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NET FARM INCOME AS REFLECTION OF CRITICAL LAND EVALUATION IN WELANG WATERSHED, INDONESIA

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Abstract

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Agriculture activities in Indonesia is currently faced with many dynamic changes and environmental developments and fundamental issues such as population growth and market demand bring about deforestation or conversion of forests toward coffee plant that finally degrade the quality of watershed function. Watershed in several zone of Indonesia are run into environmental degradation especially land resources lead up critical land. Critical land conditions get impact toward soil productivity decreased and finally farming had been economics losses. As is it known that farm declared loss if total of cost larger than revenue in calculated of farm analysis. The purpose of this research is to determine the profile of the criticality of the highlands of Welang watershed and know the area which has the highest profit in the cultivation of coffee. Sample a coffee grower 60 spread of at Purwodadi, Prigen and Tutur District, Pasuruan, East Java. Data analysis technique used is the calculation of farm analysis and statistical tests using One Way Anova and supported by Geographic Information System (GIS) spatial analysis. The results showed that the regions with the highest coffee farm profits are Purwodadi but less efficient in production expenses than Prigen. Tutur had lowest rated coffee production areas it is necessary to reconsider the physical suitability parameters topography, climate and soil.

Key words: critical land; income; land evaluation; watershed

Introduction

Indonesia is an agricultural country with enormous potential in the agricultural sector. One of the biggest contributors to economic development from the agricultural sector is the estate subsector. During the period of 2010 to 2014 the value of GDP of plantation crops increased. In 2010, plantation crops have a value of Rp. 47.151 billion and continue to increase so that in 2014 to Rp. 57.246 bln. The total value of agricultural sector GDP also increased due to the other agricultural sub-sectors experienced an increase in value every year. Among the preeminent commodities in the coffee plantation subsector are plantation products that have good market opportunities. In 2015, the International Coffee Organization (ICO) said on the international coffee commodity competition map that Indonesia is the fourth largest coffee exporter in the international market after Brazil, Vietnam and Colombia. The possibility of a growing market competition and open the coffee Indonesia has the hope of continuing to increase foreign exchange for the country. However, the

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condition is not in line with the development of fluctuating coffee productivity. Behind the increasing demands of coffee production there is a problem of land use change, where many forests are converted into coffee plantations or other agricultural commodities so that the functions of forests in regulating water systems and controlling erosion are falling dramatically. This causes a peak discharge of water peak and the base discharge will widen and the erosion would be multiply.

Ironically, watershed is spread of several zones in Indonesia also experiencing environmental degradation. Land area that very critical and critical in 2013 of ± 24 303 294 hectare, consisting of very critical: 4 738 383 hectare and Critical: 19 564 911 hectare (Ministry of Environment and Forestry Statistics, 2014).

Degraded land is with soil conditions that the process of physical damage, chemical or biological that ultimately harm the function of hydrological, agricultural production, housing and socio-economic life in the surrounding area (Sumarno, 2013). Another perspective is given Washington County Critical Lands Resource Guide (2008), which suggests the term 'critical area' used to describe the landscape conditions common, land with natural constraints that may endanger the life, safety, and welfare of citizens (such as flooding and unstable slopes). If resumes term critical area is an area that has suffered physical, chemical, or biological matter damage that harms the function of hydrological, agricultural production, housing, and social and economic life in the surrounding area and cannot function properly in accordance with its designation as a media production as well as media planning water (Sumarno, 2013).

A holistic view of each watershed as coherence bio-region spatial, functional and temporal demand implications in the event of changes in one part will affect other parts, so that the change will not only be felt by the passage on site, but also the offsite (Sinukaban, 2007). That is a watershed in terms of the natural landscape includes the notion of the physical environment, including climate, topography, hydrology, and even the state of natural vegetation, all of which potentially will affect its use. The upstream is as a major water catchment area and the flow regulator; the center is as a regional distributor and regulator of water, the water users downstream. Meanwhile, the component temporal (time), which means that the dynamics of the natural process that occurs addressed by human adaptive dynamics can balance toward a good or bad way affected by the amount of human intervention on natural resources. Therefore some researchers agree on to argue that not only discuss watershed management biophysical components (Intarawichian and Songkot, 2010; Montazar and Synder, 2012), but also the economic aspects (Jafari and Narges, 2010; Shamsi, 2010).

