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Relationship of Erosion and Farmer Income in Ayung Watershed, Bali, Indonesia

Made Sri Sumarniasih
Study Program Agroecotehnology, Faculty of Agriculture, University of Udayana, Bali, Indonesia

Abstract
Ayung Watershed to be research location is the longest watershed in Bali, Indonesia, which have suffered very heavy the land degradation. The purpose of the research are: (1) Predicting the erosion, (2) Analyze the farmers income, and (3) in the Ayung watershed and its relation to the level of erosion. Analysis of the data using the USLE method to predict the rate of erosion, income analysis to analyze the farmers income that source from farming and non farming, and the descriptive-qualitative analysis to explain the results of the calculation of erosion and farmers' income. The results of research showed that the erosion in the Ayung watershed from very light to very heavy with ranged from 0,98 to 1717,12 tons /ha/year, while erosion is allowed to range from 22,60 to 57,00 tons/ha/year, the simulation results decreased to very light erosion ranged 0,98-50,85tons/ha/year; Income of farmers in the upper reaches of the Ayung watershed is the highest than the income of farmers in the central and downstream part of the Ayung watershed, but was followed by a high erosion rate. While the income of farmers in the central dan downstream part of the Ayung watershed lower than the income of farmers in the upper of the Ayung watershed, but was followed by a lower erosion rate. However, based on Spearman rank correlation analysis, there is no relationship between the level of erosion and farmers' income. This is mean the erosion rate decreases because of the efforts of land and water conservation will not be followed by a decline in the income of farmers.
Keywords: Erosion, Farmer Income, Ayung Watershed.

1. Introduction

In Bali paddy land conversion to non-agricultural interests (tourism, residential, small industrial, business infrastructure) is currently at a point which is very worrying. If the land conversion is not prevented, the consequences, the culture of agriculture, as one of the tourist attraction more and more threatened. In principle to maintain agriculture as a supply of food and preservation of agrarian culture, the presence of agriculture need to be maintained.

One important part of agriculture that is often overlooked by practitioners of agriculture is conservation of land, this happens because of the impact of land degradation are not always immediately visible on the ground, or does not drastically decrease the yields. Impact of soil erosion is not immediately visible as well as the impact of landslides or flash floods, but without an effective soil conservation action, land productivity is high and agriculture effort is difficult guaranteed sustainability.

Farming as an organization of nature, labor and capital devoted to production on the field in the form of agricultural products. Soeharjo and Effendi (1993) states that there are four things that need to be considered for the development of farming, namely, (1) on each farm there is always an element of agricultural land that represents nature, (2) there is an element of labor which is based on the farmer members, (3) Capital element of diversity and (4) an element of management delivered by personal that so-called farmer or farming manager. While Mubyarto (1991) and Dana Medana (2005) stated that the farming is a set of natural resources that are in place that are required for agricultural production, like plants, soil and water, the improvements made on the land, sunshine, parts that was established on the land and so forth. Farming may be as farming or raising livestock, the business activities of man to seek land for the purpose of obtaining crop or animal without causing reduction in the ability of the land to obtain further results.

Ayung Watershed is the longest watershed in the Bali Province, Indonesia, which is already degraded land. Problems of land in the Ayung Watershed is the rapid of land conversion from agriculture to non-agriculture, intensive of land use in the upstream Ayung Watershed for farming activities without regard to the rules of land conservation, the land cover is reduced and slopes for food crops, area of productive agricultural tended to decline, while all parties expect the Ayung Watershed maintained well demonstrated by hydrological conditions constant.

The research objectives were: (1) Predict the amount of erosion in the Ayung Watersehd, (2) analyzing the farmer income in the Ayung Watersehd, (3) analyze the relationship between erosion rates and the farmer income in the Ayung Watersehd. Results of this research are expected to be used as consideration in providing policy recommendations to plan future programs on relevant agencies.

2. Research Method

Research Location

The research location is in the Ayung Watershed, Bali, Indonesia, determined purposively based on several considerations, namely: (1) Ayung Watershed was a longest watershed in Bali, Indonesia across many regency/cities, among others, Bangli regency, Buleleng, Gianyar, Badung and the Denpasar city; (2) Ayung Watershed is one of the watershed experience of land degradation is quite heavy because of the rapidity of land conversion from agriculture to non-agriculture, intensive of land use in upper Ayung Watersheds without regard to the principles of conservation, conflict utilization of water from several parties, conflict utilization of flow river by some sectors; and (3) until now research has not been done of erosion rate and its relation to the level of farmers' income, so it is necessary to do this kind of research.

