30 Land Degradation and Community Resilience in Rural Mountain Area of Java, Indonesia

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Abstract

Soil erosion has been a major threat in land degradation processes around the world. High level of soil erosion in particular area may influence community livelihood where land resource as the main source of family income is being threatened. This study was carried out in Dieng Plateau, Central Java Province, Indonesia, with the aim to seek the level of soil erosion as well as to find out how resilient farm families are in the study area toward land degradation. Soil erosion assessment was performed using RUSLE method with various spatial data such as Landsat images, rainfall, soil erodibility, slope data, and conservation practice, while community resilience assessment was performed by comparing community preparedness to its vulnerability from 67 farm household samples. The results show most of high level of soil erosion occurred in area dominated by steep slope with less vegetation cover. It is also confirmed that soil erosion has accelerated due to deforestation indicated by the increasing area for soil erosion level 61–180 tons/ha/year from 1871 ha in 2007 to 2174 ha in 2017 (+4.07%). While the highest soil erosion level more than 180 tons/ha/year was increased for about 1.45% from 226 ha in 2017 to 34 ha in 2017, it was found as well that community resilience in the study area is classified at low level (0.27–1.01) with score 0.56. In general, the community in the study area is not resilient toward land degradation processes and hence jeopardizes livelihood sustainability.

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Keywords

Land degradation · Soil erosion · Community resilience · Preparedness · Vulnerability · Central Java · Indonesia

30.1 Introduction

The evolution of soils, which is influenced by the environmental factors, is moving toward through a long period of time. Once human being exploits soil for agricultural purposes, these processes are being accelerated and consequently leading to the rapid changes in soil properties, where land is degraded (Douglas 1994). According to Geist (2005), the acceleration of land degradation may come from biophysical aspect (e.g., land management), socioeconomic aspect (e.g., income and land tenure), and political aspect (e.g., incentives and political stability). Referring to the concept above, therefore, land degradation can be defined as the loss of a sustained economy, cultural, or ecological function due to human activity in combination with natural processes (Geist 2005). In terms of land capability, Douglas (1994) defined land degradation as the reduction in the capability of land to produce benefits from a particular land use under a specified form of land management which includes vegetation degradation, water degradation, climate deterioration, losses to urban and industrial development, and soil degradation.

In agricultural production, land degradation, which comprises a bunch of processes, has a direct impact on the socioeconomic of people, such as productivity decline and income loss. The arising problem following land degradation has been the major issue in land management for agricultural purposes and obviously reduced the capability of land in terms of production. All the actions in regard to agriculture activities are directly related to the sort of land degradation and finally affect the human life socially, economically, ecologically, and institutionally. The changing shape of

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land degradation into different aspects of human life has challenged scholars to develop resilience indices for community living with land degradation issues. The notion of community resilience is being prevalent since Adger (2000) place the resilience concern at the community level. Ever since then, many studies have been conducted in assessing the community resilience in different related variables (Cote and Nightingale 2012). Resilience research is the key to assess the ability of the community to survive from natural disturbances (Wilson 2012). Research on community resilience has widely spread with various concerns, such as natural disaster, climate change, rural/urban resilience, collective action, globalization, but less concern on land degradation. Among those few less examples were done by Kelly et al. (2015) and Wilson et al. (2016). Their research connected land degradation process with community resilience from various aspects such as social, economy, natural, infrastructural, institutional, and cultural.

This chapter is then proposed to fulfill the lack of research on the connection of land degradation and community resilience with specific purpose is to assess land degradation and the level of community resilience in Dieng Plateau, one of mountainous area in Indonesia. Following the concept of land degradation, we concern specifically on soil erosion assessment which been the major issue and thread in our study area either socially, economically, institutionally, or physically.

30.2 Material and Methods

30.2.1 Study Area

The study was conducted in Kejajar Sub-District which is a rural mountain area located in Dieng Plateau, Wonosobo Regency, Central Java Province. Dieng Plateau is an area with a great environmental problem in particular land degradation and water deficiency as the result of overuse and misuse of land resources which may threaten the continuation of agricultural activities. It is also one of the mountain areas in Indonesia with high level of deforestation and high environmental risk with different kinds of off-farm activities existing and considered as a significant contribution to the family income. Typical physical environmental characteristic has made this area suitable for agricultural production particularly for vegetables and potato and therefore led to inappropriate extensive crop production which may accelerate soil erosion.

Topographically, Dieng Plateau located on a mountain area with three areas division; higher area, middle area, and lower area. Higher area ranges from 2000 to 3000 m above sea level (asl), middle area from 1500 m to 2000 m asl, and lower area from 500 m to 1500 m asl. According to Rudiarto and Doppler (2013), higher area is dominated by potato agricultural area with subsistence-market oriented farming system and less infrastructure found. Middle area has more less similar condition as compared to high area but more developed with subsistence and market-oriented farming system. Lower area is likely dominated by market-oriented farming system with less effort of managing sloppy land as the area mostly plain area. Figures 30.1 and 30.2 show the topographical condition of the study area.