Nevertheless, the critical area if refers to the classification into potentially critical can be developed for agriculture, of course, with restrictions not erosion, effective depth of the soil, especially the top layer (top soil) is more than 20 cm, the closure of the land is still relatively high, has a flat to hilly slope, and soil fertility levels low to high. Reflecting the fact, needs to evaluate land resources. Evaluation of land resources is a process for estimating the resource potential of land for different uses. Hardjowigeno and Widiatmaka (2007) described the land suitability classification can be used for quantitative land suitability classification, where the assessment of characteristics of land quality based on quantitatively and do the economic calculations, with due respect to land's productivity.

Potential and suitability of land used as filters to recommend the most appropriate commodity to be developed and directed in order to develop the potential of a region including the conservation of soil and water resources (Nainggolan and Johndikson, 2012). Commodities became superior must be accompanied by the ability to produce economically profitable and sustainable, the development of agricultural commodities should be done in lands whose quality and characteristics are most appropriate to the growing requirements of the relevant commodity (Rossiter, 2011). Data from the physical land evaluation, followed by evaluation of economic land will be able to provide a financial picture of a commodity that is cultivated in certain management level (Rossiter 1994; Rossiter, 2011).

This paradigm that raises a question research of *"Could be Critical Land create Economic Outlook Coffee Cultivation?"*

Therefore, the study set a purpose is to a) determine the profile of the criticality of the highlands of the Welang watershed and b) know the area which has the highest profit in the cultivation of coffee. Answering these objectives, this research will be directed to the concept of farming through the calculation of production costs, revenue and gross income including comparisons area further action research, so as to provide input spatial analysis as the final phase of the study was done.

Materials and Methods

Sites

The location of this research is set in the highland Welang watershed identified be critical potential land with a total area of 1.949.79 Ha with units of plantation and plantation land use mix.

Sampling

The research sample is representative of farmers in the catchment area of the Welang's River (critical land zone) while actively cultivating coffee plants. In order to facilitate the analysis of the data, the study sample used purposive sampling to fulfill of uniformity data in each region of 20 people scattered in the Purwodadi, Prigen and in Tutur District 60 farmers. Besides the determination of this sample is also considering its own land holdings and farming at least 3 years old.

Data Processing and Software

a. Spatial Analysis

In progress of develop spatial data is digitized by using the ArcGIS 9.3 through digitization methods on screen. Compiled attribute data to provide information about existing spatial appearance resulting in a database that consists of spatial and attribute data. Data digitization process results in a layer that contains specific information. Layer that will be analyzed later get overlap with other data that supports that generate new output. The data are then analyzed by the overlay of the weighting and scoring is based on the requirements and criteria that meet for coffee cultivation activities.

In other hand, the final evaluation is based on calculations performed analysis of farming so that the final result is a map of potential areas of economic critical land evaluation highland coffee cultivation in watershed Welang in the form of thematic maps. For the economic evaluation of land classification there were differentiated into five classes, namely S1 (profitable); S2 (sufficient profitable); S3 (marginal prospect); N1 (still possible, need more inputs), and N2 (economically impossible) (Rossiter and Van Wambeke, 1997).

b. Farm Analysis

Referring to the Agriculture and Agri-Food Canada and Statistics Canada (2000), farm income are the steps to get the value of farm cash income (revenue minus operating expenses) generated from the production of agricultural goods.

