Development Communication Role in Natural Resources and Environmental Management Adaptive to Climate Change

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Abstract. The weakness of natural resources and environmental management at the household level in peri-urban communities has significantly impacted domestic waste problems. These impacts include flooding, pollution, and housing microclimates. Peri-urban communities need an appropriate development communication model to empower communities to manage household waste, primarily to address the impacts of climate change on environmental problems. Risk communication in the form of an interactive process of exchanging information and opinions among individuals, groups, and institutions is considered appropriate for managing environmental issues. This research aims to develop a development communication model for overcoming the effects of climate change, especially household waste and its impacts. This research method uses the Participatory Rural Communication Appraisal (PRCA) technique by placing researchers who live with the community during the study period to empower the community. The research location was Kebalen Village, Bekasi Regency, West Java, a peri-urban community facing the risk of flooding, pollution, and housing microclimate problems. The results showed that the participatory and convergent risk communication model changed community behaviour. There was a change in the awareness and behaviour of the community from leaving waste to external waste managers to managing waste independently, which is beneficial for social, economic, environmental, and SDGs achievement.

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1 Introduction

Domestic waste in urban areas is one of the critical problems in the era of the climate crisis. This problem is reflected in river pollution and flooding during the rainy season, especially in coastal areas that experience rising water levels or tidal flooding (Rob). In 2020, Indonesia produced 67.8 million tons and is predicted to increase by 4.4% in 2025 to 70.8 million tons. In 2021, there was 34.64% of unmanaged waste or around 9.65 million tons, and the contribution of domestic waste was 40.8%. Household waste is estimated to be a severe challenge in achieving the SDGs target until 2030.

In Indonesia, waste management still relies on the end of the pipe system; 69% of waste is concentrated in Final Disposal Sites (TPA), 12% recycled, 8% composted, 4% waste banks, 3% fuel (biogas), and others 4 % (KLHK 2019). This pattern is considered ineffective and requires the role of the household to manage waste while improving the living environment and microclimate around the home.

Households are the primary producers of domestic waste, which is reflected in the increase in the quantity of garbage that is positively correlated with an increase in population (Mulasari and Sulistyawati, 2014). Things that contribute to the identified waste problems include people's behaviour in disposing of waste and waste management technology that still needs to be appropriate and effective.

Babelan Bekasi sub-district is a sub-district bordering the North Coast, and Kebalen Village is one of the villages in the sub-district area. Several villages in this sub-district face the threat of climate crisis risk through rising sea levels. The research location is not affected directly by increasing sea level but indirectly because the sea-level rise on the Coastal Coast hinders water flow. On the other hand, the threat of flooding due to piles of garbage in the river flow from the city also restricts water flow to the beach. The research location faces two risks: flooding from upstream due to piles of garbage due to ineffective waste management and obstacles to water flow to the North Coast of West Java sea estuary.

Sea level rise reaches inundation 300 meters inland or 6-10 mm/year [1]. The rate of sea-level rise has been as high as 8 cm over the last ten years. The impacts of climate change have even inundated the community's residential areas, but the community's responses have varied. Some are indifferent, most react after being affected, others are proactive, and some are anticipatory. This shows that public awareness still needs to improve, apparently due to the ineffective communication of risks to the impacts of the climate.

From initial observations, related parties need a practical communication problem to build public awareness of the climate crisis. In theory, the development of appropriate risk communication has the potential to overcome the impact of the climate crisis, especially related to the causes of flooding by domestic waste. A proper risk communication strategy is needed to anticipate the further effects of the climate crisis.

The government's concern can be seen in regulations related to waste management and the climate crisis. The government has issued law number 18 of 2008 concerning Waste Management. In addition, there have also been derivative regulations regarding Household Waste Management contained in Government Regulation No. 81 of 2012. Presidential Decree No. 81 has been published—97 of 2017 concerning National Policies and Strategies for the Management of Household and Other Domestic Waste. Even more operational, there has been a Regulation of the Minister of Environment and Forestry No. 14 of 2021. Still, it has not had a tangible impact on the problem of handling waste, especially domestic waste.