Ayung Watershed is geographically located on 115°15'25"*BT* until 115o 15'11"*BT* and 08°39'27 " *LS* until 08°39'08" *LS*. Complete the test site and soil sampling are presented in Figure 1.

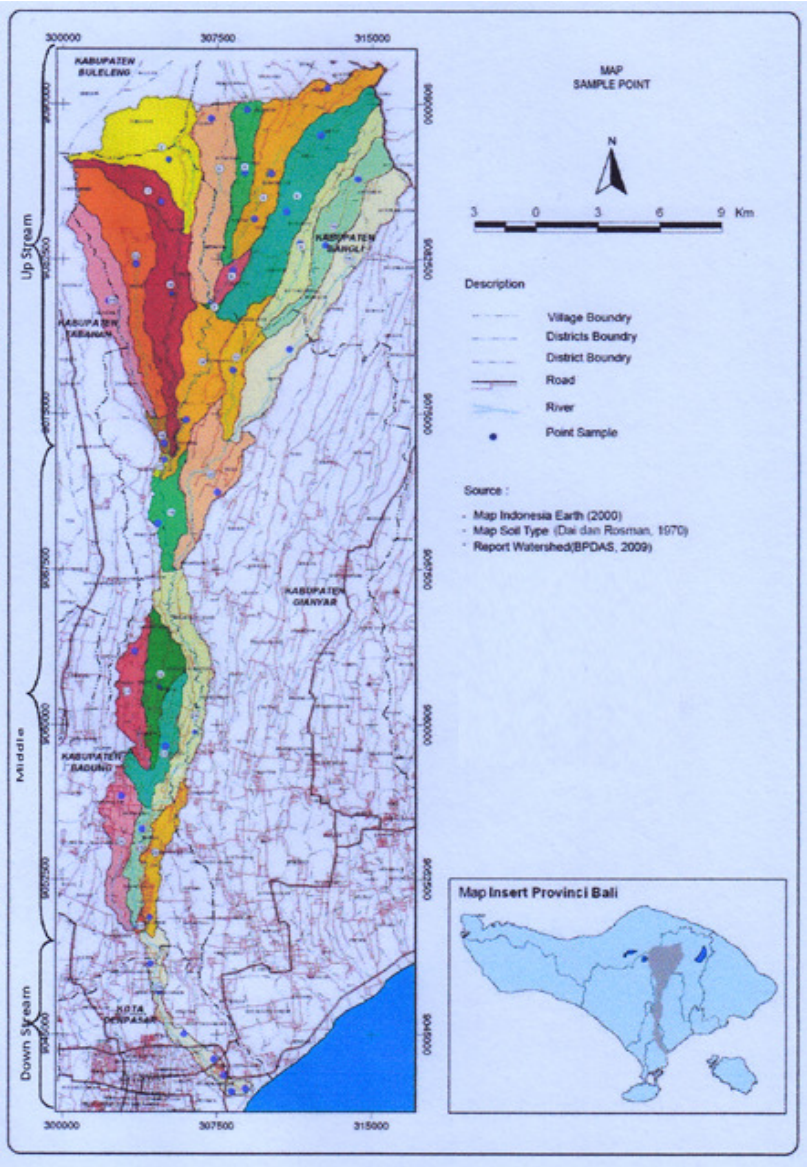

Figure 1
The Research Location in Ayung Watershed, Bali, Indonesia

Research Stages

This research through several stages, namely:

1) Gather secondary data from relevant agencies
2) Determine the unit of land management is technically based on: (1) Compilation of maps of soil types, slope maps, land use maps, and the Ayung Watersehd boundaries, so get a map unit of land; (2) Based on the map unit of land, carried out field observations. At selected locations, so get a soil sample taken 40 samples, then analyzed the physical and chemical properties in the Soil Laboratory, Study Program of Agrotech, Faculty of

Agriculture, Universit of Udayana, Bali, Indonesia.

3) Analyze farming conditions through the survey method using a structured questionnaire that respondents are farmers, as well as observed the farming behavior in Ayung Watershed ecosystem. Respondent determined farmers purposively, especially in the area around the soil sampling for analysis of soil erosion. The total sample of farmes respondents for the analysis of quantitative data and qualitative farmers' socio-economic status of 77 people who married, preferably head of families.