Rossiter (2011); stated gross income is the difference between revenue and all costs. This analysis aims to determine the benefits of the work done:

π = TR –TC whereas: π = Gross Income; TR = Total Revenue; TC = Total Cost

Criteria: TR > TC that farming profitable dan TR < TC that farming loss

The amount of income earned in the previous calculation in the recapitulation with formulations at MS. Excel 2013. Then, the difference in coffee farming income will be tested using the statistics by using IBM SPSS Ver. 21. Test different incomes do with One Way Anova. ANOVA included in parametric statistical categories. Analysis of variance can be done to analyze data coming from various types and design of the study. Analysis of variance widely used in studies which involve the comparative testing is to test the dependent variable by comparing the independent sample groups were observed. One-way ANOVA was conducted to test the difference of three or more groups based on one independent variable.

$$F = \frac{Sb^2}{Sw^2} \quad (1)$$

DF = Numerator = k-1, Denomirator = n-k

Where variance between:

$$Sb^2 = \frac{n_1(\bar{x}_1 - x)^2 + n_2(\bar{x}_2 - x)^2 + \ldots n_n(\bar{x}_n - x)^2}{k - 1} \quad (2)$$

While variance within:

$$Sw^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2 + \ldots (n_n - 1)S_n^2}{n - k} \quad (3)$$

where: Sb = variance between, Sw = variant within, Sn^2 = variant group, X = the average combined, x_n = average group, n = number of samples, k = the number of groups, n_n = number of samples in the group

Results and Discussions

Critical Land

Welang Watershed is an area of 507.36 km^2 through in three areas, namely Malang and Pasuruan district, and also Pasuruan City. Welang River itself is the main of a tributary that empties on the north coast. Watershed is an ecosystem whose major elements consist of the natural resources of soil, water and vegetation as well as human resources as a principal beneficiary of those resources. Asdak (2014) declare the watershed decreased with an indication of increased incidence of landslides, erosion and sedimentation, floods, and droughts. But the demands are to maintain its ability to support life systems, upstream and downstream communities.

One of the most identified damaged watersheds in Indonesia is Welang watersheds. From the analysis using map determinants of critical watersheds, it is known that almost all parts of the highland Welang watershed have been potential critical status.

Indicators criticality It showed the region ranging erosion is mild, the soil has effective depth deep enough, the top layer (top soil) is more than 20 cm, the percentage of land cover is still relatively high, Having slope is flat to hilly and fertility was found low to high ground there. Further, the critical level is determined by the value of land resulting

from the equation determiner Critical Land Index (ILK), the range of the value can be seen in Table 1.

Table 1
Critical Land Index (ILK)

No.	Level of Critical	ILK
1.	Very Critical	120-180
2.	Critical	181-270
3.	Slightly Critical	271-360
4.	Potential Critical	361-450
5.	Not Critical	451-500

Source: Department of Forestry (2003)

Spread of critical land on the highland that shows Welang watershed water catchment area as largely potential critical land area (Figure 1). The potential critical land is the land that is less productive when attempting to agriculture. But when the management applies the rules for conserving area, then the land will change its status away from critical. Otherwise ignoring the concept of conservation, the land will be damaged or become critical or at least turn into land slightly critical.

Coffee Farming in Critical Land

Coffee planting in land where there are generally slopes > 15% and acidic soil pH < 4.5 to 5, as well as fertility and low organic matter content. Coffee grown in the upper back area is grown with less production than the plants growing in the area next to the slopes. Meanwhile, the coffee grown in the valley areas are with the higher productivity than those grown in the higher lands. Results of research on the highland area in Welang watershed in September 2016 showed that the cultivation of coffee in this region is still largely cultivated traditionally characterized by: (1) use of local clones whose productivity is low, less than 0.6 kg/tree/year, (2) without shade, (3) do not do proper fertilization, (4) rarely do the control of pests and diseases, and (5) the plant maintenance such as pruning weeding irregular and improper. Farmers also apply the mixture gardening practices in the coffee plantation to plant crops (either wood or fruits) as cover crops of coffee and coffee quality improvement by improving coffee varieties by grafting.

