

# IDENTIFICATION OF FOREST COVER CHANGES IN POLONNARUWA DISTRICT OF SRI LANKA

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## ABSTRACT

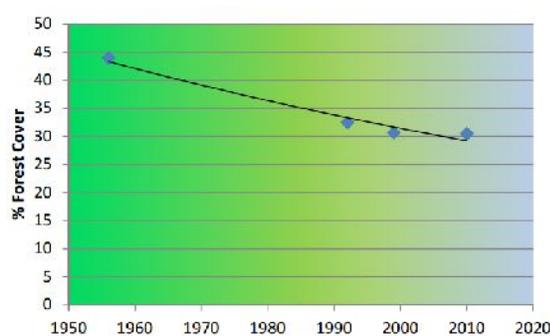
Forest covers influence on all the components of earth system such as atmosphere, biosphere, geosphere and hydrosphere. Forest is a major natural carbon stork of the earth surface which helps to reduce the concentration of green house gases (GHGs) in atmosphere. It causes to reduce the runoff rate and evaporation rate of water and increase the infiltration rate and groundwater level. Especially it is very important, having the forest covers in dry areas to recharge the groundwater and mitigate the drought impacts. Expansions of human settlementsand development projects invade the forest covers arising many physical, biological and environmental problems.This research aims to identify the forest cover changes in Polonnaruwa districts from 1972 to 2014.

Basically three segments were considered to identify the forest cover changes in district as before, during the war and after war periods. 1972 and 1985forest covers were considered to the period of before war and 1972 forest extent was derived using one inch map of survey department. 1985 forest cover extent was identified from the 1:100,000 land use map of survey department. Forest cover of war period was developed with 1:50,000 data in 2001. Present forest cover was derived using satellite images in 2014. Arc GIS 10.1 software used for the analysis and all the forest layers were digitized for the area calculations.

The result shows a considerable extent of forest cover loss in Polonnaruwa district. In 1972 forest cover extent of the district was 2603.5 sqkm and after a decade this extent was reduced to 1373.7 sqkm. As well as it was clearly identified that in the war period this extent was again increased up to 1529 sqkm in 2001. Since then forest cover had been reduced to 1331 sqkm in 2015 as a result of human activities and development projects.Results show, 48% of total forest cover has been declined by human activities within four decades in Polonnaruwa district. With the present political situation of the country, there is a probability to introduce new development projects for Polonnaruwa district. As such final outcome of this research will help for planning new development projects with paying especial consideration to the minimum effects on forest cover in the district.

## INTRODUCTION

Forests provide multiple benefits to human and other terrestrial organisms. Human and terrestrial animals depend on forests for their survival from the air they breathe to the food and wood they consume. Forest plays a key role on life of the earth including providing habitats for animals, protecting of watersheds, preventing soil erosion, reducing Green House Gas (GHG) emission and mitigating climate changes. World's forests extent continues to decline as a result of increase of human population and the increase of demand for food and land. Thirty per cent of the earth's land area or about 3.9 billion hectares is covered by forests. It was estimated that the original forest cover was approximately six billion hectares on the earth (Bryant et al., 1997). Rowe et al. (1992) estimated that 15 per cent of the world's forest was converted to other land uses between 1850 and 1980. Deforestation occurred at the rate of 9.2 million hectares per annum from 1980-1990, 16 million hectares per annum from 1990-2000 and decreased to 13 million hectares per annum from 2000-2010.As well as over the past 25 years global carbon stocks in forest biomass have decreased by almost 11 gigatonnes (Gt). This reduction has been mainly driven by conversion to other land uses and to a lesser extent by forest degradation (FAO, 2015). Expansion of agricultural land, logging and fuel wood,



Source: Forest Department of Sri Lanka

Figure 01- Forest cover change in Sri Lanka (%)

overgrazing, fires, mining, urbanization/ industrialization and infra-structure development and wars and military activities are the direct causes for declining forest cover in world wide.

