Mitigation Option on Converted Forest Zone Through Agroforestry System for Improving the Hydrological Function of Upper Singkil Watershed

Bejo Slamet[1,3], Samsuri[1], Abdul Rauf[2], Rio Kristian Sinaga[1]
[1]*Department of Forest Management, Faculty of Forestry, Universitas Sumatera Utara, Jl. Tri Dharma Ujung No 1 Kampus USU, Medan 20155, Indonesia*
[2]*Department of Agrotechnology, Faculty of Agriculture, Universitas Sumatera Utara, Jl. A. Sofyan Kampus USU, Medam 20155, Indonesia*
[3]*Natural Produk Base of Technology, Centre of Excellent, Universitas Sumatera Utara, Jl. Dr. T. Mansur No. 9 Kampus USU, Medan 20155, Indonesia*

Keywords: Converted Forest Zone, Agroforestry System, Community Preference, Mitigation Option, Upper Watershed

Abstract: The aimed of this study was to identify the mitigation option for improving the converted forest zone function on Upper Singkil Watershed through agroforestry system. Mitigation option focus on the preferences of community in the selection of the agroforestry system. Dryland mixture farming of shrubs was the dominant land use of the forest zone. Agroforestry is one of the mitigation options to restore the forest hydrological function of the upper watershed and also improve the community's access to the forest zone legally. There are two types of agroforestry system in Upper Singkil Watershed, which is simple agroforestry and complex agroforestry. The community tends to choose the simple agroforestry system due to economic reason and the ease of management. The crops preference by the community were *Musa paradisiaca, Coffea arabica, Manihot esculenta, Citrus sinensis, Cacao Theobroma, Zea mays, Oryza sativa,* and *Saccharum officinarum*. The trees preference by the community were *Durio zibethinus, Archidendron pauciflorum, Parkia speciosa, Cinnamomum verum*, and *Arenga pinnata*. Soil and water conservation techniques applied by the community are still simple vegetative techniques due to the cost of applying soil and water conservation techniques reason. The soil water conservation knowledge and skills application techniques of the community need to be improved.

1 INTRODUCTION

The total area of forest zone in Upper Singkil Watershed in 2017 identified has been converted is 55,302.90 hectares. The forest zone is converted into an open area of 1,073.64 hectares and a dry land mixture farming of shrubs of 45,548.94 hectares.

The location of this study is in the upper Singkil watershed, which is administratively included in the Pakpak Bharat Regency. Agroforestry development based on soil and water conservation technology is one of the approaches to restore the forest hydrological function of the upstream watershed and in addition to giving farmers land.

In general, Agroforestry practiced developing a more land use sustainable form that can improve land productivity and the rural community welfare (Leakey, 1996).

The aimed of this study was to identify the mitigation option for improving the converted forest zone function on Upper Singkil Watershed through agroforestry system. Mitigation option focus on the preferences of community in the selection of the agroforestry system.

2 METHOD

2.1 Research Location

The location of this study is in the upper Singkil watershed, which is administratively included in the Pakpak Bharat Regency. Agroforestry development based on soil and water conservation technology is one of the approaches to restore the forest hydrological function of the upstream watershed and in addition to giving farmers land.

The method used in this study is exploration to determine the agroforestry patterns applied by the community, the diversity of plant species and the

Slamet, B., Samsuri, ., Rauf, A. and Sinaga, R.
Mitigation option on converted forest zone through agroforestry system for improving the hydrological function of Upper Singkil Watershed.
DOI: 10.5220/0008552502480251
In *Proceedings of the International Conference on Natural Resources and Technology (ICONART 2019)*, pages 248-251
ISBN: 978-989-758-404-6

number of individual types of plants in the agroforestry plots encountered. There were 31 agroforestry plots from 4 sub-districts, Siempat Rube, Salak, Sukaramai and Tinada. Interviews were also conducted with landowners or farmers who managed the land.

2.2 Data Analysis

The research data is analyzed using descriptive statistics and displayed in the form of tables and graphs.