Farmers are defined as research subjects in the Purwodadi, Prigen and Tutur District, Pasuruan Regency basically already have knowledge of the local ecology, agriculture, and forestry which are formed by generations of their precursor, and evolve over time. Local knowledge of this form of farming and gardening experience and interact with their environment.

Although some farmers who are members of farmer groups have adopted the technology of rejuvenation by grafting clones advice, but the level of productivity achieved is still relatively low, ranging between 1.0-1.5 tons of beans/ha /year.

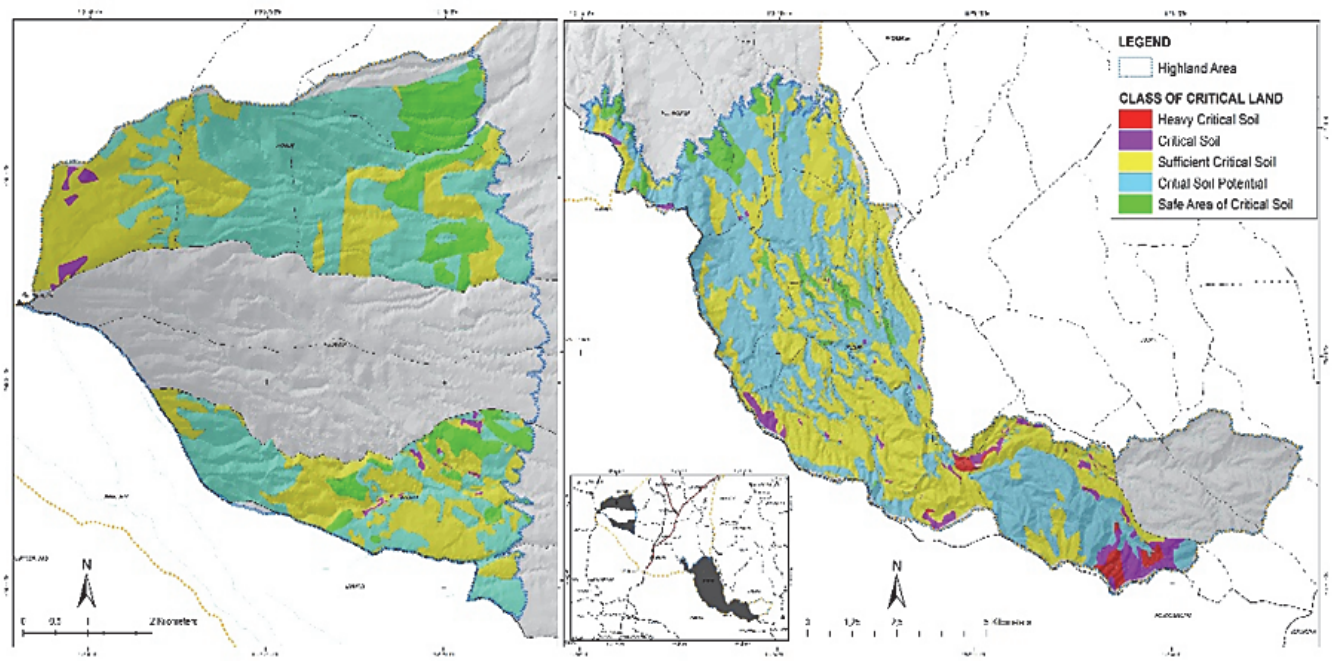

Fig 1. Map of Critical Welang Watershed.

Farmers cultivate the coffee plant still under the recommended dose, ie urea 300 kg / ha and 300 kg NPK / ha, whereas the recommended dose for urea and NPK respectively 350 kg / ha. Besides the dose is less precise, farmers fertilize only once by reason of shortage of labor, whereas according to the rules, dosages of these recommendations should be applied three times. With most of the land conditions slopes and high rainfall, the fertilizer will be easily eroded, decreasing the amount of fertilizer absorbed by the plants.

