ABDIMAS: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang
Vol.11(3) October 2026, ...-....
p-ISSN: 2721-138X e-ISSN: 2548-7159
http://jurnal.unmer.ac.id/index.php/jpkm

LPPM
UNMER
MALANG

Community-based flood early warning through an SMS detection system in Jember Lor

Muhammad Riza Darmawan[1], Martiana Kholila Fadhil[2], Dananjaya Endi Pratama[1], Ilvan Rezky Pradana[1], Riyanto[1], Antariksa Putra Darmaji[1], Andri Kusuma Ramadhani[1], ACH. Milladitya Lazuwardi[1], Nayaka Bhawika Albab[3]

[1]Department of Electrical Engineering, Faculty of Engineering, Universitas Jember, [2]Department of Information Systems, Faculty of Computer Science, [3]Department of Mechanical Engineering, Faculty of Engineering, Universitas Jember
Jl. Kalimantan No. 37, Tegalboto Campus, Jember, East Java 68121, Indonesia

ARTICLE INFO:

Received: 2026-06-07
Revised: 2026-07-21
Accepted: 2026-08-12
Published: 2026-08-20

Keywords:

Community empowerment, Early flood detection, Flood mitigation, SDG 11, SDG 13, SMS notification

ABSTRACT

Jember Lor Village, particularly RW 10 RT 02 in Patrang District, Jember Regency, is frequently affected by flooding caused by the overflow of the Bedadung River during high-intensity rainfall, while the absence of a real-time early warning system leaves residents with very limited evacuation time. This community service program aims to improve residents' understanding of and preparedness for flood disasters and to introduce an SMS notification-based flood early detection system. The system consists of a float sensor for measuring water levels, an Arduino Nano microcontroller as the data processing unit, and a SIM800L GSM module as the SMS gateway. The program was implemented using a participatory approach through counseling sessions, interactive discussions, and hands-on implementation of the system's components and working principles. The effectiveness was measured using pre-test and post-test instruments and a participant satisfaction questionnaire. The results showed that participants' average scores increased from 54.5 to 87.9, a rise of 61.3 percent, with an overall satisfaction index of 85 percent (very satisfied category). The program is expected to encourage the establishment of a community-based flood preparedness team and the sustainable installation of an early warning system in the area.

©2026 Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang
This is an open access article distributed under the CC BY-SA 4.0 license
(https://creativecommons.org/licenses/by-sa/4.0/)

How to cite: Darmawan, M. R., Fadhil, M. K., Pratama, D. E., Pradana, I. R., Riyanto., Darmaji, A. P., Ramadhani, A. K., Lazuwardi, A. M., & Albab, N. B. (2026). Community-based flood early warning through an SMS detection system in Jember Lor. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang, 11*(2), xxx-xxx.
https://doi.org/10.26905/abdimas.v11i3.17462

1. INTRODUCTION

Indonesia is an archipelagic country situated at the convergence of two major tectonic plates and along the equator line. As a result, it experiences a tropical climate, in which characterized by high volume of annual rainfall, making flood disasters one of the most frequent natural hazards across the country (Tenda et al., 2021). According to the National Agency for Disaster Countermeasure (Badan Nasional Penanggulangan Bencana; BNPB), as of November 2025, Indonesia recorded 1,502 flood events, accounting for 62.86 percent of all disaster occurrences nationwide (GAPKI, 2025). Moreover, severe flooding that affected Sumatra Island between late 2025 and early 2026 resulted in 1,204 fatalities, 140 missing persons, and the displacement of tens of thousands of residents (Muhammad, 2026).

✉ Corresponding Author: **Muhammad Riza Darmawan**: Tel. +62 331-330224 | E-mail: muhammadrizadarmawan@unej.ac.id

Jember Regency, one of the regions in East Java Province, is among the regions that frequently experience hydrometeorological disasters, particularly flooding. According to data from the Regional Disaster Countermeasure Agency (Badan Penanggulangan Bencana Daerah; BPBD) of Jember Regency, flooding in February 2026 affected 7,445 households across 10 sub-districts and 23 villages, with water levels raising from 30 cm to 2 m in height. The disaster inundated thousands of houses, caused one fatality, damaged three bridges, collapsed a mosque, and disrupted public facilities and educational institutions (Detiknews, 2026). Earlier, in December 2025, flooding triggered by the overflow of the Bedadung River following more than four hours of intense rainfall affected 1,428 households (Mubarok, 2025), inundated 20 locations, disrupted transportation by damaging bridge access (Detiknews, 2025), and resulted in casualties in Panti Sub-district (Rozi, 2026). These recurring flood events highlight the urgent need for effective community-based flood mitigation strategies and early warning mechanisms.

Jember Lor Village, particularly RW 10 RT 02 in Patrang District, is one of the areas that experiences recurrent flooding. The partner community faces three primary challenges. First, residents have limited knowledge of flood disaster mitigation and preparedness measures. Second, there was no real-time flood early warning system available to provide timely alerts when water levels begin to rise. Third, information regarding flood conditions was still disseminated manually, often resulting in delays that reduce evacuation time and increase the risk of casualties and property damage. Although the BPBD of Jember Regency has installed Early Warning System (EWS) units at several flood-prone locations (Mediajatim, 2025), these systems have not yet been distributed to RW 10 RT 02 of Jember Lor Village. The existing conditions in the partner community, where no flood early detection system is currently available, are presented in Figure 1.



