

# **Four-M Model for Bamboo Conservation in Riverbanks Management (Case Study in Communities of Soppeng Regency South Sulawesi Indonesia)**

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## **ABSTRACT**

This article introduces the bamboo conservation training model along the river bank. This experimental research is part of the development of a community empowerment model involving 20 farmers who manage land on the banks of the Soppeng river. This model was trained in May-August 2019. The aspects of knowledge assessed were knowledge of rivers, erosion, river erosion control in a non-structural, and local vegetation on river banks. While the aspect of skills assessed was a bamboo nursery with branch cuttings, stem cuttings, and rhizome cuttings. The conclusion of research that there was a significant influence on knowledge and skills in bamboo conservation. Therefore, the M Model effectively enhances knowledge and skills in the community.

**Keywords:** *Empowerment, bamboo, erosion*

## **1. INTRODUCTION**

Erosion problems on river banks due to water flow causes loss of yields and land assets. Erosion, which is a natural condition due to river dynamics, can be reduced through conservation. Several studies have shown that vegetation on the banks of the river becomes a protector of river banks with their root ability to create solidity in the material of land [1]. Therefore, planting trees is an essential effort in protecting river quality [2].

Bamboo is vegetation that is easily found throughout Indonesia. Bamboo is located in Indonesia with various species, namely around 159 species and 88 species, including endemic plants. The use of bamboo for diverse human needs makes this vegetation survive. The benefits of this vegetation on river ecosystems are enormous in maintaining the quality of river banks and preventing erosion.

The bamboo plant root system is dense and spreads in all directions. The system contributes to the stability of river banks; in addition to deep roots, bamboo plants facilitate absorption into the soil or beneficial in water conservation. The ability of bamboo plants to absorb rainwater is quite large, namely through the mechanism of interception. Therefore, bamboo can reduce the potential for runoff and erosion. Based on previous studies, during five years of planting, bamboo can

minimize soil erosion volume by 85% in riverbanks [3], [4].

Bamboo vegetation also contributes to climate change actions. The ability of carbon sequestration of up to 62 tons / Ha/year is the reason for conserving this vegetation. [5]. Besides, the use of bamboo crops for various human needs also encourages the importance of bamboo conservation efforts. However, factually, people in Indonesia do not yet have the knowledge and skills in bamboo conservation. As a result, bamboo grows naturally due to natural suitability and climate. The benefits of bamboo for protection are a fundamental reason for developing training.

Community empowerment in bamboo conservation must begin with developing knowledge and attitudes towards bamboo conservation. Environmental knowledge is the driving force for action in environmental protection activities. Various theories have proven that ecological responsibility comes from the human understanding of environmental issues and solutions to their problems [6], [7].

The development of training models in community empowerment activities is aimed at increasing community knowledge and skills. Specifically, this study focuses on developing community knowledge and skills in bamboo conservation along the river banks. The

expected impact with the application of this model is the improvement of community behavior and culture to maintain these endemic plants and directly contribute to ecological riverbank protection. The training method is carried out using the andragogy approach or learning in adults through a structured learning experience. This learning model is different from the learning model in schools with a short time using the class system [8].

The researcher developed the Four-M Model as a training model based on community potential and its problems. The aim of this study is to measure the effectiveness of the application of the Four-M Model to increase community knowledge and skills in bamboo conservation on river banks.

**2. METHODS**

This research is an experimental one group pretest and post-test design study by involving 30 farmers who manage land on the banks of the river Soppeng and researching May-August 2019. The aspects of knowledge assessed were knowledge of rivers, erosion, non-structural river erosion control, and local vegetation on river banks. The skill aspect assessed was a bamboo nursery with branch cuttings, stem cuttings, and rhizome cuttings.