30.2.2 Data Collection

As this study wants to show the development of land degradation in terms of soil erosion and community resilience, data needs to be grouped into two types: spatial and non-spatial data. Spatial data in 2007 and 2017 such as land use, soil type, rainfall, and slope were elaborated to find soil erosion level while non-spatial data were used to identify the level of community resilience in the study area. Non-spatial data were collected from 67 farm household samples exaggerated by land degradation in Dieng Plateau. Standardized questionnaires were distributed with a random sampling technique. Table 30.1 shows the data needs for this study.

30.2.3 Assessment of Soil Erosion

The Revised Universal Soil Loss Estimation (RUSLE) was applied to assess the level of soil erosion in the study area. RUSLE (Renard et al. 1997) was developed from the Universal Soil Loss Estimation (USLE) founded by Wischmeier and Smith (1978) as the empirically based model. RUSLE produces the average rates of soil loss per unit area annually based on factors influencing soil erosion such as rainfall, soil type, slope, crop management, and control practice (Rudiarto and Doppler 2013). The modification of USLE into RUSLE is more on the site location of the model application where more slopes are available. RUSLE model gives more opportunity to calculate soil erosion with several slope lengths and the average results of soil erosion rates follows the particular slope length (Angima et al. 2003). Even within a large area, RUSLE enables to estimate soil erosion potential on a cell-by-cell basis, and it may produce a better spatial pattern of soil loss (Shinde et al. 2011). RUSLE is calculated based on the following equation:

$$A = R \times K \times L\,S \times C \times P \tag{30.1}$$

where A is the average soil loss (tones/ha/year), R is the rainfall erosivity index, K is the soil erodibility factor, L is the length factor (m), S is the slope factor (%), C is the crop management factor, and P is the conservation practice.

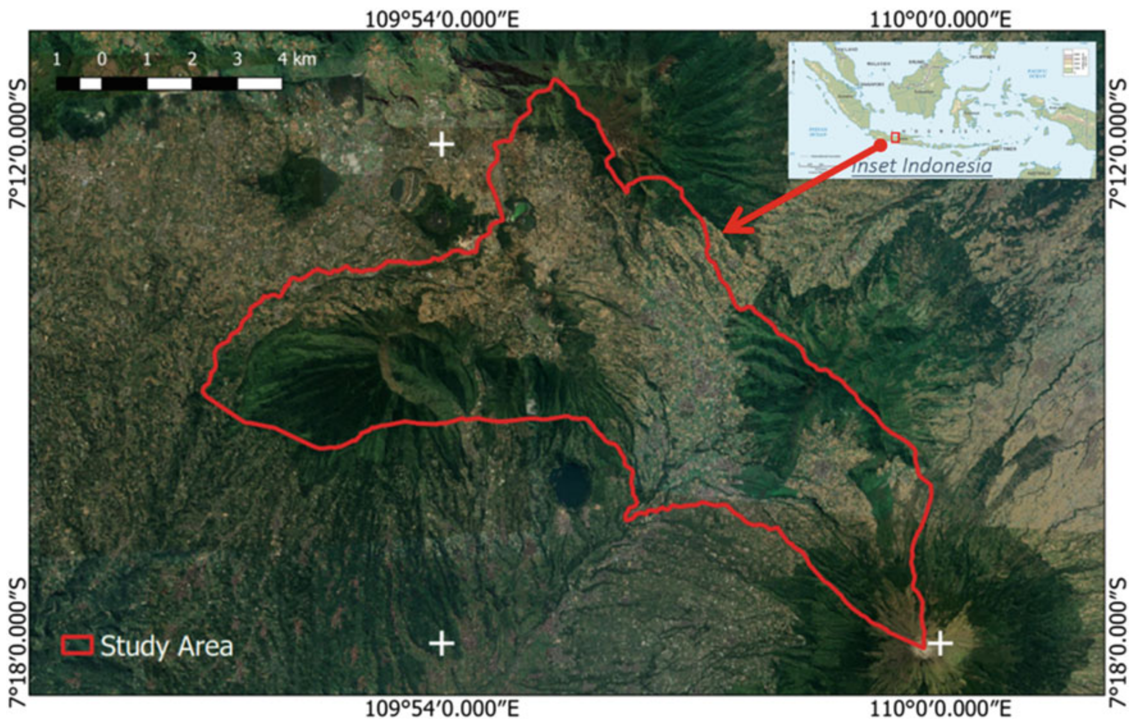


Fig. 30.1 Location of the study area

30.2.4 Assessment of Community Resilience

As this study is also aimed to discuss the resilience condition of the community living in the study area, a set of Resilience Index (RI) with its components were proposed. Based on previous study, the components of resilience index were divided into different dimensions or variables such as economic, social, physical/infrastructure, institutional, natural, and community capacity (Bruneau et al. 2003; Rose 2004; Mayunga 2007; Cutter et al. 2008; Simpson 2006; Norris et al. 2008; Shaw 2009; Ainuddin and Routray 2012; Kusumastuti et al. 2014). Though many studies on resilience have been conducted, most of the scholars agreed that it is multifaceted which includes different aspects such as social, economic, ecology, institution, infrastructure, and community (Bruneau et al. 2003; Cutter et al. 2008; Norris et al. 2008).