Sri Lanka is an important tropical country that has mainly three different climatic conditions and different forest systems within the small land extent of 65,610sqkm. Sri Lanka is divided into three main climatic zones as wet, dry and intermediate based on the average annual rainfall. Forest cover of Sri Lanka was estimated at 70% of the total land area at the start of nineteenth century. Since then the forest cover has decreased continuously. Sri Lanka's forest cover was estimated by the FAO to be 26.6% of the land area or 1.7 million hectares in 2010. Bulk of the forest estate is dense natural forests and is mainly situated in the dry zone of the island. Based on the last forest cover assessments of the 1990s, FAO extrapolated declining forest cover of 0.6 to 0.3% over the past decade (FAO, 2010).

Summary Report of "Drivers of Deforestation and Forest Degradation in Sri Lanka" prepared by Sri Lanka UN-REDD Programme shows three main historical drivers of deforestation in different three periods of Sri Lanka. 1800-1945 had been considered as pre-independence era and in the early 1800s, there was 70% forest cover in the country. Two dominant drivers have been identified for this period as growth of export plantation economy and commercial timber extraction policy. In Post-independence era from 1948-1985 shows large-scale conversion of forest cover to several land settlement and irrigation development schemes. UN-REDD has identified four major current drivers from 1992 to today for deforestation such as encroachments, infrastructure development projects, private agriculture ventures and several localized drivers cause to forest degradation.

After the war, lots of development projects and infrastructure development activities have been taken place in many parts of the country. In order to reduce the impacts on forest cover due to development activities it is very important to have a district level database of forest cover to mitigate such impacts. Temporal changes of forest cover in each district will help to develop the strategies to limit the deforestation activities which can be arisen due to development projects. As such initial step of the research to identify district level forest cover changes in Sri Lanka, this paper describes the forest cover changes in Polonnaruwa district from 1972 to 2014.

Polonnaruwa district is located between 7°39' - 8°21' North latitudes and 79°45' - 81°22' Eastern longitudes in dry zone of the country. Total land extent of the district is 3440sqkm and annual mean temperature ranges from 25.0°C to 27.5°C. Annual rainfall is 1500-2000 mm but it decline to 1250-1500 mm in the northwestern part of the district. There are major four forest types in the district including Dry mixed evergreen, Lowland savanna (Damana), Wet grassland (Villu) and Riverain forest. According to the present political situation, there is a probability to plan new development projects for Polonnaruwa district. In order to mitigate the impact on existing forest cover outcome of this research helps to plan the new strategies for development projects

## **METHODOLOGY**

Basically three different time periods were considered to identify the forest cover changes in the district such as before, during and after the war period. 1972 and 1985 forest covers were considered to the before war period and 1972 forest extent was derived using one inch map of survey department. One inch map was scanned and geo-referenced before start the digitizing. All forest areas of the district were digitized to calculate the forest land extent. A0 scanner was used to scan the maps and Arc GIS 10.1 software was used for geo-referencing and digitizing.

1985 forest cover extent was identified with the 1:100,000 land use map developed by the survey department data. This map was also scanned and geo-referenced. Forest cover of this map was also digitized to calculate the forest extent. Forest cover of war period was studied using 1:50,000 digital data in 2001. Present forest cover was derived using high resolution satellite images in 2014. Supervised or unsupervised classification of satellite images is very difficult to use for identification of forest covers. Classification results derive the vegetated areas in the district. But all vegetated areas cannot be considered as forest. Thus high resolution satellite images of Google Earth were used to derive the present forest cover. Google Earth Pro software was used to download the high resolution satellite data. These images were geo-referenced and digitized the forest areas. 1:50,000 data was very useful to separate the forest areas from other vegetated areas. It had to spend more than three months to complete the digitizing process.

## **RESULTS & DISCUSSION**

The result shows a considerable extent of forest cover loss in Polonnaruwa district. In 1972 forest cover extent in the district was 2603.5 sqkm (figure 02). According to the spatial distribution of the forest cover in this decade, middle part of the district had been invaded by the human settlements and the agricultural activities. But most parts of the district excluding center, covered by forests. This had been due to low irrigation and infrastructure facilities of the district especially before starting the Mahaweli development project. As Polonnaruwa district is located in

dry zone, often this people were suffered by drought impacts. As the main income of the people live in that area is agriculture. Thus drought was the major problem they had to face in early stages. As such settlement were found closer to the major tanks in the district.

