

Evaluating the Environmental Impacts of Urbanization in Balangoda, Sri Lanka

S. Nishanthani¹, K. Rewathy²

^{1,2}*Department of Geography, Faculty of Arts, University of Colombo, Colombo 07.*

Abstract

Urbanization in Sri Lanka has developed as a process associated with increasing urban population due to migration of people from rural to urban areas, achieving urban development and the expanding of urban boundaries. The environment is undergoing enormous changes due to the development process, and it is difficult to ensure environmental sustainability. The study is aimed at identifying the activities related to urbanization in the Balangoda area and analysing the environmental effects of urbanization. For primary data collection, twenty in-depth interviews were conducted, and observations and field photographs were utilized to demonstrate the on-going urbanization activities and environmental consequences. Google Earth images were used for the identification of environmental changes. The collected primary data were analysed through qualitative techniques and maps for the study area were generated using Arc GIS. According to the study findings, it has been identified that urbanization has been occurring in the Balangoda urban area for the past 23 years. This is commonly attributed to the increase in population from 8653 to 40,000, the expansion of urban boundaries, city development, industrialization activities, modernization, and commercialization. The identified negative environmental effects in the study area were incidents of natural disasters such as floods, landslides, rockfalls, and droughts due to the excessive removal of vegetation cover. Further, a decline in biodiversity in the study area has been identified; species such as cranes, snakes, sparrows, deer, freshwater fish, herons, and ducks are estimated to have declined. In the research area it has been discovered that the durations of the summer and rainy seasons have drastically changed. Both the wetland ecosystem and the forest ecosystem in the study area had major reductions in provisioning and cultural services. However, urbanization in the study area has also been found to have positive effects on economic growth, urban development, infrastructural development and better living conditions. Public awareness, rural development, and place-based planning have been suggested as solutions to control negative ecological effects.

Key words: Balangoda, Environment, Impact, Urban Planning, Urbanization

1. Introduction

There are various definitions given by different scholars for urbanization and urban growth. As Liu et al, (2014) stated urbanization is one of the major research topics considered globally today. Population growth in urban areas is referred to as urbanization (Uttara et al., 2012). Globally, the percentage of

Corresponding author.

E-mail address: selvarathnamnishanthani@gmail.com (S. Nishanthani)

people living in urban areas is predicted to rise from 55% in 2018 to 60% in 2030 (United Nations, 2018). The rate of urbanization nowadays is rising daily around the world resulting in both positive and negative consequences. Urbanization is becoming a significant issue in both developed and developing countries. Unplanned urbanization is a major obstacle in creating sustainable cities, particularly in developing countries. Accordingly, the most rapidly urbanizing cities are mostly in developing countries (Vlahov & Galea, 2002). Sri Lanka, a developing country, is currently experiencing the effects of urbanization as a result of rising of the population and urban development activities. The number of people living in urban areas in Sri Lanka increased from 2,797,719 in 1980 to 4,101,702 in 2020 (World Bank, 2022). Specifically, the southern and western parts of Sri Lanka have been undergoing a massive urbanization process for a very long time. However, more recently the upland areas of Sri Lanka have also been undergoing urbanization. Due to this, these regions face various social, economic, and environmental consequences. In this situation, the Balangoda area located in the Ratnapura district of Sri Lanka is facing many effects of urbanization. Especially in the Balangoda area, the ecological effects due to urbanization are causing massive damage. As a result, it has not been easy to maintain the environmental sustainability of the city. Therefore, considering this situation, this study has been carried out to identify the ecological consequences faced by the Balangoda area due to urbanization. Accordingly, forecasting urbanization and associated ecological changes is essential for developing and implementing sustainable urban planning (Ranagalage et al., 2019).

2. Literature review

In a study done by Dahanayake & Wickramasinghe (2022), Colombo is identified as the primary urbanizing area with a high population as it is the capital and economic center of the country. The study found that infrastructure development and impervious building areas have increased over the past twenty years. Further, Sakalasooriya (2021), states that, due to urbanization in the Nittambuwa area in Sri Lanka, the number of passengers passing through the city has increased and transport services have also improved. Businesses are expected to increase from 400 in 2000 to 1000 in 2050. The Nittambuwa area is currently seen as a third-tier city and is expected to be upgraded to a second-tier city as a result of future urban development. However, there haven't been any studies done yet on urbanization in the Balangoda area.

Ranagalage et al., (2019), found that upcountry cities in Sri Lanka are also undergoing massive urbanization processes and are facing environmental consequences. According to this, the land use of the Nuwara Eliya district has changed as a result of urbanization over the past 20 years, with significant

ecological repercussions. In addition, the famed Ceylon tea plantations, a sustainable industry, have seen a downturn due to urbanization. This research has been carried out focusing on the Nuwara Eliya district which is an upcountry area. So far, no research has been carried out focusing on the Balangoda area of the Ratnapura district.

