

Impacts of Soil Degradation: Case Study in Bogawantalawa South Grama Niladhari Division, Nuwara Eliya District, Sri Lanka

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Abstract: Soil degradation is one of the crucial environmental problems in the Nuwara Eliya District in Sri Lanka. The main objective of this study is, analyzing impacts of the soil degradation in Bogawantalawa South Grama Niladhari Division (GND) of Nuwara Eliya District. The study applies purposive sampling method to select 186 samples from affected families for a questionnaire survey and field observations. Data has been analyzed, using the MS-Excel and SPSS software packages. This study found multifarious environmental impacts, such as loss soil of productivity, decreasing soil quality, water pollution, natural disasters and decreasing soil organism, sue to illegal gem mining and unplanned agricultural activities- This study recommends to minimize the soil degradation, by way of controlling illegal gem mining, using efficient irrigation methods, practicing sustainable soil-conservation and farming, and strictly implementing existing soil conservation laws.

Keywords: Gem mining, Soil Degradation, Bogawantalawa

1. Introduction

Soil is an essential component of our earth, which provides immense contributions to our nature, by way producing multifarious organisms to maintain environmental balance. However, the unplanned human activities and continues process of natural factors on the soil layer contribute for soil degradation. The soil degradation refers to the loss of actual or potential productivity and utility of soils (Hegde et al, 2011). According to the archaeological evidences of ancient civilizations, such as Harappan civilization in Western India, Mesopotamia civilization in Western Asia and Maya culture in Central America, has shown numerous cryptograms that the soil degradation has been occurred, since the ancient era. (Karlen & Rice, 2015). This is a recurring issue and its volume and risk level may be varied, place-to-place and period to period, based on the soil type and causes for degradation. The soil degradation negatively impacts the 1.9 billion hectares of land annually and 12 million hectares of land lost its food production (Sustainable Food Trust, 2015). This situation is more crucial in the densely populated areas, such as South Asian countries, including Sri Lanka; leading to numerous environmental, socio-economic issues to the general public, as well as to our nation. The Nuwara Eliya district was situated in the central hill country of the island and major economic activity of the district is vegetable cultivation. According to the soil conservation Act No.25 of 1951, as amended by Act No.24 of 1996, the Nuwara Eliya district has been declared as a conservation area. It has been estimated that nearly one third of land in Sri Lanka is subjected to soil erosion (Dharmasena, 2014). Hence, this paper analyses the impacts of soil degradation in Bogawantalawa-South GND and its impacts.

2. Research objectives

- To find the major causes for soil degradation in the Bogawantalawa-South GND.
- To assess the impacts of the soil degradation in the study area.
- To explore the major types of soil degradation in the Bogawantalawa-south GND.
- To provide recommendations to mitigate and manage the negative impacts of soil degradation.

