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Research Article

Socio-economic impact of land degradation at Gunungsari Village of Tlogowungu District, Pati Regency, Central Java

C. Y. Lastiantoro*

Forestry Technology Research Center of Watershed Management (BPTKPDAS)
Jl. Jend. A. Yani-Pabelan, Kartasura. PO BOX 295 57 102 Surakarta
Tel / Fax: (0271) 716709; 716 959

*corresponding author: lastiantoro@yahoo.co.id

Abstract: The purpose of this study was to evaluate the socio-economic impact of land degradation and the role of watershed management in the development of agroforestry to support food safety and security. This study used descriptive analytical method that was based on the observations, interviews, and literature survey. Thirty respondents were randomly selected for this study. The results showed that the socio-economic impact of land degradation was the decline production of cassava for the last four years. Watershed management played an important role in the development of agroforestry to support food security. Agroforestry-based soil conservation did not run optimally due to a number of obstacles in its development. The development constraints were large area of critical lands and lack of technology transfer on watershed management. Policies needed in the development of agroforestry-based soil conservation to support of food safety and security are improvement of formal and non–formal educations, adoption of watershed management technology, and empowerment of farmers for agroforestry development.

Keywords*: agroforestry, food security management, technology adoption, watersheds*

Introduction

Land degradation is a process where biophysical environmental conditions change due to human activity on the land. The changes in environmental conditions tend to reduce food production. Natural disasters such as floods, landslides and forest fires are not included as direct factors influencing land degradation, but rather indirect result of human activity so that the impact can be referred to land degradation (BPTKP-DAS, 2012). According to Plate (2002), improvement of downstream such as river dredging or construction of dam, is not enough to overcome the floods. Improvement of upstream conditions such as cleaning up drainages, and encouraging communities not to throw garbage in the river have also to be included in overcoming floods.

Land degradation can also be caused by poor farm management that ignores soil conservation that makes permanent loss of soil nutrients, especially in sloping areas (> 30%) and soil cultivation during rainy season monoculture farming with no terrace. Land degradation has an impact on agricultural productivity which in turn affecting the food security of the family.

According to Law No. 18 of 2012 about food, food is everything that comes from biological sources of agricultural products, farming, forestry, fishery, animal husbandry, irrigation and water, which are consumed by human. Provision of food to meet human needs that provide benefits in equitable and sustainable was based on food sovereignty, food independence, and food security. Article 12 of chapter IV of the law states that in order to meet food consumption needs of the community to the individual level, both central and local governments have the freedom and responsibility to determine policies regarding food security independently.

According to Abisono (2002), food is a major issue that can determine the life or death of a civilization. It is therefore very important to

reserve and stock foods for the state and nation in order to keep people have sufficient food throughout the year. For this reason, actions toward food safety and scurrility are needed the government and local communities. Degradation of watersheds further reduces food production. This makes families need high cost to meet the family need for food. As a result, food security is generally low and to secure the food needs, the country must import food from other countries, which would deplete the country foreign exchange. This study aims to evaluate the socio-economic impact of land degradation and the role of watershed management in the development of agroforestry to support food safety and security.

Materials and Methods

The experiment was conducted at subs-watershed Gandu Suwaduk, Gunungsari Village, Tlogowungu Sub district of Pati, Central Java Province. This study was part of a study entitled "Rehabilitation of Degraded Lands with Local type" that has been going on since 2010 to date (2014) is still running. This study used descriptive analytical method based on observation, interviews and literature study. Primary data were collected from thirty respondents that were randomly selected.

Results and Discussion

Socio-economic impact of land degradation

Socio-economic impact of land degradation in the study area was the decrease of cassava (*Manihot utilizima*) production for the last four years (2010-2013) (Table 1).

Table 1. Average Cassava Production and Farmers' Income in the Gunungsari village, Tlogowungu Sub district of Pati

Years	Production (t/ha)	Income (Rp/ha)
2010	25. 40	6,351,000
2011	23. 02	7,195,000
2012	21. 98	7,695,000
2013	19. 09	7,876,000

Data presented in Table 1 show that the last of four years, the cassava production declined from 1 to 2 t/ha/year, although the average revenues increased by Rp 1,525,000 of revenue in 2010 compare to that in 2013. This was because of the increase of the cassava price determined by the tapioca factories. This increase did not taken into account the inflation value and the increase in food prices over the last four years, and the economic value of eroded soil. As a result, the farmers began to plant sengon trees in between cassava. However, cassava remained the major farming at the Gunungsari village.

Agroforestry for food security

Respondents farmed their land with monoculture or polyculture (mixed farming) such as agroforestry. The monoculture crop was mostly cassava. In agroforesrty, the cropping patterns developed by farmers were cassava + maize (30.00%), coffee + wood + maize (16.67%), coffee + wood (40.00%), and cassava only (13.33 %).

Coffee is a suitable plant in the study area that has an altitude of 600 m above sea level. Coffee plants need shades; therefore, trees are needed. Trees commonly grown as coffee shades are sengon (*Albizia chinensis*) Jabon (*Anthocephalus cadamba*), Leucaena (*Leucaena leucocephala*). Gamal (*Gliricidia sepium*), mangosteen (*Garcinia mangostana* L.), durian (*Durio zibethinus*), Duku (*Lansium domesticum* Corr) were planted in between maize and coffee, or planted as a boundary of land ownership.