Some of the studies have identified the major consequences of urbanization on natural events. According to a study conducted by Manawadu & Wijeratne (2020), Colombo and its surrounding suburbs have experienced significant flood disasters in the last two decades. It has been found that there is a huge correlation between the floods that have occurred in the Kolonnawa area in the Colombo district and the pressures that have been placed on the land due to urbanization. Further, according to a study by Dahanayake & Wickramasinghe (2018), population growth and land use change were directly related to flood risk in Colombo between 1999 and 2018. The study discovered that the northern and southern parts of the Colombo district are vulnerable to flooding because of their high levels of urbanization. In the study area, high flood-prone, moderate flood-prone, and low flood-prone areas have increased by 1.29 percent, 3.27 percent, and 5.04 percent respectively. Although research on the flooding brought on by urbanization has been done, it has only been done in the Colombo area. No research has been done in the Balangoda area.

A study by Hettiarachchi et al., (2014), found that flood buffer wetlands in Colombo have undergone massive changes since 1989 to the present due to urbanization and changes in environmental use. The study has identified that the ecological processes of wetlands are undergoing complete change due to urbanization. This review also highlights the decline in ecological services provided by wetlands in the Colombo area. However, no studies have been conducted so far regarding the decline of ecological services as a result of urbanization in the Balangoda area.

According to Dissanayake (2020), green planning should be implemented to reduce the ecological effect of urbanization. It has been strongly emphasized through this study that the temperature can be reduced by implementing green schemes in urban areas. Further according to a study by (Qiu et al., 2019), cropland reforestation and greening programs have played a major role in reducing ecosystem service losses. The above studies emphasize the implementation of the green plan as a strategy for the sustainability of the city. However, no studies related to the green project have been carried out focusing on the Balangoda area. In contrast, research which are mostly focused on solid waste disposal has been conducted in the study area.

The literature reviewed thus fills the research gap in various ways. The works of literature identified here are helpful in one way or another in providing the basics regarding the research problem for the study focused on the Balangoda area. However, the research carried out in the Balangoda area based on the topic of urbanization activities and its related ecological effects has become a new research problem and provides the basis for various studies.

3. Methodology

Both primary and secondary data collection methods were applied for this study. Primary data collection techniques such as structured interviews, unstructured interviews, and observation were used in this study to find out the ecological effects of urbanization. Data were obtained from secondary data collection techniques, namely satellite images, Google Earth Pro, statistical reports, pre-generated maps and research papers to identify the urban development activities of the study area.

3.1 Sampling and data processing techniques

The purposive sampling technique was used to select 20 study participants from the total population of the study area for interviews. Out of 20 interviews, 10 were subjected to in-depth interviews and 10 to unstructured interviews (Shown in Table 1). The narrative analysis method was used to analyse the acquired data from interviews. Data processing tools from ArcGIS were used to analyse, generate, and display the spatial data. All the processed data were presented in a descriptive form and also visualized through maps and tables.

Table 1: Interviewed participant's details

Respondent	Age	Residence	Duration of Residence	Job
1	38	Olugantota	38 years	Teacher
2	37	Balangoda	37 years	Member of the Divisional Secretariat
3	39	Balangoda	39years	Member of the Divisional Secretariat
4	68	BalangodaTown	68 years	Zonal Education Director
5	-	Balangoda	40 years	Member of the Urban Council
6	61	Thumbagoda	61 years	Teacher
7	67	Balangoda Town	65 years	Writer

8	35	Balangoda	30 years	Teacher
9	65	Balangoda	65 years	Teacher
10	38	Balangoda	38 years	Principal

Respondent	Age	Residence	Duration of Residence	Job
1	75	Balangoda	28 years	Unemployed
2	70	Balangoda	20 years	Unemployed
3	78	Ellapola	45 years	Unemployed
4	71	Olugantota	71 years	Unemployed
5	61	Bombuva	30 years	Home maker
6	51	UdaKanda	22 years	Unemployed
7	67	UdaKanda	25 years	Retired
8	75	Balangoda	27 years	Home maker
9	56	Balangoda	25 years	Unemployed
10	67	UdaKanda	27 years	Home maker

Source: Field Survey, 2022

3.2 Study area

The study area of this study is the *Balangoda* Municipal Council located in the Ratnapura District, Sri Lanka. The study area is located between latitude $6^{\circ} 39'$ North and $80^{\circ} 41'$ East. The research area is approximately 16.2 km^2 in size and is located between 1000 and 3000 feet above sea level. The area under the *Balangoda* Municipal Council includes 10 GN Divisions. The area has a temperature of 25°C and receives a rainfall of 2422 mm. The *Balangoda* City Council's a service area is home to 40000 people, divided into 9623 families. The majority of the locals work in the secondary and tertiary sectors of the economy. The region has recently faced massive urbanization and is undergoing land use changes and associated ecological consequences. Based on this background, this study has been carried out in the *Balangoda* City Council as the study area. The study area of this study is clearly shown in Figure 01.