Figure 1. Prior conditions in RW 10 RT 02, Jember Lor Village, prior to the implementation of the flood early detection system

The rapid development of Internet of Things (IoT) offers an effective and cost-efficient technology solution, including for community-based flood early warning systems. IoT enables physical devices to communicate through network connectivity, allowing environmental data to be collected, transmitted, and processed automatically. In disaster management, this technology has been widely applied to monitor environmental parameters, such as water levels in real time (Nandhini & Selvaganapathi, 2023). Similar systems integrate water-level sensors with an Arduino microcontroller and an SMS gateway to automatically deliver flood warning notifications to residents' mobile phones (Gani, 2021; Nandhini & Selvaganapathi, 2023).

Prior to this program, flood warnings in RW 10 RT 02 relied entirely on manual, word-of-mouth communication. Residents who happened to see the Rembangan River near the Jember Lung Hospital would alert their neighbors that the water was beginning to rise by going from house to house in the neighborhood. Under these conditions, there were no flood warning signals, no written evacuation

procedures, and no residents designated to monitor water levels. Consequently, preparedness depended on individual initiative and whichever residents happened to be awake at the time, rather than on flood warning signals or agreed-upon standard operating procedures (SOPs). This situation served as the baseline for assessing improvements in community knowledge regarding the SMS-based early flood detection system.

One of the primary advantages of SMS technology is its ability to reach virtually all mobile phone users without requiring an internet connection, making it particularly suitable for communities with limited internet accessibility. Consequently, SMS-based warning systems can disseminate emergency information rapidly, providing residents with valuable time to undertake protective actions, including self-evacuation and the safeguarding of personal property (Tenda et al., 2021). Therefore, implementing an SMS-based flood early detection system at the neighborhood level represents a practical contribution of higher education institutions toward community empowerment and technology transfer.

The introduction of the SMS-based flood early detection system is also closely aligned with the United Nations Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action). Specifically, the program supports Target 11.5, which aims to reduce disaster-related deaths and economic losses, particularly those caused by water-related disasters, as well as Target 11.b, which promotes the implementation of integrated disaster risk management strategies at the community level. In addition, the initiative contributes to Target 13.1, which focuses on strengthening resilience and adaptive capacity to climate-related hazards. Integrated early warning systems that combine risk knowledge, effective information dissemination, and community response capacity have been recognized as essential components of disaster risk reduction (DRR) and community resilience, as emphasized in both SDG 13 and the Sendai Framework for Disaster Risk Reduction 2015–2030 (Haque et al., 2024).

The implementation of digital technologies at the community level has also demonstrated positive outcomes in addressing local environmental challenges in Jember Regency. For example, the development of the E-WASTE application for waste bank management at the TPS 3R Baratan facility significantly improved community participation and simplified household waste management practices (Fadhil et al., 2025b). Furthermore, previous studies have shown that the reliability and ease of use of digital services significantly influence user satisfaction and technology acceptance (Ramadhanty et al., 2025). These findings emphasize the importance of designing flood early warning systems that are reliable, user-friendly, and easily understood by community members to maximize their effectiveness and long-term adoption.

However, the effectiveness of such systems depends not only on technological performance, but also on community acceptance, active participation, and sustainable management. Previous studies on flood early warning systems in urban Indonesia have demonstrated that community involvement is a critical determinant of successful implementation (Riama et al., 2021). Moreover, social factors, including technology accessibility, public comprehension, and long-term maintenance, must be taken into consideration to ensure that warning messages lead to timely and appropriate protective actions (Perera et al., 2020).

Therefore, a participatory educational approach was adopted because it has previously proven effective in enhancing participants' knowledge, engagement, and motivation in community service activities, including the Dream Tree educational program implemented at SDN Kepatihan 6 Jember (Fadhil et al., 2025a). Through this initiative, the community is expected to improve its flood preparedness and disaster awareness, while local RW and RT administrators gain the knowledge required to operate and maintain the early warning system, reflecting the role of higher education institutions in transferring appropriate technology and supporting sustainable community development.

Based on the identified needs of the partner community, this community service program aims to: (1) Improve residents' knowledge of flood disasters and mitigation strategies before, during, and after flood events; (2) Increase public awareness of the importance of flood early warning systems; and (3) Introduce the components and operational principles of an SMS-based flood early detection system.

2. METHODS

This community service program was implemented using a participatory approach, emphasizing collaboration between the community service team and the partner community, specifically the residents of RW 10 RT 02, Jember Lor Village, Patrang District, Jember Regency. A participatory approach was selected to encourage active community involvement and strengthen participants sense of ownership toward the introduced technology, thereby supporting its long-term sustainability.

The program employed several educational methods, including lectures, interactive discussions, hands-on demonstrations, and practical training on the operation of the proposed system. The educational activities were conducted in June 2026 and involved 17 participants, consisting of local residents and representatives of the RW and RT administrations. The participants comprised 9 men and 8 women, aged between 35 and 65 years, with educational backgrounds ranging from junior high school to undergraduate level. They included the Head of RW 10, the Head of RT 02, and 5 residents whose houses stand closest to the riverbank and are therefore inundated first during high water.