Community resilience was calculated by comparing preparedness and vulnerability scores from dimensions

Fig. 30.2 (**a**) Agriculture expansion in forest area; (**b**) Settlement distribution in higher area

Table 30.1 Data needs

Data and information need	Sources	Data types
Non-spatial data for community resilience assessment (see Table 30.4 for details)		
Preparedness Economic, social, infrastructure, community capacity, and institution *Vulnerability* Economic, social, infrastructure, community capacity, institution, and hazard	Micro-level survey through household samples with standardized questionnaires distribution	Primary data
Spatial data for soil erosion assessment (year 2007 and 2017)		
Administrative/boundary Land use Soil type and quality Topography Climate/rainfall Other related and derived spatial data	Satellite images (landsat images TM 5 for 2007 and Landsat 8 for 2017), DEM data from IFSAR 5 m, analog/digital maps from Geospatial Information Agency, local planning and development board, local agriculture agency	Secondary and primary data

mentioned above. As stated by Simpson (2006), the comparison of preparedness and vulnerability results in community resilience. Preparedness describes the capacity of the community in coping with disaster, while vulnerability concerns on the disaster exposure. Scoring method was applied in order to obtain a more realistic resilience condition in the study area. This study used six dimensions (social, economy, institution, infrastructure, natural, and community capacity) as the basis for the assessment of community resilience. Natural dimension was named as hazard (Shaw 2009) which related to land degradation (Table 30.4 for details).

To obtain the final score of each component, both preparedness score and vulnerability score were determined as the amount of score from all dimensions, while the dimension scores were resulted from the average of its indicators. Score Indicator (SI) was calculated following this formula:

$$\mathrm{SI}_x = \frac{T_x}{n} \tag{30.2}$$

where SI_x = Score of indicator x, T_x = total score of indicator x, and n is the number of samples. When the values for each indicator were calculated, then they were summed up to obtain score of dimensions.

Once preparedness and vulnerability were calculated, the two contributing components are then combined using the equation:

$$\mathrm{RS} = \frac{\mathrm{PS}}{\mathrm{VS}} \tag{30.3}$$

where RS = resilience score was resulted from the ratio of PS = preparedness score to VS = vulnerability score. The resilience of community then produced by associating preparedness versus the vulnerability. Resilience score is divided into three classes: low resilience, moderate resilience, and high resilience. To decide the length of each class interval, we use this formula:

$$\text{Length of class interval} = \frac{S_{\max} - S_{\min}}{\text{Number of classes}} \tag{30.4}$$

The length of class interval is determined by number of classes and maximum – minimum scores. The maximum score is 3.00 while the minimum score is 1.00, and the number of classes is 3, then the length of class is 0.74. So, as the final classification, the resilience score *0.27–1.01 classified as low resilience, 1.02–1.76 classified as moderate resilience, and 1.77–2.50 classified as high resilience.*

30.3 Results and Discussion

30.3.1 Soil Erosion

The analysis of soil erosion was completed by comparing potential soil loss in 2007 and 2017. The purpose in comparing those two is to show the physical environmental change for 10 years as well as to see the changing of environmental risk due to agricultural development in the study area. As shown in Figs. 30.3 and 30.4, potential soil loss in 2007 and 2017 was classified into four classifications from less than 15 tons/ha/year up to more than 180 tons/ha/year. Potential soil loss is dominated by the range from 15 to 60 tons/ha/year with a total area of 2983 ha in 2007 and 2711 in 2017 followed by less than 15 tons/ha/year, covered the area about 2374 ha in 2007 and 2235 in 2017. Spatially, potential soil loss of less than 15 tons/ha/year was mostly found and distributed in the southern east part of the study area, while soil loss from 15 to 60 tons/ha/year concentrated more in the middle and western part. Soil loss from 61 to 180 tons/ha/year was found more on the steep slope area which covered area of 1871 ha in 2007 and 2174 ha in 2017. The highest

