

PAPER • OPEN ACCESS

The Impacts of Change Forests into Agricultural Land to Social Economic Conditions Society in the Upstream of Bedadung Watershed

To cite this article: J M Petrina *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **515** 012045

View the [article online](#) for updates and enhancements.



The Impacts of Change Forests into Agricultural Land to Social Economic Conditions Society in the Upstream of Bedadung Watershed

J M Petrina¹, F K Alfariy¹, I Andriyani², and L P Suciati²

¹ Student of PS Masters in Agricultural Water Resources Management, Postgraduate Faculty, University of Jember

² Agricultural Water Resources Management, Postgraduate Faculty, University of Jember

Corresponding author's email address: jenitramilan@gmail.com

Abstract: The upstream areas of Bedadung watershed are generally hilly with steep slopes, so have highly landslides potential and erodibility. In the upstream areas occur illegal logging of protected forests and changes in forest plant around the Argopuro mountains into coffee plant, sengon, and horticultural crops. This condition having impact on increasing flooding during rainy season, and water shortage during dry season. This study aims to identified conservation measures in the upstream area, to describe social impact change, and to calculate economic impact community. The research method uses quantitative descriptive analysis. The data collected using questioners and interviews. Total respondents are 60 farmers who manage land in the upstream of Bedadung. The results explain that the conservation actions which have been carried out in the upstream community are the terraces, agroforestry system, and reducing the amount of chemical fertilizer used. The impact of social changes on natural conservation are land use and natural resources management which increase environmental degradation. Environmental degradation impacts on reducing agricultural revenue.

Keywords: Upstream, Conservation, Agroforestry, Environmental Degradation

1. Introduction

Jember Regency is one of the areas located on Java Island, precisely in East Java Province. Jember Regency is surrounded by three large watersheds, namely Bedadung watershed, Mayang watershed, and Tanggul watershed. Bedadung watershed is one of the largest watersheds in Jember Regency [1]. The Bedadung watershed is one of the Jember watersheds that experience the threat of water quality pollution. All human activities in the upstream, central or urban areas, and downstream cause pollution of watershed waters.

Some areas in Jember Regency have the potential for natural disasters such as floods and landslides are Panti, Sukorambi, and Silo Districts [2]. The cause flash floods of according to the community is that the forest around the mountain slopes is already deforested and high intensity of rainfall results in the forest being unable to absorb water until later there are flash floods and landslides. In addition, land cover or forest vegetation is converted into plantations and settlements. The forest area in the upper reaches of the Bedadung watershed is only 93.16 km² or 16.25% of the Bedadung watershed area [3]. UU 41 of 1999 states that the minimum area of forest in a watershed area is 30% of the total



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

watershed area. As a result of the lack of forest area, erosion is in the upstream area. The value of erosion in upstream Bedadung watershed showed 92,57 ton/ha/year [4]. The erosion value is included in the category of moderate erosion [5].

Conservation activities can do in the upstream area of the Bedadung watershed, including maintenance activities according to the situation and condition. Conservation activities are carried out to reduce the condition of deforested land in the upstream area of the watershed, so that it requires the cooperation of various parties that are integrated, especially the involvement of the village community. Integrated water resources management is a combination of local wisdom and modern technology by involving community participation, this method has been applied to human life in Thailand [6]. Meanwhile this is similar to Vishnudas [7], saying that integrated and sustainable watershed management in India needs to adjust local conditions and be supported by appropriate institutional arrangements. At present water is no longer a public good, but is an item that has economic value and has a social dimension [8]; [9].

This study purpose (1) to identify conservation activities in the upstream Bedadung watershed Jember Regency East Java, and (2) to describe social impact change, and (3) to calculate economic impact community in the upstream Bedadung watershed Jember Regency East Java.

2. Methods

The study was conducted in Bedadung watershed in Jember Regency East Java. Administratively Bedadung watershed the most 96% in Jember Regency, while 4% in Bondowoso Regency [10]. The map of the research area is presented in Figure 1. The upstream area of the Bedadung River Basin covers the Sumberjambe, Jelbuk, and Panti Districts, while the downstream is in the Puger District, seen in Figure 2. This research conducted was deliberately chosen by two Sub-Watersheds, that is Jompo Sub-watershed in Sukorambi Sub-District, and Antrokan Sub-Watershed in Patrang District. Both sub-watersheds are part of the Bedadung watershed. The reason for choosing Sukorambi and Patrang District was because the location was part of the upstream Bedadung watershed and had experienced natural disasters of flash floods and landslides in 2002. The need for irrigation in Patrang District depends on the availability of water in the upper Jompo watershed located in Sukorambi District. The map of the research area is presented in Figure 3.