The introduced SMS-based flood early detection system was developed using Internet of Things (IoT) and consisted of five main components: (a) a float sensor for monitoring water level; (b) an Arduino Nano microcontroller for data processing; (c) a SIMCOM SIM800L V2.0 Quad-Band GSM/GPRS module functioning as an SMS gateway to transmit flood warning notifications to registered residents; (d) a waterproof enclosure to protect the electronic components from environmental exposure; and (e) a solar panel with a rechargeable battery to provide an independent power supply. When the monitored water level reached predefined threshold levels (Normal, Alert, Standby, and Emergency), the microcontroller automatically instructed the GSM module to send warning messages via SMS to registered community members (Gani, 2021; Tenda et al., 2021).

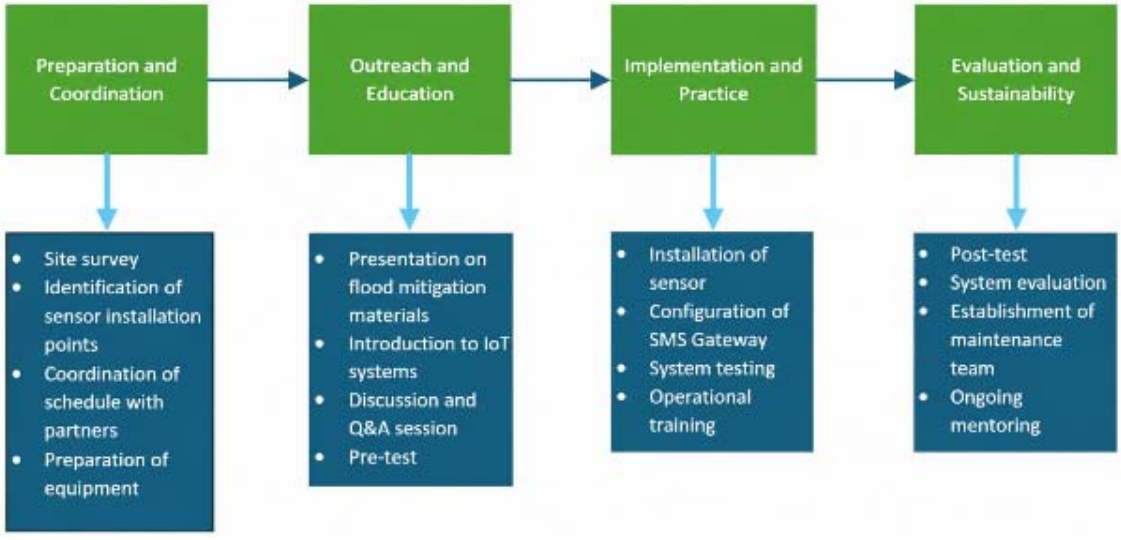


Figure 2. Stages of the community service program implementation

The implementation of the community service program consisted of four sequential stages. The first stage involved preparation and coordination, including a field survey of flood-prone locations, coordination meetings with the heads of RW 10 and RT 02, preparation of educational materials, and the development of pre-test, post-test, and participant satisfaction evaluation instruments. The second stage focused on community education and awareness, during which participants completed the pre-test, attended educational sessions on flood disaster mitigation and the importance of early warning systems, and engaged in interactive discussions. The third stage comprised system implementation and practical demonstrations, during which participants were introduced to the components, operating principles, and practical operation of the SMS-based flood early detection system. At final stage, the evaluation stage, the administration of the post-test and participant satisfaction questionnaire is included, followed by data analysis and preparation of the community service report. The overall workflow of the program implementation is illustrated in Figure 2.

The effectiveness of the community service program was evaluated using two assessment instruments. First, participants knowledge improvement was measured through pre-test and post-test assessments, each consisting of 15 questions. The questions covered three themes such as basics of floods and mitigation, flood early warning system, and flood detection system. The satisfaction questionnaire captured five aspects such as program organization, educational materials, facilitator, program benefits, and overall program evaluation.

Second, participant satisfaction was assessed using a structured questionnaire based on a four-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (4). Individual scores were obtained by dividing the number of correct answers by the 15 items and converting the result to a 0–100 scale. The satisfaction index was obtained by dividing the average item score by the maximum score of 4 and expressing the result as a percentage. The success indicators established for the program included an improvement in participants knowledge, as reflected by higher post-test scores compared with pre-test scores, and an overall participant satisfaction index of at least 80 percent.

3. RESULTS AND DISCUSSION

Results

Preparation and coordination

The preparation and coordination stage was conducted in May 2026 as the initial stage of the community service program. This stage included a field survey to identify flood-prone areas, coordination meetings with the heads of RT 02 and RW 10, the development of educational materials, and the preparation of assessment instruments, including pre-test and post-test questionnaires as well as participant satisfaction evaluation forms. These preparatory activities were essential to ensure that the program was implemented systematically and effectively while addressing the specific needs and conditions of the target community.