It is interesting to study how to develop an appropriate development

communication model in environmental management to overcome the risks of the climate crisis, especially household waste and flood risk, pollution, and housing microclimate problems. Risk communication is considered appropriate in environmental management through community empowerment by utilizing waste for ecological improvement. Various journals mention that risk communication can be one of the potential alternative solutions to anticipate the impact of the current and future climate crisis.

Development communication is a two-way process of information dissemination and dialogue among stakeholders. Development communication is an environmental management tool to help assess risks and opportunities for environmental, social, and economic crises [2]–[5]. Servaes (2020) emphasizes the importance of adapting to the dynamics of ecological change so that people are ready to face changes in the social, economic, and technological fields [6]. Hemer and Tufte (2006) showed that with suitable risk communication methods, all of the above can be achieved [7]. In the context of empowerment [8], [9], the participatory communication paradigm that promotes dialogue impacts mutual understanding, mutual agreement, and collective action among participants according to their respective portions.

Development communication aims to build consensus by sharing knowledge for positive change initiatives in development. Development communication is a two-way process of sharing ideas and expertise using various communication tools and approaches that empower individuals and communities to take action to improve their lives ([10], [11]. Participatory development communication refers to using mass media and traditional interpersonal communication that empower communities to take responsibility for their development [6], [8], [12].

Risk communication is often mixed with crisis communication; in this study, risk communication is interpreted as crisis communication. Crisis communication is a dialogue process between various parties related to crises that occur in public, which is carried out to overcome the current crisis. In this case, a communication strategy is needed to overcome threatening emergencies. A situation is different from everyday problems. A concern is a big problem that hurts people's lives, but if the trouble can be handled properly, it will be positive for people's lives. Crises often become public attention and media coverage that sometimes affects people's lives in politics, law, and government.

Some of the cases that are the basis of thinking in this study can be described as follows. In the case of COVID-19 in Wuhan, China, applying appropriate risk communication in community empowerment can reduce the risk of COVID-19 [13]. Using risk communication in reducing greenhouse gas emissions to overcome the impacts of climate change [14]. Accessibility and information disclosure about the risk of the impact of COVID-19 can be improved by forming convergence in the risk communication process, especially related to existing uncertainties. The risk communication model in the form of collaborative networks between parties effectively empowers the community to overcome the risk of the COVID-19 outbreak. The parties involved in handling the outbreak are the government, experts, and the public. Their respective roles and responsibilities in community empowerment to overcome the impact of COVID-19, especially in China, the Government is the leading actor. Three principles can be learned in improving the effectiveness of risk communication through community empowerment in Wuhan, namely: (1) Communication to overcome public health emergencies, (2) Three main factors that play an essential role: the government, experts and the community, (3) The synergistic network of the three actors in the risk communication process of managing the impact of the Covid 19 outbreak. Risk communication uses an interactive communication model that produces an understanding of risk communication strategies and principles. In simple terms, it can be seen in the following Figure 1.

In the case of Wuhan, local government decision-making and limited information caused the handling of COVID-19 to be ineffective. Still, after establishing a risk communication timeline and focusing on messages to identify problems and their causes objectively, it turned out to be significant progress. The communication process becomes effective when it is carried out by integrating accessibility and openness about risk information, timing, and intensity of communication related to the uncertainty of crises.

As a process, dynamic, interactive, and adaptive communication or following media access to information by related parties becomes effective risk communication [15]. Policies on risk management form the basis of risk communication and are communicated adaptively. Risk uncertainty must be considered, and the delivery of risk information should be designed to be culturally adaptive, particularly the suitability of features to the audience. Collaboration between related parties is carried out openly, inclusively, and deliberately by prioritizing the dialogue process in risk communication. The importance of objectivity (honesty) risks and is delivered frankly, objectively, and adaptively. The public can receive messages about honest and open risk information through various accessible message channels. Here, the importance of collaboration and coordination with credible sources of information about risks through information sharing and networking between agencies and related parties.

