

1. Community Indigenous knowledge in soil and water conservation

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The Naruan Micro Catchment (NMC) is the upstream part of the Bengawan Solo river basin. The NMC area is dominated (more than 50%) by land with steep slopes (>250) which is prone to erosion. In accordance with conservation principles, land with steep slopes should be cultivated by perennial crops in a monoculture or agroforestry pattern. The actual dominant land use in that area is dry land cultivated by maize and cassava, which is prone to erosion. Erosion that continues to occur not only has an impact on the downstream area but also reduces on-site soil fertility. This condition needs optimal soil and water conservation effort. To gain the successful effort, it is necessary to apply the appropriate technology and the participation of the community as landowners.

Looking at the history of farming practices in NMC, farming land in the NMC was originally bare land. To meet their needs of food, the community then cleared land and planted maize and cassava. Along with the increasing knowledge and needs of the community, the cultivated commodities are growing. Considering that land is the main source of food needs, the people at that time already had local wisdom to maintain the fertility of their land. They realize that without preventive measures, the soil fertility of the land will decrease; as a result, yields will also decrease. The people at that time did not realize that those actions were part of soil and water conservation efforts. Currently, soil and water conservation is generally carried out in a civil technique and vegetative manner, while soil and water conservation carried out by the community at that time was only carried out the vegetative measures. Some forms of local wisdom in the NMC were:

1. Prevention of surface erosion

To prevent surface soil erosion, Community made grass barriers and mounds. Grass barriers were planted in the waterways (*panciran*), which aimed to trap the soil that was carried by water. The fodder grass was chosen to be planted because at that time the community also raising cows. The fodder grass was chosen to be planted because at that time the community also raising cows. The mounds were carried out on strips for seasonal crops, which also gained to trap the soil.



Figure 1. Grass barrier

At that time, the community had also planted woody plants. The species to be planted was pine which was expected to give conservation function and provide wood for housing. Along with the development of community knowledge in woody plant species, woody plants also function as savings. But unfortunately, the timber plantation is only carried out on the land boundary, so its conservation function is not optimal. It showed that social and economic considerations were taking into account in the selection of actions and plant species.



Figure 2. Woody plants in NMC

2. Prevention or gully erosion

In some places, there are gully that potential to be bigger if not addressed. To control the gully, the community planted several clumped plant species. The species commonly planted are bamboo, cordyline, and king grass. To trap the soil eroded, those species were planted at the toe of the gully. Hopefully, the eroded soil would be restrained by

the plants and accumulated in the gully. Finally, the gully will be naturally closed.

The traditional soil and water conservation showed that the community already had the awareness to maintain their land, and it becomes a capital to increase community participation in soil and water conservation. However, due to the increasing pressure on land, more serious efforts and better technology are needed to encounter the erosion that occurs continuously.



Figure 3. Cordyline as gully erosion

2. Land Rehabilitation and Income-Generating Challenges

By: Purwanto

The Naruan micro watershed is made up of Lawu Mountain parent material, which has a high fertility but is easily eroded due to the steep slope conditions (average > 40%). This type of land is commonly used in Indonesia for the cultivation of seasonal crops such as corn, cassava, and vegetables. Although allocating limited land resources for these seasonal crops is economically sound, these activities increase the likelihood of soil erosion. As a result, soil fertility is declining and water bodies are silting up (rivers and reservoirs).

Narrow land ownership, averaging 0.595 ha per household, leads to low farmer incomes, causing young people to migrate to cities. Farmers migrating at a young age have a habit of selling meatballs and herbs in the city. As a result, the working age of farmers in the Naruan Micro Watershed exceeds 56 years, resulting in low productivity. According to Lewis (1954), the movement of people from rural to urban areas is caused by the difference in labor wages between rural and urban areas, where wages for labor in cities are higher than wages for workers in rural areas. In terms of land rehabilitation, the migration of people from villages to cities is expected to increase the area of vegetation cover because they will leave their cultivated land and plant trees that do not require intensive management.

Some of the returning nomads in their village were actively involved in this project activity. Some of them took the initiative to purchase avocado plants with their own money, but after evaluation, some of the plants were successful while others were not. The success of rehabilitation activities on land owned by migrants was observed to be due to the diligence or laziness of the smallholders who were trusted by the land owners to manage their land. Plant growth is good when cultivators are diligent; however, plant growth is slow when they are lazy. This has consequences for the extension method that must be used for project sustainability or as an exit strategy in the extension sector. It is necessary to provide counseling to land cultivators in addition to liaison officers.

APFNet-funded land rehabilitation in the Naruan Micro Watershed for Phase I increased farmers' income by an average of Rp. 1,318,486/ha/year. This increase in yield was achieved through the use of agroforestry, specifically a combination of woody plants (albizia) and seasonal crops (corn and cassava).

Farmers make money by felling albizia trees and growing seasonal crops. The owners of the albizia plants planted in Phase I have partially cut them down. The diameter of the tree's base has grown to an average of 33 cm. Up to 10% of the avocado plants planted in early 2018 (Phase I) have flowered. One avocado tree yielded approximately 52 fruits. Because 1 kg of avocado is estimated to contain three fruits, the initial production per tree is approximately 17 kg. If the price of an avocado is Rp. 15,000 per kg, the income per tree can reach Rp. 255,000. According to farmers, avocados over 10 years old can produce Rp. 1,500,000 per tree per year if purchased directly by the merchant while still in the tree. Some of the citrus plants are already bearing fruit. However, because avocados and citrus are still early fruit production, there is not

enough data to be included in financial analysis.

Plant from Phase II, avocado, coffee, limpaga, and albizia, are still in the vegetative growth stage. Farmers' income is expected to increase once the avocado and coffee plants bear fruit. There is currently a culinary development in Indonesian urban areas that has the potential to accommodate their production.



(a)



(b)



(c)



(d)



(e)



(f)

Figure 1. Some potential yields of agroforestry patterns: albizia (a) & (b); corn (c) & (d); citrus (e); and avocado (f)