Implementation of community education and awareness program

The community education and awareness program was conducted in June 2026 at RW 10 RT 02, Jember Lor Village, and was attended by 17 participants, including local residents and representatives of the RW and RT administrations. The program commenced with an opening session followed by the administration of a pre-test to assess participants initial comprehension of flood disaster mitigation and early warning systems. Subsequently, educational materials were delivered covering flood disaster mitigation strategies, the importance of early warning systems in reducing disaster risks, and the introduction, implementation, and operational principles of the SMS-based flood early detection

system. The session also included interactive discussions and a question-and-answer segment, allowing participants to clarify technical aspects and share their experiences related to flood events in the area. At the end of the program, participants completed a post-test and a satisfaction evaluation questionnaire to assess knowledge improvement and the overall effectiveness of the activity.

The participants demonstrated a high level of engagement throughout the program, as reflected by their active participation during the discussion session and the measurable improvement in their comprehension of flood mitigation and the operation of the proposed early detection system. This finding indicates that the educational approach, which combined theoretical explanations with practical demonstrations and interactive discussions, effectively enhanced participants awareness and preparedness for potential flood disasters. The delivery of educational materials, the introduction and implementation of the SMS-based flood early detection system, and the discussion session are presented in Figure 3.



Figure 3. Community education activities, including flood disaster mitigation training, introduction and demonstration of the SMS-based flood early detection system, and interactive discussion sessions

System implementation and practical demonstration

The system implementation and practical demonstration were conducted in June 2026 at RW 10 RT 02, Jember Lor Village, with the participation of 17 community members, including local residents and representatives of the RW and RT administrations. The activity began with the installation of the SMS-based flood early detection system, followed by the installation of the float sensor, configuration of the SMS gateway, system testing, and hands-on training on system operation. Through these activities, participants were directly involved in the installation process, system configuration, and operational procedures, enabling them to independently operate and monitor the early warning system.



Figure 4. SMS-based flood early detection system
Figure 5. Float Sensor

During the system testing stage, the installed device successfully detected changes in water level and automatically transmitted flood warning notifications via SMS to registered users. This practical demonstration allowed participants to observe the complete operational workflow of the system, from water level detection to the delivery of warning messages, thereby increasing their confidence in the system's reliability and usefulness for community-based flood preparedness. The SMS-based flood early detection system is presented in Figure 4, the installed float sensor is shown in Figure 5, and an example of the flood warning SMS received by community members is presented in Figure 6.

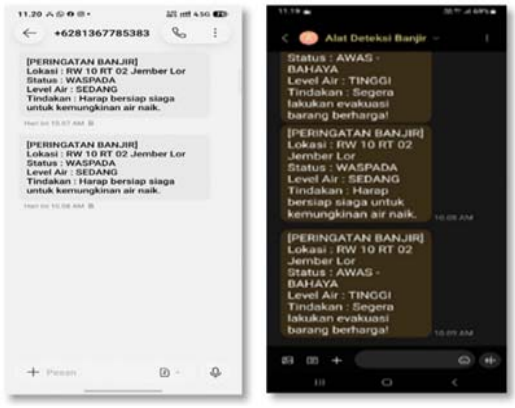


Figure 6. Example of an SMS flood warning notification received by community members

Evaluation and sustainability

The evaluation and sustainability stage was conducted in June 2026 at RW 10 RT 02, Jember Lor Village, with the participation of 17 community members, including local residents and representatives of the RW and RT administrations. This stage began with the administration of a post-test to evaluate participants knowledge following the educational and practical training sessions. Additional activities included a comprehensive evaluation of the SMS-based flood early detection system, participant satisfaction assessment, the establishment of a community maintenance team, and the provision of periodic mentoring to support the long-term operation and sustainability of the system.

Table 1. Summary of participants pre-test and post-test scores

Information	Score
Average Pre-test Score	54.5
Average Post-test Score	87.9
Average Increase Score	33.4
Percentage Increase	61.3 percent
Number of Participant	17 Person

The effectiveness of the community service program was assessed by comparing participants pre-test and post-test scores. The results demonstrated an improvement in participants' comprehension of flood disaster mitigation, early warning systems, and the operation of the SMS-based flood detection system, indicating that the educational and practical training activities successfully enhanced community knowledge and preparedness. A summary of the pre-test and post-test results is presented in Table 1, while the comparison of participants scores and their distribution is illustrated in Figures 7 and 8, respectively.

The establishment of a community-based maintenance team and the implementation of periodic mentoring were intended to ensure the sustainability of the program beyond the completion of the community service activities. By involving local stakeholders in system maintenance and monitoring, the program promotes community ownership and strengthens the long-term utilization of the flood early detection system as a disaster risk reduction initiative.