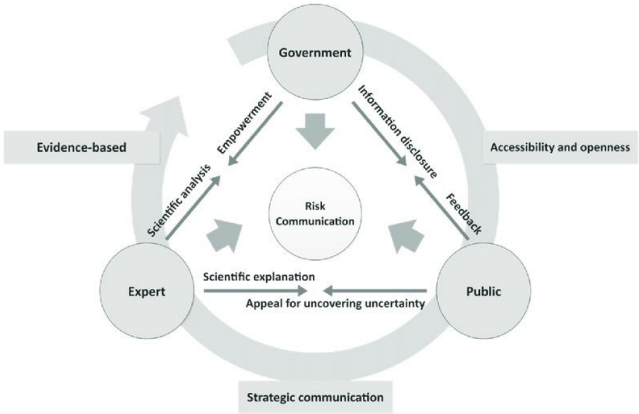

Fig 1. Government-Expert-Public Risk Communication Model

In the case of risk communication, in dealing with the climate crisis and disaster events, Indonesia faces risks, including rising sea levels, flooding, and air pollutants [14]. Efforts to reduce the rate of greenhouse gas emissions require risk communication. Still, the risk communication process between parties has yet to be effectively integrated, so a more precise risk communication model is needed.

Zhong et al. (2021) raised the issue of risk communication in floods, and this study emphasizes the importance of early warning against flood risk through social media, mass media, sirens, and the internet [16]. Each type of media has different specifications and accuracy for flood warnings. Communication between neighbours in a community plays a vital role in disaster early warning. Risk communication is interpreted as exchanging related information about environmental risks and knowledge about the dangers of the threat of flooding. Effective communication affects trust, cooperation, and various threats of disaster risk. Intense contact with neighbours, such as in suburban communities, is higher than in urban areas. Effective risk communication raises awareness about the level of disaster hazard losses and increases community participation in disaster hazard

reduction. People who ignore the early warning of disaster hazards show a weak dimension of community resilience. Social communication between close neighbours dramatically influences people's attitudes and behaviour toward disaster warnings and mitigation actions. Variables significantly affecting change in community behaviour are ethnicity, residence ownership, and trust in the accuracy of disaster risk information.

Based on the reference to risk communication that has been described, it is interesting to explore the following points as the main findings of this study: (1) Risk communication model in environmental communication in dealing with the impact of the climate crisis, (2) Risk communication paradigm, and (3) The role of various parties in risk communication through community empowerment efforts.

2 Methods

This study uses the Participatory Rural Communication Appraisal (PRCA) method; researchers live with the community at the research location during the pre-, process and post-risk communication development. A triangulation cybernetic approach is applied to obtain factual information and data in the field. Technically, participating in observations and in-depth interviews with figures considered to understand and are involved in disaster mitigation efforts, the impact of weak domestic waste management is carried out. In addition, FGDs were also conducted involving informal village officials at the RT/RW level. PRCA obtained factual and actual information, community understanding of disaster risk and its management, and perceptions and critical knowledge of analysis before and after intervention programs for empowerment and development of risk communication networks. Various key informants revealed the impact of the empowerment program on community participation and the functioning of collaborative networks in dealing with the risk of flooding and air pollution as well as the micro-climate of the home environment, as well as the decision-making process in planning, implementing, and monitoring the evaluation of the results and benefits of community empowerment. From several previous studies, the PRCA method has shown advantages as a research method, namely, the information obtained is objective, actual, and in-depth [3]–[6], [17], [18]. The research location was chosen in Kebalen Village, Bekasi Regency, West Java, considering that in that village, the risk of flooding is still found and is in the process of empowering the community to overcome this risk.

3 Result

As the problem raised in this study, the research objective is to develop a communication model for community empowerment in overcoming the impact of household waste in the form of flooding, pollution, and housing microclimate by utilizing waste for environmental improvement. Specifically analyzing (1) the condition of household waste and the risk of the climate crisis, (2) the Risk communication model in environmental communication in dealing with the impact of the climate crisis, (3) the Risk communication paradigm, and (4) The role of various parties in risk communication through community empowerment efforts.

3.1 The Condition of Household Waste and The Risk of The Climate Crisis

At the research location, initially, waste management relied on the end of the pipe system, where more than 90% of the waste was concentrated in the Final Disposal Site

(TPA); there was no recycling process, composting, and few households managed a waste bank, no biopic and other efforts. As a result, garbage scattered in residential garbage disposals causes an unpleasant smell, smoke from burning garbage flies that have the potential to spread germs, and in ditches and rivers, there are piles of garbage.

