received

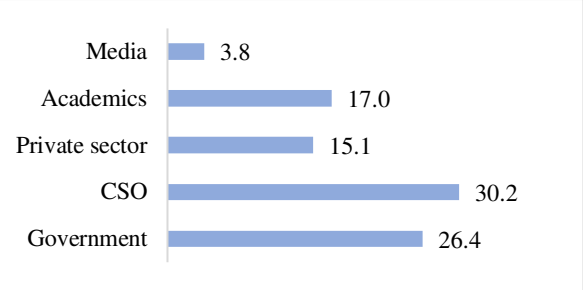

Figure 2: Percentage of respondents by most remembered message source

Each party uses a different communication strategy in delivering the mangrove rehabilitation message (Table 2). Of the five message senders, the Mangrove Activist Community/*Komunitas Pegiat Mangrove* (KPM) uses a more varied strategy. KPM delivers messages in a combination model: two-way through indoor and outdoor face-to-face meetings. The messages delivered by KPM are persuasive. KPM uses audiovisual, visual, and text media in indoor socialization activities. In addition, KPM also utilizes telephone networks and WhatsApp to communicate with the community. In this case, KPM has had closeness to the community to develop interpersonal communication.

Table 2. Communication strategies used by message senders

Sender	Communication model	Message characteristic		Receiver	Channel
		Media	Purpose		
Bekasi Regency Government	Two-way	Audiovisual	Persuasive	Community (adult)	Face-to-face (indoor meeting)
Village Government	Two-way	Audiovisual	Persuasive	Community (adult)	Face-to-face (indoor meeting), written (formal letter)
CSO (*Komunitas Pegiat Mangrove*/ Mangrove Activist Community)	Combination	Audiovisual, visual, text	Persuasive	Community (adult, youth)	Face-to-face (indoor meeting; outdoor meeting); personal network (phone, WhatsApp)
Private Sector	Two-way	Visual, text	Informative	Community (adult)	Face-to-face (indoor meeting), print media (brochure, poster)
Scholar	Two-way	Audiovisual	Persuasive	Community (adult)	Face-to-face (indoor meeting)

The government and academics developed the same communication strategy: two-way communication through indoor face-to-face meetings. Meanwhile, the Village Government carried out socialization and mangrove planting activities in collaboration with the private sector. The Village Government and Academics used audiovisual messages to persuade targets through images and videos displayed during presentations. The private sector also used a two-way communication strategy: informative messages through face-to-face meetings, visual media, and texts in brochures and posters. The four message senders who utilized two-way communication, as shown in Table 2, also opened up space for participant feedback by opening a dialogue.

Half of the respondents in this study stated that they could participate actively, and half participated passively, namely, only listening to messages from the sender (Figure 3). Most respondents who could participate actively conveyed other information/knowledge that the sender had not discussed (44.4%). The rest, as many as 25.9 percent of respondents, conveyed statements of disagreement with the sender's message, 14.8 percent statements of agreement/strengthening, and 14.8 percent of other categories (Figure 4).