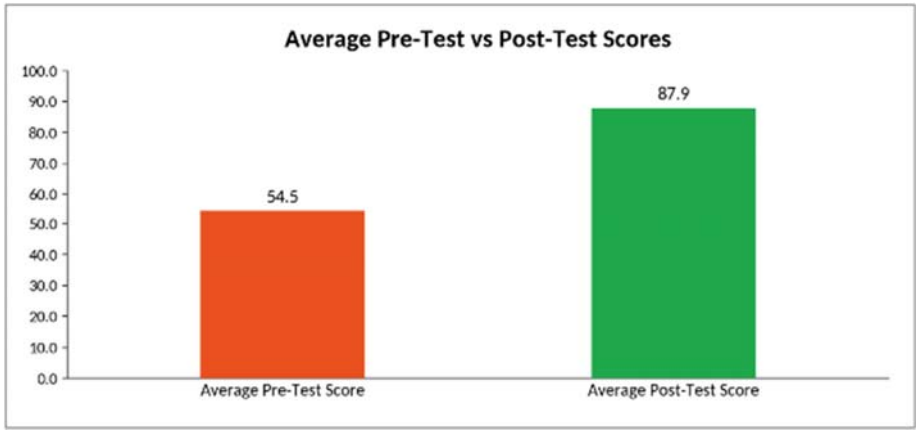


Figure 7. Comparison of participants average pre-test and post-test scores

Participants' comprehension of flood mitigation and of the early warning system grew markedly over the course of the program. Every participant (17 of 17) scored higher in the post-test than in the pre-test, indicating that the gain in capacity was distributed evenly across the group rather than concentrated in a few individuals who were previously better informed. This growth is reflected in the average score, which gained from 54.5 to 87.9, an increase of 33.4 points or 61.3 percent (Table 1). This progress is also become evidence in how the residents describe their preparedness. One resident explained that in the past, they learned about rising water levels through word-of-mouth from house to house, whereas now SMS alerts are easily understood as a signal to evacuate residents. The head of RT 02 added that the community no longer needs to estimate water levels manually, as every resident living near the river will receive an SMS message containing a water level warning at the same time.

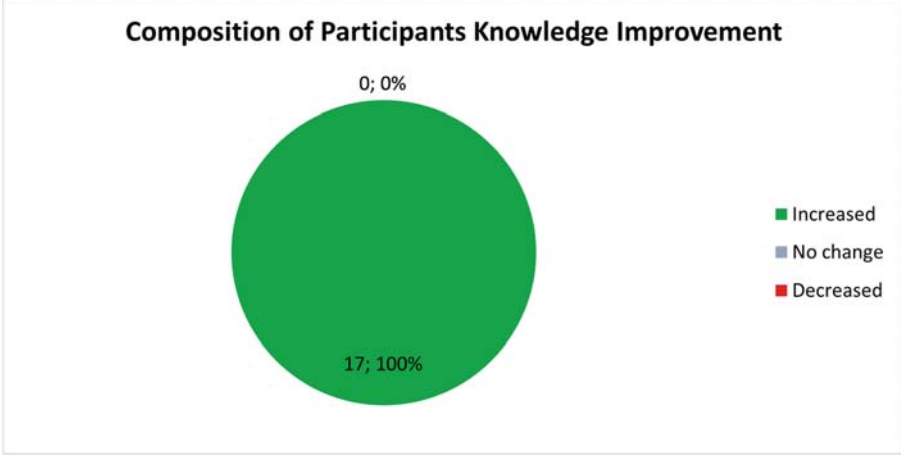


Figure 8. Distribution of participants knowledge improvement

The substantial increase in participants knowledge can be attributed to the combination of theoretical instruction, practical demonstrations, and interactive discussions implemented throughout the program. This integrated learning approach enabled participants to gain not only conceptual knowledge, but also practical skills in operating the early warning system, thereby strengthening community preparedness for potential flood events.

Participants satisfaction with the implementation of the community service program was also evaluated using a post-activity questionnaire. The satisfaction results for each evaluation aspect are summarized in Table 2 and illustrated in Figure 9.

Table 2. Participant satisfaction index by evaluation aspect

Aspects	Index (%)	Category
Program Organization	95.5	Very Satisfied
Educational Materials	82.0	Very Satisfied
Presenter / Facilitator	82.8	Very Satisfied
Program Benefits	82.8	Very Satisfied
Overall Program Evaluation	81.0	Satisfied
Overall Satisfaction Index	85.0	Very Satisfied

As presented in Table 2, the highest participant satisfaction index was recorded for the program organization aspect, reaching 95.5 percent, while the overall program evaluation received the lowest satisfaction index at 81.0 percent. Nevertheless, the overall participant satisfaction index reached 85.0 percent, which falls within the very satisfied category. The overall index of 85.0 percent was calculated from the mean of all questionnaire items rather than from the unweighted mean of the five aspect indices, which yields 84.8 percent; the difference of 0.2 percentage points arises from the differing number of items per aspect and from rounding, and does not affect the resulting category. These results indicate that the community service program was well received by the participants and successfully met their expectations in terms of content delivery, implementation, and overall benefits.