This condition is related to the gap in the management of the impact of household waste. At the research location, four aspects cause waste problems in Kebalen Village, namely: (1) Low public awareness; (2) There is no special effort for waste management; (3) There is no law enforcement at the community level regarding waste management, and (4) There is no institution that functions to manage domestic waste. As a result of this condition, waste accumulates in the TPA, which causes odour pollution, flies and smoke from burning garbage, and other environmental pollution. The debris that is spread is not transported correctly and causes unpleasant odours and public discomfort. As Tanjung et al. (2021) found, this condition is caused by aspects of human/community awareness, unclear management problems, unclear rules at the community level, and the absence of cadres to drive waste management.

3.2 Risk communication model and climate crisis impact mitigation

Risk communication is considered the right alternative solution to empower the community to overcome the danger of flooding caused by weak household waste management problems that impact the threat of flooding for urban communities. Risk communication effectively raises public awareness of the risks of waste in the climate crisis. The changes referred to about this waste problem are (1) the threat of flooding due to scattered garbage obstructing the flow of water in ditches and rivers, (2) the threat of health problems in the form of the presence of flies due to environmental pollution due to unmanaged waste, and (3) discomfort in the home environment due to hot air due to lack of oxygen from plants around the settlement.

The risk communication model implemented through a dialogue approach has effectively built public awareness of the risks of weak household waste management. The application of the self-social engineering approach developed by Sumardjo et al. (2020), which places the community as the leading actor in community empowerment [9], [19], turns out to be effective in developing Creative Social Energy (CSE). CSE is the internal strength of the community to face the climate crisis, with the main components in the form of ideals, ideas, and friendships. Ideal, in this case, is the mitigation of the impact of waste and flood risks and the positive economic and social impact of urban farming development on the community. This positive impact can be seen in the discussion of the effects of community empowerment. These ideas inspire and motivate the community to develop creative ideas, as illustrated in the subject matter of the stages of community empowerment based on risk communication. Then, these ideals and beliefs produce a collaborative communication network between related parties, namely the government, the community, experts/academics, the business world, and the media, known as the Penta helix in the risk communication model.

3.3 The impact of interventions through community empowerment on the environment

There has been a change in people's awareness and behaviour of people's lives from ignoring waste and being handed over to external waste managers and shifting to self-waste management, which is beneficial for social, economic, and environmental life (Table 1).

Table 1. Conditions before and after empowerment/mentoring activities

No	Indicators	Before the Program	After the Program
1	Household waste management	• There are a small number of households • Even though there is household waste management, 90% of the waste is disposed of at TPSS	• More massive waste management activities involving communities in several RWs in Kebalen village through the 3 Ah (Prevent, Sort, Olah) Movement at the household level. Approximately affects approximately 402 families • There is waste reduction: - Inorganic solid waste 2055 kg/month - Organic Solid Waste 28 kg/month - Cooking oil 153 L/month
2	Advocacy for the Kebalen Village government	Nothing	There are several Kebalen Village government policies throughout the mentoring period, including: • The Kebalen Sub-District Government issued an appeal letter for the use of plastic shopping bags to traders, prohibited the dumping of garbage into rivers and riverbanks, encouraged the manufacture of biopori and cleaning activities on certain Saturdays/Sundays (advocacy) • Support for Kebalen village-level cleaning competitions
3	Environmental management	• Some household waste transported by carts is disposed of to the TPSS, which is a source of community conflict • Some residents throw their garbage on vacant land, riverbanks, etc • The existence of illegal TPSS and vacant land as a place for residents' garbage disposal	• To reduce waste disposal to illegal TPSS, the kelurahan government facilitates communication with the DLH Bekasi Regency to transport residents' waste to the TPA. (Some of the residents' waste is transported to the TPA.) • Encouraging the use of vacant lands of former waste disposal into gardens or productive gardens for residents • Utilization of yards to strengthen household food security through urban farming • Reforestation activities on riverbanks and irrigation rivers • Making biopori holes in residential areas (400 biopori holes)
4	Waste management innovation	Not yet, especially for organic waste	• Organic waste management innovation through composting, maggot cultivation, making POC, Mol, Ecoenzyme • Encouraging handicraft products processed from inorganic waste (pots from gallon mineral water waste, bags from leftover packaging, sandals, masks, etc.)
5	Waste management institutions	There is 1 group, but it is not active	• seven waste banks are actively managing residents' waste in 6 RW • There is a Garbage School, an educational place for waste management • There are environmental cadres who are active in waste management and waste advocacy (reprimanding residents who litter)