Method of Data Analysis

Data analysis method used is the USLE method to answer the purpose of the first reseach is to analyze the rate of erosion, income analysis to answer the second research purpose is to analyze the level of farmers' income derived from farming and outside farming, and descriptive qualitative analysis to explain and describe qualitatively results calculating the rate of erosion and farmers' income, each of which is described briefly as follows:

1) USLE Method

Prediction erosion by USLE method is based on the relationship of erosion and the factors that cause erosion itself, if it is written in the form of the equation is: A = f (R, K, LS, C, P), where: A is the number of soil erosion (ton/ ha /year), R is a factor or erosivitas rainfall (mm/ha/hr/yr), R = 6.119 (rainfall)$^{1.21}$ (amount of precipitation)$^{-0.47}$ (maximum rainfall)$^{0.53}$ (Bols, 1978), K is the soil erodibility (tonnes ha/hr rain/ha), 100K=1.292 {2,1M^{1,14} (10^{-4}) (12-a) + 3.25 (b-a) + 2.5 (c-3)}. LS is the length and slope factor, LS = √L (0.0136 + 0,00965S + 0,00138S2), and C is a factor of soil and vegetation cover and crop management, and P is a factor of soil conservation action.

2) Income Analysis

To analyze the income of farmers used the following formula (see Soekartawi, 1997),:

Π = TR - TC

TR = Y. py

TC = VC + VC

Where:

Π = Gross income (labor farmers are not counted as expenses)

TR = Total Revenue (farm and off farm)

TC = Total Cost

VC = Variable Cost = variable costs, ie all costs incurred by the farmer (seed, fertilizer, labor, pesticides) associated with the agricultural production process, which the amount depending on the size of the production process.

FC = Fixed Cost namely the costs incurred by farmers that are fixed, that is not dependent on large-smallof agriculture production proses. Example, the land tax, dues of *Suba*k, etc.

Y = Yield = production, the amount of production of each type of crop or livestock farmers who cultivated and income from outside the farm.

Py = Price per unit of Y, depend of each type of production.

3) Qualitative Descriptive Analysis

Qualitative descriptive analysis method is to provide a review or discussion of the results of the numeric calculation such as the calculation results of erosion rate and calculation result of farming, so as to ability to description of qualitative meaning of the results of the calculation**.**

3. Result and Discussion

Erosion Prediction and Erosion Allowed in Ayung Watershed

The result analysis showed that in some land use, erosion levels exceed permissible erosion, so that it becomes a problem and needs to get treatment in watershed management. Erosion in the Ayung Watershed from very mild to very severe with a range of 0.98-1,717.12 tons/ha/year (Table 1).

Very mild to mild erosion occurred on paddy land use and forests, while heavy to very heavy erosion occurred on land use mixed gardens, moor and bushes. Mild erosion occurs at Ayung Watershed, starting from the middle to downstream, from the Petang village, Bongkasa, Abiansemal, Kesiman, towards the South reached the mouth of the Ayung river in the Padanggalak beach with the use of wetland. While the use of forest land located in the hills of the village of Kintamani and evening. Severe to very severe erosion occurs in the middle to upper part of the Ayung Watershed. At the start of the Petang village to the North, Buahan village, Buahan Kaja, Kerta, Kintamani, Langgahan, Mangguh, Mengani, Lembean, Ulian, Gunung Bau, Serahi, Manikliyu, Bayung Cerik, Blanga, Blancan, Daup, Blantih, and Catur, with the use of a mix of garden land, moor and shrubs. Results of analysis erosion rate allowed (Edp) obtained values ranging from 22.60 to 57.00 tonnes/ha /yr, whereas some land use has a greater erosion of the Edp. Land units that need conservation treatment are: 2, 7, 8, 17, and 19 (moor land use); 20, 22, 23, 26, 28, 30, 32, 33, 34, 36, 37, 38 and 39 (the use of a mixture of garden

soil); 25, 29, and 40 (scrub land use) (Table 1).

