FORESTRY

ESTIMATES GLOBAL CLIMATE IMPACT

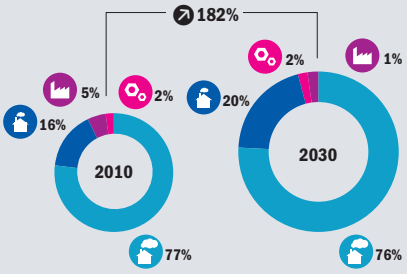
2010 EFFECT TODAY

USD **LOSS** PER YEAR **5 BILLION**

2030 EFFECT TOMORROW

USD **LOSS** PER YEAR **45 BILLION**

ECONOMIC IMPACT



CONFIDENCE **INDICATIVE**

SEVERITY

AFFECTED

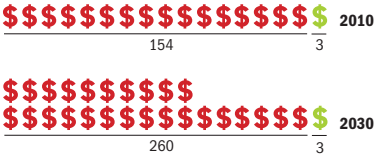
INJUSTICE

PRIORITY

MDG EFFECT

- Climate change is shifting the world's climate zones as the planet warms
- As this occurs, commercial and native tree stands are becoming stranded in climate zones with less than optimal growing conditions
- Many forests are suffering from invasive species, more extreme weather, and flooding, further compounding stresses
- As a result, forests in all regions of the world are in decline or a state of flux, although gains in forest area and growth are evident in some regions
- Reversing the large-scale, rampant deforestation of recent decades would help to attenuate new losses due to climate change

RELATIVE IMPACT



HOTSPOTS

2010 $ 2030

2,500 **BRAZIL** 20,000

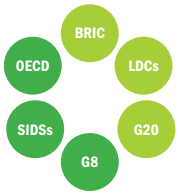
1,000 **MEXICO** 7,750

450 **ANGOLA** 4,500

400 **VENEZUELA** 4,500

400 **BOLIVIA** 4,250

GEOPOLITICAL VULNERABILITY



$ Economic Cost (2010 PPP non-discounted)

Developing Country Low Emitters | Developed

Developing Country High Emitters | Other Industrialized

$ = Losses per 100,000 USD of GDP

Change in relation to overall global population and/or GDP

$ = Millions of USD (2010 PPP non-discounted)

Forests cover nearly one-third of the world's land surface, and both commercial and native forests nearly everywhere are affected by the changing climate (Shvidenko et al. in Hassan et al. (eds.), 2005; Bolte et al., 2009). The potential for large-scale tree diebacks and loss of vegetation and forest biodiversity is considered significant. As the planet warms, climate zones are shifting, with stationary forests now in inhospitable conditions, triggering rapid decline and widespread tree mortality, although in some cases forests may be expanding into new areas (Gonzalez et al., 2010). The permanence of forests presents a unique challenge in terms of long-term planning and management, such as substituting tree varieties, although this is not a concern for seasonal crop-based agriculture. Communities that rely on forestry in threatened zones, including indigenous groups, are particularly at risk. If empowered through knowledge, resources, and legal support, these same communities can play a key role in helping forests to adapt. Forests are also a vital carbon sink, helping to contain GHG emissions, which widespread tree mortality counteracts (Kurz et al., 2008).

CLIMATE MECHANISM

Heat stress, increased propensity to drought and flooding, all consistent with climate change, can damage tree growth and forest stands (Allen et al., 2009; Lewis et al., 2011; Kramer et al., 2008). Growing risks from fires, pests, and disease are also of concern (Kurz et al., 2008). Above all, it is the shift taking place in forest habitats that outpaces the ability of stationary forests to naturally adapt (Shvidenko et al. in Hassan et al. (eds.), 2005; Bonan, 2008). Particularly affected are those tropical zones already at the maximum heat threshold, which will see further reductions in their viability as rainfall decreases. Boreal forests established at high altitudes or forest stands on permanently frozen land also risk the inevitable disappearance of their natural habitat as warming increases. Elsewhere forests have been observed, and are expected, to grow faster (McMahon et al., 2010).

IMPACTS

The impact of climate change on the world's commercial and native forests is currently estimated to incur annual losses of around 5 billion dollars, increasing by 2030 to around 45 billion dollars or triple the cost as a share of global GDP.

Brazil and Mexico incur the largest overall losses at around 10–20 billion dollars a year in 2030. A number of lower-income countries such as Angola, Central African Republic, Timor Leste and Zambia suffer the most severe effects as a share of GDP. Other South America countries, such as Bolivia, Chile, Colombia, Paraguay, and Venezuela are all also estimated to experience large-scale impacts.

In general, developing countries on all continents are significantly affected. Among developed countries, Australia and Canada stand out, as well as those in Southern Europe, while Russia incurs the largest scale losses among industrialized nations.