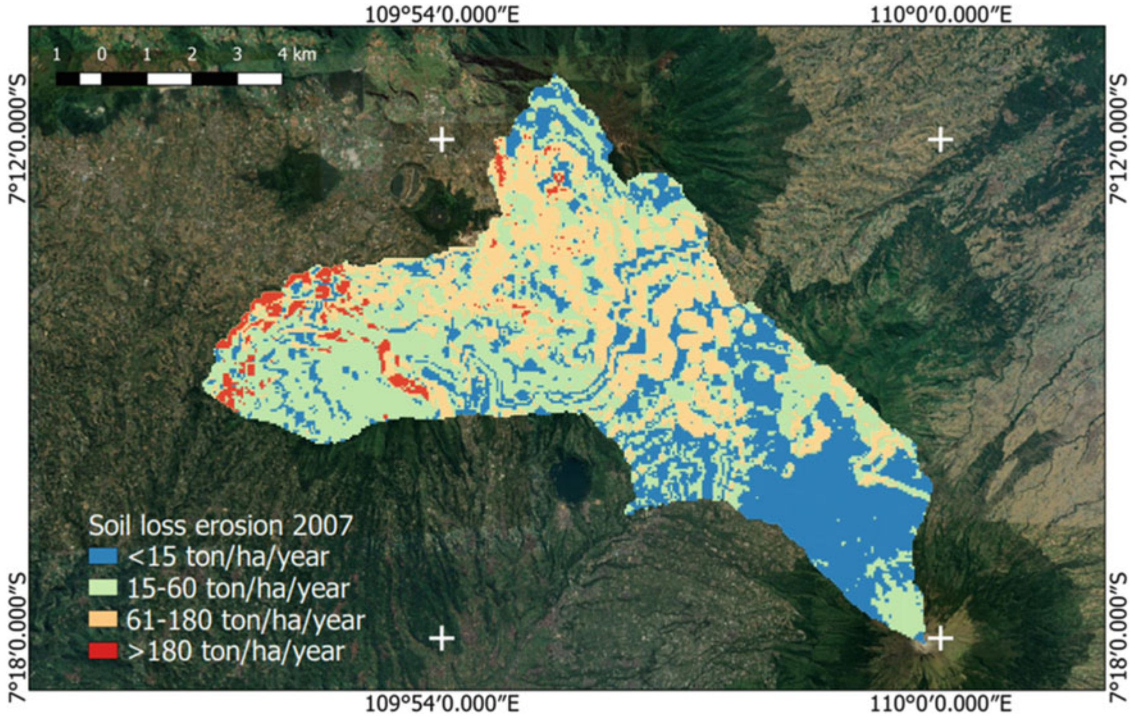


Fig. 30.3 Spatial distribution of soil loss in 2007

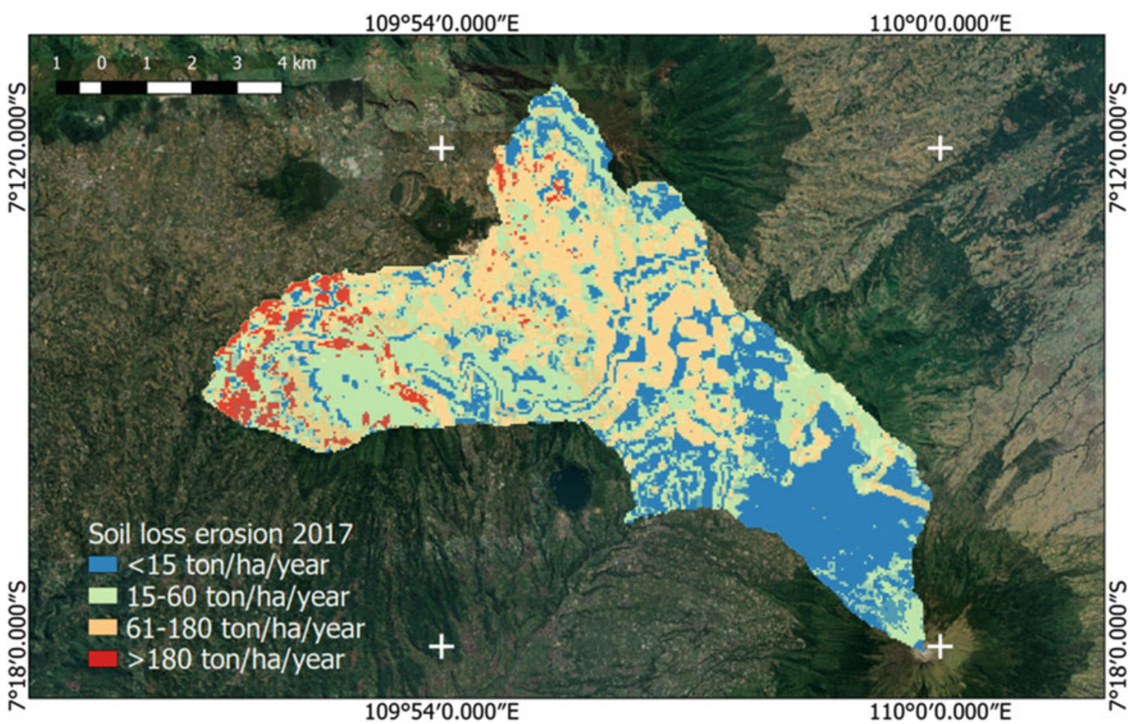


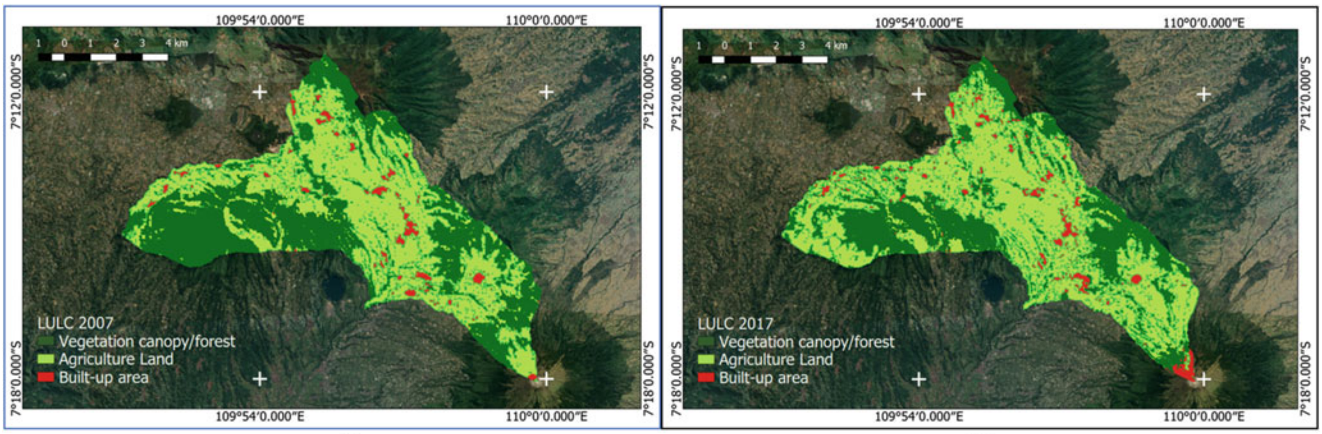
Fig. 30.4 Spatial distribution of soil loss in 2017

potential soil loss with more than 180 tons/ha/year is distributed more in very steep slope area particularly in the western part which covered the area of 226 ha in 2007 and 334 ha in 2017.

As the comparison (Table 30.2), during 10 years of development, soil loss has increased quite ominously for the rate of 61 to 180 tons/ha/year from 25.10% in 2007 to 29.17% in 2017. This increasing is also followed by the highest rate of

Table 30.2 Average rate of soil loss

	Area (ha)				Difference	
Range of rate	2007	%	2017	%	Area (ha)	%
<15 ton/ha/year	2374	31.85	2235	29.98	−139	−1.87
15–60 ton/ha/year	2983	40.02	2711	36.37	−272	−3.65
61–180 ton/ha/year	1871	25.10	2174	29.17	304	+4.07
>180 ton/ha/year	226	3.03	334	4.48	107	+1.45
Total	7454	100.00	7454	100.00		



a) b)

Fig. 30.5 Land use: (**a**) 2007 and (**b**) 2017

Table 30.3 Land use change

	Area (ha)				Difference (ha)	
Land use	2007	%	2017	%	Area (ha)	%
Vegetation canopy/forest	3273	43.91	2573	34.52	−700	−9.39
Agricultural	3865	51.85	4412	59.19	547	+7.34
Built-up area	316	4.24	469	6.29	153	+2.05
Total	7454	100.00	7454	100.00		

soil loss with more than 180 tons/ha/year with total difference 1.45% from 3.03% in 2007 to 4.48% in 2017. Simultaneously, two other rates of soil loss have been reduced from 31.85% in 2007 to 29.98% in 2017 for soil loss less than 15 tons/ha/year and from 40.02% in 2007 to 36.37% in 2017 for 15–60 tons/ha/year. Similar trend showed from previous study done by Rudiarto and Doppler (2013) from 1991 to 2006 where soil loss in Dieng Plateau increased for about 7.63% from 53.02% in 1991 to 60.65% in 2006 for the higher range of rates, whereas for the lower rates, the tendency showed declining rate for about 11.23% from 1991 to 2006.

