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Economic valuation of erosion

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Abstract. Various results of erosion research on highland vegetable farming land indicate that the erosion level is classified as dangerous. This condition cannot be tolerated, because it will cause economic problems in the future both society and government. For farmers who are actively processing potatoes, the longer the farming the greater the cost of production so that the rate of profit gained tends to decrease. For the government, environmental degradation will reduce the possible use of the budget for the development of social welfare because the available funds are used to finance the prevention and handling of environmental disasters such as floods and landslides. The purpose of this study is to find out how many profit opportunities are lost due to erosion occurring in potato farming, using the method of analysis of agricultural systems and then calculate the opportunity price of potato farming system. The results of this study indicate that the value needed to reduce erosion by 0.54 t.ha⁻¹ in one harvest season was IDR. 5,605,556.-. The opportunity to earn a profit of IDR. 5,600,000.- will be lost if farmers do not apply conservation techniques to potato farming in sub-districts Tinggimoncong.

1. Introduction

Limitations of agricultural land, especially for horticultural commodities, cause the highlands to become the preferred land for agriculture [1, 2]. Utilization of agricultural land in the highlands has higher management complexity and lower productivity compared to lowland farmland [3, 4]. Based on the inherent qualities of highland land such as slope and soil sensitivity to erosion and high rainfall, the chances of erosion, especially on land used for vegetable cultivation are high [4, 5, 6]. Farm management practices currently applied by farmers have caused multifunction (positive externalities) of vegetable farming, especially in erosion and flood control are not optimal. The problem of business land degradation and vegetable production leveling-off is generally related to the fragmentation of business land, ie small family farming areas resulting in inefficient management of farming [7] and land management systems that are not insightful of physical conservation as well as fertility [8, 9, 10].

Results of erosion research on highland vegetable farms with slope slopes above 15% indicate that the erosion rate between 87 - 652 ton ha⁻¹ year⁻¹ [11, 12, 13, 14]. When referring to the tolerable limits of erosion of about 13.5 ton ha⁻¹ year⁻¹ [15], the extent of soil erosion is considered harmful [16, 17].

Conditions like that cannot be allowed, because it will cause economic problems in the future. Not only for the general public and government but also for horticulture farmers, especially the potato farmers themselves. For farmers of active potato cultivation, for example, the longer the production cost



of farming will be greater, the profit rate will decrease. Long term consequences will reduce the farmer's investment capability in managing land assets, so that at one time the land can no longer be planted with potatoes or no longer able to generate profits. For the government, severe environmental damage will reduce the possibility of using the budget for social welfare development due to limited funds to finance the prevention and handling of environmental disasters such as floods and landslides.

Therefore, holistic considerations are needed in making the policy of restoration of the Jeneberang River Basin, the complexity of the problem is very high with various causes ranging from economic, social and institutional causes of society and government, to the quality of human resources and the availability of science and technology. Even in many cases the causes are related to each other. The economic valuation of land resources for the Jeneberang watershed area can be an input for policy intervention to solve problems related to sustainable farming economy. Therefore, economic valuations of ecological benefits and losses for damage to land and forest resources in the Jeneberang River Basin are necessary.

Various environmental issues combined with farmer behavior in managing potato farming need further attention to find a solution to solve the problem. Therefore, this research tries to do some fundamental analysis to the farming business analysis based on the application of different conservation techniques.

The conservation farming system is an agricultural system that integrates land conservation techniques into existing farming systems with the aim of increasing the income and welfare of farmers while reducing erosion, so that the agricultural system can continue on a continuous basis. Conservation farming system is characterized by: 1) agricultural production and income is high enough, 2) agrotechnology applied acceptable and applied by farmers in accordance with its ability continuously, 3) commodities cultivated in accordance with local biophysical condition, accepted by farmers and sell well in market, and 4) minimal erosion so that the productivity of the land can be maintained on an ongoing basis [8].

The purpose of this research are to calculate the economic value of potato farming as measured by the rate of profit of production and harvesting that is influenced by the applied conservation pattern and to calculate the internalization of farmers to reduce erosion and surface runoff using the Opportunity Cost approach.