Land management and soil and water conservation measures based on local wisdom suggested to farmers, among others: (a) increase the density of plants in the mix garden of citrus plants with coffee plants, terracing of individuals as well as set the time of fertilization to overcome climate change; (b) the pattern of intercropping of maize plants with nuts or with horticultural crops on dry land, the rest of the plant used the addition of organic matter or as mulch, repair or manufacture of a flat terrace or gulud terrace according topography by planting brace the terrace commonly grown in research areas. Planting of seasonal crops such as *pacar* or *gumitir* flowers, after the rice crop is in *Sasih Kesadha* (May-June) to overcome climate change, (c) set the time of planting rice in paddy fields based Sasih namely: *Sasih Kalima, Kaenem, Kapitu* (November-December-January) and planted simultaneously (*Kertamasa*) to overcome climate change, to avoid pests and diseases, and regulate the distribution of water based *Subak* systems, (d) planting of woody trees on river banks / ravine by wrapping the Balinese cloth (*poleng* cloth or checkered black and white) on the tree, sacred to conduct worship, so that people are afraid to do the logging because it considers the area haunted, magical atmosphere and (e) the regulation of such prohibition or tightening permitting the construction of tourism facilities in the border Ayung River, providing strict sanctions for those who commit violations.

The simulation results show that by improving crop management and conduct soil and water conservation measures and based on local wisdom (CP), in accordance with previous suggestions, the erosion decreases. On the land use of mix garden without conservation action (CP = 0.2000) erosion occurred 457.88 - 1186.49 tons/ha/yr, after the improvement of crop and land management, making the individual terracing (CP = 0.0030), erosion decreased become 19.62-50.85 tonnes/ha/year, a decrease of 95.71%. The use of rice fields to plant corn with the patio benches (CP = 0.0256) erosion of 54.84 tonnes/ha/yr and use of moor land for mix crops with traditional terrace (CP = 0.0280), erosion occurs 97.00-517.63 tonnes/ha/yr, after the improvement of crop and land management with several types of plants, plant flowers of *pacar* or *gumitir* that has economic value, repair the porch or patio benches gulud (CP = 0.0030), erosion becomes 1,39- 34.28 tonnes/ha/year, a decrease of 93.38%. In the scrub land with steep topography, slopes >25% with no conservation action (CP=0.1200), erosion occurred 1404.69-1717.12 tons/ha/yr, after planting a tree on river banks or reforestation (CP = 0.0010), erosion becomes 1.34-1.64 tonnes/ha/year, a decrease of 99.90%. This means that the appropriate land use designation and follow the rules of soil and water conservation can reduce erosion to 90%.

According Pudja (1984) and Windia (2006), in relation to managing the human relationship with the environment harmoniously effort required to insert real activity, ie religious rituals. This pattern in which there is the meaning of the philosophy of Hinduism namely the *Tri Hita Karana*. While Utomo (1994) states that erosion can be prevented by making swales or terrace on land use other than rice field. Terracing is building soil and water conservation mechanically made to shorten the length of slope or decrease the slope by the way excavation and pile up of soil transverse slope. The purpose of terracing is to reduce run-off and increase water infiltration, thus losing the ground is reduced. In outline, the condition of the slope terracing is made stepped staircase that can shorten the length of the slope, reduce run-off, and can be used for landscaping. This situation should be maintained because the rice terraces in addition to preventing erosion, is also a cultural heritage that has been recognized by the world. Rice cultivation is maintained and remain stable because of the *Subak* that still bind member local customs, manners meekly also customary in village rules (Windia, 2006). Rice paddies teraseringnya is one of the local wisdom that can prevent erosion and local culture that can bring in domestic or foreign tourists, so as to increase farmers' income, because it is one of the destinations that have attraction. For example, rice fields with the most common found in the village of Jatiluwih, Penebel District, Tabanan, Bali Province has become a tourist attraction (Bali Post, 2013).

The Farmer Income in Ayung Watershed

Respondents of farmers in this research mostly has only one type of work in agriculture. Based on the results of a structured interview of the 77 respondents along the Ayung Watershed (upstream, midstream and downstream), 67 respondents (77.11%) main occupation is farming, and only 10 respondents (12.99%) main job outside the farm like as trader and laborer. Farm work is supported by the geographical conditions are very suitable for agriculture, and farming is a job that does not work like a time-bound office workers.

