POTENTIAL CLIMATE VULNERABILITY MAPPING OF TEA LANDS IN NUWARA ELIYA DISTRICT OF THE UPPER MAHAWELI CATCHMENT

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Introduction

The tea sector is currently facing many constraints of which the impact of climate change is becoming a prominent issue. Tea depends greatly on weather for optimal growth. Under these circumstances, the tea industry in Sri Lanka is clearly vulnerable to predicted climate changes (Wijeratne *et al.*, 2007). Therefore, vulnerability mapping is essential to design specific adaptation mechanisms to minimize negative impacts of climate change on the sector.

Thus, this study was conducted to identify current climate vulnerability of tea plantations in Nuwara Eliya district of the upper Mahaweli catchment. The specific objectives were to identify the spatial variability of rainfall and temperature, identification of drought prone areas, develop a soil erosion map for tea lands and finally develop a climate vulnerability map based on annual mean temperature, rainfall, soil erosion and agricultural drought for tea lands in the study area.

Materials and Methods

Arc-GIS 9.2 (Arc/Info) software was used for mapping and analyzing of information. Monthly rainfall (from 41 rainfall recording stations) and temperature (Island wide temperature recording stations were selected and clipped for the study area) data for the period from 1946 to 2005 were considered in the study area and monthly averages were computed. Drought severity classification in *Yala* and *Maha* seasons was identified using drought index based on moisture availability index (Chithranayana and Punyawardena, 2008). Moisture Availability Index (MAI) is the ratio of the Dependable Rainfall to Potential Evapotranspiration. Erosion hazard maps were developed based on erosion hazard ratings for the upper Mahaweli catchment developed by Stocking (1992). Climate vulnerability mapping for the study area was developed, using weighted overlay modeling in Geographic Information Systems (GIS) by allocating appropriate weightages for all four variables mentioned above.

Results and Discussion

Rainfall data analysis for the study period revealed that months of January, June, July and August had high rainfall variability, which emphasizes the need for special attempts to reduce impacts. Around 65% of land extent of the study area

possessed an ideal temperature (18-25 ^{0}C) for growth of tea. The entire study area did not exhibit droughts during the *Maha* season. However, almost all agro-ecological regions of the up country Intermediate zone, drought proneness was relatively higher except in IU_2, during the *Yala* season. There was a slight possibility of drought conditions occurring in the Wet zone of the study area during *Yala* season.
In the study area, 1,574 ha (3.96%) under tea was highly vulnerable for soil erosion whereas 31,658 ha (79.64%) and 6,519 ha (16.40%), respectively fell under less and moderately vulnerable for soil erosion categories. The climate vulnerability map revealed that 5,225 ha (13.15%) of tea land extent in the study area was highly vulnerable for current climate vulnerability whereas 8,165 ha (20.54%) and 26,361 ha (66.31%) were categorized as moderately and less climate vulnerable, respectively (Fig. 1).

Tea lands which possessed less canopy cover were highly vulnerable for soil erosion. Soil erosion is high in poorly managed seedling tea fields compare to vegetatively- propagated tea. Poorly managed seedling tea fields have more open patches which are vulnerable to soil erosion. Special emphasize should be given to tea lands in steep slope regions. The area which was identified as highly vulnerable should be given much emphasis on soil erosion and soil moisture conservation techniques. Biological strategies such as soil rehabilitation, Slopping Agricultural Land Technology (SALT), cover crops and infilling of tea lands can be used as adaptation measures. For relatively high drought prone areas, drought tolerant varieties can be used. Planting of shade trees to reduce the drought impacts in IU regions is important (Wijeratne *et al.*, 2007).

Few climate vulnerability modeling studies have been done in order to assess the climate vulnerability in Sri Lanka. Composite vulnerability index for multi-hazard exposure for each district in Sri Lanka were developed and results showed that Nuwara Eliya distrct was ranked as 80-100 (high vulnerable) range (Eriyagama *et al.*, 2010).

Conclusions

Climate vulnerability mapping revealed that 5,225 ha (13.15%) of tea extent in the Nuwara Eliya district were considered as highly vulnerable for current climate vulnerability. 8,165 ha (20.54%) and 26,361 ha (66.31%) tea extents were categorized as moderately and less climate vulnerable respectively. With the predicted climate changes in the future, moderately vulnerable areas can become highly vulnerable. Necessary adaptation strategies should be taken immediately to ensure the sustainability of the tea industry.

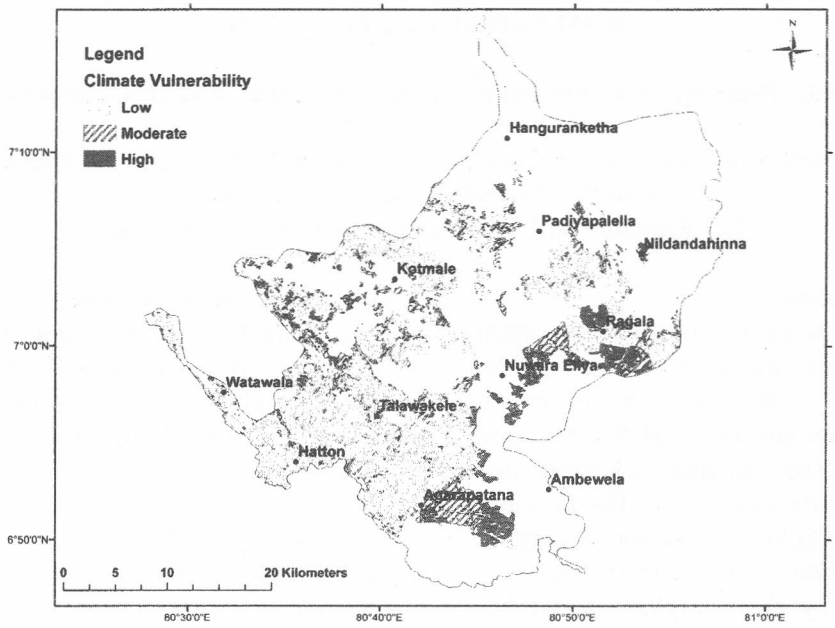

Fig.1 Climate vulnerability map for Nuwara Eliya District of the Upper Mahaweli Catchment

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