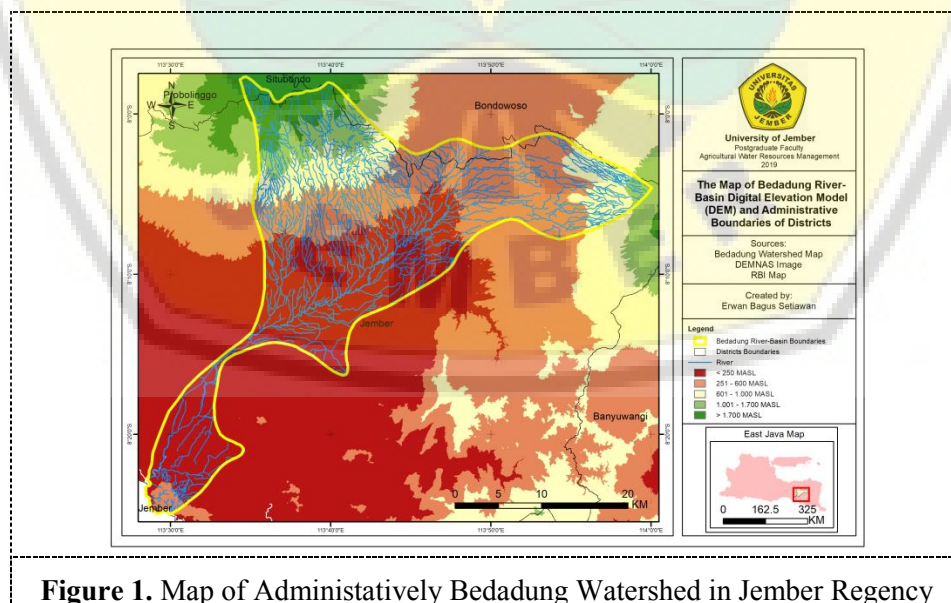


Figure 1. Map of Administratively Bedadung Watershed in Jember Regency

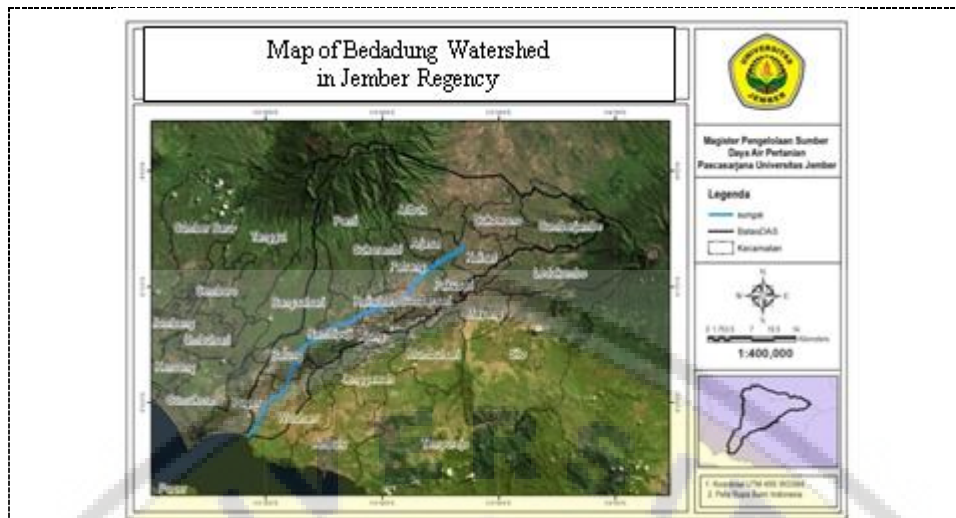


Figure 2. Map of Upstream and Downstream Bedadung Watershed in Jember Regency

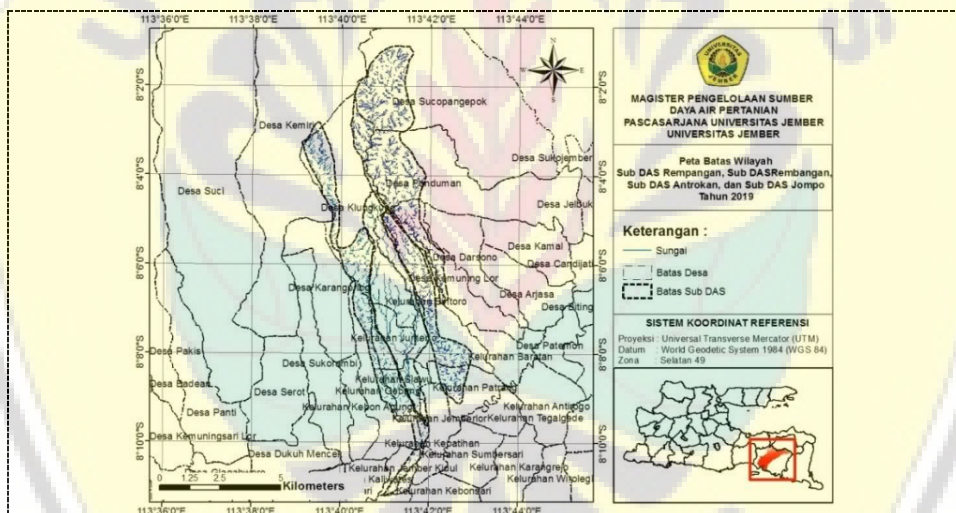


Figure 3. Map of Sub DAS Jompo and Sub DAS Antrokan

This research uses a participatory approach to collecting data and information. Data collected method with field observation, interview, and literature studies. Determining of sampling use slovin and stratified random sampling.

$$n = \frac{71}{1 + N.e^2}$$

$$n = \frac{71}{1 + 71.(0,05)^2}$$

$$n = 60 \text{ Respondent}$$

Primer data collection technique is done by field observations and interviews. According to Muslimin [11], Field observation is a way to obtain data information by observing behavior from the target of observation. Interviews were conducted to get information about the main things verbally between the interviewer and the respondent. Interview activities were carried out with the

questionnaires for the chosen 60 respondents include the sub-District Head, Village Head, Farmers, and the community in the upstream Bedadung watershed. The information includes community income data, types of plants, community knowledge natural disasters, conservation activities that have been carried out, and potential natural resources in the upstream of Bedadung watershed. Secondary data is data obtained from literature studies, and documents from the Forestry Service in the form of forest area data, number of trees, and number of conservation plants. Data from the Central of Statistics Jember Regency is like data on population in the upstream of Bedadung watershed.

The first problem statement is to identify conservation activities carried out by the upstream community, using descriptive analysis. Descriptive analysis is a study conducted to determine the existence of a variable, either only on one or more variables without making comparisons and looking for the relationship of that variable with other variables [12]. Based on the results of interviews and questionnaires to respondents, then identification of soil and water conservation activities that have been carried out by communities around the upstream of the Bedadung watershed.