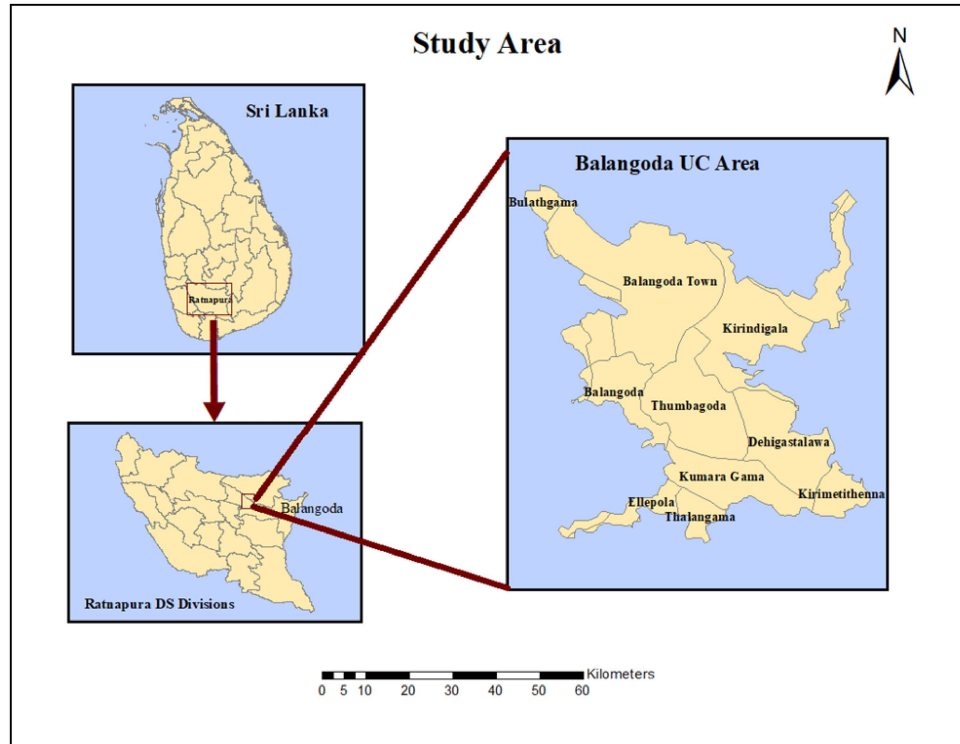


Figure 1: The Spatial location of the study area; source: Generated by the researcher using Arc GIS 10.8

4. Results and Discussion

Balangoda is one of the cities in Ratnapura district that has undergone massive urbanization process in recent times (Urban Development Authority, 2014). In Ratnapura district, Balangoda is growing as a secondary city for service delivery (Urban Development Authority, 2014). A comparison of the growth of the city over time can confirm that the area has undergone massive urbanization process since the year 2000. According to the urban development authority, Balangoda has reportedly been urbanizing for roughly 23 years. The causes of the urbanization in the Balangoda urban council area have been determined using the information gathered through interviews and discussions. According to this, modernization, commercialization, industrialization, development of services and business opportunities have been identified as the causes of urbanization whereas the growth of services has been cited as the primary cause of this. People have moved from rural to urban locations for a variety of reasons, including the availability of amenities like education, healthcare, and transportation. In particular, they moved to the city of Balangoda, which has more service development, from less developed areas of Udakanda, Welikkapola, Pettigala, and Rassagala.

The presence of urbanization activity in the Balangoda urban council area is identified based on four indicators. Based on four indicators, namely, population growth, urban border extension, industrialization activities, and urban development initiatives, the level of urbanization is calculated. Among the indicators identified much attention has been given to population growth. Based on the information given, it can be concluded that the city's population has grown over the past 50 years. To accomplish this, graph 02 has been used to show how the urban population has changed in thirty years from 1971 to 2021. According to the graph, from 2000 a rapid urban growth can be identified.