Manage the coffee farming is the ability of farmers to act as operator of farming. Farming is a process that involves a series of set of inputs or factors of production such as land, capital, labor and other production facilities that support farming activities resulting in optimum production with maximum profit.

Table 2
Means of Production, Total Cost, Revenue, Gross Income and R/C Ratio Coffee Farming in three Research Area

Coffee Farming Analysis	District		
	Purwodadi	Prigen	Tutur
Production	2 242	1 593	1 310
Total Cost	5 546 800	2 959 475	4 004 250
Revenue	10 089 000	7 169 625	5 895 000
Gross Income	4 542 200	4 210 150	1 890 750
R/C Ratio	2.28	3.02	1.75

Source: Data Analysis (2017)

This study was described which region has the advantage that coffee farming is higher than in other regions. In this case that is used is the approach nominal gross income (Gross Margin) regardless of the value of money over time but that is used is the prevailing price, which can be directly calculated amount of spending and the number of admissions during the period of production (Rossiter and Van Wambeke, 1997; Rossiter, 2011). Agriculture and Agri-Food Canada and Statistics Canada (2000) also states to facilitate the measurement of farm income then isitilah early gains received by farmers is' net cash income "where the income cash flow of agricultural businesses to net cash (revenue minus operating expenses) generated from production of agricultural commodities. The calculation of the cost of production, revenue and income in the three areas of research can be seen in Table 2.

The average value of production, costs of production, revenue and gross income as well as R / C Ratio coffee farm in Purwodadi, Prigen and Tutur District (Table 2). Farmers in Purwodadi District are able to provide the maximum benefit compared with the two other areas. Unknown value of revenue (revenue minus costs) amounted to 4.5422 million IDR from around coffee production of 2.242 Kg. The area with the second coffee farm profit level is Prigen that is equal to 4.21015 million IDR from 1 593 Kg of coffee can be produced. While the District of Said was the region with the lowest level of 1.89075 million IDR gains are only able to produce 1.310 Kg.

Table 2 also shows the Revenue Cost Ratio (R/C), R/C ratio as an analyzer to measure the cost of production. The survey results revealed Prigen has a value of R/C ratio of 3.02 compared to two other areas, are Purwodadi and Tutur District with respective values of 2.28 and 1.75. This means that coffee farming in Prigen give more feasibility of farming from the perspective of cost efficiency, though the cumulative revenue earned has a difference lower than Purwodadi for 332.050 IDR.

Based on data recapitulation and then do the next step which is the ratio of income statistically by Analysis of Variance (ANOVA). ANOVA is a multivariate analysis technique that serves to distinguish the average more than two groups of data by comparing the variance. Analysis of variance widely used in studies which involve the comparative testing is to test the dependent variable by comparing groups of independent samples was observed. Results of ANOVA analysis are shown in Table 3.

Table 3 shows the descriptive value of the average income of the largest is the Purwodadi District amounted to 4.5422 with an average interval of the lowest are 3 559 419.30 and highest are 5 524 980.70. While the average income of the area is the District Speech lowest with a value of 1.890.750 data interval of the lowest average are 1 427 891.75 and the highest as 2 353 608.25. According to Table 3 homogeneity of variance of data known value of Sig. 0.037. And this value is less than 0.05, what means three variances are not identical, therefore, the variance equality test for Anova test has been done. These results are also confirmed from the F test seen the value of F count equal to 12.861 and significance $0.000 > \alpha = 0.05$, which states among the three groups of data have different values real income. Simultaneously, the three regions have a variance of different coffee income data (Table 3 and Figure 2).

Calculation of coffee farming further into GIS input. GIS as an integrated process and change the geographical data (criterion maps input) and the assessment of the value (decision-maker preferences and uncertainty) to obtain an overall assessment to choose among alternative courses of action (goal), hypotheses and location (Malczewski, 2006), and also have the ability to overlay different map.