The second problem to inform social impacts from changes land use in the upstream of the Bedadung watershed with descriptive analysis. Identify social changes in the upstream community by looking at things as follows:

- a. Utilization of upstream community land for food crops
- b. Increase population, resulting in changes in land use from dry land into residential land
- c. The majority of the population's livelihood as farmers
- d. Low level of knowledge and level of education
- e. The use of technology to manage natural resources

The third problem, to calculate economic impact community in the upstream Bedadung watershed Jember Regency East Java, with community income analysis. Income analysis is done by calculating the value of R / C ratio, and Break Event Point (BEP) of rice farming in Sumber Makmur farmer groups in Jumerto Village, Patrang District. Income is total revenue minus total costs [13].

3. Results and Discussion

3.1. Identification of conservation activities by upstream community

The results of interviews of 60 respondents in the upstream area of the Bedadung watershed, explained that in the upstream area there were several vulnerabilities, such as floods, landslides, earthquakes, winds, and drought. The highest result of disaster presentation is flood disaster with a percentage value of 29%, while the lowest percentage is drought with a percentage value of 1%. This is because in the upstream area there is a lot of tree felling and land use changes that were previously forested, turned into plantations, reinforced research results from Wardhono [14], in upstream of Bedadung happen is illegal logging and the conversion of forest plants around the Argopuro to plantation crops such as coffee, cocoa and rubber. The Argopuro as protected forests are water catchment areas, turned into plantations and production forests, so that they are subjected to logging and deforestation. [15].