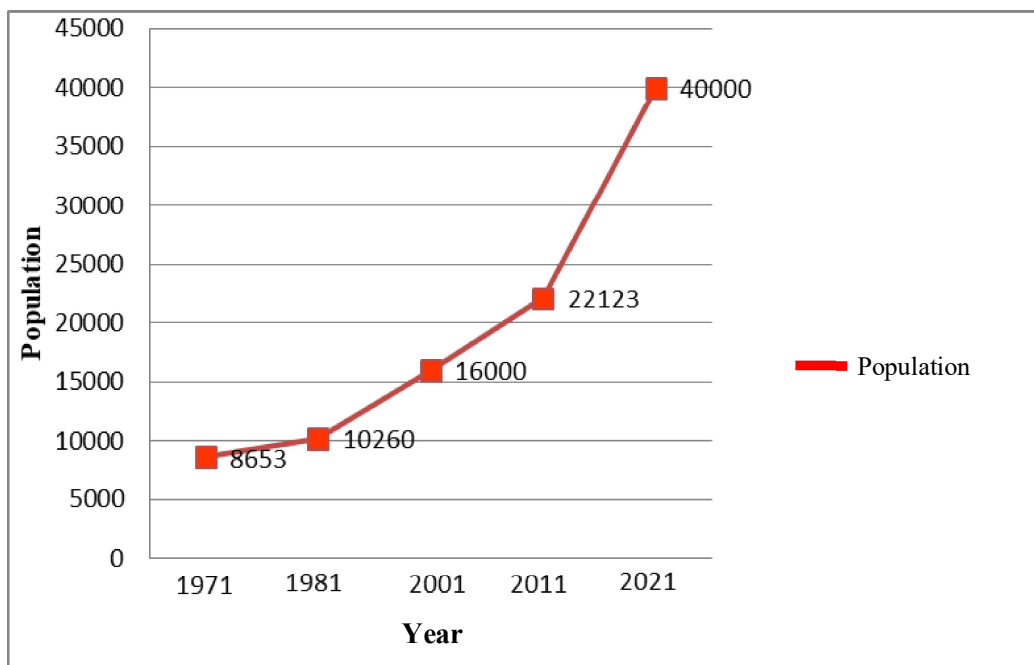


Figure 2: The progression of Urban population in the Balangoda Urban Council Region; source: Divisional Secretariat of Balangoda, 2023

Moreover, when we observe the expansion of the city limits, we can identify a significant change over a period of time. According to this, the Municipal Council boundary which included 09 GN Divisions in the period of 2001 has been modified to include 10 GN Divisions in the period of 2021. During the expansion of the city limits, some GN units absorbed into the city were reorganized and some new GN units were incorporated. It is clear that the city council border, which in 2001 encompassed the 09 village service units Ellapola, Dehigastalawa, Thumbagoda, Kirindigala, Olugantota, Dorawala, Gotukodella, Balahamulla and Korakamada has grown to include the 10 village service units Ellapola, Balangoda, Balangoda town, Kirimetithenna, Bulathgama, Dehigastalawa, Thumbagoda, Kirindigala, Thalangama and Kumaragama in 2021. Figure 03 depicts the growing urban Council limits.

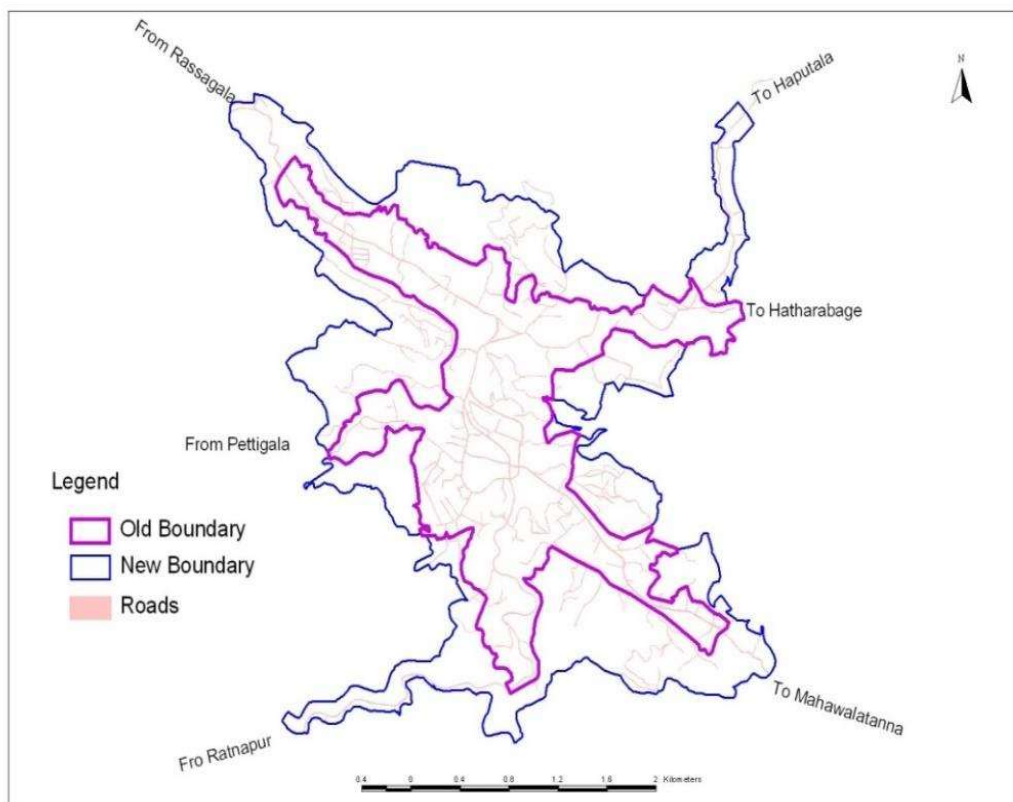


Figure 3: The expansion of the city limits in the Balangoda Urban Council Region;
source: Urban Development Authority, 2014

When comparing the years from 2001 to 2021, it is clear that the urban development in the *Balangoda* urban council area has increased significantly. In the *Balangoda* urban council area, it is possible to see that numerous infrastructure facilities and service developments, including bus stops, a new road, a playground, banks, store buildings, markets and factories have been absorbed between the years 2001 and 2021. Figure 04 demonstrates the growth of the *Balangoda* city area in detail.