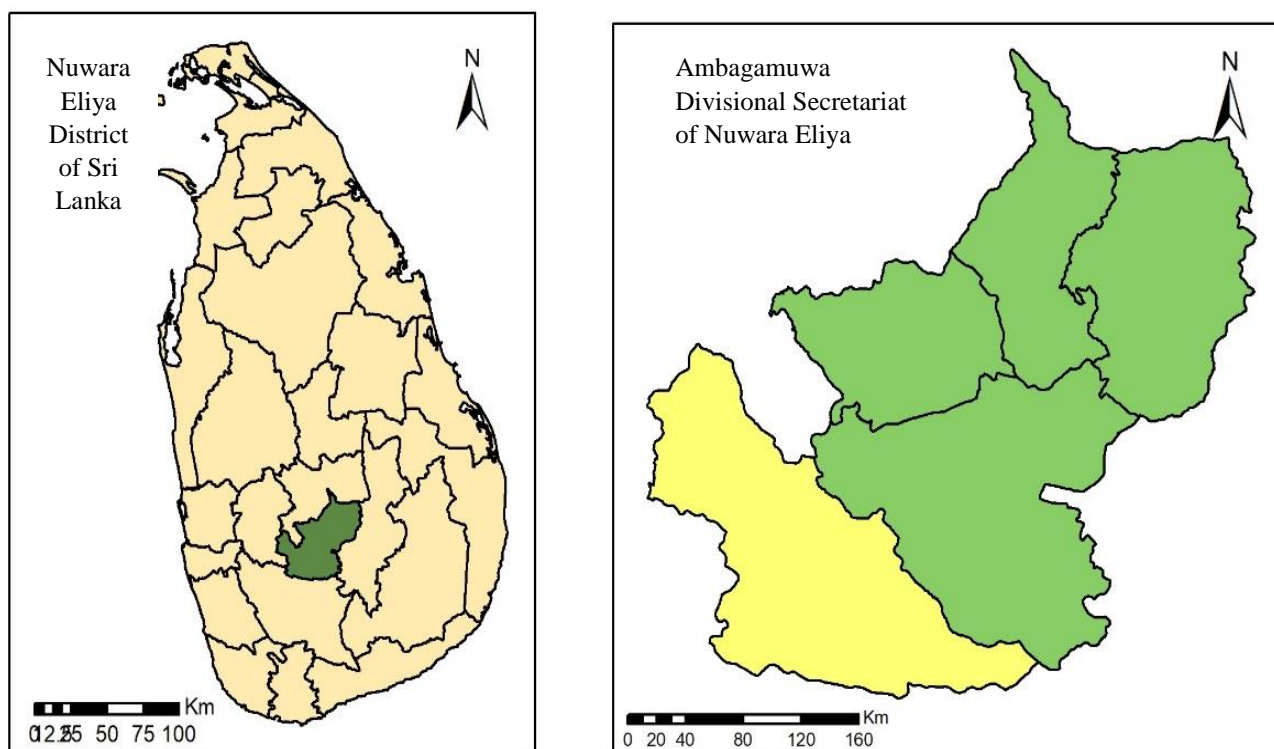
3. Literature review

Mapa, (2003), states that the main types of agricultural land degradation in Sri Lanka is soil erosion, fertility decline, salinization and compactions. Approx. 33% of the land area in Sri Lanka was degraded, due to the soil erosion, which should be controlled by introducing agroforestry systems and conservation of farming, building-up the organic matter of soil content. The existing Soil Conservation Act No. 24 of 1996 should be amended to accommodate the current needs. Dharmasena, (2014) elaborated that the Nuwara Eliya has highest amount of soil erosion (58%), in the potato-cultivated land found. According to the Ajayi (2015), the soil degradation is induced by the human activities, which resulted from erosion, losses of organic matter, plant nutrients and soil compaction.

