Climate Change-Related Risk Management Methods for Tropical Forestry[1]

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Identification of climate change-related risk strategies requires identification of possible, but unpredictable, climatic changes likely to affect forestry. While some changes could lead to positive effects, this paper will only deal with those likely to cause negative effects. The changes most likely to negatively affect forestry are those related to hydrological patterns and temperature. These changes could cause the following:

1. Reductions in rainfall, causing drought
2. Increases in fire susceptibility and occurrence
3. Increases in rainfall and water logging
4. Increases in occurrence of pests and diseases
5. Habitat changes, leading to reduced regeneration of certain species
6. Species loss
7. Expansion of areas presently marginal for tree growth
8. Reductions in productivity

Different forest types, which have different species composition and management systems, have varied degrees of susceptibility to these risks and consequently require different risk management strategies. In particular, it is important to note the distinctions between plantations and natural forests. Table 1 shows the relevance of these risks to plantation and natural forests in the tropics, and Table 2 summarises risk management methods appropriate for these forest types.

In general, natural forests are more flexible habitats than plantations, because of their wider variability of species. The speed of ecological adaptation of natural forests, however, is expected to be slower than the rate of climatic changes. Since these forests cannot be “relocated” in the same way as plantations, these habitats are very susceptible to environmental changes.. Susceptibility to climatic changes is enhanced if these habitats are degraded by human interventions. Risk minimisation strategies for natural forestry should focus on reducing damage and stress to the original habitats to allow sufficient time for natural adaptation.

Plantations, on the other hand, are intrinsically inflexible. Adaptation to climatic changes, therefore, have to rely on more intensive management interventions. The combination of much shorter rotation cycles than in natural forests, and the fact that each rotation is often re-initiated from replanting, provide plantation forestry managers with more tools for adaptation. Furthermore, the plantation forestry sector is generally more sophisticated than the natural forestry sector, and more able to cope with these required adaptations.

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[1] Proceedings of IPCC meeting on Climate Change Risks, Toronto, 1998.

Table 1: Climate change-related risks associated with different forest types in the tropics

Risk	Plantations	Natural Forests
Drought	High risk likelihood and serious consequences, since plantation species are usually very water demanding to maintain adequate growth rates. Frequent replanting increases exposure of seedlings to harsher environments.	High likelihood and serious consequences, since it is not possible to "relocate" such forests. Drought increases danger of forest degradation and expansion of marginal areas.
Fire susceptibility	Medium risk likelihood and consequences, since plantation industry likely to have better control and monitoring strategies.	High likelihood and very serious consequences, since it is extremely difficult to prevent and control fire outbreaks in large patches of natural forests in the tropics.
Increases in rainfall, water logging and floodings	Medium risk. Main consequences include damage to infrastructure (in case of flooding), reduced growth of certain species, and increased susceptibility to diseases.	Medium likelihood, consequences, including disruption of harvesting cycles, flooding affecting infrastructure, increased soil erosion and damage
Pests and diseases	Serious risk. For a fair number of plantation species in the tropics, little amount of research and knowledge is available about pest and disease susceptibility and control.	Milder risk, since these habitats have higher biodiversity, leading to larger number of host and natural control predators.
Reduced regeneration	Not important, since most plantations in the tropics are regenerated through replanting	This can be a serious problem for some tropical species, which require particular environmental conditions for germination. Some species are also very demanding in relation to environmental conditions for flowering and fruiting.
Species loss	Not important.	High likelihood and serious consequences, particularly relevant in cases where there is selective harvesting of a few species or natural forest areas constrained by other land uses. Associated with poor regeneration, commercially targeted species may not succeed in certain areas.
Expansion of marginal areas	Serious consequences, since this is likely to be associated with increases in land prices and competition with agricultural land.	Serious consequences. If forests constrained by other land uses, this may lead to reductions in forest area.
Reductions in productivity	In the medium term, this is likely to lead to a steady decline of the forestry sector in affected areas. In the longer term, it can be more easily relocated to better sites.	While carbon fertilisation and increases in temperature are likely to increase overall net primary productivity, biomass accumulation is likely to be slower due to the effect of the factors above. Likely to lead to forest degradation and land use change.

Table 2: Climate change-risk management methods for different forest types in the tropics

Risk	Plantations	Natural Forests
Drought	Species selection, avoidance of marginal areas, microclimate manipulation to reduce seedling mortality.	Minimise stress and damage to forest matrix, prevent disruptions in forest canopy, minimisation of logging damage, enrichment planting with drought tolerant species
Fire susceptibility	Fire monitoring and control mechanisms, appropriate forest management practices to reduce accumulation of combustible fuels and facilitate control in case of outbreaks, controlled fires, corridors and fire breaks, species mix, staff training, observations during dry seasons, etc.	Integrated monitoring including ground and satellite methods for early warning detection of hot sots such as NOAA; strategies for control of fire outbreaks, possibly in a regional or transnational cooperation basis; enforcement of selective logging practices aiming at keeping a dense and healthy forest; enforcement of riverine buffer zones; better management of human-forest interface, including environmental education to prevent accidental creation of fires, review of land use legislation in order to reduce the purposeful creation of fires to “induce“ land use change, creation of buffer zones between natural forests and agricultural areas, ban burnings for land clearance.
Increases in rainfall, water logging and flooding	Careful design of roads, bridges and other infrastructure, to minimise disruptions of hydrological cycle; site-species matching	Better design of infrastructure to avoid disturbances to hydrological cycles; planning of downstream land use to allow free drainage of rivers and accommodate fluctuations in river bank level.
Pests and diseases	Species diversification, avoidance of marginal areas, introduction of strips of natural vegetation between monoculture blocks, integrated pest/disease control mechanisms,	Maintenance of adequate areas of undisturbed forest fragments to ensure the preservation of habitats of a wide range of natural control organisms and a variety of hosts; minimise canopy disruption and harvest damage to remaining trees.
Reduced regeneration	Not a major problem, since trees usually rely on replanting.	Diversification of the range of species harvested; maintenance of adequate numbers of seed-bearing trees; research on germination and regeneration requirements of a wider range of species; maintenance of areas of permanent protection within areas allocated for commercial forestry, to ensure preservation of undisturbed micro-habitats favourable for regeneration of certain species.
Species loss	-	Expand range of species harvested, to reduce pressure on individual species; maintenance of appropriate numbers of seed bearing trees; creation of ex-situ germplasm banks; in a longer term profile, creation of “biological corridors” to enable species migration.
Expansion of marginal areas	Research and utilisation of less demanding species, increase productivity in remaining areas	Conservation areas should be created in non-marginal areas, to ensure best representation of biomes.
Reductions in productivity	Species selection and diversification, breeding	Diversification of species harvested.