As shown in Fig. 30.5a, b, the spatial distribution of land use has been changed significantly during 10 years' development at the higher area. This happened particularly to the forest land in the western and southern part of the study area. On the other hand, agricultural land seems more dominant in the area where forest land has been declined. Built up area is found more in 2017 distributed close to the current condition in 2007. In Table 30.3, forest land has been decreased for 9.39% from 3273 ha in 2007 to 2573 in 2017. Agricultural land increased 7.34% from 3865 ha in 2007 to 4412 ha in 2017, while built up area increased for 2.05% from 2007 to 2017. These results showed that deforestation in the study area is at critical phase, and as shown in Table 30.2, the soil erosion has been accelerated accordingly. The alteration of soil rates due to land use change significantly affects the amount and character of protection covering the surface materials (Park 2002). Therefore, the obstinacy of land from soil erosion risk is determined by a specific land use cover.

There are actually two ways of estimating erosion rates by using RUSLE model: potential erosion and actual erosion. Potential erosion implies only on the natural calculation (R, *K*, *L*, and *S* factor) where no human interference has been considered. It means that under the natural conditions, the erosion still occurs. Accordingly, actual erosion is calculated by considering *C* and *P* factor as the human interference factor. The interference of human is heavily subjected for any kind of land use change activities, such as deforestation, land clearance, cultivation, and other forms of activities which obviously influences the soil erosion (Renschler et al. 1999; Ananda and Herath 2003; Rudiarto and Doppler 2013; Ganasri and Ramesh 2015). Therefore, the *C*-factor of vegetative cover as well as types of conservation practices play an important role in determining the actual rate of soil erosion in the study area. If the soil loss rates increased in a specific period, then it may be concluded that the practice of agricultural activities has influenced the CP factors' availability. This condition confirmed that the environmental risk has been subsequently increased due to shifting of human activities on land, such as agricultural expansion to the forest area (Zhao et al. 2013; Ganasri and Ramesh 2015).