Land use in the upstream Ayung Watershed is largely dry land, topographic sloping, slope >25%, land use is not in accordance with the designation, planting crops without terracing or swales that are vulnerable to erosion. In the last 10 years occurred land conversion from coffee planting to citrus planting that is considered more beneficiary, but the land vulnerable to erosion due plant density is lower and more open land, the existing traditional patio without plants booster terrace and maintenance. Farmers cultivated plant species that is coffee, orange, mixed crops such as bananas, *undis*, sweet potatoes, etc., and cattle. Farmers who were respondents are 26 people, spread over Blancan village, Kintamani, Bayung Cerik, Manikliyu, Lembean, Ulian, Gunung Bau, Serahi, Daup, Mengani, Binyan, Blanga, Blantih, and Catur. Sources of farmers' income is from farming (citrus, coffee, fields, livestock) and outside the farm (trade, laborer, and others). Gross income per farmer per average

land size (0.61 ha) per year is Rp 107, 973,390, - derived from citrus farming income of Rp 88,042,615 (81.54%), coffee farming Rp 576,923 (0.53%), mix farming of Rp 3,600,000 (33.33%), the cattle business is Rp 8,000,000 (7.41%), and outside the farm (trade and laborer) of Rp 7,753,846 (7,18%). Viewed from the gross income, the income of farmers in the upper Ayung Watersheds mostly come from farming income, can be said to be advantageous, because the total revenue is Rp 132,084,620,- is greater than the total cost of Rp 24,111,23 million. The ratio of revenues and costs (R/C) were obtained at 5.48 which is greater than one, means farming in the upstream Ayung Watershed feasible continued (Table 2).

Table 1 Prediction Erosion, Erosion Allowed, Value-Land Crop Management (CP), and Erosion of Simulation Result in the Ayung Watershed, Bali, Indonesia

Land Unit	Location (Viilages)	Land Use	Erosion (ton/ha/yr)	Erosion Allowed (ton/ha/th)	CP Value	Result of Simulation (ton/ha/th)	Criteria
1	Padanggalak	Rice Field	0.98	27.25	0.0004	0.98	VL
2	Padanggalak	Moor	54.84	34.50	0.0160	34.28	L
3	Kesiman	Rice Field	0.98	27.73	0.0004	0.98	VL
4	Kesiman	Rice Field	1.01	31.17	0.0004	1.01	VL
5	Penatih	Rice Field	0.96	26.13	0.0004	0.96	VL
6	Peguyangan Kangin	Rice Field	1.22	27.50	0.0004	1.22	VL
7	Peguyangan Kaja	Moor	137.07	26.00	0.0004	1.96	M
8	Sibanggede	Moor	97.00	22.60	0.0004	1.39	M
9	Sibangkaje	Rice Field	1.86	27.73	0.0004	1.86	VL
10	Mambal	Rice Field	1.50	35.40	0.0004	1.50	VL
11	Abiansemal	Rice Field	1.56	23.83	0.0004	1.56	VL
12	Bongkase	Rice Field	2.00	24.48	0.0004	2.00	VL
13	Taman	Rice Field	2.21	28.25	0.0004	2.21	VL
14	Carangsari	Rice Field	2.13	24.48	0.0004	2.13	VL
15	Pangsan	Rice Field	2.28	29.60	0.0004	2.28	VL
16	Petang	Rice Field	2.49	28.25	0.0004	2.49	VL
17	Petang	Mixed Garden	887.68	56.50	0.0030	38.04	VH
18	Antapan	Moor	517.63	33.90	0.0003	5.55	VH
19	Plaga	Hutan	40.37	56.50	0.0001	2.31	L
20	Plaga	Moor	421.97	28.25	0.0003	4.52	H
21	Plaga	Mixed Garden	969.04	52.00	0.0030	41.53	VH
22	Tambakan	Mixed Garden	955.72	57.00	0.0030	4.09	VH
23	Melinggih Kelod	Rice Field	2.69	32.02	0.0004	2.69	VL
24	Puhu	Rice Field	3.19	25.90	0.0004	3.19	VL
25	Kerta	Mixed Garden	1186.49	56.00	0.0030	50.85	VH
26	Bayung Cerik	Forest	31.05	56.50	0.0001	1.72	L
27	Blancan	Mixed Garden	799.48	49.00	0.0030	34.26	VH
28	Kintamani	Forest	32.68	57.00	0.0001	1.76	L
29	Manikliyu	Mixed Garden	760.31	47.00	0.0030	32.58	VH
30	Serahi	Scrub	1404.69	52.50	0.0001	1.34	VH
31	Buahan	Rice Field	3.93	47.00	0.0004	3.93	VL
32	Langgahan	Mixed Garden	1062.92	23.50	0.0030	45.55	VH
33	Bunutin	Scrub	1717.12	54.50	0.0001	1.64	VH
34	Mengani	Mixed Garden	855.42	54.00	0.0030	36.66	VH
35	Ulian	Mixed Garden	648.88	51.00	0.0030	27.81	VH
36	Gunung Bau	Scrub	1526.32	56.50	0.0001	1.45	VH
37	Daup	Mixed Garden	565.82	56.50	0.0030	24.25	VH
38	Blanga	Mixed Garden	457.88	50.50	0.0030	19.62	H
39	Blantih	Mixed Garden	651.70	49.50	0.0030	27.93	VH
40	Catur	Mixed Garden	471.88	57.00	0.0030	20.22	H