3 RESULTS AND DISCUSSIONS

3.1 Forest zone conversion

Forest cover area tends to decline from 1990 to 2016, while the extent of dryland agriculture is increasing (Fig. 1 and Fig. 2), it indicates that there has been a conversion from forest land cover to another use, especially for dryland agriculture. This conversion occurs because the allocation of land designated for non-forestry uses is only 19% of the total area of Pakpak Bharat Regency.

Conversion of land cover can increase erosion and sedimentation originating from the agricultural area (Momm et al., 2019).

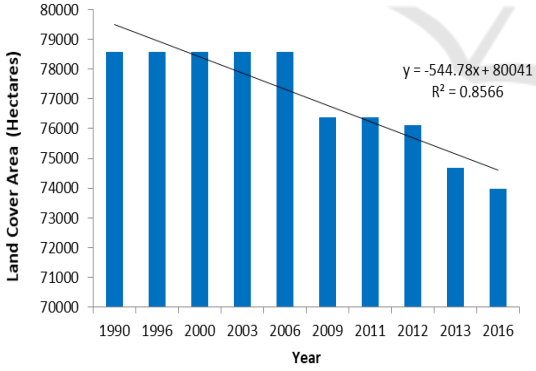

Figure 1: Trend of the forest cover area loss in upper Singkil watershed.

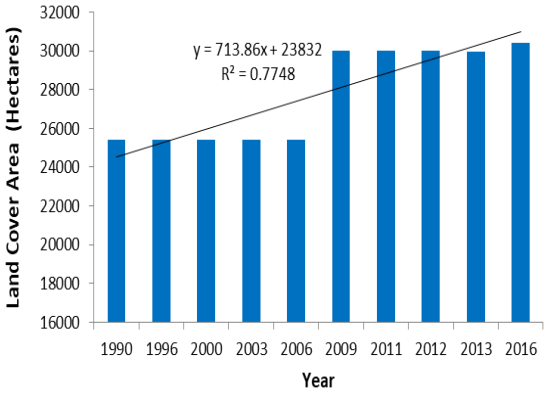

Figure 2: The increasing trend of dry land agriculture area in upper Singkil watershed.

3.2 Agroforestry pattern

There are two types of agroforestry system in Upper Singkil Watershed, which is simple agroforestry and complex agroforestry. The community tends to choose the simple agroforestry system due to economic reason and the ease of management.

Generally, A wide range of traditional cropping patterns applied by farmers in the study location is still included in the definition of agroforestry (Ramachandran Nair, 2014). Most of the agroforestry patterns found in the upstream region of the Singkil Watershed Pakpak Bharat Regency are included in the category of shade trees or shade canopy (Schroth and do Socorro Souza da Mota, 2014). Trees planted by farmers are used as shade for understorey with seasonal crops. Also, patterns of complex multistrata agroforestry systems (CMSAF) were found both based on shade-tolerant understorey crops and Mixed systems of understorey and overstorey trees although were not dominant.

Fruit-producing trees, food or drinks are the ones most often planted by farmers for agroforestry. Figure 3 shows that *Durio zibethinus, Archidendron pauciflorum, Parkia speciosa, Cinnamomum verum*, and *Arenga pinnata* are the most commonly planted species. These trees are known as food-producing in the form of fruit or can be used for drinks. Economically, this tree is faster to provide money compared to a tree which only produces wood. This reason is the factor that influences tree selection for agroforestry by farmers in the upper Singkil watershed.

The same trend was found during the selection of crops. Fruit-producing plants, food, and drinks are the main choices. The next choice is staple food-producing plants such as corn and rice. The most common species are *Musa paradisiaca, Coffea*

arabica, *Manihot esculenta*, *Citrus sinensis*, *Cacao Theobroma*, *Zea mays*, *Oryza sativa*, and *Saccharum officinarum* (Figure 4).