The negative effects are quite widespread, with around 50 countries showing vulnerability levels of high or above. Around 20 countries experience gains that are mainly small in scale, with the exception of Argentina, whose gains are already significant, reaching almost 10 billion dollars a year in 2030.

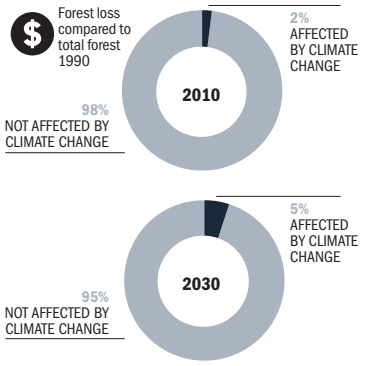
THE BROADER CONTEXT

The Forestry sector is relatively stable, with increasing value but fluctuating production over the last decade (FAOSTAT, 2012). Demand for forest products of all kinds including timber is expected to increase significantly over the coming decade. Illegal logging and deforestation, especially of native forests, remains a serious and widespread concern, with rates estimated at about 10 million hectares per year—an area larger than Greece—although in parts of Europe and North America in particular reforestation is significant (Shvidenko et al. in Hassan et al. (eds.), 2005).

VULNERABILITIES AND WIDER OUTCOMES

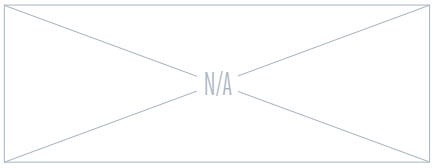
The size of forests as an economic sector and their land area constitute the main components of structural vulnerability for countries in the affected zones. In 2005, 25 countries were estimated to have no remaining forest cover; other countries have less than 10% of forest cover remaining. High rates of deforestation clearly also accentuate vulnerability by diminishing local bio-capacity to withstand changes and increasing risks of invasive pests, flooding, drought, and irrigation-driven water stress (Shvidenko et al. in

BIGGER PICTURE

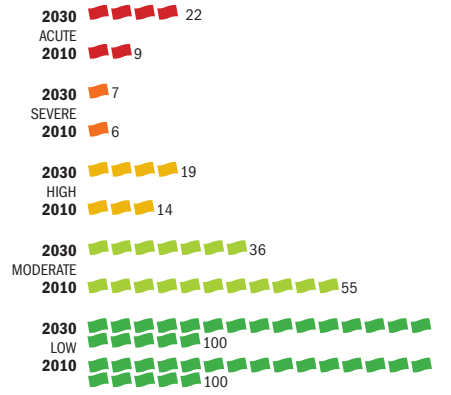


SURGE

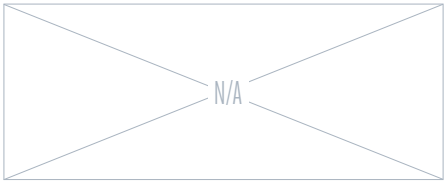
OCCURRENCE



VULNERABILITY SHIFT



PEAK IMPACT



GENDER BIAS

INDICATOR INFORMATION

MODEL: US Forest Service (2010)

EMISSION SCENARIO: SRES A1B (IPCC, 2000)

BASE DATA: FAOSTAT (2012)

= 5 countries (rounded)

Acute Severe High Moderate Low

Hassan et al. (eds.), 2005; Bolte et al., 2009). Vegetation vulnerability is widespread globally, with forest stands at risk on every continent and in almost all regions, and with Boreal conifer and tropical broadleaf forests equally threatened (Gonzalez et al., 2010). Reliance on forests for market and non-market benefits, from water to biodiversity to wildlife or plant products, is highest among lower-income groups. Forest-based or forest-reliant indigenous groups are also heavily dependent on the health of local forest stands (Munasinghe, 1993; Salick and Byg, 2007). Accordingly, lower-income countries and countries with significant indigenous groups have accentuated vulnerability to the impact of climate change on forests. The loss of vital ecological services as forests die back or decline is a major concern for human development (SCBD, 2009).