The selection of crops (coffee, cassava, and maize), and trees (sengon, jabon, mangosteen and duku) was because they are suitable in the study area as well as market for the products are widely open. Cassava is maintained because it has several advantages, e.g. its production is easily sold as raw material of tapioca industries, its farming does not require big capital, and it does not require intensive farming maintenance so that farmers still have time for other farming activities. Although the price of cassava was relatively low and determined by the tapioca factories, the advantages of cassava farming make the crop is widely cultivated in Pati Regency

In terms of soil conservation, cassava can accelerate erosion because it is planted on sloping and open land without terrace, and its harvest time in the rainy season reduced soil density. The occurrence of erosion was also caused by soil tillage with no application of soil conservation-based farming that made rainwater peeled off the soil surface. As a result, a layer of fertile soil was continuously eroded. To improve soil fertility, farmers commonly bought chemical fertilizers (urea, superphosphate, calcium chloride), and manures. In cassava monoculture, some farmers also planted maize in between cassava rows for their own composition, while cassava was sold as family income.

Agroforestry as a household food security solution

In relation to household food security, agro-forestry can produce a variety of food products other than wood. This will ensure the availability of food and household food security of farmers. The use of farm production and its potential in relation to food security are presented in Table 2. In addition to food products that ensure food security, agroforestry also produces wood that can be sold as family savings. This additional income can increase household purchasing power of farmers for the provision of facilities such as family transport (motorbike) and household appliances. Contributions of agroforestry to the total income of farm households are presented in Table 3.

Table 2. Potential farm products for food security in Gunungsari village

Farm Product	Production (t/year)	Utilization
Rice	446	backup and foodstuffs as well for sale
Maize	121	food reserve and sale
Cassava	24.715	sale
Groundnut	46	sale

Source: Badan Pusat Statistik Kabupaten Pati. 2011.

Table 3. Income and contribution of agroforestry farming patterns

Farming patterns	Income (Rp/ family leader)	Contribution to total revenue (%/family leader)
Cassava + maize	7,096,669	84.27
Coffe+wood+ maize	5,975,000	83.98
Coffee + Wood	6,322,085	84.43
Cassava	7,446,252	80.87
Average	6,646,500	83.30

The average contribution of agroforestry to household incomes of farmers amounted to Rp 6,646,500 per year, or about 83.30 % of the total household income. The high contribution of agroforestry demonstrates the important role of agroforestry to the household economy and food security of households. At present, the financial income of polyculture (mixed farming) of cassava mixed with maize provides a greater contribution than timber plants and food crops. However, the financial revenues from timber plants will be higher than food crops (cassava and maize) in the next five years when sengon is harvested. On average, a farmer has 30 sengon planted on the land. The price of five-year-old sengon ranges from Rp 200,000 to Rp 300,000 depending on the plant growth. Therefore, the family income of the wood can range from Rp 6,000,000 to Rp 9,000,000.

Role of watershed management in food security

A watershed is an area that provides inputs for the growth of food crop, horticulture, cash crops and timbers as well as other services. The availability of plant nutrients, water supply, microclimate, and other environmental services generated from watershed management will be able to develop agroforestry. According to Suntoro (2008), socio-economic conditions of forest communities are a very important factor to be considered in the development of forests in watershed areas.

Agroforestry is suitable for watershed (controlling floods and landslides) with the following considerations; (1) agroforestry is able to cover the soil surface, so effectively suppress runoff, erosion / landslides and floods which in turn increases infiltration / supply and groundwater reserves, (2) variation in plants that form a strong root network both in top and sub soils will improve stability cliff, thereby reducing susceptibility to landslides (through specific cropping pattern), (3) in relation to land rehabilitation, agroforestry is capable of increasing soil physical fertility (improvement of soil structure and water content), soil chemical fertility (increasing levels of organic matter and nutrient availability), and soil biological fertility (increasing the activity and diversity of soil organisms), soil morphology (solum formation), (4) economically, agroforesty can increase farmer's income and reduce the risk of crop failure, and (5) agroforestry plays an important role in the rehabilitation of degraded land.

According to Lastiantoro (2013), watershed management can result in a positive impact of increased agricultural production, forest products, livestock production, recreation revenue, and water storage. However, watershed management can also result in negative impacts such as erosion, sedimentation, nutrient loss, erosion that decrease soil productivity. If the positive impacts of watershed management are greater than the negative impacts, then the management of

watershed provides positive benefits for life. According to Suntoro (2008), setting of land uses in the watershed by setting a minimum forest area of 30 % of the watershed area is one of the main steps in tackling floods and landslides, besides other conversation methods. Forest has a very important role in restraining run- off that can significantly reduce floods and landslides.

Conclusion

The socio-economic impact of land degradation in this area was the decrease of cassava production for the last four years. Agroforestry can be used as one of food security strategies in dry land farming. Agroforestry plays important roles in contributing the household income of farmers, which in turn stabilize household food security of farmers. Watershed management plays roles in the development of agroforestry to support food security. Constraints of agroforestry development are large area of degraded land and lack of technology transfer on watershed management. Policies needed in the development of agroforestry are improvement of formal and non-formal educations, adoption of watershed management technology, and empowerment of farmer groups for the development of agroforestry.

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