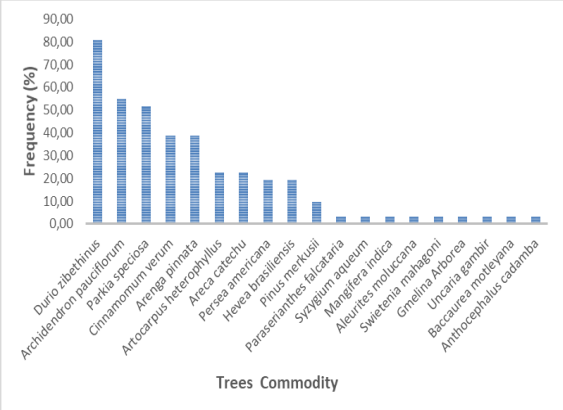

Figure 3: The frequency of forestry commodity found from the whole plots.

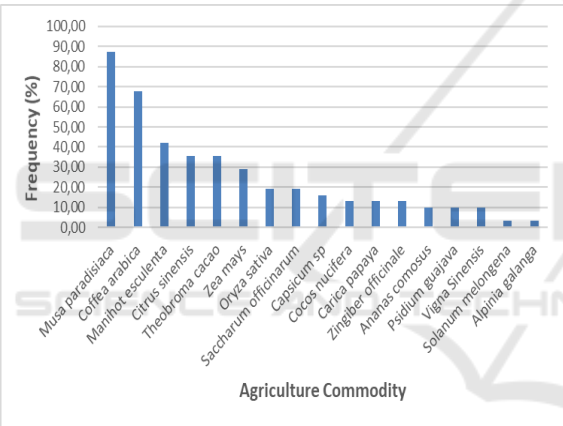

Figure 4: The frequency of agriculture commodity found from the whole plots.

3.3 Soil and Water Conservation Practice

Soil and water conservation techniques applied by the community are still simple vegetative techniques due to the cost of applying soil and water conservation techniques reason. The soil water conservation knowledge and skills application techniques of the community need to be improved.

The main obstacle to the dissemination and development of agroforestry is the lack of public policy support that pays attention to tree-based farming systems. Consequently, it is often absent from recommendations even though many agroforestry practices have been shown to contribute benefits for rural community development, help the rural community adapt to climate change, and contribute to improving the hydrological function mitigation. Furthermore, there was no effort to assist agroforestry practices that implement the proper soil and water conservation techniques by the government.

Agroforestry systems provide both strategies of mitigation and adaptation for hydrological function and provide several pathways to securing food security for poor farmers. Agroforestry must attract more attention on the global agenda of hydrological mitigation because of its convince social and environmental impacts. Adding/introducing trees into the existing planting system requires learning advanced planting methods and some support to ensure rapid adoption (Mbow et al., 2014).

4 CONCLUSION

The community tends to choose the simple agroforestry system due to economic reason and the ease of management. Fruit-producing trees, food or drinks are the ones most often planted by farmers for agroforestry.

ACKNOWLEDGMENTS

We thank the Directorate for Research and Community Service, Ministry of Research, Technology and Higher Education, the Republic of Indonesia for an Penelitia Unggulan Perguruan Tinggi Grant 2017 (No. 003/ADD/SP2H/LT/DRPM/VIII/2017 to BS).

REFERENCES

Leakey, R. R. B. 1996. Definition of Agroforestry Revisited. *Agroforestry Today*, 8**,** 5-7.

Mbow, C., Smith, P., Skole, D., Duguma, L. Bustamante, M. 2014. Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. *Current Opinion in Environmental Sustainability,* 6**,** 8-14.

Momm, H. G., Porter, W. S., Yasarer, L. M., ElKadiri, R., Bingner, R. L., Aber, J. W. 2019. Crop conversion impacts on runoff and sediment loads in the Upper Sunflower River watershed. *Agricultural Water Management,* 217**,** 399-412.

Ramachandran Nair, P. K. 2014. Agroforestry: Practices and Systems. *In:* Alfen, N. V. (ed.) *Encyclopedia of Agriculture and Food Systems*. San Diego: Elsevier.

Schroth, G., do Socorro Souza da Mota, M. 2014. Agroforestry: Complex Multistrata Agriculture. *In:* Alfen, N. V. (ed.) *Encyclopedia of Agriculture and Food Systems*. San Diego: Elsevier.