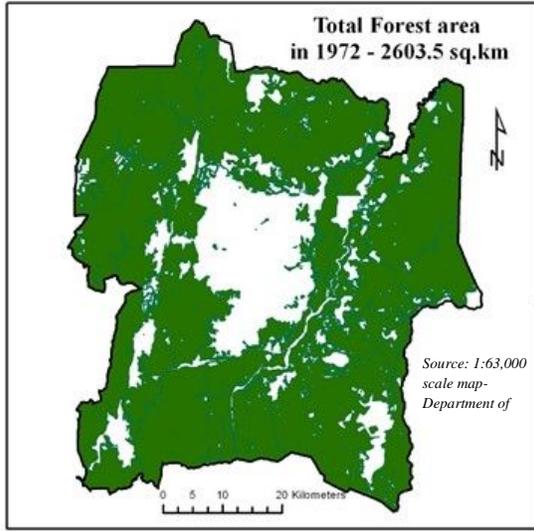


Figure 02- Forest cover change in year 1972

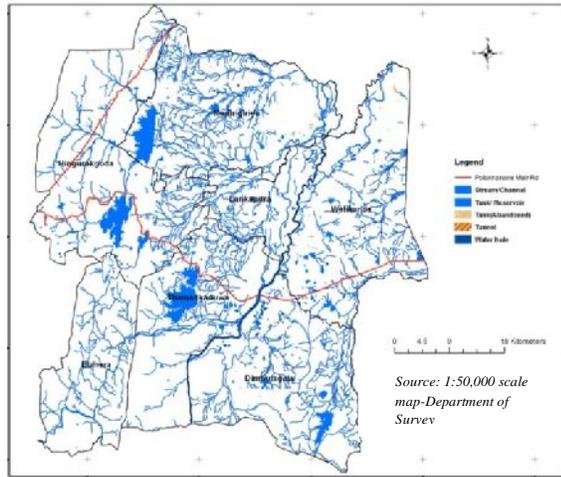
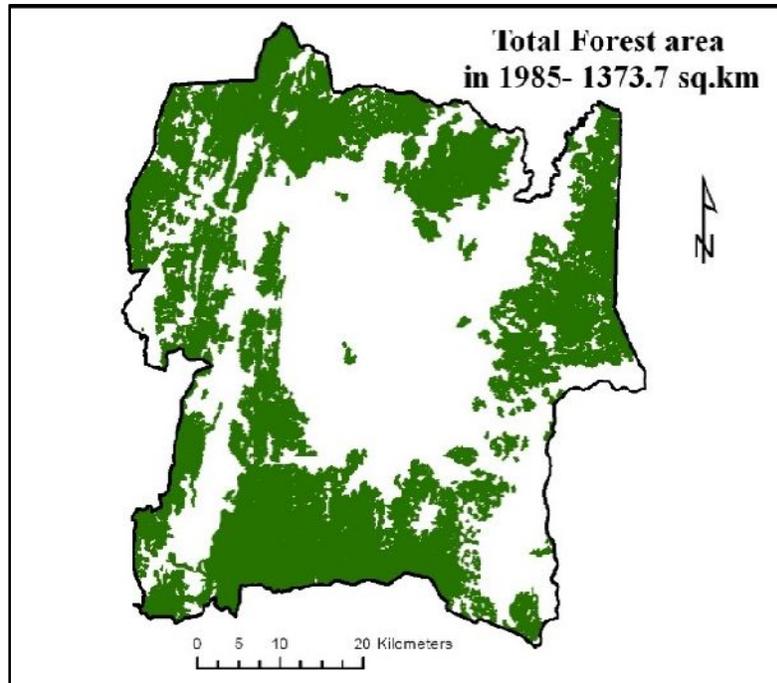


Figure 03 - Water bodies in Polonnaruwa D.