Sources : Analysis Result
Discription : VL= Very Light, L= Light, M= Moderate, H= Heavy, VH=Very Heavy, CP= Value of Land Management, EA=Erosion Allowed

Land use in midstream Ayung Watershed is dominated by paddy fields and only a small portion of dryland (upland). Paddy terraces to prevent erosion on slopes or hills, which can be said of land use based on local wisdom. Lowland rice is grown twice a year and in between rice interspersed with crops such as corn, there is also a small dry land or a yard planted with bananas, *undis*, sweet potatoes. On average each farmer maintain a

single head of cattle. On the sidelines of the busyness of family farmers work in farming, they also work outside the farm such as trade and laborer, the results of which can add to the family income of farmers. Farmer respondents were 31 people scattered in Plaga villages, Payangan, Abiansemal, Sibang Gede and Peguyangan Kangin. Average income per farmer per area cropland (0.30 ha) per year is Rp 17,945,640, - or Rp 1,495,470 per month. Revenue is derived from farming Rp 15,623,066, - (87%) and outside the farm of Rp 2,322,581 (13%). Farmers' income derived from farming with an average of 0.30 ha land size is Rp 15,623,066 comes from the four branches of the farm, from planting rice farming with a frequency of twice a year to Rp 11,180,809, - (62%), corn farming with cropping frequency of once a year at Rp 2,471,290,- (14%), mixed crop farming Rp 164,516 (1%), and the livestock business is Rp 1,806,452 (10%). Generally, respondents farmers in the central part of the Ayung Watershed is a tenant farmer or sharecrop farmer, so there are expenses for the rent of land amounting to Rp 2,478,710,- per average area cultivated per year (Table 2).

Land use in the Ayung Watershed of downstream part everything for rice fields, the type of farming that develops in the lower of the Ayung Watershed is paddy planted twice a year, and on the sidelines of rice is grown sweet corn. Tenant farmers or sharecop farmer around Padang Galak, Subak Delod Sema, Kesiman Petilan Village planting sweet corn is continuously considered more profitable than planting paddy. Farmers also maintain at least one head of cattle per household. But beyond the time busy working in the fields, farmers and their families are also conducting trade and laborer as a source of additional revenue. Dryland farming is not found in the downstream Ayung Watershed. Distribution of respondents farmers in the lower part of the Ayung Watershed is in the Padanggalak Village, Kesiman, Penatih (East Denpasar), the number of respondents were 20 farmers. Based on the calculations, the income of farmers per farmer per average land size (0.36 ha) per year is Rp 23,547,380,- or Rp 1,962,281, - per month. This income comes from farming Rp 16,167,363,- (67%) and from outside the farm (trade and laborer) is Rp 7,830,000,- (33%). Farm income comes from planting rice farming with a frequency twice in one year is Rp 5,844,362,- (24%), corn farming Rp 3,923,000,- (16%), and the livestock business is Rp 6,400,000,- (27%) (Table 2).

Table 2 Farmers Income in the Upstream, Midstream, and Downstream of Ayung Watershed, Bali, Indonesia

No	Description	Ayung Watershed		
		Upstream (area: 0.61 ha)	Midstream (area: 0.30 ha)	Downstream (area: 0.36 ha)
1	Revenue (R) (Rp)	132,084,620	28,248,390	40,885,000
2	Cost (C)(Rp)			
	2.1 Fixed Cost (FC)(Rp)	300,000	2,728,710	8,003,580
	- Land Rent (Rp)	0	2,478,710	7,653,580
	- Tax (RP)	0	250,000	350,000
	2.2 Variable Cost (VC)	23,811,000	7,574,040	9,334,040
	- Land Cultivation	3,000,000	927,740	738,000
	- Planting	1,000,000	767,100	1,198,000
	- Fertilization	426,460	500,000	450,000
	- Fertilizer	6,432,310	1,492,260	2,039,860
	- Pesticide	2,243,080	528,500	294,500
	- Spraying Cost (Rp)	363,230	300,000	100,000
	- Harvest Cost (Rp)	8,346,150	2,453,230	2,730,000
	- Seed (Rp)	2,000,000	605,210	1,783,680
	2.3 Total Cost (TC)(Rp)	24,111,230	10,302,750	17,337,620
3	Gross Income (π) (Rp/cultivatioan area)	107,973,390	17,945,640	23,547,380
4	Gross Income (π) (Rp/ha)	165,987,640	59,818,800	65,409,389
5	R/C	5.48	2.74	2.36