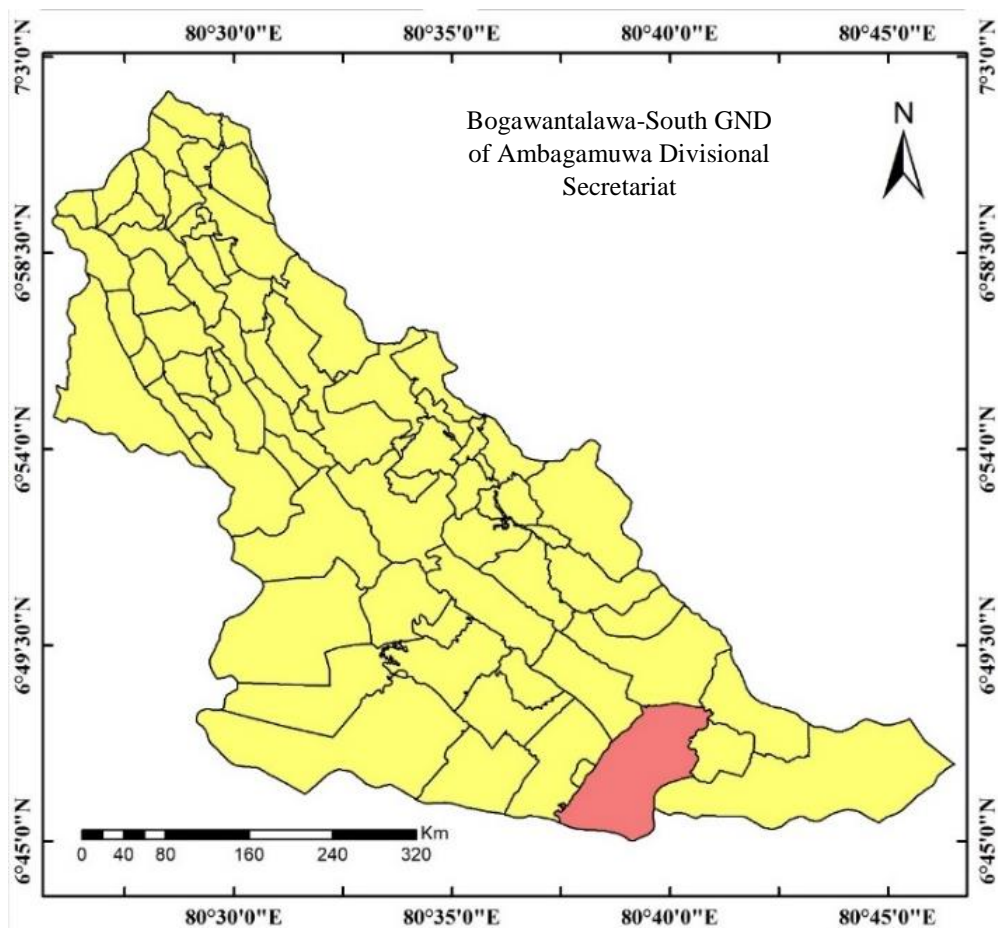
4. Study Area

The Bogawantalawa-south GND is selected as the study area which is located of Ambagamuwa Divisional Secretariat Division of Nuwara Eliya district, Sri Lanka. The coordinates of the study area are 06^o47'56.43" N Latitudes and 80^o40'19.3" E longitudes. The Bogawantalawa-south GND is located in the Nuwara District, as depicted in the below Figure-1.

Figure -1: Study area



Source: Survey Department of Sri Lanka, 2012



Source: Survey Department of Sri Lanka, 2012

5. Research problem

The major income source of Bogawantalawa-south GND is agricultural activities and gem mining. Hence, an immense soil erosion can be observed and has gravely led to the soil degradation of the area, affecting to its environment and socio-economic status of the dwellers. Although, the dwellers of the area are well aware about these issues; they are helpless, due to their poverty. Hence, it was decided to carry out a research study on this vital problem. In addition, the increasing volume of gem mining of the study area accelerates the soil degradations further. Although, there are mitigation activities, taken place by the government and non-governmental organizations, the impacts could still be observed in the study area.

6. Research Methodology

The primary and secondary data collection methods have been deployed, following the qualitative and quantitative approaches. The primary data was collected mainly through questionnaire survey, following purposive sampling techniques. 186 severely affected families from 1427 families in Bogawantalawa-south GND have been elected for this study. Specially, Purposive sampling techniques has been appropriated to find the research objectives. The field observation, 05 structured interview and 03 small groups discussion are other data collection tools, used for this study. Secondary data have been collected from research articles, annual reports, related books and internet sources. Data has been analyzed through MS-Excel and SPSS and presented in the form of charts, graphs and pictures.

7. Result and Discussion

7.1: Major causes for soil degradation in the study area

According to the result of this study, approximately 30% of the gem mining activities attributes 52% of the soil degradation in the study area. The gem mining process, with the approval of National Gem and Jewelry Authority of Sri Lanka, has been taken place close to the Kesalgamuwa river basin (Chaplton-Bridwell). However, this legal gem mining process has also not been carried out, following the laid down guidelines and standards and there are no productive follow-up or management system to secure the safety of the soil layer of the area. Its unsystematic digging and refilling process, and lack of maintenance of the extracted soil provide evidences for validating this statement true.

Further the second prime cause for this recurring issue is vegetable cultivation (24%), with the usage of chemicals, pesticides and fertilizers, irregular irrigation method (supply water by a garden hose and watering cans) and mono-cropping (carrot, potato and beetroot) *etc.* Accumulation of all these activities attributed for 47% land degradation of the study area.

Similarly, 21% of tea cultivation in the study area has also contributed for the soil degradation in the long-term. This study observed that the many previously tea planted land plots have been abandoned, due the illegal gem mining activity. According to the Dharmasena, (2014), “Soil erosion is very high on abandoned and poorly managed tea lands in the upcountry”. This reveals that the Government and non-government organizations have ore concerns about the soil quality of tea land. Hence, this factor has a minimum contribution to the soil degradation (55%) of the study area.