Figure 4: Shows the growth of the urban development in the Balangoda Urban Council Region; source: Google Earth Pro, 2021

Industrial conditions and employment are seen as reasons for migration from rural areas to urban areas in the Balangoda area. So, it can be confirmed that industrialization activities are also taking place. The on-going urbanization processes of Balangoda area have had a variety of negative social, economic, and environmental effects. Among these, ecological effects have been found to be severely damaging, particularly in the Balangoda urban council area. According to the data gathered, it has been discovered that urbanization is having a variety of ecological repercussions on the Balangoda urban council area, including the prevalence of natural disasters, a loss of biodiversity, environmental pollution, a reduction of the ecological services and climate change. Based on this, the following ecological effects of urbanization in the study area can be seen.

The most significant impact of urbanization in the Balangoda urban council area is natural disasters. Natural disasters such as floods, landslides, rock falls, soil erosion and droughts have been identified in the study area. Among these, particularly floods and landslides have been identified as the

most impactful disasters. The major reason for the acceleration of such disaster has been identified as the removal of forest cover.



Figure 5: The forest cover change for 20 years; source: Google Earth Pro, 2023

Figure 5 depicts the gradual change and urban growth of Balangoda area for twenty years. Due to the urbanization and the mushrooming of settlements, most of the natural vegetation covers were removed.

As a result of urbanization, the areas of Ellapola, Thumbakoda, Krindigala, Buladgama, *Balangoda*, Pettigala, Saraswathiwaththa, massanna, Hunukumbura, Gulana, Dorawala, Kumaragama and Mugunamale mountain have been recognised as being at a high risk of landslides. Hanukumbura, Ellepola, Pallekanda, Mugunamale road, Kirimatithanna, Paragahakumbura road, Anandha maithriya road, Rassagala road and *Balangoda* town have also been named as the most vulnerable places for flooding. Also, it has been found through the study that people face the risk of rock falls in the areas of *Balangoda* city and drought in the areas of, *Balangoda* town, Udakanda, Kirimetithenna, Pallekanda and Karawaketiya. Also, according to the data collected in the research field, it has been found that the disaster of land subsidence is also occurring in the Massanna area. The areas of Saraswathiwaththa, Mugunamale mountain, Wey river, Dorawala and Walawe river have been identified as prone to soil erosion. On 19.05.2019, it was discovered that urbanization had caused significant flooding to occur in the *Balangoda* area. During this time, rain water had fully engulfed the bus stop. Figure 06 of the images illustrates this.



Figure 6: Flooding due to urbanization in the Balangoda Urban Council area; source: Balangoda Urban Council, 2019

Additionally, instances of rock falls have been reported on the sides of the new road. The following statements confirm that the people living in the *Balangoda* urban area are facing various types of natural disasters due to urbanization. Accordingly to the statement of interviewee No 12,

“In the late 1980s the course of the Dorawala Ganga was massively altered due to the initiation of development activities in the city. The river which used to run on the right side of the playground in the 1980s was later diverted to the left side of the playground. Due to this, we are facing massive problems. In other words, because houses are built today where the course of the river was seen at the beginning, water leaks in the walls of the houses and the floor is damp. Due to this, we have to live with a massive threat during heavy rains.”

Due to the availability of such information, it has been confirmed that there were occurrences of natural disasters in the study area due to the alteration of environmental phenomena. Figure 7 discloses the natural vegetation depletion in the area from 2001 to 2021.