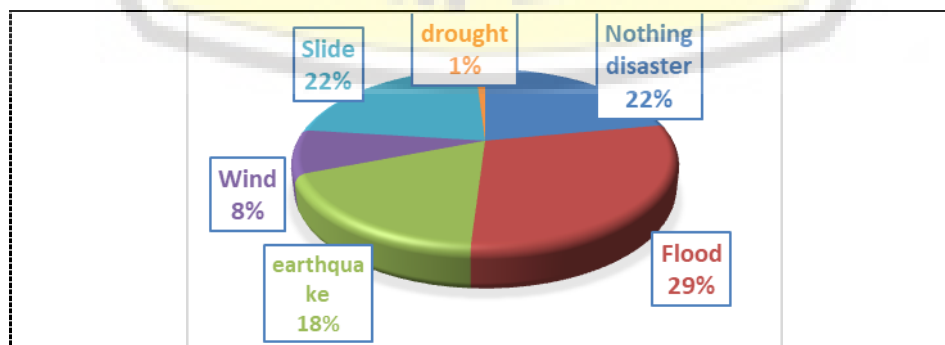
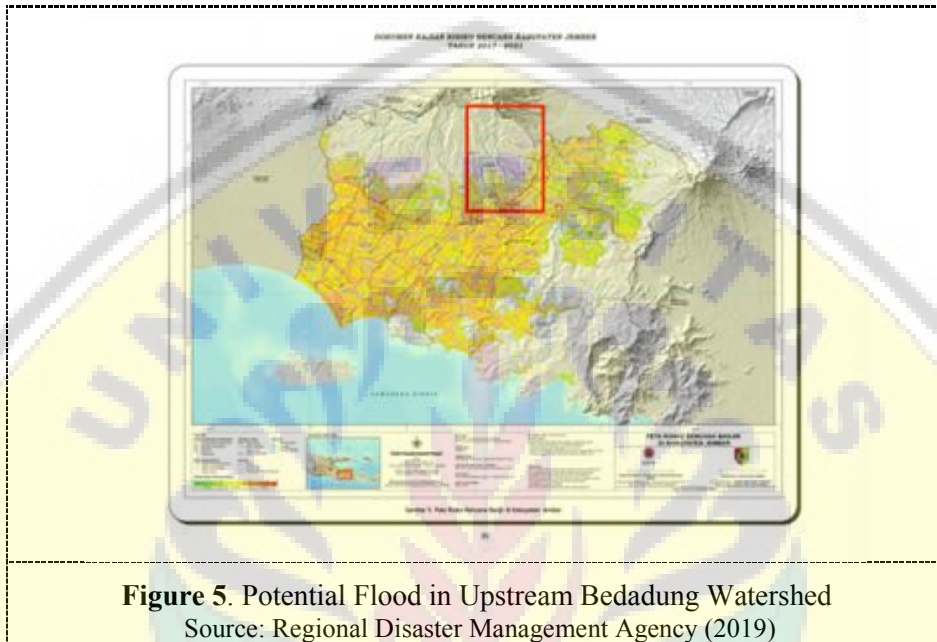


Figure 4. Potential Disasters in Upstream Bedadung Watershed

Source: Primer Data, processed (2019)

The results of the analysis of the data obtained in the field are also strengthened by the results of stakeholder interviews Regional Disaster Management Agency / BPBD Jember Regency, explained the upstream area of the Bedadung watershed has the potential to be flooded during the rainy season, this has been proven in 2006 the Panti District has experienced flash floods which claimed thousands of victims. Figure 5 is map of floods in Jember Regency. On the red square, the location of the 2 sub-watersheds conducted by the study, there is a reddish yellow, meaning that the color shows a high risk indicator for flood disaster.



