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Climate Change Impacts on Plant Biomass Growth

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Illustration of Symbols

C_i	Carbon content of the continuous input where $i = 1, f, b, s, w$ stands for leaf, fine root, branch, stem and woody roots respectively.
C_m	Continuous input of soil organic matter through the decomposition of litters.
D_p	Lifetime of wood productions.
$g_c(t)$	Quantity of stored carbon in time (t).
$g/g/day$	Gram per gram per day.
g_m	Carbon content in old growth tree.
Gt	Gega tonne.
h_b, h_s, h_w	Discrete input of branch, stem and woody root material that is left over after harvest.
H_i	Discrete input with $i = 1, f, b, s, w$.
k_i	Fractional rate of decomposition of litters to soil organic matter where, $i = 1, f, b, s, w$.
k_m	Fractional rate of decomposition of soil organic matter to gaseous component.
LAP	Leaf Area Partitioning.
L_l, L_f, L_b, L_s, L_w	Continuous litter accumulation from leaf, fine root, branch, stem and woody root respectively. If suffixed by (t) it means the accumulation material within that time of rotation.
$Mg\ C\ ha^{-1}$	Million grams of carbon per hectare.
Mkm^2	Million square miles.
MPa	Mega Pascal.
Mt	Million tons.
μ_i	Fraction of litter compartment that becomes soil.
$\mu l/l$	Micro Litre per litre, equiv. to ppm.
NAR	Net Assimilation Rate.
NPK	Nitrogen, Phosphorus and Potassium.
NPP	Net Primary Production.
Pg	Petagram = 10^{15} g = One billion tons.

ppb	Parts per billion.
ppm	Parts per million.
P_x	Different types of wood products, where $x = 1, 2, \dots, x$.
RGP	Root Mass Partitioning.
T_m	Maximum mean annual increment.
T	Time (rotation time).
Tg	Tetra gram.
U_j	Fraction of removed material used for product j .
$Y_{(t)}$	Fractional quantity of stored carbon in each gram of tree material.

Chapter 1

Introduction

Plant biomass plays an important role in sustaining environment and life including human life on earth. The earth system is a closed system except for its absorption of solar energy. Green biomass is the only component of the earth system that captures bursts of solar energy, converts them, and allocates them to flows to other components and consumers of the ecosystem. In an ecosystem, where green biomass is the primary producer, humans occupy almost all positions, primary, secondary, or tertiary, within the consumer chain. Humans derive their essentials – food, fiber, fuel, and fodder – directly from green biomass and indirectly through other primary and secondary consumers of green plants. Hence, performance of green biomass growth in an ecosystem is not only important for smooth functioning of all components of the earth system but also for human existence in a befitting manner.

Besides obtaining energy from it, humans use the ecosystem environment for recreation, sport, aesthetics, shelter, clothing, medicine, and education. For these, the human being tends to regulate the environmental factors involved in the growth and development of green biomass. However, climate change, the unpredictable and irreversible change in environmental conditions, poses serious risks and uncertainties as to how the vegetation will respond to these changes, firstly because the changes are complex and slow to reveal their influence in a generation and secondly they are irreversible. Due to the climate change situation, the success of human beings in maintaining a sustainable environment will largely depend on the art and the science of using the changed environmental factors for green biomass growth.

The art and science, that is, the management, of environmental factors requires interplay of a number of “P” words – application of *pre*-acquired knowledge of *professionals* in a *planned* way so that *procurement* of *predicted* performance and *profit* are *possible* from a *production* system. In this regard, management of green plant biomass occupies a special situation. The management of green biomass, as professional forest managers adopt their appropriate roles, usually involves application of several environmental regimes for manipulation of growth of seedlings in order to produce mature trees within a particular ecosystem – a process