**3. RESULT AND DISCUSSION**

**3.1. Characteristics of the Four-M Model**

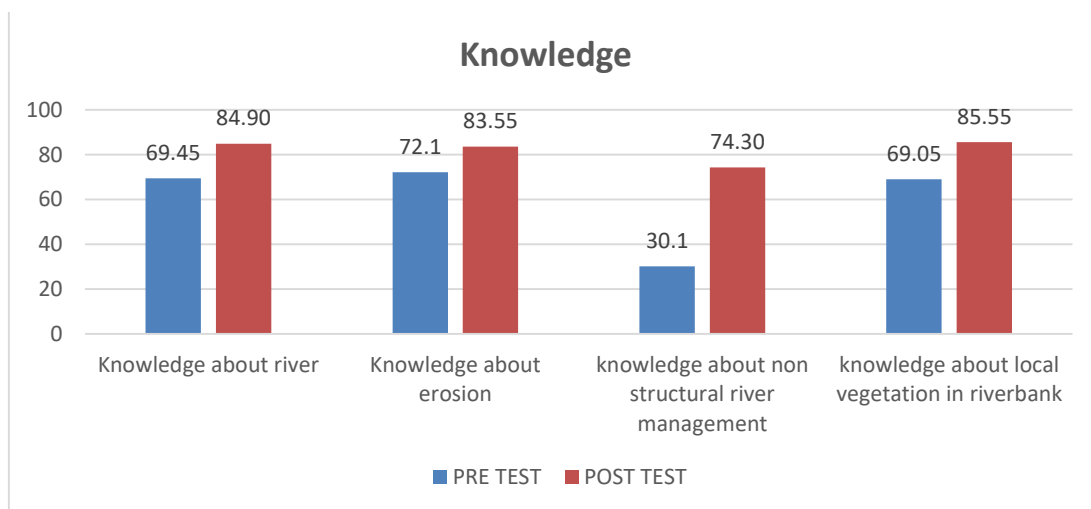
The syntax of the Four-M model that is carried out refers to a method that is compatible with several components - the model of andragogy and problem-based learning. There are four syntaxes of interaction activities between instructors and participants in the model as follows: (1). Mappikiri is a Bugis language expression that implies an awareness within oneself to find answers to environmental problems on river banks.

This awareness will give birth to the spirit to participate in preventing liver damage. The instructor provides the opportunity for participants to express concerns on the riverbank based on their experience. Instructors' using flipchart as learning resources, (2) Mappanessa, is an expression in the Bugis language, which implies the existence of beliefs in participants about the damage that occurred, as well as the causes and risks. Through this syntax, the participants can identify the type of environmental damage on the river banks. (3). Mappattjung is an expression in the Bugis language, which implies decision making about the steps to repair ecological damage. Through this syntax, there is a process of directing participants by the instructor through discussion activities to formulate strategic measures and actions in solving problems. (4). Mappedeceng is an expression in Bugis Language, which implies a story that develops from the previous decision making. The action was a result of the participants' internal motivation to take part or participate in solving the problem of flooding and erosion on the river banks. This syntax aims to divide the role of each participant in the implementation of training actions. The instructor's role is to direct participants to take responsibility for the given task.

The support system of this model is the implementation guide, indoor and outdoor classes, and flipcharts as a discussion aid. The developing social network is intensive communication between participants, while the instructional impact is to achieve the increase of knowledge, skills, and attitudes of farmers' environment.

**3.2. Descriptive Analysis**

Descriptive test of community knowledge about river conservation Statistical test results about community knowledge divided into four indicators is presented in figure 1.



**Figure 1** Test the Knowledge of Farmers about River Conservation

Figure 1 shows that before applying the knowledge model about rivers, erosion, and vegetation on river banks are in the high category (between 60.01 - 80.00). The knowledge of non-structural river management is relatively low (between 20.01 – 40.00). Furthermore, community knowledge after the application of the conservation model shows very high categories (between 80.01 – 100) on three aspects of learning. Knowledge of non-structural river management is increasing well.

The community empowerment model in river conservation also develops community skills in bamboo

cultivation. This model introduces three types of cultivation, namely bamboo stem cutting, bamboo branch, and bamboo rhizome. The researcher tested the community's skills before applying the model, and the results were that the community skills were relatively low.

The detailed test results are presented in figure 2.