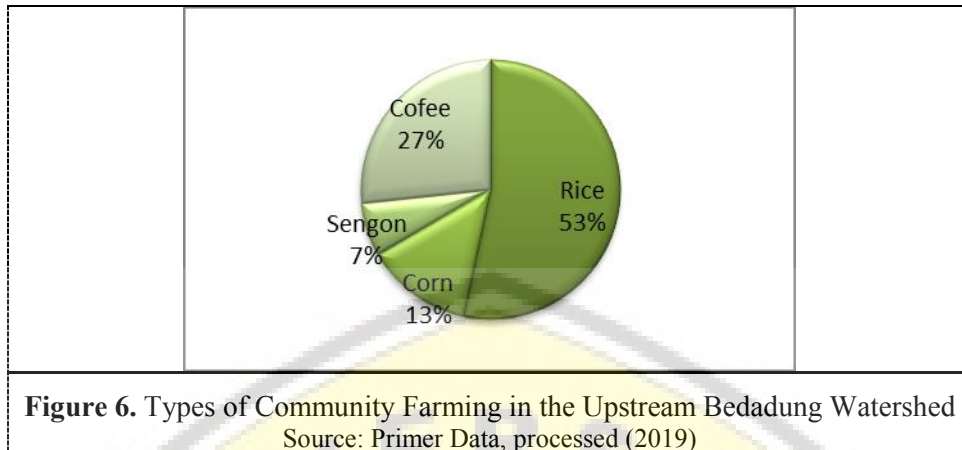
Conservation activities that have been carried out by communities in the upstream watershed are making terraces on sloping land, planting durian and avocado trees as coffee shade plants. The aim is to reduce the condition of deforested forest in the upstream watershed, so that it requires the cooperation of various parties that are integrated, especially the involvement of village communities. Integrated water resources management is a combination of local wisdom and modern technology by involving community participation, his method has been applied in Thailan (Kongsat, Annongrit, Kitti, 2009). Meanwhile similar things by Vishnudas (2006), is integrated and sustainable watershed management in India, needs to adapt to local conditions and be supported by appropriate institutional arrangements.

3.2 The social impact is due to changes in land use in the upstream of the Bedadung Watershed

Identify social changes in the upstream community by looking at things as follows:

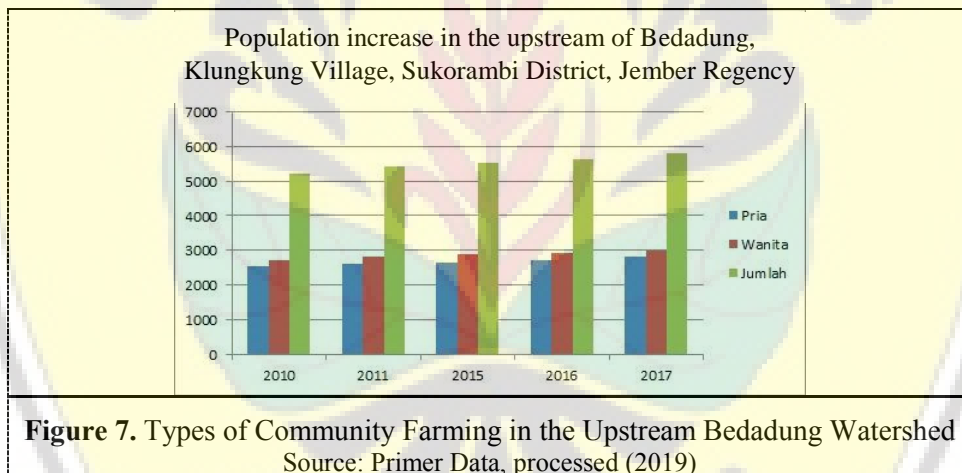
a. Utilization of upstream community land for food crops

Based on the results of interviews with respondents, it appears that farming carried out by the upstream community is rice, coffee, corn, and sengon. Farms that are mostly done by upstream are rice with a value of 53%. The magnitude of each percentage of upstream community farming is explained in Figure 6. Rice is a food crop, whereas the upstream area is not suitable for farming food crops. The upstream area functions as a regulator of the hydrological system, to supply water to the downstream area and store water during the dry season. The types of plants that are suitable for upstream areas are perennials, such as durian, mahogany, avocado, bamboo, and petai.



b. Increasing population

The population in the upstream area is the Klungkung Village, Sukorambi Subdistrict, each budget increase (Statistics Indonesia, 2018), illustrated in Figure 7. As a result of increasing population, food and shelter needs will increase. The results of the upstream community interviews prove that there is a change in the function of the forest into a coffee plantation. In addition, the above fields were planted with sengon. This resulted in erosion, landslides and floods that had occurred in 2002 and 2006.



c. Occupation of the population as farmers

Based on the results of interviews with respondents the type of community work in the upstream Bedadung watershed is the majority work as farmers with the highest percentage value, which is 53%. The rest are working as entrepreneurs, and farm laborers.