Changes in behaviour as a result of the application of the risk communication paradigm on the aspects of individuals, groups/communities, and village areas are described in the following explanation. At the individual level, through socialization and training, there is a change in waste management at the household level. People are becoming aware, knowledgeable, and actively participating in preventing, sorting, and processing waste. This has an impact on

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reducing household waste. The waste school activities also produce environmental cadres who actively encourage environmental advocacy activities in their respective areas.

At the community level, managing waste encourages creating a better environment through their respective environmental management activities, agricultural activities, and increasing greenery by using vacant land. The birth of new institutions, such as waste banks and schools, as well as pilot communities in the Kebalen Village environment. At the Village level, advocacy to the Village government encourages government awareness through support for the implementation of empowerment programs and regulations issued by the village government.

The channels used to implement risk communication in community empowerment programs occur online and offline. The first year, as the initiation stage, plays a vital role in building public awareness about waste management. Therefore, socialization is carried out from the Kelurahan to RT levels through various media and community communication forums (arisan, PKK meetings, Karangtaruna, RT/RW meetings, recitations, etc.). Online training and coordination were also carried out during the COVID-19 pandemic, which did not allow offline meetings. However, offline communication is considered more effective for several reasons, including offline meetings, which encourage community cohesion during the pandemic and effectively encourage the spirit of togetherness and ease of exchanging information. In addition, not all community members are technology literate. Hence, they are often reluctant to be invited to attend online meetings and are overcome by offline meetings that apply the COVID-19 health protocol set by the government.

3.4 Stages of community empowerment based on risk communication

The following is an overview of the stages of community empowerment activities and the obstacles/obstacles that occur. Community empowerment activities are pursued through the development of independent waste schools carried out by the following methods: (1) socialization and awareness starting from the Kelurahan, RW to the minor RT units; (2) initiation or strengthening of existing institutions such as waste banks which SK Kelurahan strengthens; (3) upscaling to increase the capacity of the community and environmental cadres; (4) technology application in the form of introduction to waste management techniques; (5) build a pilot demonstration plot as a learning centre for residents; (6) hygiene competition to motivate residents.

The mentoring activity was carried out for three years. The first year is the program's initiation, the second year is the program strengthening stage, and the third year is realizing independence, where it is hoped that existing activities can continue even though the mentoring activities have ended. The obstacles faced were mainly the threat of the COVID-19 pandemic in the first and second year periods, which caused communication problems between various parties face-to-face in program implementation. However, these obstacles can be overcome with online meetings to maintain the spirit of the citizens and the application of health protocols in limited group meetings.

3.5 The paradigm of risk communication in community empowerment

The principle of implementing risk communication in empowerment is centred on messages related to the risks of the climate crisis faced by the community with the regulations: (1) Communication to deal with flood and health risks that threaten the community, (2) The functioning of the collaborative risk communication network of five main actors, namely the government, community, academics, business world and media (3) Risk communication network to deal with household waste and flooding, (4) Build ideal conditions that the community wants to realize. The application of this risk communication principle is a combination of the findings of Zhong et al. (2021) regarding the risk of "bandang" flood due to the climate crisis, the findings of Sumardjo et al. (2022) on community-based waste management, the findings of Zhang et al. (2020) regarding risk communication related to the threat of the Covid-19 pandemic.

The description of the application of the risk communication paradigm according to the version of Zhang et al. (2020) and what was found in this study to empower the community effectively can be seen in Figure 2.

Fig 2. Climate crisis Risk communication network model

One manifestation of the application of the risk communication paradigm is the application of an independent waste school with the penta-helix principle involving the government, academics/experts, the community, the business world, and the communication media. Some activities included capacity building, cleaning competitions, mentoring, institutional development, application of processing technology, making demonstration plots for processing and utilizing waste, and law enforcement (Figure 3).