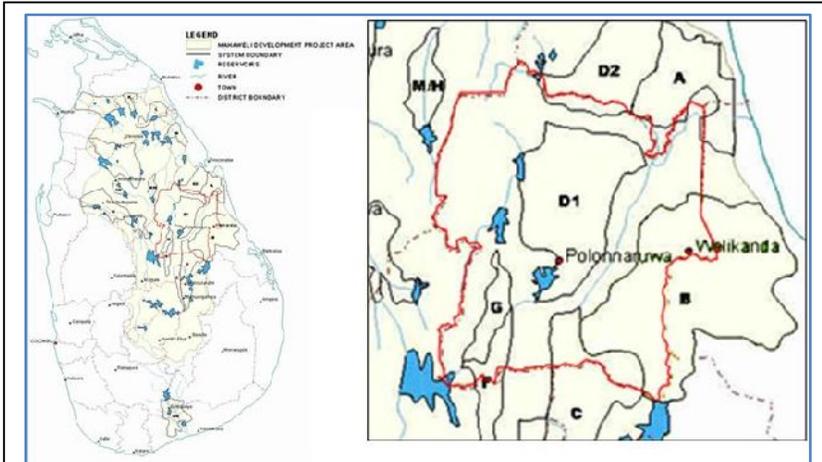
There are three major tanks in the middle of the district including ParakramaSamudraya, Minneriyawewa and Kaudullawewa. Those tanks had caused to the spatial pattern of the settlements and agricultural activities in the decade of 1970. Thus lots of forest covers in the district were not disturbed by the human activities. Low infrastructure facilities of the district were also caused to limit the distribution of settlements throughout the district. That situation had been changed in 1980s. According to 1:100,000 map of 1985, forest extent had been declined to 1373.7sqkm (figure 04). That represents the 48.62% loss of forest cover. It has been due to Mahaweli development project that started in 1980s and lasted more than 25 years.

Under that project, new settlements were established and infrastructure facilities were also developed in the district. As a result of that increase the population as well as agricultural activities which affected to decline the forest cover. That was the largest development project which affected on Pollonnaruwa district forest cover. More than 48% of the forest cover was in the district had been deforested due to that project. According to the figure 05, it is obvious Mahaweli system G & B affected to decline the forest covers in southwestern and southeastern parts of the district.



100,000 scale map-Department of Survey

Figure 04 Forest cover in 1985



Source – Mahaweli Development Authority

Figure 05- Mahaweli Zones in Polonnaruw District

Figure 06 shows that the 2001 forest cover data (1:50,000 data), forest land extent of the district had been increased up to 1529sqkm. When comparing to the background information of the decade, it is distinguishable, that increase of forest cover was a direct result of the war that lasted more than 30 years in the Northern and Eastern parts of the country. Thus lots of people migrated to more safer areas. Forest cover in southwestern, western and northwestern parts of the district had been increased under this situation.

The present forest cover of the district shows (figure 07), forest cover had been declined again to the extent of 1331sqkm. That represents the decline of 42 sqkm than the 1985 forest extent and 198 sqkm than the 2001 forest extent. Especially after the war most of the people who migrated to other came back to the district. Thus forest cover had been declined in Eastern and southwestern parts of the district due to those resettlement activities. As well as many infrastructure development activities and increase of agricultural activities are also affected on forest degradation. Total extent of paddy cultivated areas had been changed from 438sqkm in 2001 to 948sqkm in 2014. As well as total extent of settlement areas had been changed from 307sqkm in 2001 to 436.4sqkm in 2014. According to that it is obvious, that expansion of agricultural and settlement areas had caused to decline the forest cover in the district.