In addition, the increasing trend of infrastructure developments function (14%) has become a reason for soil compaction, soil erosion and landslide in the area. In 2014, approximately 163,260 (sq.ft) of new land were used for constructing new buildings in Nuwara Eliya district (Department of Census and Statistics, 2015). Indian housing project (Own land –Own village) has contributed for soil degradation at a percentage of 34%.

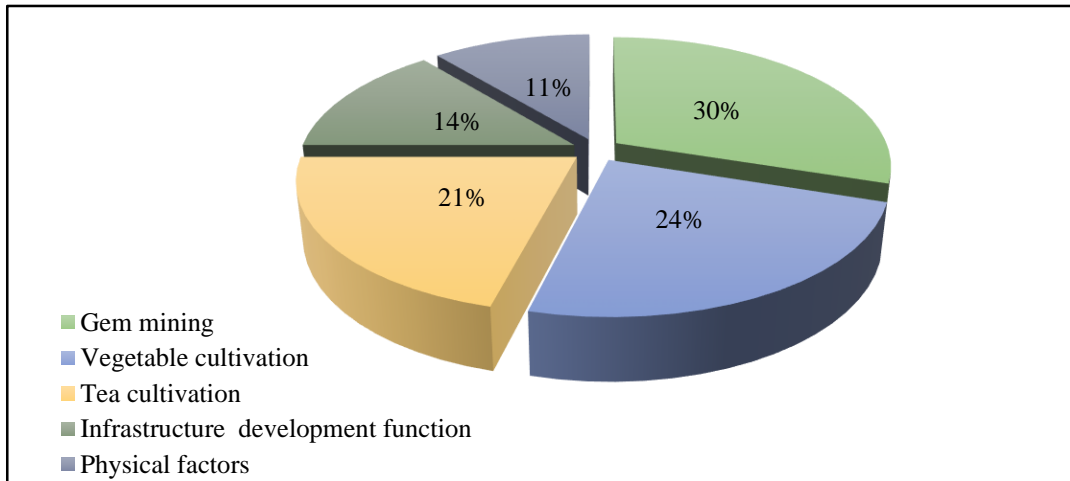
The research findings indicate that the 11% of physical factors have been contributing to soil degradation in the study area. Table-1 illustrates the annual average rainfalls in the Nuwara Eliya District and excessive rainfall damages the topsoil layer and causes the soil erosions subsequently. Especially, deep valley and steep slope spread in Nuwara Eliya district accelerates the high volume of soil degradation. Both of these physical factors are interrelated to landslide and flood and 80 families in the Amabagamuwa divisional secretariat divisions were affected, due to the landslides and flooding in the year 2018 (Amabagamuwa Divisional Secretariat Division, 2018).

Table-1: Annual average rainfalls in the Nuwara Eliya District (2013-2017)

Year	2013	2014	2015	2016	2017
Annual average Rainfall (mm)	2157.8	1057.7	2021.2	138.2	1707.6

Source: Department of Census and Statistics, 2017

Figure -2: Major causes for soil degradation in the study area



Source: Field Survey, 2019.