30.3.2 Community Resilience

As mentioned before, community resilience is the proportion of preparedness to vulnerability in a specific location. Therefore, the community resilience is discussed in its components: preparedness and vulnerability. The complete scores for preparedness and vulnerability as well as its dimension and components are available in Table 30.4.

30.3.2.1 Preparedness Score

The dimension as well as the indicator scores of preparedness in the study area shows the total score of 7.48. The highest score is community capacity dimension, while the lowest is infrastructure dimension. The score of preparedness from the highest to the lowest are community capacity, social, institutional, economic and infrastructure. The higher score shows the better level of community preparedness. Figure 30.6a shows the level of preparedness in the study area, while the scores are available in Table 30.4.

The higher result of community capacity among other dimensions due to the effort applied by the farmers in soil management such as crop rotation and soil conservation. Farmers are willing to do crop rotation and grow additional commodities in order to give more economic value to the family. Since Dieng Plateau is located on various sloppy areas, ranged from plain to highly step slope areas, terrace system with additional soil conservation practice such as stone has been commonly found. Poor agricultural practice related to soil conservation has been one of the main issues

Table 30.4 Score of vulnerability and preparedness dimensions and indicators

Components of resilience	Dimensions	Indicators	Score	Mean	Total
Vulnerability	Social	Dependency ratio	1.49	1.78	13.34
		Level education of household head	2.33		
		Social conflict	1.51		
	Community Capacity	Knowledge on farming practices	2.60	1.90	
		Understanding of land degradation	1.54		
		Understanding of soil conservation	1.55		
	Economic	Source of income	2.76	2.59	
		Decrease of agricultural yield	2.24		
		Decrease of household income	2.78		
	Institutional	Number of government assistantship programs	1.66	2.01	
		Access to local government assistance programs	2.37		
	Infrastructure	The availability of irrigation facilities	2.46	2.46	
	Hazard	Crop failure	2.82	2.60	
		Soil erosion	2.72		
		Number of natural disaster in past 3 years	2.25		
Preparedness	Social	Farmer group activities	1.99	1.73	7.48
		Farmers' participation in farmer group	1.48		
	Community Capacity	Crop rotation on agricultural land	2.01	2.02	
		Land conservation on agricultural land	2.03		
	Economic	Saving ownership	1.31	1.36	
		Additional jobs available	1.40		
	Institutional	Socialization of sustainable agricultural	1.52	1.37	
		Soil conservation programs from governance	1.22		
	Infrastructure	The availability of cheek dam in agricultural land	1.00	1.00	
		The availability of diversion ditch in agricultural land	1.00		

Source: Simpson (2006), Cutter et al. (2008), Shaw (2009), Cutter et al. (2010), Kusumastuti et al. (2014)

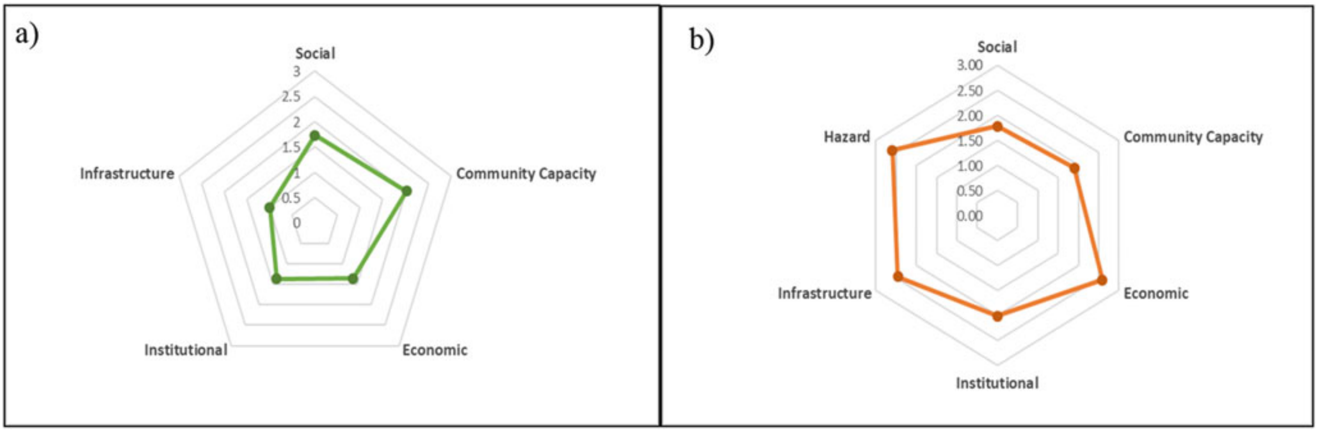


Fig. 30.6 (**a**) Preparedness and (**b**) vulnerability

among other causes in soil erosion (Kelly et al. 2015). Therefore, farmers have to develop their capacity to overcome the natural challenge related to soil and land conditions that exist in the study area in order to reduce soil loss and environmental risk to sustain agricultural activity.