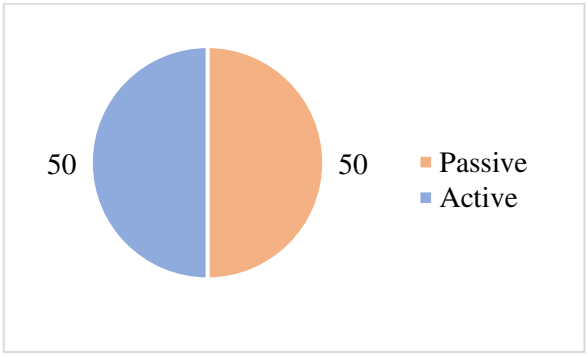

Figure 3. Percentage of respondents by participation in dialogue

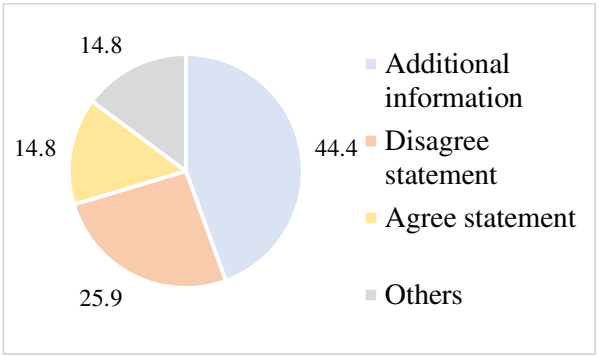

Figure 4. Percentage of respondents by type of opinion in the dialogue

The effects resulting from the ongoing communication process vary. This study measures the effects of communication from changes in knowledge, understanding, awareness, and action in mangrove rehabilitation. The results of this study show that in terms of knowledge and understanding, most respondents stated that they experienced a sufficient increase in knowledge (41.5%) and could understand the importance of mangrove rehabilitation (38.5%). Regarding awareness, most respondents were motivated to conduct mangrove rehabilitation (43.4%). Meanwhile, in terms of action, 30.2 percent of respondents stated that they had built collective action for mangrove rehabilitation, the remaining 28.3 percent carried out mangrove planting initiated by other parties, 18.8 percent carried out mangrove planting themselves, and 22.6 percent did not take any action (Figure 8).

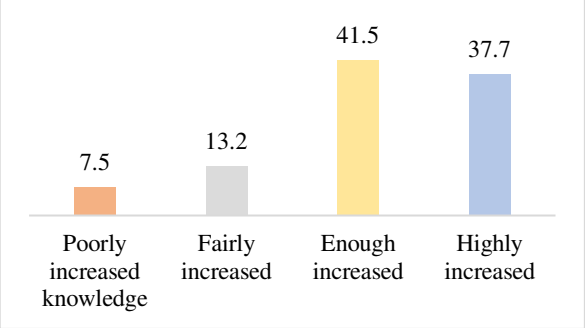

Figure 5. Respondents' knowledge after receiving mangrove rehabilitation messages

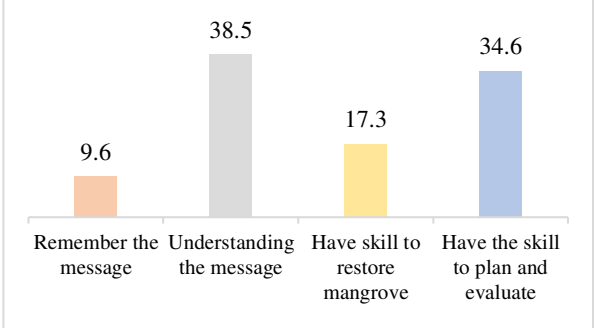

Figure 6. Respondents' understanding after receiving the mangrove rehabilitation message

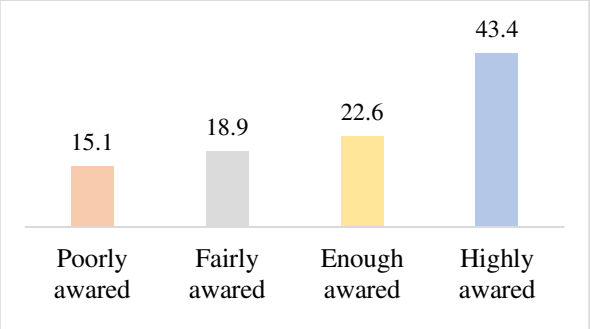

Figure 7. Respondent's awareness after receiving mangrove rehabilitation messages

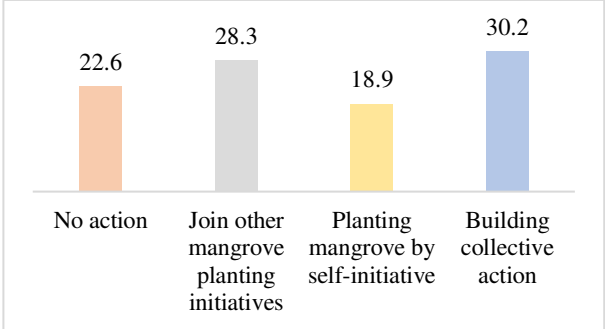

Figure 8. Respondents' actions after receiving the mangrove rehabilitation message

Since the environmental communication and mangrove rehabilitation programs, the community has initiated mangrove planting activities by themselves and other parties. The study by Maulani et al. (2021) shows a significant increase in the area of mangroves in Muara Gembong from 2009 to 2019,

reaching 66%. Unfortunately, there has been no stakeholder collaboration in implementing environmental communication programs. From the regression test results, the coefficient of determination/R R-squared value is 0.47, which means that changes in knowledge, awareness, and behavior of respondents can be explained by communication factors as much as 47%; factors outside of communication explain the rest.