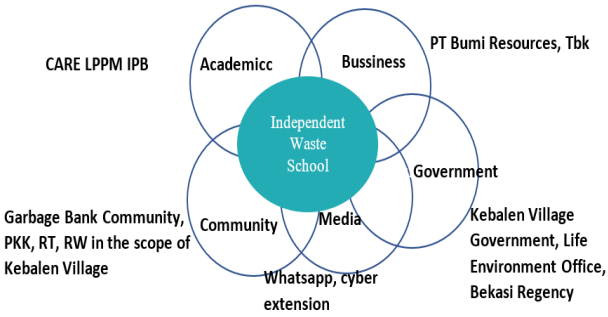

Fig 3. Implementation of the risk communication network between parties in the Mandiri Garbage School

3.6 The actors who play a role in the risk and environmental communication process

The collaborative communication network involves related parties, namely the government, the community, experts/academics, the business world, and the media, known as the Penta helix in the risk communication model—the role of CARE IPB University in developing communication on the risk of environmental impacts from household waste. Formal community leaders and community groups, especially homemakers, carry out risk communication. This approach has proven effective in building public awareness of the risks of the impact of domestic waste and the climate crisis. Through the learning-by-doing process, the community discusses efforts to overcome the dangers of the effects of household waste and the potential threat of the climate crisis to the life of the home environment.

One of the practical initial steps in following up on this risk awareness is forming a group of housewives at the RT level and cadres to mobilize waste management at the RW and Village levels. Furthermore, groups held a waste management competition at the household level. The match was conducive to having a Waste Independent School (SeSaMa), which essentially manages domestic waste at the household level, along with the benefits of waste management results. This awareness is realized through manufacturing biopori around settlements, waste management with commercially valuable maggots, and planting urban farming in the house's yard and public lands.

The business/private sector in risk communication sponsors funds for seed capital and conducts training on organic waste management and waste bank management. The role of the village government is to facilitate the implementation

of waste management by making regulations at the village level in the form of village regulations. This includes the use of public land and public facilities for the implementation of independent school waste management.

The public has been made aware through a series of risk communication processes to support the activities of mothers and leaders in household waste management to create a healthy, pollution-free environment and a household microclimate with fresher air. The role of each actor in the success of risk communication-based community empowerment programs can be seen in Table 2.

Apart from institutional actors, individual actors, such as local cadres and community development officers (CDOs), spearheading the program's success. Their role is significant in socializing the program, motivating and mobilizing the community to bridge the relationship between the community and related institutions. Local cadres, often called local heroes, generally come from posyandu cadres, PKK cadres, RT, or RW heads.

The role of the empowerment facilitator is to develop such a situation in a participatory manner so that the community plays a role as a subject in planning, implementing, monitoring, and evaluating community empowerment programs to overcome the risks of the climate crisis. The empowerment facilitator is also a liaison, both as a liaison between the community and the company, as well as with the local government. The role of empowering facilitators in community empowerment is also in synergizing digital communication with conventional communication to build social capital. The community's assessment is very positive for the empowerment facilitator because the mentoring method applied by the empowerment facilitator is participatory. Referring to the opinion of Sumardjo et al. (2020), the participatory approach is very appropriate to be used in community empowerment programs because the participatory process will produce mutual understanding and mutual agreements and will become a collective action of group members in the future.

The role of the empowering facilitator is in line with the part of the extension worker. Based on Law No. 16 of 2006, the role of the instructor is to carry out a learning process to improve the quality of human resources. According to Sulandjari et al. (2020), extension is an information service. In addition, counselling also provides consulting services by providing advice if farmers face problems.

3.7 Impact of Community Empowerment on the SDGs' Achievements

Waste management activities in the assisted communities of Kebalen Village have succeeded in driving a circular economy (Garbage Bank Income) of Rp. 25,962,000,-. It has successfully reduced the waste produced to 13.24 tons and mobilized the active participation of 2.05% of dated houses in Kebalen village.