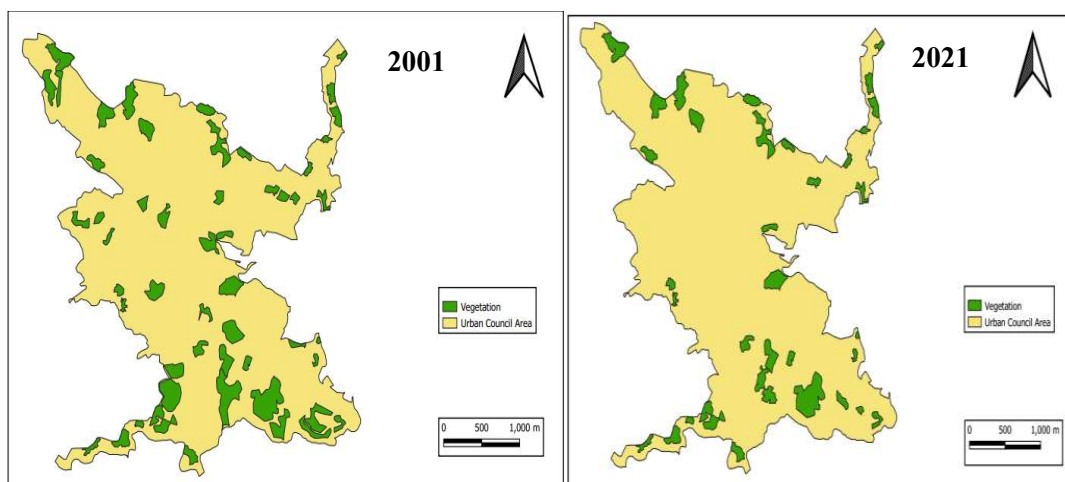


Figure 7: Vegetation removal in the study area; source: Generated by the researcher using Arc GIS 10.8, 2023

Due to the effect of urbanization most of the vegetation cover in the *Balangoda* urban council area has been destroyed and species are also threatened. The extent, diversity and stability of the forests in the study region have been decreased as a result of urban development. According to this, the development activities brought on by urbanization pose a serious threat to species including snakes, sparrows, deer, freshwater fish, herons, cranes and ducks. The majority of native species habitats are currently being destroyed, which poses a threat to their survival. This is revealed in the statements of older citizens of the community provided to the researcher when they were gathering data in the study area. Accordingly,

“About 15 years back, cranes used to fly in large numbers towards the Bengiwatta area in the evenings. In recent times, the number of cranes have declined as their habitats have been compromised following urbanization.”

The statement confirms the decline of species in the study area. Most of the trees like surrogate, teak, and jackfruit have been felled by urban development, and structures have been built in their place. The closing of the majority of wetlands and water bodies has also resulted in the extinction of numerous waterfowl and reptile species. According to this, most of the forests have been destroyed in the areas of Mugunumale Mountain, Udakanda, and Ellapola. Further, most of the wetlands were covered with soil to make way for bus stand, market block, the stadium and a new road, killing the living creatures. Small canals, drainage and wells have been closed to make way for concrete roads, which have also destroyed the creatures that lived in small water bodies.

Land use changes associated with urbanization in the *Balangoda* urban council area have reduced the services of most eco-blocks. Particularly in forest ecosystems, wetland habitats, freshwater ecosystems, and mountain ecosystems, ecosystem services have drastically decreased. Provisioning services, regulating services, cultural services, and supporting services are all declining in the research area. Out of these, delivery services and cultural services have particularly declined. Food, drinking water, wood fuel, natural gas, oils, medical supplies, raw materials, etc., have decreased significantly in Provisioning services. Also various cultural services such as recreation, heritage values, tourism, and aesthetic experiences have also declined. Pollination, water treatment, flood management, carbon sequestration, and climate control have all declined in the regulating services in the study area. Additionally, the supporting services that manage the regulatory and cultural services have drastically decreased. The *Mugunu* mountain area, *Dorawala* Ganga region, and wetlands located in the middle of the urban city have been identified as areas with a massive decline in ecological services. The following statement confirms the decline of various ecological services in the study area. According to an interview participant (No 16), it is clear that the ecological services in the study area have decreased.

“In the early days, the green fields and swamps were abundant when visiting the city. At that time there was pure air and peace of mind. But today the urban area is filled with polluted air and buildings everywhere. This does not satisfy the mind at present.”

It has been discovered that ecological services in these places have completely declined for a variety of reasons, including plans for settlement, urban expansion, the formation of artificial ecosystem blocks, etc. Numerous historical indications suggest that ecological services have drastically declined, particularly in the *Muhunamale* region.

Due to changes in production and consumption patterns brought on by the dense population of the city, the environment has become more polluted and has generated more garbage. In *Balangoda* urban council area, environmental contamination has increased in the air, water, and land sectors. It has been discovered, that most of these pollutants are found in air the and other bodies of water. Because solid sewage is used to capture pollution, it is substantially less prevalent on the land. In the *Balangoda* city, the main cause of water contamination is fertiliser used in agriculture. Fertilisers with high nitrogen and phosphorus contents are typically used in urban small-scale agricultural practises. Fertilisers wash off during heavy rains and combine with water bodies, contaminating the water. Also the air in the study area is highly polluted due to increased transportation development and industrial

development. Although it was considered the cleanest city in Sri Lanka earlier, today it has become one of the most polluted cities due to urbanization. Further, solid waste has also increased in the study area. Particularly this can be seen in the areas of *Balangoda* town, *Dorawala – pola*, *Wey River*, *Dorawala oya*, *Olugantota*, *Walawe River* and *Thumbakoda*. According to the interviewee No 7,

“During 1990 the water of Dorawala Ganga was used for drinking by all the people of this area. However, today the water is so polluted that it is difficult to even take a bath.”