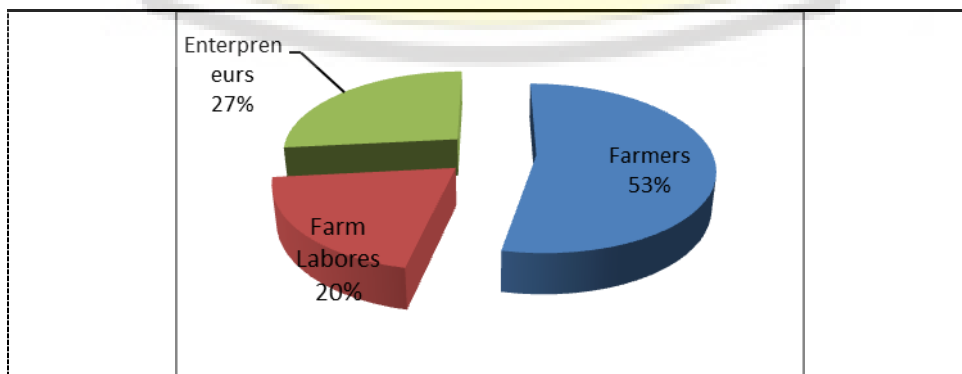


Figure 8. Types of Community Work in Upstream Bedadung Watershed
Source: Primer Data, processed (2019)

d. Low knowledge and education

The results of the interviews of 60 respondents obtained a percentage of 50% of upstream community education level is elementary school, then 29% junior high school, the rest have high school education, have a degree, and do not attend school. These results provide the conclusion that the low education has an impact minimum knowledge about natural resource management and the function of preserving nature, so need assistance from relevant stakeholders or an environmental community.

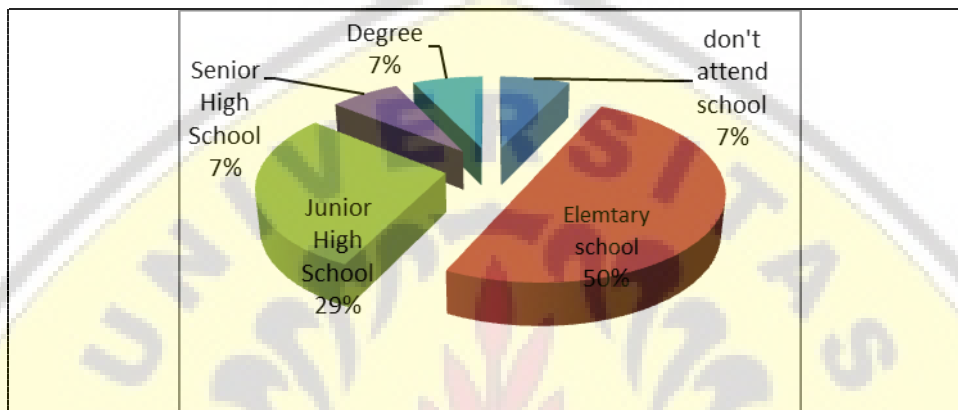


Figure 9. Education Level in Upstream
Source: Primer Data, processed (2019)

e. The use of technology to manage natural resources

Water from Klungkung Village, Sukorambi Subdistrict, use to the people in Jumerto Sub-District drain clean water by making water supply pipes with paralons. The water is managed by upstream community self-help, while the community in Jumerto Sub-District Patrang District pays Rp 10,000 for each house every month. These costs are used for maintenance.

3.3 The economic impact is effect changes in land use in the upstream

Based on the results of farmer group interviews, information about revenue farmer in the past 10 years was more than now. Ten years ago, farmers could plant rice for three seasons in one year, but now farmers only plant two seasons of rice and one season corn. The selling price of grain is higher than that of corn. Changes in cropping patterns due to reduced water availability. The price of grain is Rp 4,700 / kg, while corn is Rp 2,000 / kg. The revenue of farmer in the upstream watershed is calculated by revenue analysis. To calculate farm income, two main information are needed, namely expenses for the farm run during the specified time and all receipts. Farm receipts are the value of money received from sales, obtained from the production multiplied by the price. Analysis of rice farming income is as follows:

Table 1. Fix Cost

No	Cost component	Total	Total (Rp)	Age of Use	Total
1	Land lease	1 ha	1500000	1 season	1000000
2	Land Tax	1 ha	200000	2 season	200000
3	Irrigation	1 ha	225000	3 season	225000
Total					1425000