Based on interviews with several informants, other factors driving changes in community behavior include the following: First, the high threat of mangrove ecosystem degradation has caused community vulnerability. The damage to mangrove land since the 1970s has caused serious vulnerability, even though the community depends on coastal resources to meet their daily needs. The community is aware of the degradation of mangrove impact, which drives the community to participate in mangrove rehabilitation. Second, there is technical assistance in the form of mangrove seeds from various parties.

Communication Elements and Effectiveness of Environmental Communication

The two-way communication model is more widely used by CSOs, the government, and academics to disseminate mangrove rehabilitation messages in Muara Gembong. This two-way communication model inspires the community to interpret the environment not only as an object to fulfill their economic and personal needs but also to foster an attitude of altruism to contribute to environmental sustainability (Hadiprashada et al., 2019). Of the three parties that utilize the two-way communication model, the two-way communication carried out by KPM occurs continuously. In contrast, the Government and Academics conduct communication activities less frequently. In addition to the communication model, communication elements are also important factors that determine the success of environmental communication, including factors of sender, message, channel, and recipient, as well as impact and evaluation.

Sender Factor

The sender element is the most decisive influence on the effectiveness of communication in the findings of this study (P-value = 0.039 at the 5% level). An important aspect that the message's sender needs to have is credibility. Communities tend to rely on the credibility of sources to evaluate information before making decisions, especially when they lack knowledge about environmental issues (Zhang & Skoric, 2020). Source credibility can consist of two main aspects, namely expertise and trustworthiness (Borah & Xiao, 2018). Among the message senders, KPM is the party that often carries out environmental communication compared to other stakeholders.

Most respondents stated that the message sender has expertise appropriate for mangrove rehabilitation (62.3% appropriate and 26.4% very appropriate). Although CSOs do not have as much professional education as the government, private sector, and academics, respondents considered that KPM has knowledge and skills relevant to mangrove rehabilitation. Key actors in CSOs have participated in various capacity-building training sessions related to mangrove rehabilitation. In addition, KPM, which was formed on the initiative of local actors, also has a close relationship with the community. Intense closeness is an important factor in increasing the effectiveness of communication. Because of the close relationship, CSOs not only build formal communication but also informal communication.

Message Factors

The presentation of messages in various modes is an important factor in influencing the audience's ability to process information (Zhang & Skoric, 2020). Paivio's study (2013) shows that specific message modes are processed by different cognitive subsistences, resulting in different memory abilities. For example, a graphical presentation will make statistical information easier to remember than other modes (Griffin & Stevenson, 1996). Meanwhile, images or photos are practical tools for telling stories and environmental information visually (Abdullah et al., 2014), so they can influence the emotions and perceptions of the audience (Thatcher et al., 2019).

In mangrove rehabilitation communication in Muara Gembong, 82.8% of messages were delivered in audiovisual form, 13.8% in visual form, and 3.4% in text form. This study shows that the message factor does not significantly affect communication effectiveness (P Value = 0.119 at the 5% level), considering that the form of messages the sender delivers tends to be homogeneous.

Audiovisual messages are preferred by senders because, currently, more persuasive messages are delivered. Informants stated that the community has gradually experienced an increase in knowledge and awareness of the importance of mangrove rehabilitation since the beginning of the development of various environmental communication programs. Thus, persuasive communication is the primary focus of message senders, considering the level of mangrove damage in the Muara Gembong area is very severe.

Channel Factors

Effective communication depends on how both parties can access and use the communication channels (Hallerberg et al., 2018). This study shows that most mangrove rehabilitation messages are delivered face-to-face (94.2%), the remaining 3.8 percent through network channels, and 1.9 percent through written channels. Although digital technology has rapidly increased in recent decades in environmental campaigns because it can reach a wider audience at a relatively lower cost (Zhang & Skoric, 2020), this is unsuitable for implementation in Muara Gembong. Face-to-face communication is most appropriate in Muara Gembong due to the lack of telecommunications and digital infrastructure. In addition, the poorly educated communities tend to have low digital literacy. Thus, in this study, the communication channel did not significantly affect communication effectiveness (P Value = 0.717 at the 5% level).

Face-to-face communication has several advantages. Through face-to-face communication, speakers can utilize visual cues from the audience to get quick feedback and make adjustments immediately (Storper & Venables, 2004). Visual cues and the participation of the communicants in face-to-face dialogue help communicators understand each other's backgrounds, skills, and experiences (Hömke, 2019). Observing the listener's cues is important because people usually focus on evaluating the person who is speaking (Holler & Kendrick, 2015). These cues can build trust in groups that interact face-to-face (Storper & Venables, 2004). Face-to-face communication is also more effective in building community learning processes (Battiston et al., 2021), as developed by KPM.