Environmental contamination in the research area is made worse by population increase, economic development, industrial development, urban and transit construction, combustion of fossil fuels, and industrial wastes. In this area urban pollution has been linked with a lack of initiative for urban regeneration, urban greening, and smart city development. Environmental pollution brought on by urbanization has been found to be greater on the plains than in hilly areas.

In the *Balangoda* urban council area the temperature has increased due to increase in buildings and increase in concrete roads due to change in heat absorption capacity. During the study, the interviewee No 19 commented:

“We think that the temperature in the city may have risen at times as most of the vegetation cover in the surrounding areas has been destroyed to make way for new settlements.”

This clearly shows the rise in temperature in the urban and the reason for it. The thermal stability of the *Balangoda* urban council area has improved now compared to earlier times. The temperature in the central part of the city is relatively higher than in the suburbs. According to reports, compared to the early phase, there is currently no set time limit for temperature and rainfall. It has been discovered that issues relating to climate change are also being dealt with. Accordingly an increase in temperature can be observed in the area of the *Balangoda* Town area, *Kirimetithenna*, *Ellapola* and *Pallekanda*. *Balangoda* had a rise in temperatures from 20⁰C in 2001 to 25⁰C in 2021.

Thus, it is possible to analyse the ecological effects of urbanization in the study area. Although such ecological problems were identified in the study area, some positive effects were also identified during data collection. It has been found that there are social and economic benefits. According to this, the data obtained during the interview revealed that there are positive effects such as economic growth, urban development, infrastructure development and better living conditions. According to the interviewees in the study area,

urbanization activities have been found to play a massive role in regional development and maintaining human well-being. However, negative ecological effects are largely caused by these socio economic benefits. Such ecological consequences are seen as a major problem in ensuring the sustainability of the *Balangoda* city.

5. Conclusion

Through this research the urbanization-related activities of the *Balangoda* urban council area have been discovered and the related ecological repercussions have also been thoroughly examined that the *Balangoda* urban council area has undergone significant urbanization as a result of commercialization, industrialization, the growth of services and modernization. As a result, the study has shown that urbanization-related activities, such as population growth, city boundary expansion, urban development accomplishments, and industrialisation activities, have occurred. It has further revealed that as a result of urbanization in the *Balangoda* urban council area, people are experiencing ecological issues such as natural disasters, a decline in biodiversity, a reduction in ecological services, an increase in environmental pollutants, and a rise in temperature. The difficulty of guaranteeing ecological sustainability exists in *Balangoda* City as a result of the lingering ecological repercussions of urbanization. By adopting steps to slow down urbanization and by improving spatial planning, the ecological effects of urbanization can be managed. The aforementioned analysis is useful in protecting the environment of *Balangoda* and transforming it into a sustainable city.

6. Recommendations

The environmental consequences can be lessened by regulating the urbanization-related activities in the *Balangoda* urban council area and by taking action to rehabilitate the impacted ecosystem. In this regard, the following actions can be taken.

- Stakeholders and the general public should be made aware of the environmental issues brought on by urbanization. Labels can be issued for this, and public hearings about environmental protection can be held.
- To foster biodiversity and combat climate change, green infrastructure such as green roofs, urban forests, water management, and green spaces should be developed. This will preserve the biodiversity of the study area.

- It is possible to carry out biodiversity conservation programmes such as restoring habitat, creating animal corridors, and creating protected areas.
- It is important to adopt waste reduction strategies including reuse, recycling, and efficient trash disposal. This can be accomplished by recycling non-digestible waste and conducting composting operations using digestible materials.
- Before beginning any development-related work in an urban area, environmental impact assessments should be done. This can reduce the impact of natural disasters during development projects in the study area.
- To lessen the ecological effects of urbanization, migration from rural to urban regions should be managed. To achieve this, rural residents' welfare needs to be raised. For this, education, health and transport should be developed in rural areas.
- In order to repair the harm caused by the elimination of natural ecological blocks, artificial spiral blocks can be made. During this time the problems related to the decline of ecological services can be solved.
- To lessen air pollution, greenhouse gases from car exhaust and agricultural chemicals should be evaluated. This is the time to combat climate change.
- Ensure environmental management practices. According to this, management practices should be implemented in all activities like growing plants, protecting biodiversity and restoring wetlands. The degradation of the environment can be managed during this time.
- To lessen ecological pressures brought on by urbanization, laws should be enforced against people who engage in deforestation, siltation of wetlands, and destruction of biodiversity.
- The expansion of heat-absorbing plant blankets is necessary to regulate the temperature rise in urban areas brought on by the construction of structures.
- The identified programmes and activities can be introduced and put into practise in the research area to reduce the adverse effects of urbanization on the environment.