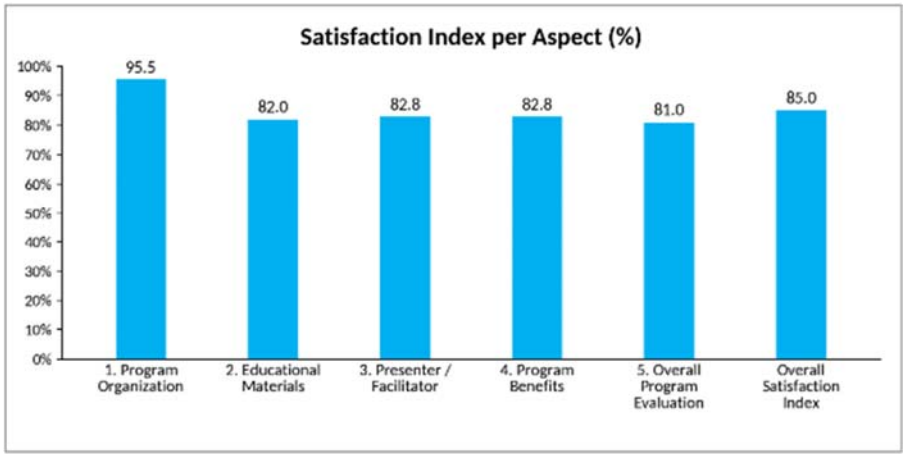


Figure 9. Participant satisfaction index by evaluation aspect

The aspect with the lowest score, namely the overall program evaluation at 81.0 percent, indicates that participants also notice a room for improvement. Feedback from this activity, based on the questionnaire in Section 5, indicates that participants were satisfied with the overall implementation

of the activity; however, they felt that the sessions were too short, which affects the opportunity for each participant to practice operating the devices individually. Future plans should include specialized support for residents who are still unfamiliar with operating the devices on their own.

To promote the long-term sustainability of the program, a community maintenance team was established consisting of the Head of RW 10, the Head of RT 02, five local residents from RW 10 RT 02, and three members of the community service team. The local maintenance team is responsible for the routine operation and maintenance of the SMS-based flood early detection system, while the community service team provides technical guidance and consultation as needed. This mentoring is conducted remotely through communication platforms such as WhatsApp and telephone calls, enabling timely assistance whenever operational issues arise.

Periodic mentoring is expected to strengthen the capacity of the local maintenance team and ensure the continued functionality of the flood early detection system after the completion of the community service program. By encouraging active community participation and shared responsibility, this sustainability strategy supports long-term community resilience and contributes to more effective flood disaster risk reduction.

Discussion

The marked improvement in participants post-test scores compared with their pre-test scores demonstrates that the participatory educational approach, combined with hands-on implementation of the SMS-based flood early detection system, effectively strengthened participants' knowledge and comprehension. This finding is consistent with previous community service initiatives and related studies, which have reported that flood disaster mitigation programs supported by early warning systems can substantially improve community knowledge, awareness, and preparedness for disaster events (Tenda et al., 2021). The integration of theoretical instruction with practical demonstrations provided participants with direct experience in operating the system, making technical concepts further accessible to individuals with diverse educational backgrounds.

The 61.3 percent increase in participants' average scores is consistent with, and in several respects is higher than, the outcomes reported by comparable community service programs. Alhadar et al. (2026) recorded an increase in average scores from 66 to 92 (39.4 percent) after flash-flood mitigation education in Ternate. Still in Jember, Elisanti et al. (2024) found that 83 percent of 30 youth organization *(karang taruna)* members improved their knowledge after being trained to use a flood-monitoring application as an early warning system. Furthermore, the installation of the SMS-based device in this program parallels the deployment of an IoT-based flood early warning system at the neighborhood (RT) level in Balikpapan (Widodo et al., 2023), reinforcing that low-cost, neighborhood-scale sensor systems combined with community education are a feasible and replicable flood-mitigation strategy.

Beyond test scores, the clearest indication of the program's impact is the empowerment of community members to become technology operators responsible for monitoring, checking, and maintaining the SMS-based early flood detection system. The formation of a maintenance team led by the Head of RW 10, residents willingness to provide locations for sensor points, and the continued use of WhatsApp to report readings and ask technical questions after the sessions ended are all outcomes of this program. These forms of engagement are difficult to quantify through test scores, but they represent an equally valuable outcome in determining whether the early warning system remains functional over time. Sustained community ownership, rather than the 61.3 percent improvement alone, represents the deeper contribution of this initiative.

Participants strong enthusiasm for the SMS-based flood early detection system further indicates that SMS technology remains a practical and appropriate communication medium for community-based disaster risk reduction. Unlike internet-dependent notification platforms, SMS services can reach virtually more mobile phone users regardless of internet access, making them particularly suitable for emergency communication in local communities (Gani, 2021; Nandhini & Selvaganapathi, 2023). Furthermore, the overall participant satisfaction index of 85.0 percent, categorized as very satisfied, confirms that the program successfully achieved its predefined performance target of at least 80 percent participant satisfaction. This result reflects the effectiveness of the program design, implementation strategy, and the relevance of the technology introduced to the community.

Several supporting factors also contributed to the successful implementation of the program. These included the strong support provided by the RW 10 and RT 02 administrators in facilitating the venue and mobilizing community participation, the high level of participant engagement throughout the educational activities, and the readiness of the SMS-based flood early detection system for practical implementation. However, differences in participants initial levels of knowledge presented a challenge during the training process. This issue was addressed by adjusting the duration of the instructional sessions, using simple and easily understandable wordings, and providing individualized guidance during the practical demonstrations.