This study provides a map output commodities Economic Land Evaluation coffee in the highlands of the watershed Welang. The evaluation results of its economic land conditionally, because it depends on the situation and

Table 3
One way ANOVA Comparison of Farming Coffee in three Research Areas

A Descriptives

Gross_Income

	N	Mean	95% Confidence Interval for Mean		Minimum	Maximum
			Lower Bound	Upper Bound		
Purwodadi	20	4542200.00	3559419.30	5524980.70	1070000	9090000
Prigen	20	4210150.00	3234319.73	5185980.27	2075000	9527500
Tutur	20	1890750.00	1427891.75	2353608.25	555500	3540000
Total	60	3547700.00	2996686.31	4098713.69	555500	9527500

B Test of Homogeneity of Variances

Gross_Income

Levene Statistic	df1	df2	Sig.
3.504	2	57	0.037

C ANOVA

Gross_Income

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	83467071100000.000	2	41733535550000.000	12.861	0.000
Within Groups	184965908499999.970	57	3245015938596.491		
Total	268432979599999.970	59			

market opportunities that can change at any time. Data and information on the suitability of land are physically and economically indispensable for planning the development of superior results at the farm level.

Data and information resource potential physical and economic land a big contribution in the agricultural development program, which is expected to increase income and household economy of farmers and multiplayer effect for the economy in other sectors.

Land suitability economically differentiated into five classes, namely S1 (profitable); S2 (sufficient profitable); S3 (marginal prospect); N1 (still possible, need more inputs), and N2 (economically impossible) (Rossiter and Van Wambeke, 1997).

Figure 2 refers to the result of the comparison plot which states that Purwodadi is the region capable of producing the highest coffee cultivation revenue than the other two regions. Based on that Purwodadi District had fixed to the classification S1 (Profitable) for coffee plants. Whereas Prigen have a land evaluation economic classification S2 (sufficient profitable) and the Tutur classified as an area S3 (Marginal Prospect).

Land suitability classes economically, including the N1, potential fit physically derived from the class S3, S2, or even S1, but exist problems of economic aspects, such as roads, markets, product selling prices, and labor have not been met or not support (Figure 3). If the requirements of the economy have been built or are met, then the land suitability class economy will change to the better class (Rossiter and Van Wambeke, 1997). In contrast to the land that is physically N2 class derived from class N, which is not appropriate for their permanent limiting factor is very bad, good physical properties and morphology, as well as chemical properties of soil are difficult to repair.