Source: Primer Data, processed (2019)

Table 2. Variable Cost

No	Cost component	Total (Kg)	Cost / Unit	Total
1	Seed	100	11000	1100000
2	Urea fertilizer	50	5000	250000
3	ZA fertilizer	50	7000	350000
4	Phonska	50	2300	115000
5	Organic fertilizer	50	1000	50000
No	Wage for Labor	Total (HOK)	Cost / Unit	Total
1	Wage for Planting	20	35000	700000
2	Wage for Weeding	15	35000	525000
3	Wage for fertilezation	3	35000	105000
4	Wage for spraying	2	35000	70000
5	Wage for harvest	10	35000	350000
6	Freight costs			50000
Total				3665000

Source: Primer Data, processed (2019)

Table 3. Receipts

Quantity (Q)	Price (P)	Total	Receipts
4800	4700	22560000	22560000

Cost and Revenue Analysis

$$\begin{aligned}
 TC &= FC + VC \\
 &= 1425000 + 3665000 \\
 &= 5090000
 \end{aligned}$$

$$\begin{aligned}
 TR &= P \times Q \\
 &= 4700 \times 4800 \\
 &= 22560000
 \end{aligned}$$

$$\begin{aligned}
 \text{Revenue} &= TR - TC \\
 &= 22560000 - 5090000 \\
 &= 17470000
 \end{aligned}$$

R/C ratio Analysis

$$\begin{aligned}
 \text{R/C ratio} &= TR / TC \\
 &= 4.43
 \end{aligned}$$

R/C ratio value of more than 1 means that the use of these costs is productive or profitable

Analisis Break Event Point (BEP)

$$\begin{aligned}
 \text{BEP}_{(Q)} &= \frac{FC}{(P-VC)} \\
 &= \frac{1425000}{4700-763.541} \\
 &= 3936.46 \text{ Kg}
 \end{aligned}$$

$$\text{BEP}_{(S)} = \frac{FC}{(1 - VC/S)}$$

$$= \frac{1425000}{(1-(3665000/22560000))}$$

$$= \text{Rp } 1.701.402$$

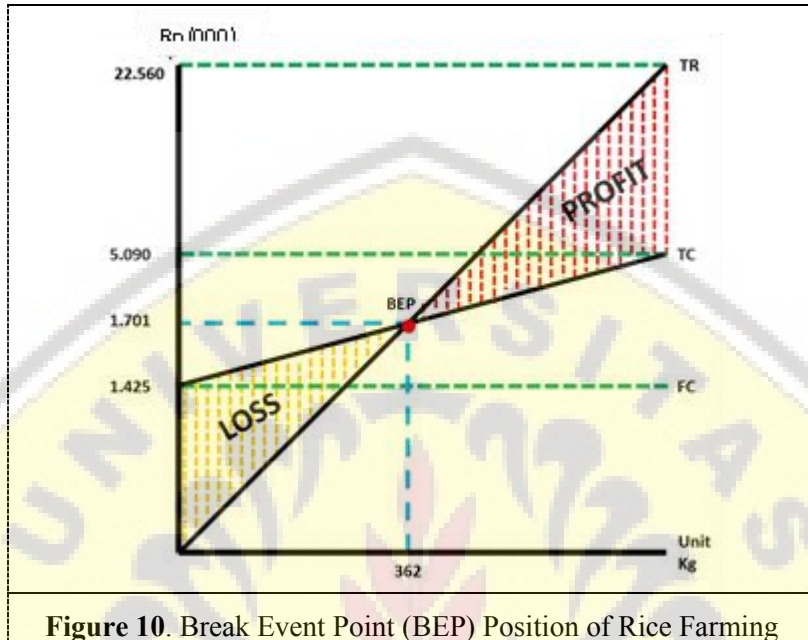


Figure 10. Break Event Point (BEP) Position of Rice Farming

4. Conclusion

The conservation actions which have been carried out in the upstream community are the terraces, agroforestry system, and reducing the amount of chemical fertilizer used. The impact of social changes on natural conservation are land use and natural resources management which increase environmental degradation. Environmental degradation impacts on reducing agricultural revenue.