To ensure the long-term sustainability of the program, several follow-up initiatives have been planned. These include the establishment of a community-based Flood Response Team at the RW level, the development of Standard Operating Procedures (SOPs) for the operation and maintenance of the early detection system, and the permanent installation of the SMS-based flood early warning system at strategically selected monitoring locations within the partner community. These sustainability measures are expected to strengthen local disaster preparedness, encourage community ownership of the technology, and support the continued operation of the early warning system beyond the completion of the community service program.

4. CONCLUSION AND RECOMMENDATIONS

The implementation of this community service program demonstrated positive outcomes in improving community knowledge, awareness, and preparedness for flood disasters. First, an increased comprehension of residents of RW 10 RT 02, Jember Lor Village, regarding flood disaster mitigation, as evidenced by the increase in the average test score from 54.5 in the pre-test to 87.9 in the post-test, representing a 61.3 percent improvement. Second, the program successfully increased community awareness of the importance of flood early warning systems as an essential component of disaster risk reduction. Third, participants gained practical knowledge of the components, operating principles, and implementation of the SMS-based flood early detection system. Furthermore, the overall participant satisfaction index reached 85.0 percent, indicating that the program was very well received by the community. Overall, this community service initiative contributes to the achievement of Sustainable Development Goal (SDG) 11: Sustainable Cities and Communities, particularly by strengthening community resilience and promoting inclusive disaster risk reduction through the adoption of appropriate early warning technology.

This program had several limitations, as it involved only 17 participants from a single neighborhood unit (RW 10 RT 02), the early detection system was installed at a single monitoring point, and the post-program mentoring period was relatively short, thus the long-term system reliability and knowledge retention could not yet be assessed. The current design also poses technical risks that the public needs to be aware of. Since the system relies on three sensors, one microcontroller, and one GSM module, a

failure in any single one of these components will disable the entire flood warning system. The module will also stop transmitting signals if the SMS credit runs out or if the solar panel and battery fail to charge during minimum exposure to sunlight, and debris caught around the float sensor may trigger false alarms. The maintenance team addresses these risks through a division of tasks outlined in the SOP: designated members inspect and clean the float sensors, others are responsible for recharging and tracking SMS credits, and still others monitor battery voltage. Openly acknowledging these risks demonstrates that the community has been thoroughly equipped with the knowledge to keep the system running, not just received the equipment.

Based on these limitations, several suggestions are proposed. First, for the partner community, the flood preparedness team should be formally established with routine tasks, and the maintenance schedule in the SOP should be applied consistently, supported by periodic technical refresh for the designated local operators. Second, for policymakers, the Jember Lor Village administration and the Regional Disaster Management Agency (BPBD) of Jember Regency are encouraged to replicate the system at other flood-prone points along the Bedadung River and to integrate neighborhood-level alerts into the regency's official early warning network. Third, for future community service teams, subsequent programs should expand coverage with multiple sensor points, complement SMS with additional notification channels such as a WhatsApp gateway or an IoT dashboard, to involve a larger and more diverse group of participants, and to evaluate knowledge retention and system performance over a longer observation period.

ACKNOWLEDGMENTS

Sincere gratitude and acknowledgements are expressed to the Institute for Research and Community Service (LPPM), University of Jember, for providing financial support through the Beginner Lecturer Community Service Grant funded by the University of Jember Research and Community Service Grant Program for the 2026 Fiscal Year (Rector's Decree No. 8376/DST/UN25/KP/2026 and Grant Agreement No. 4690/DST/UN25.C2/PM/2026). The authors also extend their appreciation to the Head of RW 10 and the Head of RT 02 of Jember Lor Village, as well as all community members who actively participated as partners throughout the program. Finally, the authors gratefully acknowledge the dedication and contributions of all members of the community service team in the successful implementation of this project.

REFERENCES

Alhadar, N. I., Misbah, Z. K., Rauf, I., Syaibani, A. Z., & Amelia, D. (2025). Sosialisasi dan edukasi mitigasi banjir bandang di SDN 66 Kota Ternate. *Jurnal Abdimas Kartika Wijayakusuma*, *6*(4), 2032-2039. https://doi.org/10.26874/jakw.v6i4.1082

Detiknews. (2025, December 16). *Banjir rendam 20 titik di Jember, 1.271 KK terdampak-akses jembatan putus* [Internet]. Detiknews. Retrieved from: https://news.detik.com/berita/d-8261802/banjir-rendam-20-titik-di-jember-1-271-kk-terdampak-akses-jembatan-putus

Detiknews. (2026, February 14). *Banjir di Jember meluas hingga 23 desa terendam, 7.445 keluarga terdampak* [Internet]. Detiknews. Retrieved from: https://news.detik.com/berita/d-8355677/banjir-di-jember-meluas-hingga-23-desa-terendam-7-445-keluarga-terdampak

Elisanti, A. D., Susanto, B. M., & Ardianto, E. T. (2024). Community empowerment karang taruna Kelurahan Sempusari melalui penggunaan Aplikasi Pantau Banjir dan pelatihan evakuasi

korban. *KACANEGARA Jurnal Pengabdian pada Masyarakat*, *7*(2), 141-148. https://doi.org/10.28989/kacanegara.v7i2.1892