Social dimension is the second main issue in terms of preparedness with a moderate score (1.73). Two components in this dimension were assessed, i.e., farmer group activities and farmers' participation in the farmer's group. The score for farmer group activities was higher (1.99) as compared to farmer's participation (1.48). The assessment of activities and participation of the farmers in social dimension is to show the level of social interaction and intervention. Farmer group can be used as an opportunity to build partnerships as well as to develop and to transfer knowledge and experience in regard to sustainable farming system.

In terms of institutional dimension, the preparedness score is relatively low (1.37) from two aspects, i.e., socialization of sustainable agricultural and land conservation programs from government. Based on the questionnaire results, socialization of sustainable agriculture was applied instead of land conservation programs. It is indicated by the score 1.52 for socialization of sustainable agriculture and 1.22 for land conservation programs. It shows that land conservations program is likely less followed by the community. However, although government program was not always followed by the community, government programs are actually there to encourage farmers in enhancing environmental awareness due to land degradation.

The economic dimension in preparedness shows also a relatively low score (1.36). This happens due to low saving ownership (1.31) and lack of additional job (1.40). Low-saving ownership indicates that farm families in the study area have less ability to organize and to manage their income and expenses. The ability to saving money is also considered as an important part in dealing with uncertainty and inevitable disturbances. Additional job availability was found limited since most of the farmers were less educated which may lessen the opportunity to get diversified jobs. Additional job is very much related to the education level and skill owned by the farmers.

Among all dimension of preparedness, infrastructure was found as the lowest score with only 1.00. This lowest score was assessed from the availability of check dam and diversion ditch which showed score 1.00 for both. All respondents stated that there are no such agricultural infrastructures applied in order to reduce the effect of soil erosion in their farm field. Therefore, the farmers are not well prepared for soil erosion which makes them vulnerable.

30.3.2.2 Vulnerability Score

As shown in Table 30.4, the vulnerability score is 13.34 with hazard dimension as the highest score and social dimension as the lowest. The complete score of each dimension in vulnerability aspects leads by hazard (2.60), economic (2.59), infrastructure (2.46), institutional (2.01), community capacity (1.90), and social (1.78). The higher the score indicates, the more vulnerable the community. The vulnerability diagram from all dimensions is presented in Fig. 30.6b.

Hazard dimension identified as the most vulnerable among other dimension. The score of hazard dimension in vulnerability aspect was calculated from three components, i.e., crop failure (2.82), soil erosion (2.72), and a number of natural disasters for past 3 years (2.25). The higher score of hazard dimension is due to most of farm families experienced with crop failure and having trouble with unpredictable risk. High level of land degradation in the study area was not followed by proper land management which directly influenced soil fertility and increasing natural hazard. Hazard dimension is very close to different aspects such as soil quality, water quality and availability, type of vegetation, and terrain accessibility (Basso et al. 2010; Sendzimir et al. 2011). From field survey, there were about 20 landslides and 8 floods disaster that occurred in the study area for the last 3 years. According to TKPD (2013), the intensity of landslide and flood disaster annually occurred in most of the villages in Dieng Plateau and obviously becomes a major thread for livelihood sustainability in the future.

In terms of economic dimension, land degradation has been contributing to the vulnerability more on decreasing of household income (2.78) followed by source of income (2.76) and decreasing agricultural yield (2.24). Those three components were interconnected where land degradation may result in the destruction of farm field or decreasing of soil quality. Disturbance on farm filed due to land degradation may result to decreasing of agricultural yield and consequently less income gain. The farmers therefore need to find solutions and alternatives for future income possibilities to cope with economic vulnerability.

Infrastructure dimension was assessed from the availability of irrigation facilities which shows a high vulnerable score (2.46). Since the study area is a sloppy area with high different of altitudes, water distribution has become a major challenge. Irrigation facilities are one of the basic components of agriculture which can affect the soil fertility. Farmers build non-permanent irrigation channels in dry season and detach it in rainy season. Farmers with limited budget built small pond in their farm field to overcome water need but only for temporarily.

Institutional vulnerability is quite vulnerable with score 2.01 from two components, i.e., number and access to government assistantship program. Overall, farm families get access to local government assistance programs. There are a quite number of assistantship programs from local government in order to increase the quality of farm families' life. Similar to institutional vulnerability, community capacity also has a quite vulnerable score (1.90). Vulnerable score in community capacity was derived from three indicators, i.e., knowledge on farming practices (2.60), understanding of land degradation (1.54), and soil conservation (1.55).

Social dimension was found as the less vulnerable dimension with total score of 1.78 from three indicators: dependency ratio (1.49), social conflict (1.51), and the level of education (2.33). From the field survey, it was found that most of the respondents were low educated with elementary or primary school graduated. It is also relevance with the community capacity dimension particularly knowledge on farming practices which indicated vulnerable since the education level is low.