**Figure 2** Descriptive test of community performance in riverbank conservation

The skills of farmers in bamboo cultivation with cutting systems in the high category (60.01 - 80). This indicates that farmers often do this activity. In the skills of farmers to make bamboo seedlings using the Branch technique, the medium category (40.01 - 60). This value indicates that there are still farmers who are not familiar with this method. The bamboo rhizome technique is also not yet recognized by farmers. This is seen in the low value of skills (20.01 - 40). After applying the model, there was a very significant increase in skills. Farmers' skills in stem cutting techniques and branch technics increase and reach grades between 80.01 - 100 or in

excellent categories. Medium technical skills rhizome show a high class.

**3.3. Test Statistics**

The statistical test of the application of the model becomes a reference in determining the effectiveness of the treatment. The difference between community knowledge before and after treatment shows that the model applied is effective in increasing community knowledge. The results of different community knowledge tests before and after treatment are presented in table 1.

**Table 1.** Test the statistical knowledge of the community before and after treatment

Information	t Value	t Table	Decision
Knowledge about river	9.454	1.729	There is a different knowledge about the river between the pretest and post-test scores
Knowledge about erosion	5.719	1.729	There is a different knowledge about erosion between the pretest and post-test scores
Knowledge about non-structural river management	19.476	1.729	There is a different knowledge about non-structural river management between the pretest and post-test scores
Knowledge about local vegetation in riverbank	8.515	1.729	There is a different knowledge about local vegetation in riverbank between the pretest and post-test scores

The results of statistical tests for the four indicators show that there is a difference between community knowledge before and after treatment. The higher value of t value than the value of t table is the basis of decision

making. By this, the Four-M model is useful in increasing public knowledge in riverbank conservation.

Statistical tests to analyze differences in community skills in bamboo cultivation are presented in Table 2.

**Table 2.** Different tests of community skills before and after treatment

Information	t Value	t Table	Decision
Bamboo stem cutting	8.762	1.729	There is a difference skill about bamboo stem cutting between the pretest and post-test score
Bamboo branch	28.536	1.729	There is a difference skill about bamboo branch between the pretest and post-test score
Bamboo Rhizome	26.226	1.729	There is a difference skills about bamboo rhizome between the pretest and post-test score

Different test results showed value higher than t table. They indicated that there were significant differences between farmers' skills before and after treatment. The Four M useful model enhances the community's knowledge and competence in bamboo cultivation. Also, their understanding of the conservation and protection of river banks will contribute to the habit of maintaining the riverbanks.

### 3.4. Discussion

The riverbanks damage is a new natural phenomenon after much deforestation in upstream. The phenomenon causes flooding and erosion and naturally worsen the riverbanks. Even the worse condition that the river flow was eroding the farmers' land in the form of rice fields and gardens. Therefore, the empowerment model is a guide to invite farmers and to respond to this natural phenomenon. Consequently, they will look for solutions to overcome the protection of riverbanks in a non-structural way or using a vegetation system.

The activity of planting or cultivating bamboo for communities is a new idea because the previous thought that bamboo plants are endemic plants that grow wild around the farmers' land. Even if there are people who plant bamboo, they usually do it just as a protector around the house, or to meet particular needs, but not for conservation purposes. Therefore, farmers' knowledge regarding several ways of bamboo cultivation is also minimal. The empirical of community knowledge for bamboo planting is only limited.

The introduction of conservation methods is easy to do for farming communities. This simplicity was due to the training material being very close to the daily activities of farmers as well as to the erosion and flooding problems they experienced.

The syntax of the Four-M Model following the theory of learning andragogy. The existence of four stages that begin with intellectual and skill development activities. Furthermore, participants were actively involved in discussing the material and issues intensively. The results

of the discussion process stimulated the community to reflect on and make decisions. The final stage is the improvement of learning outcomes and evaluation [9], [10].

## 4. CONCLUSION

Based on the analysis, there was a significant influence on knowledge and skills in bamboo demonstrations in Soppeng District. The results showed that the Four-M Model effectively increased knowledge and skills in the community.

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