
Implementation of Community Education and Catchment Area Management to Reduce Surface Runoff and Sedimentation in Mr. R. Jawak's Orange Orchard Agricultural Land in Rakut Besi Village

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ABSTRACT

Agriculture is a sector with highly dependent on environmental conditions, especially the availability of water and land quality. However, land agriculture in various regions of Indonesia is increasingly affected by increased runoff water and sedimentation. Runoff water occurs when rainwater does not infiltrate the soil but instead flows over the surface, carrying eroded soil particles with it. This condition is worsened by degraded and poorly managed watershed areas, potentially disrupting irrigation system, reduce soil fertility. To solve this issue requires a comprehensive approach that encompasses both technical and social dimensions. One effective strategy is public education. Education can enhance farmers' understanding and engagement in protecting and managing the environment surrounding agricultural land, especially the watershed. When the communities comprehend the significance of soil and water conservation, they tend to be more motivated to implement sustainable practices. Community service was carried out in Rakut Besi Village. This village has serious problems with runoff water and sedimentation. This situation has led to a decline in agricultural productivity and crop failure. The primary cause is the community's lack of knowledge about sustainable land and water catchment management. Therefore, implementing community education and managing catchment areas are crucial steps to reduce the impact of runoff and sedimentation. This approach is expected to create an agricultural system that is more resilient to environmental disturbances and minimize the risk of future crop failure, becoming a strategic step in reducing surface runoff and sedimentation on agricultural land.

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1. INTRODUCTION

Surface runoff and sedimentation are serious problems that frequently occur on agricultural land, particularly in areas with hilly topography such as Rakut Besi Village. Excessive runoff not only leads to the loss of fertile topsoil but also decreases land productivity and contributes to environmental degradation, such as river shallowing and downstream flooding. Additionally, runoff occurs when rainwater does not infiltrate the soil but instead flows over

the surface, carrying eroded soil particles with it [1]. Sedimentation resulting from soil erosion can obstruct irrigation systems and damage aquatic ecosystems.

Rakut Besi Village, which has significant agricultural potential, especially in citrus commodities [2], faces challenges in managing its land to remain both productive and sustainable. The community's lack of understanding about the importance of catchment area management and soil conservation techniques has led to suboptimal land management practices, increasing the risk of surface runoff and sedimentation.

Community education on soil and water conservation techniques, as well as catchment area management, is a strategic step in mitigating these negative impacts. Through community empowerment and integrated resource management, surface runoff is expected to be minimized and sedimentation effectively controlled, thereby maintaining soil fertility and ensuring sustainable agricultural production.

This study aims to examine the implementation of community education and catchment area management as efforts to reduce surface runoff and sedimentation on agricultural land in Rakut Besi Village, while also providing recommendations that can be applied sustainably.

2. METHOD

This study employed a dominant less-dominant research design, combining two approaches: a qualitative approach as the dominant (primary) method and a quantitative approach as the less-dominant (supporting) method. The purpose of the qualitative approach in this research was to complement and provide context for the findings derived from quantitative techniques[3].

The qualitative approach was conducted through narrative descriptions, including results from in-depth interviews, observations, field notes, documentation, or stories that illustrate the context and meaning of the phenomenon being studied. Meanwhile, the quantitative approach involved numerical data collected through surveys and questionnaires, which generated average values and statistical measures related to the phenomena under investigation.

For qualitative data collection, purposive sampling was used, a technique in which participants are deliberately selected based on specific criteria relevant to the research objectives. Participants were chosen because they had direct experience, active involvement, or deep insight into the topic under study, such as farmers who participated in the extension activities and were directly involved in the implementation of the program.

Due to the limited number of participants, saturated sampling (total population sampling) was used for the quantitative data—meaning that all members of the population were included as samples. There was no selection or filtering process; all available data were incorporated into the study [4].

A pre-test and post-test were conducted to measure the extent of farmers' understanding before and after the socialization activities related to the issues being addressed. This method aimed to assess the development and progress of farmers' knowledge and awareness over time [1]. The approach emphasized the process and significance of the facts occurring in the field.

The stages of this research are as follows:

2.1 Research Design

2.1.1 Case Study

This research adopted a case study approach, focusing on farmers in Rakut Besi Village as the primary research site.

2.1.2 Qualitative Approach

A qualitative method was employed to understand the perspectives and experiences of the local community regarding soil and water conservation practices. Qualitative data were collected through interviews and group discussions with local residents to identify farming duration, land size, types of crops cultivated, cultivation techniques, knowledge, attitudes, and conservation practices that had been adopted.

2.1.3 Quantitative Approach

- a. Interviews: Structured interviews were used to collect quantitative data on levels of knowledge, practices, motivation, and barriers faced by the community.
- b. Field Observations: Field observations were conducted to observe existing agricultural and conservation practices in the area.
- c. Documentation and Literature Review: This included reviewing literature and policy documents related to catchment area management and community education.

2.1.4 Data Processing and Analysis

Data analysis was performed with tabulated and presented in a way descriptive qualitative and quantitative (mixed-methods [1]) analysis descriptive done For get description description results achievements socialization in accordance objective devotion , level satisfaction society, change patterns and attitudes knowledge and skills, program sustainability, creation empowerment source learning, solving problem social or recommendation policies used in frame effort mitigation impact change climate through technology conservation friendly land and water environment [5].