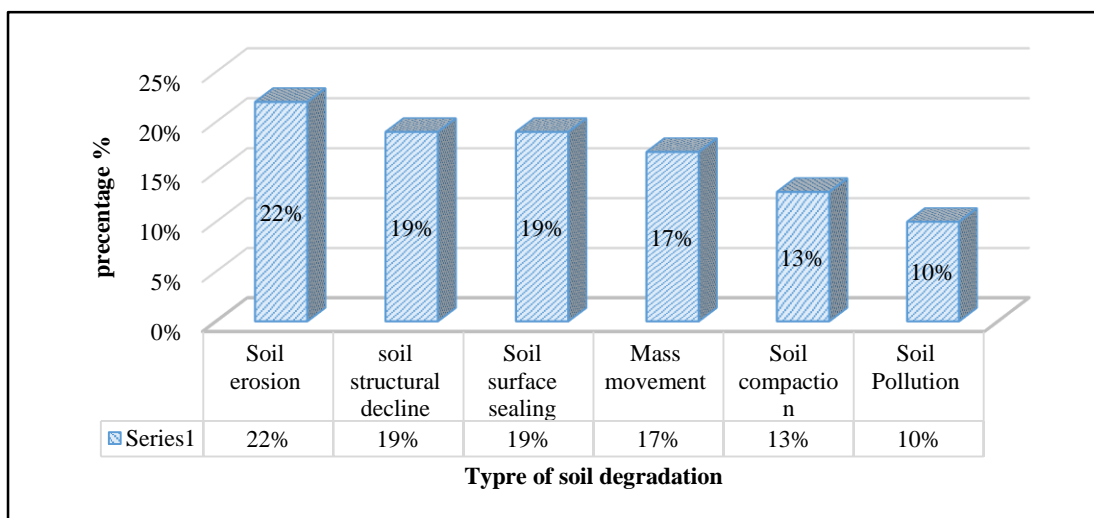
Finally, this study observed that the soil degradation is a result of the continue process of soil erosion. Mapa, (2003) stated that the soil erosion is the major factor responsible for soil degradation in Sir Lanka.

7.2: Types of soil degradation in the study area

Below figure-3 shows the major types of soil degradation in the study area. The soil erosion (22%), soil structural decline (19%), soil surface sealing (19%), mass movement (17%), soil compaction (13%) and soil pollution (10%) are major types of soil degradation that this study has found. The soil erosion has been frequently occurred in the gem mining land spots, vegetable and tea cultivated lands, due to the water flows in the area. Further, soil structural decline and soil sealing increase the soil degradation level, especially in the infrastructure developing area, such as Indian housing project (Own land-Own village) and rural road developments, exists in the study area.

Mass movement of land in the irregular tea growing slopes and gem mining pits, is an unfavorable soil degradation's type, damages residential property and environment of the area. The frequent such process induces the soil compaction, which could be seen footpaths, concrete road, playground and residential areas in Bogawantalawa-south GND. Soil pollution is mainly caused by residents.

Figure-3: Types of soil degradation in the study area



Source: Field Survey, 2019.

Figure-4: Types of soil degradation in the Bogawantalawa south**1. Soil erosion****2. Soil structural decline****3. Soil surface sealing****4. Mass movement****5. Soil pollution**

Source: Field Survey, 2019.

7.3: Impacts of soil degradation

The multifarious negative environmental impacts have categorized as 1. Loss of soil productivity, 2. Natural disasters, 3. Decrease the soil quality, 4. Water pollution, and 5. Decrease the soil organism. Moreover, it was identified that the negative impacts on socio-economic status of the dwellers in the study area would be summarized as: 1. Decrease the income, 2. Abandonment of the land, 3. Increase the land maintenances cost, 4. Decrease the land value, and 5. Family conflicts *etc.*

85% of the respondents have accepted that they have negative impacts on their land. Loss of soil productivity has occurred in the tea estate and vegetable garden. Since last five-years, the vegetable farmers have lost their yield and it had a gradual decreasing trend in context of farmer's income, similar to the Tea estate workers. They have been paid Rs: 25/-/Kg, without day wages.

A natural disaster is an important negative impact on the study area. Landslide and flood affect the vegetation canopy and day-to-day lifestyle of dwellers. Below table-2 shows the affected families, due to the landslides and floods in the Ambagamuwa Divisional Secretariat.

Table-2: Number of the people affected by the landslide and flood in the Ambagamuwa Divisional Secretariat (2013-2018)

Types of disaster	2013	2014	2015	2016	2017	2018
landslide	432	233	128	50	22	53
flood	17	05	06	06	02	27

Source: Ambagamuwa Divisional Secretariat Division, 2018

Highest numbers of people were affected in 2013 and 2014, due to the landslides. The heavy rainfall caused this unfavorable situation. However, the number of affected people has been reduced from 2015 to 2017, due to the favorable climate conditions during the periods under reference. The affected people in the year 2013 and 2018 have been increased, due to the removal of soil for gem mining activities and transportation of such soil to the river. This has decreased the river level and water catchment area and caused for flood disaster. Due to this landslides and flooding, it was observed that residential properties and agricultural lands were completely destroyed and dwellers of the area have been displaced.