The mangrove rehabilitation communication built by KPM includes continuous face-to-face communication in groups (group discussion activities) and continuous interpersonal face-to-face communication. KPM uses these two strategies to build a grassroots movement in mangrove rehabilitation. Through interpersonal communication, information and ideas are exchanged between the parties involved in the communication process. Intense interaction is not found in communication carried out by the Government and Academics. Although the Government and Academics also use face-to-face channels, the frequency is less than that of KPM. Several respondents stated that the asymmetrical relationship between the sender and the recipient also caused feedback not to be delivered optimally.

Recipient Factors

Identifying the characteristics of the message recipient, including demographic characteristics, social context, personality, interests, and concerns, is important in determining communication strategies (Rice & Atkin, 2012). Understanding the characteristics of the recipient can increase the effectiveness of message delivery by determining the priority of the target audience according to the communication objectives. It will also help communicators determine the message content, form, and channels appropriate for the target group (Wilkes-Allemann et al., 2021). Respondents who received the mangrove rehabilitation message in this study came from various livelihood groups: fishers, fish cultivators, small-scale traders, and housewives. Respondents had varying educational backgrounds, namely elementary school graduates (26.4%), junior high school graduates (32.1%), high school graduates (22.6%), diploma graduates (1.9%), and bachelor's degree graduates (17.0%).

This study shows that recipient factors significantly affect communication effectiveness (P Value = 0.049 at the 5% level). The attribute that has the most decisive influence is work background (P Value = 0.008 at the 5% level), where housewives show the most significant impact on changes in knowledge, awareness, and behavior. From the perspective of ecofeminism, which combines feminist and ecological perspectives, women are intrinsically attached to nature (Shiva & Mies, 2014). Since its introduction in 1974 by the book Le Féminisme ou La Mort, environmental and social movements led by women have emerged (Saave, 2022). Likewise, in the mangrove rehabilitation agenda in Muara

Gembong, women who are members of KPM can lead environmental conservation. KPM focuses explicitly on women and youth as target recipients of information because both are considered strategic development agents. According to informants, informal interpersonal communication is more widely used to target these two groups. KPM uses personal closeness to mobilize women and youth to get involved in mangrove rehabilitation.

Impact and Evaluation

Evaluation is needed to assess the effectiveness of the communication strategy developed and refine the future environmental communication agenda. Although the sender has carried out careful communication planning, the target audience's level of acceptance of the message can vary depending on various factors, so evaluating the communication strategy remains essential (Wilkes-Allemann et al., 2021). The sender can assess how the communication strategy developed can increase knowledge, understanding, and awareness, ultimately encouraging changes in environmental conservation behavior (Nishio, 2010). It also allows the sender to improve communication skills and strengthen relationships with the audience. Evaluation requires a willingness and listening skills so the sender can learn to improve communication effectiveness (Hömke, 2019).

Communication evaluation includes before, during, and after the communication process. (O'Neil, 2017) mentions that the elements of communication that need to be the focus of evaluation are the sender, message, channel, recipient (including the recipient's values, views, and background), noise, and environmental context. This study shows that not all message senders evaluate communication strategies.

Conclusion

Environmental communication conducted by various stakeholders has supported the mangrove rehabilitation agenda in Muara Gembong. The community showed significant knowledge, understanding, awareness, and behavior changes. The communication factors that influenced these changes were the sender and recipient factors. Meanwhile, the message and channel factors did not have a significant effect because the characteristics of the messages and channels used by the message sender were homogeneous. This study shows that in carrying out persuasive communication, the two-way communication model is effective in fostering an attitude of altruism to preserve the environment. Face-to-face channels are still the most appropriate choice amidst the massive development of digital technology for target audiences with limited access to digital infrastructure and low literacy.

Unfortunately, the effectiveness of the communication strategy developed has not been accompanied by integrating the strategies of each message sender stakeholder. Thus, there is no room for sharing experiences and learning in developing a mangrove rehabilitation communication strategy in Muara Gembong. In addition, each message sender has not evaluated the implemented communication strategy. Evaluation is important for improving and creating sustainable communication to achieve the expected impact. This finding encourages stakeholders to carry out mature communication strategy planning and evaluate the communication process after the communication takes place. Furthermore, communication experts must provide a more comprehensive perspective on developing environmental communication strategies.

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