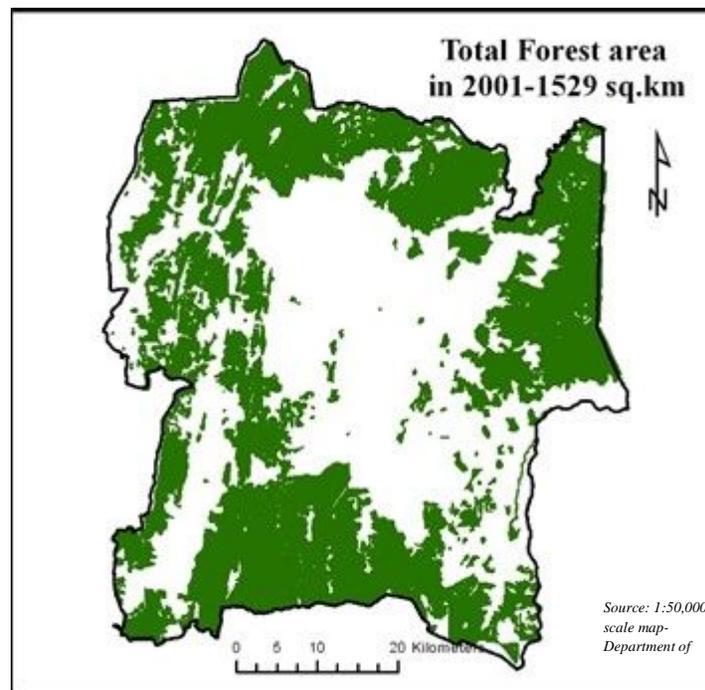
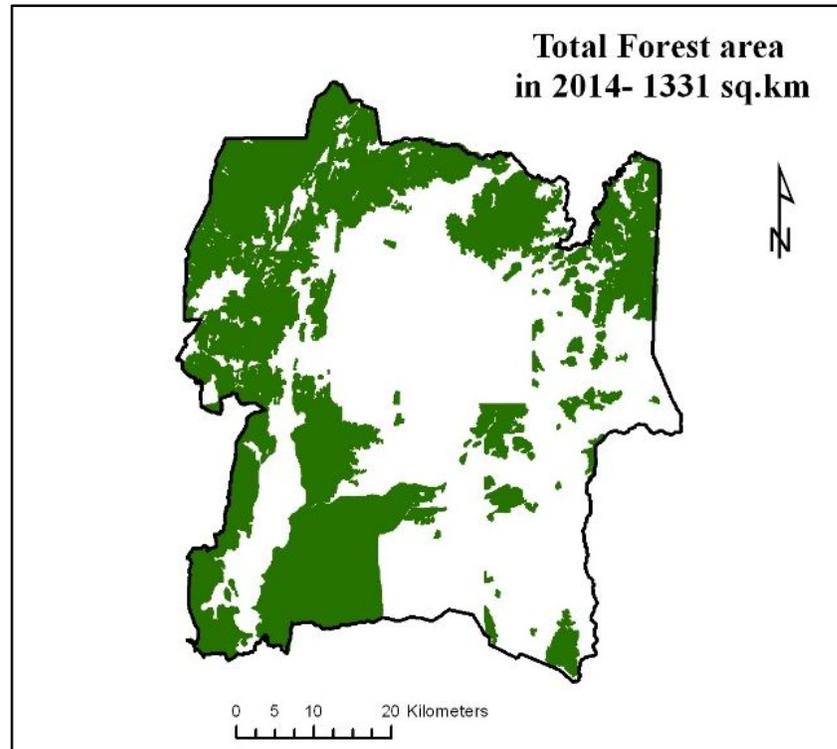


Figure 06 Forest cover in 2001



Source: 1:50,000 scale map-Department of Survey

Figure 07- Forest cover in year 2014

## CONCLUSION

The result shows a considerable extent of forest cover loss in Polonnaruwa district. According to the present situation 48.87% of forest cover in the Polonnaruwa district had been deforested comparing to the 1972s. In 1972 forest cover extent of the district was 2603.5 Sqkm and after a decade this extent was reduced to 1373.7 Sqkm. As well as it was clearly identified that in the war period this extent was again increased up to 1529 Sqkm in 2001. Since then forest cover had been reduced again to 1331 Sqkm in 2014 due to increase of human activities. In order to reduce minimum effects on existing forest cover in the district with the present political situation of the country and proposed development plans there should be a special attention on that and introduce new strategies for reforestations..

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