Sources: Result of Research

The Relationship of Erosion and Farmers Income in Ayung Watershed

Referring to Table 3, the average of farmers income of respondents is highest in the upstream Ayung Watershed is Rp 107,973,390 per year followed by farmers in the downstream Ayung Watershed is Rp 23,547,380, - and the smallest farmers income in the central part of the Ayung Watershed is Rp 17.945,640,-. The difference between the income of farmers in the Ayung Watershed part due to differences in farming ecosystem, the average land size, and sideline the community. For example, farmers' income highest in the Upstream Ayung Watershed, caused by an average of cultivated land is more extensive, but also due to the ecosystems of dry land cultivated for citrus plants that have high economic value despite exploiting intensified land without regard to conservation principles. The average income of farmers sample at each part of the Watershed (upstream, midstream, downstream) associated with the rate of erosion in each section DAS, it turns farmers' income highest in the upstream Ayung Watershed followed by the erosion rate of heavy to very heavy (457.88 to

1,717.12 tons/ha/yr). The average income of farmers in the midstream and downstream Ayung Watershed lower than the average income of farmers in the upstream, followed by the erosion rate is very light to light (0.98 to 50.85 tonnes/ha/yr) (Table 3). This indicates that the highest income of farmers in the upstream part is the contribution of the citrus plantations, coffee and other crops, thus pushing going over the land to citrus crops. High income can be said to be also the result of over exploitation of land resources and do not follow the rules of the conservation of land and water and is not based on local wisdom. For example, the conversion of coffee area with the citrus area in the catchment area in the Kintamani area, on the one hand generate income higher when the price of citrus is high, but on the other hand accelerate the erosion of land due to the citrus plant area density lower than the coffee area, plus methods of farming did not pay attention to the rules of soil and water conservation. Over exploitation of land resources in the short term was to improve the welfare, but in the long run will harm children and grandchildren in the future, the degradation of land, both because of erosion surfaces washed nutrients as well as landslides when heavy rains.

Table 3 The Realationship of Farmers Income and Erosion Rate in the Upstream, Midstream, and Downstream of Ayung Watershed, Bali, Indonesia

No.	Description	Ayung Watershed		
		Upstream	Midstream	Downstream
1.	Gross Income (π) (Rp/ha/year)	165,987,640	59,818,800	65,409,389
2.	Erosion Rate	Very Light-Very Heavy: (1.04-724.86 t ha^{-1} yr^{-1}.)	Very Light-Moderate and Very Heavy: (0.50- 32.29 and 221.97 t ha^{-1} yr^{-1})	Very Light: (0.22-12.74 t ha^{-1} yr^{-1})

Sources : Result Analysis (processed from Table 1 and Table 2)

Hypotesis : H_0: There is not significant relationship between the farmer income and erosion rate

H_1: There is significant raltionship between the farmer income and erosion rate.

Based calculation H0=accepted → Rs (Corelation Coeficient of Rank Spearman) = 0,25 < R-Table (5%, n=3)=1.00.

The heterogeneity of farms in three parts of Ayung Watershed (upstream, midstream and downstream) will be more meaningful when compared and fitted with erosion rates in each section, so that the obtained information relationship farmers income and the rate of erosion. Statistical non-parametric namely Spearman Rank Correlation is used to analyze the closely relationship between erosion rate and farmers income, meaning that what is the increase in income followed by a high erosion or otherwise decrease erosion followed by a decline in income Ho or H1, accepted or rejected).

Based on Spearman Rank Correlation analysis obtained correlation coefficient, Rs=0.25 < R-Table (5%, n=3) =1.00 →Ho received, meaning there is no significant correlation between the level of farmers' income and the rate of erosion in three sections (upstream, midstream, downstream) of Ayung Watershed. Meaning of correlation calculation result of this is that although the erosion rate decreased due to efforts to conserve land and water, will not be followed by a decline in the income of farmers. Instead increasing the farmers' income due to conservation efforts and implement local wisdom will not be followed by an increase in erosion. Therefore, farmers in the upstream Ayung Watershed be permitted continued planting citrus throughout foolowed by efforts to conserve land, so the land is protected from erosion and will become more productive.