A circular economy (CE) is a resource utilization system in which reduction, reuse, and recycling processes occur (Kirchherr et al. 2017; Schröder et al. 2019). Furthermore, Kirchherr et al. (2017) stated that in the long run, CE seeks to improve economic welfare, environmental quality, and social justice. CE is conducive to strengthening community motivation to strengthen the quality of behaviour sustainably and healthily (Ünal et al. 2019). Waste management carried out through circular economy principles can reduce the problem of landfilling and make it a beneficial commodity.

Impact of Community Empowerment on the SDGs' achievements in this paper refers to the findings of Sumardjo et al. (2023) about Sustainable City Life as one of the 17 Global Goals set out in the 2030 Sustainable Development Agenda [4]. Related to aspects of sustainable development, this activity is expected to contribute to the indicators for achieving the SDGs, as shown in Table 2.

Table 2. The role of each actor in the success of risk communication-based community empowerment programs

No	Stakeholders	Name of Stakeholder	Role
1	Government	Village Government of Kebalen	1. Create a waste management policy 2. Guidance on waste management to the community 3. Ratification of waste bank institutions/organizations 4. Supporting waste management assistance programs through consultation, socialization, and monitoring and evaluation activities
		Dinas Lingkungan Hidup Kabupaten Bekasi	Supporting waste management assistance programs through participation in training activities, hygiene competitions, waste bank involvement in events at the district level
2	Academics/Experts	Care LPPM IPB	1. Designing a waste management assistance program in Kebalen 2. Conducting waste management education and training

No	Stakeholders	Name of Stakeholder	Role
			3. Consulting services to the community accompanied 4. Encouraging community participation in waste management activities in Kebalen 5. Build coordination with relevant parties. 6. Regular monitoring and evaluation
3	Community	Bank Sampah	1. Invite and educate the public 2. Facilitator for waste management
		PKK, RT/RW	1. Invite and educate the public 2. Participation in the Jury Team for the Cleanliness Competition
4	Private Company	PT Bumi Resources Tbk	1. Coaching 2. Support for the provision of infrastructure and the implementation of socialization and training 3. Regular monitoring and evaluation
5	Media	Social media and cyber extensions	1. Whatsapp group is a media forum for risk communication between neighbours and related parties. 2. Reference sources of information that provide appropriate innovations for household waste management and urban farming in the form of YouTube and related agency websites.

Table 3. Contribution of Community Empowerment to Achieve the Goals of SDGs

SDGs Number	SDGs Indicator	Empowerment Impact Indicator	Description
2	Zero hunger	Efforts to achieve food security and nutrition improvement and promote sustainable agriculture	Improvement of organic farming production: • 150 kg/household/month of fresh organic vegetables, • 7 litres/household/month of coenzyme, • 18,7 kg/household/month of solid organic fertilizer
3	Good health and wellbeing	Promote healthy lifestyles and support welfare for all ages	Application waste management activities as a community lifestyle
11	Sustainable cities and communities	reduce per capita adverse urban environmental impacts, including by paying particular attention to air quality, including municipal waste management	Waste management activities to create a better living environment
12	Responsible consumption and production	Reduce waste production through prevention, reduction, recycling and reuse.	Removal of household waste by 31.24 tons (solid waste) and 30,35 litres (liquid waste)
13	Climate	The air in the home	• Increased oxygen by greening activity, especially on riverbanks and vacant land

SDGs Number	SDGs Indicator	Empowerment Impact Indicator	Description
	Action	environment is cooler	eks garbage dump • Waste management activities have the potential to reduce CO_2 emissions by 0.022 Gg/yr
17	Partnerships for the Goals	Synergi internal and external partnership	Improving internal and external social capital

Source: Sumardjo et al. (2023)

4 Conclusions

The results showed that the appropriate development communication model used to address the risk of climate impacts is the risk communication model. The risk communication model is a participatory and convergent communication, which is effective in changing the community's behaviour to be better prepared to face the problems of waste, flooding, pollution, and settlement microclimate problems. Risk communication with a participatory approach results in changes in community awareness and behaviour from ignoring destruction and leaving it to external waste managers to independent waste management that benefits social, economic, and environmental life. The actors that play a role in collaborative management based on the risk communication process towards changes in ecological impacts are government, academics, communities, businesses, and communication media. The society actively becomes the subject of waste management and can even realize some SDGs.

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