2. Research Methods

This research was conducted in Pattapang Village, Tinggimoncong Sub-district, Gowa Regency, which is the center of potato production. Research method with interview to get information about farming system and saprodi used. Method of erosion plot to obtain production data. The farmers interviewed were farmers who did not apply randomly selected conservation techniques.

In conducting potato cultivation, cost and income analysis is the beginning in determining the attitude of conducting potato cultivation. Calculation analysis was conducted to give an idea about production and sales price which will ultimately affect farmers income in potato cultivation business in Kabupaten Tinggimoncong Gowa regency.

2.1. Analysis of Potato Farming

Research on the analysis of potato farming was conducted in potato garden by making 12 observation plots of 88 m² with the following characteristics:

1. Plot 1: Plots with potato cultivation conditions are usually carried out by farmers (P1) as controls (Conventional Plots).
2. Plot 2: Plots with potato cultivation conditions treated with soil mechanical conservation consisted of (1) slope cutting (P2); (2) planting cut the slopes of 2 plants with drainage channels (P3); (3) planting cut the slope with rorak every 5 meters. (4) In this plot the planting was set cut the slope, then the plot is called the Conservation Plot (P4).

The study was conducted with three replications, the data collection was started after the plot was completed so that the planting of land for planting could begin. Some of the data taken were the number

of seeds used, the amount of fertilizer applied and also the number of work day (HOK) was calculated from land preparation to harvest.

2.2. Opportunity Cost Analysis

This method was conducted to calculate the costs incurred to conserve profits, rather than value the profit itself. For example, to assess the magnitude of the economic benefits to be sacrificed in the event of a change so that the quality of the environment cannot be restored as it was. Stages of implementation were:

- 1) Identify the opportunity lost due to another activity / change.
- 2) Assess the magnitude of each type of economic benefit lost.
- 3) Sums up the magnitude of all the lost economic benefits.

According to Soekartawi [18], there are three variables that need to be considered in the financial analysis of farming, namely (1) farm income, (2) farm costs and (3) net farm income.

1. Farm income, is the multiplication of production obtained with the selling price, the equation as follows:

$$TR = \sum Y_i.P_{yi} \quad (1)$$

where: TR = total revenue; Y_i = production obtained in one i-plant season (kg); P_{yi} = i commodity price (IDR).

2. Farm Costs, is the value of all inputs used in one growing season during the production process, either directly or indirectly, with the following equation:

$$TC = \sum X_i.P_{xi} \quad (2)$$

where: TC = Total cost; X_i = physical number of farm inputs; P_{xi} = input price i (IDR) and i = kinds of commodities developed in a farm.

3. Net Farm Income, is the difference of total revenue to total expenditure.

$$PU = TR - TC \quad (3)$$

where: PU = farm income (Rp); TR = total revenue (IDR); and TC = total cost of farming (IDR).

The analysis of financial feasibility of farming based on R/C ratio (Return Cost Ratio) [18] calculated by the following formula:

$$RCR = \text{Income} / \text{Production Cost} \quad (4)$$

Value of RCR = 1 means that the farming can only return capital.

3. Results and Discussion

3.1. Analysis of Potato Farming

The final result of analysis of production cost and harvest of potato crops for both erosion plots is presented in the following table:

Table 1. Cost analysis of potato farming plots

Needs every ha	Treatment			
	P1	P2	P3	P4
Number of Plants (plants)	292	275	251	261
Seeds (IDR)	9,954,864	9,375,300	8,557,092	9,102,564
Manure (IDR)	3,977,400	3,579,660	2,943,275	3,341,016
Chemical fertilizers (IDR)	6,775,000	6,775,000	6,775,000	6,775,000
Plant medicines (IDR)	6,889,000	6,889,000	6,889,000	6,889,000
Labour (IDR)	3,400,000	3,400,000	3,400,000	3,400,000
Additional Workforce (IDR)	3,400,000	3,400,000	3,400,000	3,400,000
Total Cost (IDR)	30,996,264	30,168,960	28,689,368	29,657,580
Production (tonnes)	9.92	10.91	11.29	9.89
Production Value (IDR)	55,681,818	56,477,273	56,401,515	42,848,909
Profit (IDR)	24,685,554	26,308,313	27,712,147	20,191,329
R/C Ratio	1.79	1.87	1.96	1.64