30.3.2.3 Resilience Score

The resilience score of farm families due to land degradation in the study area is 0.56 classified as low resilience (0.27–1.01) (Table 30.5). With that classification, farm families were not resilient concerning land degradation as the capacity to cope with the threats in terms of preparedness is lower than its vulnerability. Nevertheless, since the resilience is derived from the comparison of preparedness and vulnerability aspects, therefore, change of scores of each indicator in those two aspects is influential. More effort in enhancing preparedness components will subsequently reduce the vulnerability and at the same time, level of resilience improves. In simple term, people are more resilient if they are less vulnerable and more prepared within a specific condition.

The contribution of vulnerability aspect in hazard, economic, and infrastructure dimension was found less resilient as the score in vulnerability is high. Hazard dimension was identified as the most vulnerable while social dimension as the less vulnerable. The high level of vulnerability in hazard dimension is due to high-level soil erosion followed by other disasters such as flood that occurred in the study area. On the other hand, inappropriate agricultural practices such as intensification and over use of soil have been contributing to higher level of land degradation. Agricultural practices therefore have become one of the major contributions in soil erosion (Collins et al. 2001; Qian 2002; Nunes and Seixas 2003). Economic dimension has significant role in creating community resilience and land degradation processes and even previous study argued that both of them is the most important to the community (Gray and Moseley 2005; van Oudenhoven et al. 2011). Land degradation reduced soil quality where top soil as the main element washed out by the water. Therefore, the existence of land resource as the main source in agriculture sector can threat the livelihood sustainability. Infrastructure dimension in terms of the availability of irrigation facilities is one of the major determinants in farm production. A well-prepared and managed irrigation facility determines the sustainability of water supply.

Other dimensions of vulnerability aspect such as community capacity, social, and institutional were also significant in shaping community resilience. Social and community capacity showed a more resilience condition while institutional was

Table 30.5 Resilience score

Resilience score		Total score	Range of classification	
Preparedness	Vulnerability			
7.48	13.34	**0.56**	**0.27–1.01**	**Low**
			1.02–1.76	Moderate
			1.77–2.50	High

The value of 0.56 is calculated from 7.48/13.34 while classification value is the range for each resilience category. The value 0.56 is in the range between 0.27 and 1.01, categorized as low resilience fairly resilience. The result also showed that farm families were more vulnerable in terms of knowledge of farming practices. Socialization and education in various types of soil conservation are imperative issues to fill out the lack of knowledge in farming practice as well as more assistantship delivery against land degradation and other natural hazard in the study area. However, it is very often found that ideas and suggestion toward more resilience trajectories were hardly applied. Stakeholders are sometimes reluctant to break through the dependencies on current systems or traditions which called as cultural resistance (Burton et al. 2008). Therefore, a more convincing approach followed by simple practices is more workable for the community since they like to see more simple and applicable approaches.

Concerning the preparedness aspect, it was found that infrastructure dimension as the less resilience and community capacity was the most resilience dimension. Agricultural infrastructure is noteworthy to reduce the risk of land degradation. This issue is also related to farmers' knowledge in farming practice where the existence of agriculture infrastructures was not really necessary. In their opinion, agricultural infrastructure will reduce the farm size and having these infrastructures mean more money to spend. They have to expend more money to build it. It is also found that farmer's involvement in government program and social interaction are relatively low which makes them less resilience both in institutional and social dimension. A limited number of farm family heads reported to have a strong social network in farmers' group. To be the member in farmer's group is of importance to the farmer, as it may increase the opportunity to discuss similar circumstances and access the relevance issues in improving farm productivity. Social dimension further gives the instance of farmers into planning process through decision or policy making within the community (Kelly et al. 2015; Wilson et al. 2016). Economic dimension was found less resilient where economically the farmers have only small money left and, on the other hand, their education level is not adequate to access more jobs.

30.4 Conclusion

Land degradation in the study area is being escalated most by forest land conversion into agricultural land and conservation practices which were very limited. This escalation was indicated by the level of soil loss in 2007 and 2017. Agricultural expansion to the forest area with steep slope condition and poor land management are the major combinations in accelerating soil loss. It is confirmed by the analysis that most of soil loss increment to higher level is due to those reasons. Land expansion for agricultural purpose and low level of soil conservation techniques indicate the needs of developing oriented strategies. However, the function of land is not only as the production factor but also as other important factors that support human life, like recreation, cultural, habitat, and regulation function. Hence, to have a good erosion control, we need to understand the historical changes of the environment in a particular area.

Vulnerability aspect is more dominant than preparedness aspect in determining the level of resilience in the study area. In principal, community very much depends on the higher level of preparedness and lower level of vulnerability to achieve more community resilience. Dimensions and indicators in community resilience calculations are able to inform household, farm families, and even stakeholders on what kind of variables should be addressed for more resilience community in facing land degradation issues. It is a decisive method entirely based on the condition of the community. High level of community resilience can be further improved by enhancing community preparedness concerning the availability of agricultural infrastructures, government assistance programs in soil conservation, and socioeconomic characteristics of farm families. Therefore, micro-level approaches in order to portray more real condition on how land degradation impact livelihood development is a great challenge for future research.

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