References

- Balangoda* Divisional Secretariat, (2023), Statistical Book.
- Dahanayake, H. D. and Wickramasinghe, D., (2022). Impacts of floods on Colombo during two decades: Looking back and thinking forward. *Progress in Physical Geography: Earth and Environment*, p.697-715. Available at https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=urbanization+

- [of+land+use+change+flood+in+sri+lanka&btnG=#d=gs_qabs&t=1670033583509&u=%23p%3DktH_QALbNCMJ](https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=ecological+effect+of+landuse+change+in+sri+lanka+&btnG=#d=gs_qabs&t=1670032946308&u=%23p%3D-Z2qN5_TNQAJ)(Accessed 25 November.2022)
- Dissanayake, D. M. S. L. B., (2020). Land use change and its impacts on land surface temperature in Galle City, Sri Lanka. *Climate*, 8(5),p.65. Available at https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=ecological+effect+of+landuse+change+in+sri+lanka+&btnG=#d=gs_qabs&t=1670032946308&u=%23p%3D-Z2qN5_TNQAJ(Accessed 26 November.2022)
- Hettiarachchi, M., Morrison, T.H., Wickramasinghe, D., Mapa, R., De Alwis, A. and McAlpine, C.A., (2014). The eco-social transformation of urban wetlands: A case study of Colombo, Sri Lanka. *Landscape and Urban Planning*, 132, pp.55-68. Available at https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=the+eco+social+transformation&oq=the+eco+social+trans#d=gs_qabs&t=1669774116754&u=%23p%3D5G9NaQidE9MJ(Accessed 27 November.2022)
- Liu, Y., Huang, X., Yang, H. and Zhong, T., (2014). Environmental effects of land-use/cover change caused by urbanization and policies in Southwest China Karst area—A case study of Guiyang. *Habitat International*, 44, pp.339-348. Available at https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=environmental+effect+of+land+use+change&btnG=#d=gs_qabs&t=1670144474122&u=%23p%3DznjJiWT4Sk0J(Accessed 29 November.2022)
- Manawadu, L. and Wijeratne, V.P.I.S., (2021). Anthropogenic drivers and impacts of urban flooding-A case study in Lower Kelani River Basin, Colombo Sri Lanka. *International Journal of Disaster Risk Reduction*, 57, p.102076. Available at https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=anthropogenic+drivers+and+impact+of+Urban+flooding+&btnG=#d=gs_qabs&t=1669774615300&u=%23p%3DgpvkG1CNnjMJ(Accessed 29 November.2022)
- Qiu, L., Pan, Y., Zhu, J., Amable, G.S. and Xu, B., (2019). Integrated analysis of urbanization-triggered land use change trajectory and implications for ecological land management: A case study in Fuyang, China. *Science of the Total Environment*, 660, pp.209-217. Available at https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Integrated+analysis+of+urbanization-triggered+land+use+change+trajectory+and+implications+for+ecological+land+management%3A+A+case+study+in+Fuyang%2C+China&btnG=#d=gs_qabs&t=1686817303062&u=%23p%3DMoFAgwwg_DUJ(Accessed 02 December.2022)
- Ranagalage, M., Wang, R., Gunarathna, M.H.J.P., Dissanayake, D.M.S.L.B., Murayama, Y. and Simwanda, M., (2019). Spatial forecasting of the landscape in rapidly urbanizing hill stations of South Asia: A case study of Nuwara Eliya, Sri Lanka (1996–2037). *Remote Sensing*, 11(15), p.1743. Available at https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=spatial+forecasting+of+the+landscape+in+rapidly+urbanizing+hill+stations+of+South+asia

- [&btnG=#d=gs_qabs&t=1669773735791&u=%23p%3DTPEZ9FDckj8J](#)(Accessed 03 December.2022)
- Sakalasooriya, N. (2021). Causes of Accelerating the Urbanization of the Nittambuwa Town in Sri Lanka. *International Journal of Humanities and Social Science*, [online] 9(2), pp.1–10. Available at: <https://www.researchgate.net/publication/349710403> (Accessed 02 December.2022)
- Uttara, S., Bhuvandas, N. and Aggarwal, V., (2012). Impacts of urbanization on environment. *International Journal of Research in Engineering and Applied Sciences*, 2(2), pp.1637-1645. Available at https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Impacts+of+urbanization+on+environment.&btnG=#d=gs_qabs&t=1686817526941&u=%23p%3DX2A0fBQMfVYJ(Accessed 08 December.2022)
- Urban Development Authority, (2014) Development Plan for the *Balangoda* Urban Development Area.
- Vlahov, D. and Galea, S., (2002) Urbanization, urbanicity, and health. *Journal of Urban Health*, 79(1), pp.S1-S12. Available at https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=urbanization+urbanicity+and+health&oq=urbanization+urbanic#d=gs_qabs&t=1662929264964&u=%23p%3D9IFyknHINywJ (Accessed 10Sept.2022)