3. RESULTS

3.1 Community Service Location Profile

Rakut Besi is a village in Pamatang Silimahuta District, Simalungun Regency, North Sumatra Province. Situated on a plateau approximately 1,400 meters above sea level, the village enjoys cool air and is surrounded by plantations and forests. It covers an area of approximately 14.500 km². Rakut Besi Village boasts a relatively high level of productivity in managing citrus plantations in Silimahuta District. The Siamese orange is the most common citrus variety in Rakut Besi Village. The oranges in Rakut Besi Village are generally marketed within the village.[2] The boundaries of Rakut Besi village are as follows:

- North borders with Saribujandi Village
- South with Mardinding Village
- East with Purbatua Village
- West with Nagasaribu Village

As for the activities devotion This done on land Mr. R. Jawak's oranges and several farmer around the location .

3.2 Field Observation

Activity observation field carried out on July 5, 2025 with activity interview towards farmers . The purpose of the observation field is For get information and condition data land cultivation from system agriculture conservation so that existing problems in public can mapped with Good in accordance goals and objectives main devotion.

3.3 Community Service Program Socialization

The socialization process was carried out with the aim of ensuring that all farmers, especially those participating, better understand the goals and objectives of the activity. The socialization took place on July 5, 2025, at Mr. R. Jawak's garden and was attended by approximately 10 other farmers. The activity can be seen in Figure 1.



Figure 1. On-site training activities

Table 1. Farmers' understanding of surface runoff, sedimentation and treatment areas before and after extension

No	Question	Pre Test			Post Test		
		Yes	No	Doubful	Yes	No	Doubful
	Understanding Catchment Area Management, Surface Runoff, and Sedimentation on Agrigultural Land						

1	You know about Catchment Areas	2	7	1	9	1	0
2	You Know the definition of sedimentation	3	5	2	10	0	0
3	You know te signs of soil sedimentation	2	6	2	10	0	0
4	You know the causes of sedimentation	4	3	3	10	0	0
5	You know the process of sedimentation	1	8	1	8	1	2
Total		12	29	9	47	1	2
Average		2	6	2	9	0	0

Participants appeared enthusiastic throughout the training. This was demonstrated by their focused attention during the training. They also actively participated in the Q&A session, reinforcing their enthusiasm for the training. Their presence from beginning to end also indicated their interest in the training. From this activity, we gained the impression that participants had minimal knowledge about catchment area management to reduce surface runoff and sedimentation on agricultural land. This was evident from the questions and statements participants received regarding the material presented. During this activity, many farmers also asked about pests (fruit flies) that eat away at their crops. These various questions made us even more enthusiastic about expanding our knowledge in the agricultural sector.

4. DISCUSSION

The results of the farmer understanding questionnaire regarding understanding catchment area management, surface runoff, and sedimentation on agricultural land in Rakut Besi Village are shown in Table 1.

4.1 Quantitative Results

The results of the pre-test observations showed that only 2 participants (20%) understood regarding catchment area management, surface runoff, and sedimentation. meanwhile, 6 participants (60%) answered that they did not know and 2 people answered that they were unsure about what was asked. On the other hand, the post-test results were satisfactory; almost all participants understood the topic. Nine participants answered "know," indicating that 90% of the farmers understood the speaker's message.

4.2 Qualitative Results

In-depth interviews with 10 participants revealed that most found the training materials easier to understand because they were delivered in an interactive and contextual manner. One participant stated: *"After this training, I now understand the importance of protecting the catchment area. I used to think it was nothing special."* Field observations also indicated changes in participatory behavior, such as active involvement in group discussions and initiatives to develop follow-up action plans after the training.

Overall, the outreach materials successfully changed participants' perceptions about soil damage caused by surface runoff. Participants began to understand the techniques needed to minimize surface runoff entering their farmland. Furthermore, farmers learned about the underlying causes of crop death and root rot in certain areas. Based on the results of the *pre-test* and *post-test* that have been carried out, it shows that there has been an increase in the knowledge of the farmer groups regarding the material implemented.

5. CONCLUSION

Surface runoff and sedimentation are serious issues that directly impact the productivity and sustainability of agricultural land in hilly areas such as Rakut Besi Village. The findings of this study indicate that a lack of farmers' understanding regarding catchment area management and soil conservation is a key factor exacerbating these conditions.

Through a mixed-methods approach with a qualitative dominance, this research demonstrates that community education through socialization and interactive training significantly improves farmers' knowledge, as evidenced by the comparison between pre-test and post-test results. Interviews and field observations also indicate behavioral changes and increased awareness of the importance of sustainable agricultural land management.

The implementation of conservation strategies such as cover crops, terracing, and participatory catchment area management provides practical steps to reduce runoff and control sedimentation. Therefore, synergy between education, community participation, and the application of appropriate conservation technologies is essential to building an adaptive, productive, and sustainable agricultural system for the future.

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REFERENCES

- [1] N. Naharuddin, R. Rahmawati, A. Ariyanti, E. Erniwati, dan M. Muthmainnah, “Pemberdayaan Masyarakat melalui Teknik Konservasi Tanah dan Air dalam Upaya Mitigasi Dampak Perubahan Iklim (Community Empowerment through Soil and Water Conservation Techniques in Mitigating the Impact of Climate Change),” *Agrokreatif Maret 2023*, vol. 9, no. 1.
- [2] S. Kasus, D. Rakut Besi, dan K. Pamatang Silimahuta, “ANALISIS PEMASARAN JERUK (Citrus Sinensis L).”
- [3] N. Fajeriana dan A. Ali, “The Role of Local Communities in Implementing Soil and Water Conservation Practices for Sustainable Food Production Enhancement in the Salawati District, Sorong Regency,” *Jurnal Penelitian Pertanian Terapan*, vol. 24, no. 1, hlm. 134–147, Mar 2024, doi: 10.25181/jppt.v24i1.3402.
- [4] “yusufkurnia,+Journal+manager,+6.+Cahayadi(60-73)”.
- [5] “M011181374_skripsi_28-04-2023 1-2”.