Fadhil, M. K., Azzahro, F., Darmawan, M. R., Astuti, S., & Affandi, M. I. (2025a). Pohon impian: Program edukasi untuk meningkatkan motivasi siswa SDN Kepatihan 6. *Room of Civil Society Development*, *4*(2), 298-308. https://doi.org/10.59110/rcsd.572

Fadhil, M. K., Soepandi, H., Leba, K., Darmawan, M. R., Novtahaning, D., & Fitriyasari, M. (2025b). Pengembangan bank sampah menggunakan aplikasi E-WASTE di TPS 3R Baratan Jember. *Room of Civil Society Development*, *4*(5), 912-924. https://doi.org/10.59110/rcsd.777

Gani, A. R. F. (2021). Sistem peringatan dini banjir berbasis Arduino Uno dengan notifikasi SMS. *Jurnal Teknologi*, *9*(1), 42-51. https://doi.org/10.31479/jtek.v9i1.90

GAPKI. (2025, December, 16). *Evaluasi faktor-faktor pemicu banjir di Indonesia berdasarkan data BNPB 2025* [Internet]. Gabungan Pengusaha Kelapa Sawit Indonesia. Retrieved from: https://gapki.id/news/2025/12/15/evaluasi-faktor-faktor-pemicu-banjir-di-indonesia-berdasarkan-data-bnpb-2025/

Haque, A., Akter, M., Hussain, M. M., Rahman, M. R., Salehin, M., & Rahman, M. (2024). An integrated risk-based early warning system to increase community resilience against disaster. *Progress in Disaster Science*, *21*, 100310. https://doi.org/10.1016/j.pdisas.2023.100310

Mediajatim. (2025, October 30). *BPBD Jember sebut 7 desa ini rawan banjir dan longsor* [Internet]. Mediajatim. Retrieved from: https://mediajatim.com/2025/10/30/bpbd-jember-sebut-7-desa-ini-rawan-banjir-dan-longsor/

Mubarok, M. A. R. (2025, December 18). *Pasca banjir Sungai Bedadung Jember, BPBD: 1.428 KK terdampak, 1 meninggal dunia* [Internet]. Pantura7. Retrieved from: https://www.pantura7.com/2025/12/18/pasca-banjir-sungai-bedadung-jember-bpbd-1-428-kk-terdampak-1-meninggal-dunia/

Muhammad, N. (2026, January 27). *Dua bulan banjir Sumatra, 1.204 orang meninggal dunia dan 140 hilang* [Internet]. Databoks. Retrieved from: https://databoks.katadata.co.id/lingkungan/statistik/697823a95573b/dua-bulan-banjir-sumatra-1204-orang-meninggal-dunia-dan-140-hilang-selasa-27-januari-2026

Nandhini, B., & Selvaganapathi, C. (2023). Smart flood monitoring and alert system using IoT. *International Journal of Innovative Research in Engineering*, *4*(3), 6-10.

Perera, D., Agnihotri, J., Seidou, O., & Djalante, R. (2020). Identifying societal challenges in flood early warning systems. *International Journal of Disaster Risk Reduction*, *51*, 101794. https://doi.org/10.1016/j.ijdrr.2020.101794

Ramadhanty, V. D., Fadhil, M. K., Darmawan, M. R., Azzahro, F., Saputra, M. A. W., & Pratama, D. E. (2025). Evaluasi kualitas layanan digital aplikasi Tomoro Coffee terhadap kepuasan kaum produktif menggunakan framework e-service quality. *JSAI (Journal Scientific and Applied Informatics)*, *8*(3), 650-662. https://doi.org/10.36085/jsai.v8i3.9245

Riama, N. F., Sari, R. F., Rahmayanti, H., Sulistya, W., & Nurrahmat, M. H. (2021). The level of public acceptance to the development of a coastal flooding early warning system in Jakarta. *Sustainability*, *13*(2), 566. https://doi.org/10.3390/su13020566

Rozi, F. (2026, February 3). *Banjir bandang terjang Pakis Jember, seorang pegawai Kecamatan Panti hilang terseret arus* [Internet]. Suara Indonesia. Retrieved from: https://suaraindonesia.co.id/news/peristiwa/69816a18d3bd0/banjir-bandang-terjang-pakis-jember-seorang-pegawai-kecamatan-panti-hilang-terseret-arus

Tenda, E., Lengkong, A. V., & Pinontoan, K. F. (2021). Sistem peringatan dini banjir berbasis IoT dan Twitter. *Cogito Smart Journal*, *7*(1), 26–39. https://doi.org/10.31154/cogito.v7i1.284.26-39

Widodo, W., Kusniyawati, R., Garwydan, H., Tsaqif, A. M., Susantha, F. P., Sajida, F., Primadi, N. P., & Aulia, D. A. (2023). Penerapan Flood Early Warning System (Flews) sebagai upaya mitigasi banjir di Kelurahan Sungai Nangka Balikpapan Selatan. *Abdimas Universal*, *5*(1), 159-167. https://doi.org/10.36277/abdimasuniversal.v5i1.298