Acknowledgments

This research was funded by Grant of DRPM the Ministry of Research and Technology education and college by the Postgraduate Research Thesis - Student Thesis Research (PPS-PTM) Budget Year 2019, through Decree Number: 7/E/KPT/2019 with the Contract Number of DRPM 7/E/KPT/2019: "Model Konservasi Yang Berkelanjutan Berbasis Partisipasi Masyarakat Dan Jasa Lingkungan Di DAS Bedadung." Acknowledgments to the Farmer Groups, Forest Village Community Institutions who have assisted in conducting research activities.

References

- [1] M. Prosdocimi, P. Tarolli, and A. Cerdà, "Mulching practices for reducing soil water erosion: A review," *Earth-Science Rev.*, vol. 161, pp. 191–203, 2016.
- [2] M. Fernández-Fernández, C. Vieites-Blanco, M. X. Gómez-Rey, and S. J. González-Prieto, "Straw mulching is not always a useful post-fire stabilization technique for reducing soil erosion," *Geoderma*, vol. 284, pp. 122–131, 2016.
- [3] P. R. Robichaud, S. A. Lewis, J. W. Wagenbrenner, L. E. Ashmun, and R. E. Brown, "Post-fire mulching for runoff and erosion mitigation. Part I: Effectiveness at reducing hillslope erosion rates.," *Catena*, vol. 105, pp. 75–92, 2013.
- [4] M. F. Anshari, E. Boedianto, A. A. R. Fernandes, and E. Arisoesilaningih, "Hydroseeding application using pioneer local plant seeds for coal postmining soil in Tanah Laut Regency , South Kalimantan," *J. Degrad. Min. Lands Manag.*, vol. 5, no. 4, pp. 1335–1345, 2018.
- [5] D. Azalia, C. Retnaningdyah, and E. Arisoesilaningih, "Germination of seeds of some local

- pioneer plant species in different hydroseeding mulches for revegetation of post-coal mining soil,” *J. Dregaded Min. Lands Manag.*, vol. 3, no. 4, pp. 609–615, 2016.
- [6] W. D. Blankenship, L. A. Condon, and D. A. Pyke, “Hydroseeding tackifiers and dryland moss restoration potential,” *Restor. Ecol.*, pp. 1–12, 2019.
- [7] G. Lee, R. A. McLaughlin, K. D. Whitely, and V. K. Brown, “Evaluation of seven mulch treatments for erosion control and vegetation establishment on steep slopes,” vol. 73, no. 4, pp. 434–442, 2018.
- [8] D. R. Kendarto *et al.*, “ADDITIONAL STUDY OF GUAR GUM AND SEEDS OF BERMUDA GRASS,” *J. Rekayasa Lingkungan.*, vol. 11, no. 1, pp. 25–30, 2018.
- [9] S. F. Vaughn *et al.*, “Evaluation of alternatives to guar gum as tackifiers for hydromulch and as clumping agents for biodegradable cat litter,” *Ind. Crops Prod.*, vol. 43, no. 1, pp. 798–801, 2013.
- [10] M. Giolo, F. Ferrari, and S. Macolino, “Estimation of Base Germination Temperature of Ten Seeded-Type Estimation of Base Germination Temperature of Ten Seeded-Type Bermudagrass Cultivars,” *Eur. J. Hortic. Sci.*, vol. 79, no. June 2014, pp. 129–134, 2016.
- [11] J. T. Brosnan and J. Deputy, “Bermuda Grass,” *Turf Management, College of Tropical Agriculture and Human Resources (CTAHR). University of Hawai‘i at Manoa*, 2008. [Online]. Available: http://turfgrass.ctahr.hawaii.edu/downloads/Bermudagrass_NEW2.pdf.
- [12] M. K. Haruni Krisnawati, Evelina Varis, Maarit Kallio, *Paraserianthes falcataria (L .) Nielsen: Ecology, silviculture and productivity*. Bogor, Indonesia: Center for International Forestry Research (CIFOR), 2011.
- [13] O. Range *et al.*, “Soil Temperature Conditions for Vegetable Seed Germination (in degrees F) Days to Appearance of Seedlings at Various Soil Temperatures from Seed Planted at ½ " Depth Soil temperature in degrees F.”
- [14] B. Wasis and H. Sa, “Pertumbuhan Semai Sengon (*Paraserianthes falcataria (L .) Nielsen*) Pada Media Tanah Bekas Tambang Kapur dengan Penambahan Pupuk Kompos dan NPK,” *J. Silvikultur Trop.*, vol. 09, no. 01, pp. 51–57, 2019.