Note: family labour is not taken into account

Calculation of the total selling price of Potato per hectare shows that the total price of Potatoes in a conventional plot (P1) for one hectare can reach IDR. 55,681,818.- and on the conservation plot reached IDR. 56,477,273.- (P2), IDR. 56,401,515.- (P3) and IDR. 42,848,909.- (P4). There is a difference in selling price of IDR. 1,622,000.- for P2 treatment and about IDR. 3,026,000.- for the treatment of P3 at the price of potato crops in conventional plots (P1). In the P4 conservation plot, there is a difference in selling price with conventional plot (P1) of IDR. 11,494,000.- lower, this is because in conservation plot P4 there is excess labour cost and production in plant maintenance when compared to others. Selling price of potatoes varies for each type, where potato selling price for size criteria of AB and DN are IDR. 5000.- and 7000.- per kg, respectively and small potatoes have a selling price of IDR. 2000.- per kg. The results of this study show that about 75% produced were AB size potatoes and about 7 - 10% were in DN size and 15-20% were categorized as small potatoes.

Calculations in table 1 show that the R/C ratio for conventional plots is 1.79 while the R / C ratio for conservation plots P2 is 1.87, P3 is 1.96 and P4 is 1.44. It means that potato farming on conventional plot with capital of IDR. 1000. - will get sale result of IDR. 1790.- while potato farming in conservation plot of treatment of P3 with capital of IDR. 1000.- will get result of sale equal to IDR. 1960.-. This shows that from the feasibility aspect of farming, P3 conservation plot is very feasible to be developed because it can give bigger advantage when compared with conventional plot (P1).

Application of conservation techniques can provide greater benefits to potato farming in Tinggimoncong sub-district, which reduces the erosion rate of 0.54 ton.ha⁻¹ per season. However, farmers are still reluctant to apply conservation techniques to potato cultivation due to consideration of longer cultivation time. Reducing the rate of erosion in preserving the environment is an obligation that must be done by every farmer in the sub-district of Tinggimoncong upstream of Jeneberang watershed. By not applying conservation techniques to potato farming, farmers will lose the opportunity to gain profits because the resulting production is less due to the rate of erosion.

3.2. Opportunity Cost analysis

Table 2 shows that the value required to decrease 0.54 tons of erosion during one harvest season was IDR. 5,605,556.-. The value is derived from the difference in harvest yields from conventional potato farming (P1) with conservation potato farming (P3). The resulting difference is then divided by the value of the erosion difference from conventional potato farming with conservation potato farming.

The results of this study indicate that soil conservation requires less seed, increasing the production of potatoes when compared with conventional soil treatments. Conventional soil processing requires more seeds but does not produce large production, because the soil layer is eroded so that the nutrients needed by the plants drift along with the eroded soil. Soil productivity decreases, input production is higher in the next planting season.

Table 2. Opportunity cost value of potato farming on the conventional plot and conservation plot

Component	P1	P3	Difference
Profit (IDR)	24,685,000	27,712,000	3,027,000
Erosion (tonnes)	3.07	2.53	0.54
OP (IDR)	-5,605,556		

P1: conventional plot

P3: conservation plot

From the above calculation, then the value of opportunity cost is obtained if the farmers want to change the technique of soil processing on potato soil from soil processing techniques in the direction of the slope into a technique of soil processing with planting two lane value of cutting the slope of IDR. 5,605,556.- hectare⁻¹ for each harvest.

4. Conclusion

Based on the results of the discussion it can be concluded that the value of economic valuation of erosion on potato crop is IDR-5,605,556.- (a negative value indicates a loss of revenue). This means that farmers will experience a loss of income of IDR. 5,605,556.- per hectare due to the rate of erosion that occurred.

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