More usage of pesticides and weedicides have decreased the soil organism. Particularly earthworm, ant, soil beetles and soil insects support to originate fertile soil. An amount of soil organisms was decreased in the vegetable garden and tea estates. Sri Lanka's tea plantation sector used the glyphosate weedicide until 2015 (Central Bank of Sri Lanka, 2017).

Gem mining activities in the area pollute the pure water. Similar, adverse impacts on the environment created many social crises, such as drinking water problem and conflict between gem mining workers and residents. Further, the soil degradation has a negative impact on the land value in Bogawantalawa-south. Approximately, 95% of gem mining pits were not refilled properly in the Chaplton-Bridwell mining area. These pits has a large threat to the residents of the area and devalue the land plots in the vicinity. Moreover, grasslands have severely plagued by the gem mining and also impact the animal husbandry (cow and goat) activities of the area. Gem mining workers reside temporarily with the local community, creates multiple social issues, such as child abuse, sexual harassment and loss of peaceful family life and increase of social conflict.

7.4: Conclusion and Recommendations

7.4.1. Conclusions

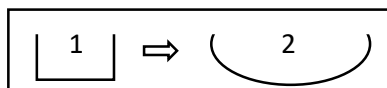
This research found Impacts of Soil Degradation in Bogawantalawa-south GND. Approximately, 30% of the gem mining activities attributes 52% of the soil degradation in the study area. Further the second prime cause for this recurring issue is vegetable cultivation. Similarly, 21% of tea cultivation in the study area has also contributed for the soil degradation in the long-term. Moreover, infrastructure developing function and physical factors have been contributing to soil degradation in the study area. This study has found the soil erosion (22%), soil structural decline (19%), soil surface sealing (19%), mass movement (17%), soil compaction (13%) and soil pollution (10%) are major types of soil degradation in the study area. Soil degradation has shown a rapidly increasing trend, due to the anthropogenic and natural factors in the study area, the multifarious negative environmental impacts have

categorized as 1. Loss of soil productivity, 2. Natural disasters, 3. Decrease the soil quality, 4. Water pollution, and 5. Decrease the soil organism. Moreover, it was identified that the negative impacts on socio-economic status of the dwellers in the study area would be summarized as: 1. Decrease the income, 2. Abandonment of the land, 3. Increase the land maintenances cost, 4. Decrease the land value, and 5. Family conflicts *etc.* To mitigate the impacts, the productive strategies together with viable solutions should be implemented to reduce the impacts of soil degradation.

7.4.2 Recommendations

a. Gem mining area

1. It is recommended to interfere the Government to control the illegal gem mining activities.
2. Approved Gem mining activities should be properly monitored by the respective Government Authority and abundant pits should be refilled immediately.
3. Protect the extracted soil from the water erosion, covering such extracted soil by waterproof bags and waterproof sheets.
4. Create the eco-friendly gem mining pits as depicted below. The diagram number-2 is suitable than the diagram number-1. Since this could minimize the landslide.



5. Accommodation should be provided to gem mining employees by their owners. Thus, it preserves the local community.

b. Vegetable and tea gardens

1. Use the more efficient irrigation method, such as sprinkler irrigation and drip irrigation in the vegetable garden.
2. Stop the irregular land preparation and use the contour ploughing in the slope lands.
3. Build the stone fence or grow the grass in the slope lands.
4. Improve the existing drainage system in the area.
5. Use of natural fertilizers instead of chemical fertilizer and stop the usage of harmful chemical pesticides and weedicides.

c. Other recommendations

1. Make a public awareness within impacted area and provide solutions about soil degradation in Bogawantalawa-south GND to understand the value of soil.
2. Strictly implement the existing soil conservation law (Soil Conservation Act 1951 (No.25.of 1951) and Soil Conservation Amendment (Act.No.24.1996)); among the rural community.
3. Quantitative research and exploratory research are necessary to identify the more impacts of soil degradation in Bogawantalawa-south.
4. Sustainable soil conservation activities should be made by the government and it should be started from the rural level.
5. Provide a productive soil conservation policy.

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