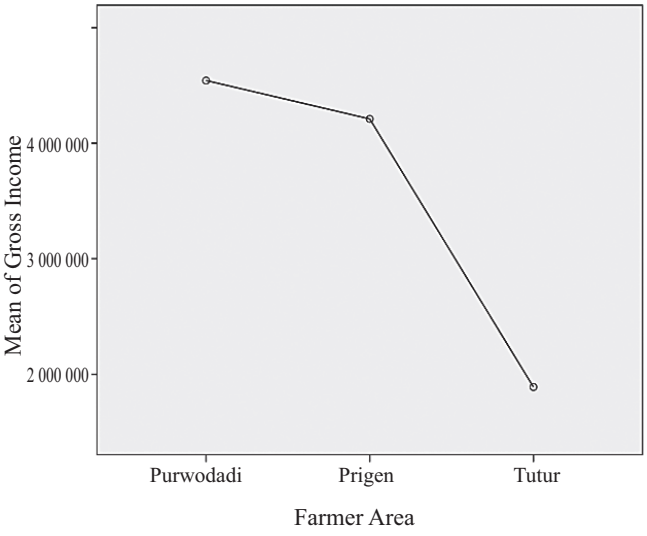

Fig 2. Means Plot Gross Income of Coffee Farming

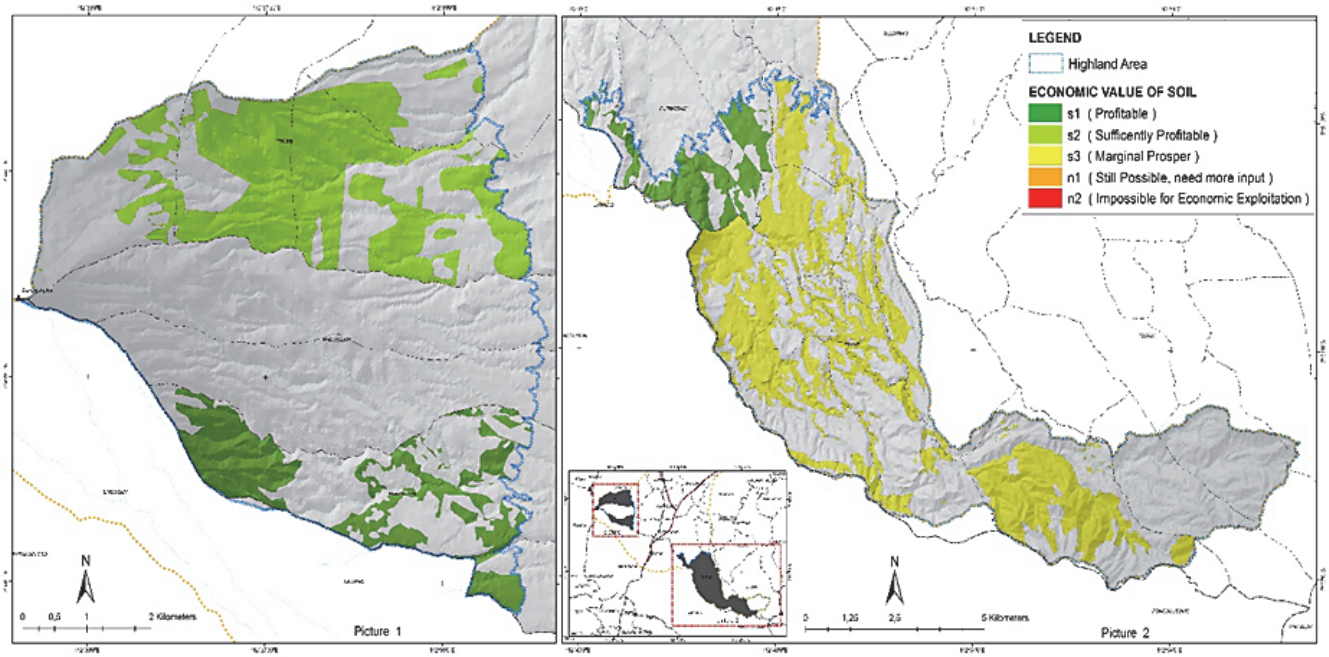

Fig 3. Maps of Economic's Land Value of Coffee Farming

On the other hand, the land economically possessing S1 physical suitability is generally derived from S1 class. Land economically, including the S2 class, likely to be physically derived from S1 or S2 class, but cannot be from the class S3 (marginal prospect).

Land suitability classes economically less chances of physical land suitability classes. This can occur if the output value of commodities cultivated and selling price is not comparable with the input, so the purpose of farming from the financial aspect is not achieved.

Conclusions

- The highland of Welang watershed has a relatively large potential area, so that the necessary critical thinking construction was directed towards farmers not to plant land conservation in sloping areas or are at high slope position.
- The area with the highest coffee farm profits Purwodadi District but less efficient in operating expenses than Prigen. This proves that the maximum benefit need to consider the optimum allocation of production inputs either from the coffee plant seed needs appropriately, the effectiveness of the dose of fertilizer and pesticides as well as the use of human resources as appropriate.
- Purwodadi district had economic land evaluation of fixed to the classification S1 (Profitable) for coffee plants. Whereas Prigen have a land evaluation economic classification S2 (sufficient profitable) and the Tutur classified as an area S3 (Marginal Prospect) if cultivate coffee plants. Tutur district rated lowest coffee production areas it is necessary to revisit the physical suitability parameter ie topography, climate and soil. So that unknown land quality matching with the requirements of the land use in the cultivation of the coffee plant.

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