4. Conclusions and Recommendations

Conclusion

Based on the results and discussion can be formulated some conclusions, namely:

1) The erosion in the Ayung Watershed from very light to very heavy ranged from 0.98 to 1,717.12 tons/ha/yr, while erosion is allowed ranged from 22.60 to 57.00 tonnes/ha/yr, simulation results erosion decreases be very light ranges 0.98-50.85ton/ha/yr.
2) The income of farmers in the upstream of the Ayung Watershed is the highest than the income of farmers in the Ayung Watershed in the midstream and downstream, but is followed by the highest erosion rates as well. While the income of farmers in the Ayung Watershed in the midstream and downstream lower than the farmers income in the upstream Ayung Watershed, but was followed by a lower erosion rate.
3) Based on Spearman Rank Correlation analysis, there is not relationship between the level of farmers' income and the rate of erosion in the Ayung Watershed. That is mean the erosion rate to decreased due to efforts to conserve land and water will not be followed by a decline in the income of farmers.

Recommendation

1) Extension about the importance of the watershed are conducted regularly and continouely.
2) Need for cost sharing, between the communities in the upstream as preservation of watershed and communities in the downstream as beneficiaries of watershed preservation.
3) Agriculture paddy field needs to be maintained to conserve land and water resources.

References

Arsyad, S. 2000. *Konservasi Tanah dan Air*. Penerbit IPB Press, Bogor.

Asdak, C. 2004. *Hidrologi dan Pengelolaan Daerah Aliran Sungai*. Penerbit Gajah Mada University Press. Yogyakarta.

Badan Perencanaan Pembangunan Daerah Provinsi Bali. 2002. *Rencana Pengelolaan Secara Terpadu Daerah Aliran Sungai Ayung.* Kerjasama Bapeda dengan Pusat Penelitian Lingkungan Hidup Universitas Udayana. Denpasar.

Bakosurtanal. 2000. *Peta Rupa Bumi Indonesia*. Jakarta.

Bali Post. 2013. Diserbu Investor, Status WBD Jatiluwih Terancam. *Bali Post.*30 Januari. Denpasar.

Bols, P.L. 1978. *The Iso–Erodent Map of Java and Madura*. Sri Bogor. Indonesia.

BPDAS. 2009. *Rencana Pengelolaan DAS Terpadu SWP DAS Pangi Ayung.* Laporan Balai Pengelolaan Daerah Airan Sungai Unda Anyar. Denpasar.

Dana Medana, D.G. 2005. Analisis Usahatani Rumput Laut di Desa Ped, Kecamatan Nusa Penida, Kabupaten Klungkung. *Skripsi* (tidak dipublikasikan). Fakultas Pertanian Universitas Udayana. Denpasar.

Daniel, M. 2002. *Pengantar Ekonomi Pertanian*. Penerbit Bumi Akasara. Cetakan Pertama. Jakarta.

Dinas Tata Ruang dan Perumahan. 2013. Banyak Sawah Di-LC kan. RTHK Denpasar Berkurang 100 hektar. *Bali Post*. Denpasar. Bali.

Hernanto, F. 1989. *Ilmu Usaha Tani.* PT. Penebar Swadaya. Jakarta.

Mubyarto, 1991. *Pengantar Ekonomi Pertanian*. LP3ES.Cetakan Ketiga. Jakarta.

Pudja, G. 1984. Agama Hindu. Penerbit Mayasari. Denpasar.

Soehardjo, M. dan S. Effendi. 1993. *Sendi-Sendi Pokok Ilmu Usahatani.* Departemen Ilmu-Ilmu Sosial Ekonomi. Fakultas Pertanian IPB. Bogor.

Soekartawi, A.1997. *Prinsip Dasar Ekonomi Pertanian.* Penerbit Rajawali Press. Jakarta

Utomo, W.H. 1994. *Erosi dan Konservasi Tanah.* Penerbit IKIP Malang. Malang

Windia, W. 2006. *Transformasi Sistem Irigasi Subak yang Berlandaskan Konsep Tri Hita Karana*. Pustaka Bali Post. Denpasar. Bali.

Wischmeier, W.M., dan D. D. Smith . 1978. *Predicting Rainfall Erosion Losses-A Guide to Conservation Planning*. Washington DC,US Gov.US Dep of Agriculture, Agric. Print Off. Handbook.