Section 2:

Executive Summary of the Project

Forests constitute a highly important form of vegetation in Sri Lanka. Exponentially increasing atmospheric carbon dioxide concentrations has been the key factor responsible for global warming and long-term climate change. Forests have the capacity to mitigate climate change by absorbing and storing (i.e. sequestering) substantial amounts of atmospheric carbon via photosynthesis and biomass production. Therefore, the objective of the present project was to determine the biomass production and carbon sequestration capacity of major natural forests and forest plantations of Sri Lanka.

The project was carried out as two separate components, one on natural forests and the other on forest plantations. In the first component, we developed a novel combination of methodology to quantify the carbon sequestration capacity of natural forests, which is a highly complex ecosystem with high species density and diversity. One component of this methodology consisted of canopy hemispherical photography to characterize the forest canopy and estimate its radiation interception capacity. Conversion of intercepted radiation to forest biomass carbon through photosynthesis was quantified by developing a multi-layered canopy photosynthesis model. Long-term carbon sequestration was computed by adding a further component to the model to estimate heterotrophic respiration. Using this methodology, both medium-term carbon sequestration rate (C_{seq}) in terms of net primary productivity (NPP) and long-term carbon sequestration rate (C_{seqL}) in terms of net ecosystem productivity (NEP) were computed for the two major lowland wet evergreen forest ecosystems in Sri Lanka, the Sinharja Man and Biosphere Forest Reserve and the Kanneliya-Dediyagala-Nakiyadeniya (KDN) Forest Complex. The computations were based on 343 canopy hemispherical photographs representing different forest regions and elevation zones and photosynthetic light response curves of 14 forest tree/plant species occupying different vertical strata of the forest canopy.

The estimated C_{seq} rates of Sinharaja and KDN forest complexes are 7.403 (± 0.094) and 8.953 (± 0.133) mt C ha^{-1} yr^{-1} respectively. Through these carbon sequestration rates, Sinharaja and KDN forest complexes absorb 2.52% and 3.26% of the current annual CO_2 emissions of Sri Lanka. Considering the fact that Sinharaja and KDN forest complexes occupy only 0.13% and 0.18% of the total land area of Sri Lanka, the above values of their percentage absorption of national CO_2 emissions indicate that these two tropical rainforests are extremely efficient carbon sinks. The residence times of this initially sequestered carbon were estimated to be 42.2 and 35.5 years for Sinharaja and KDN respectively. Accordingly, long-term C_{seqL} rates of Sinharaja and KDN are 0.371 (± 0.003) and 0.378 (± 0.003) mt C ha^{-1} yr^{-1}. In addition to these estimates of carbon sequestration, a comprehensive analysis was carried out on canopy and photosynthetic properties of these two natural forests to elucidate their role in controlling the carbon sequestration rates. A comparative analysis was also done to compare our estimates with published carbon sequestration rates of similar lowland tropical forest ecosystems such as the Amazon.

In the second component of the project, the total carbon stocks of all forest plantations maintained by the Forest Department of Sri Lanka were estimated using the basic forest inventory data in the FORDATA database. The total estimated monoculture C stock in 2008 amounted to 4.23 million metric tons in an area of 57618.8 ha. Around 89% of this total C stock in monocultures is contributed by five tree species, namely, *Pinus caribaea* (44%), *Tectona grandis* (21%), *Eucalyptus grandis* (11%), *Eucalyptus camaldulensis* (7%) and *Swietenia macrophylla* (6%), occupying 92% of the area. Total C stock in mixed cultures in 2008 amounted to 0.681 million tons in 5949.6 ha. Five mixed cultures, i.e. *Eucalyptus robusta & E. grandis* (17%), *Pinus* mixed (13%), *E. grandis & E. microcorys* (12.5%), *Eucalyptus* mixed (7%) and *Acacia mangium & A. auriculiformis* (5%), contributed 55% of this C stock.

Our estimates of per ha C stocks of Sri Lankan forest plantations were compared with the global standards for comparable climatic zones. The maximum per ha C stocks observed from some of the Sri Lankan forest plantations in different climatic zones were either on par or above the benchmark average C stock values specified by the Intergovernmental Panel for Climate Change (IPCC) for the respective climatic zones.

The average medium-term carbon sequestration rate (i.e. C_{seq} in terms of NPP) of the forest plantations is 2.575 mt C ha^{-1} yr^{-1} with an average residence time of 30 years. Through this carbon sequestration, forest plantations absorb 4.95% of the annual CO_2 emissions of Sri Lanka. Here again, in view of the fact that the forest plantations occupy only 1% of the total land area of Sri Lanka, the nearly 5% absorption of national CO_2 emissions by the forest plantations indicate their role in climate change mitigation as highly efficient carbon sinks.

A quantitative index of the efficiency of the respective carbon sinks showed that Sinharaja and KDN forest complexes have greater efficiencies as carbon sinks than even the most productive forest plantations in Sri Lanka.

The above-described quantitative information on the carbon sequestration capacity of both natural and plantation forests of Sri Lanka has been generated in this project for the first time in Sri Lanka. They will be extremely useful in the formulation of policies and strategies for climate change mitigation in Sri Lanka.

We strongly propose that the new combination of methodology that has been developed in this study be employed in a second phase of this research project in the future, to estimate the carbon sequestration rates of the rest of the forest types of Sri Lanka, which include the Knuckles forest reserve, Peak Wilderness forest reserve, the Montane forests in the Horton Plains and the dry zone forests.