RESPONSES

Despite the challenges presented, numerous responses can be foreseen to stem forest decline as a result of climate change or other man-made factors. Stand substitution with more suitable tree varieties can occur progressively; however, the substitution options for the hottest and driest tropical zones are much more limited than elsewhere. Planting, harvesting and thinning regimes and schedules can be adjusted in accordance with altered local conditions (Bolte et al., 2009). Expanding primary forest conservation, particularly in high-risk developing countries, is a priority, but requires increasing capacity to implement that will depend in many cases on foreign assistance (Lee and Jetz, 2008). Additional adaptation strategies may include the establishment and management of biodiversity corridors that reinforce self-supporting connections between forest and non-forest ecosystems (Tabarelli et al., 2010). Pest management could be considered in some managed forest situations. Community forest programmes that support local groups in taking a more proactive involvement in forest conservation and management or sustainable agroforestry projects have the potential to yield double dividends for the environment and development (Hella and Zavaleta, 2009). This could be extended to specific support to indigenous communities (Salick and Byg, 2007). Finally, strong environmental governance, especially if it is community-based, is also key to protecting forest ecosystems, including threats from illegal or condoned deforestation (Baltodano et al., (eds.), 2008). Payment for ecosystem services has met with success in some countries for preserving and enhancing forest ecosystems, Costa Rica being a prime example (Pagiola, 2006).

THE INDICATOR

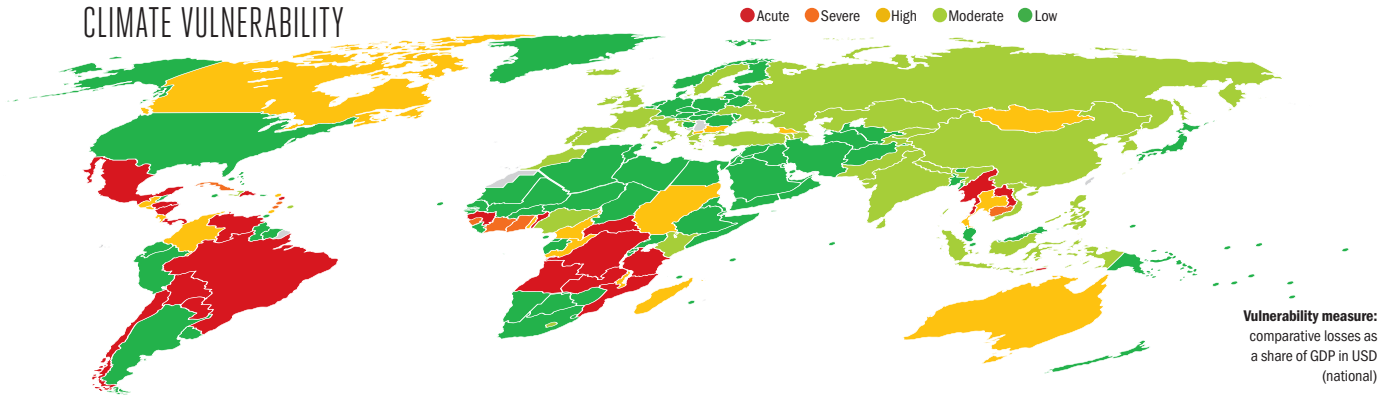
The indicator considers the scale of estimated shifts in the location and area of different forest biomes due to climate change (Gonzalez et al, 2010). Forestry and biodiversity losses are well recognized in climate science, and are closely linked to significant temperature changes (IPCC, 2007). A key limitation is the valuation method for forests of commercial and non-commercial types, including all varieties of trees in every continent. To simplify the problem, generic values are used for topical and non-tropical forest stands, including bundled biodiversity values (Costanza et al., 2007).

ESTIMATES COUNTRY-LEVEL IMPACT

COUNTRY	2010	2030
ACUTE		
Angola	450	4,500
Benin	20	200
Bolivia	400	4,250
Brazil	2,500	20,000
Central African Republic	5	75
Chile	300	2,000
Dominica	1	10
Dominican Republic	55	600
DR Congo	15	150
Guinea	10	100
Honduras	25	300
Laos	5	100
Mexico	1,000	7,750
Mozambique	75	700
Myanmar	50	600
Nicaragua	10	150
Panama	35	400
Paraguay	100	1,250
Tanzania	35	350
Timor-Leste	20	250
Venezuela	400	4,500
Zambia	150	1,500
SEVERE		
Cambodia	10	150
Cote d,Ivoire	10	100
Cuba	40	450
Ghana	15	150
Saint Lucia	1	5
Saint Vincent		5
Sierra Leone	1	10
HIGH		
Antigua and Barbuda		1
Australia	100	300
Bulgaria	10	100
Cameroon	10	90
Canada	150	500
Colombia	80	900
Congo	1	20
Costa Rica	10	150
El Salvador	5	75
Georgia	1	20
Grenada		5
Guatemala	10	150
Macedonia	5	35
Madagascar	1	25
Malawi	1	10
Mongolia	1	30
Sudan/South Sudan	10	100
Thailand	100	1,500
Togo	1	10
MODERATE		
Albania		1
Armenia	1	5
Azerbaijan	1	25
Barbados		1
China	60	650
Croatia		
France	30	90
Greece	10	25
Haiti	1	5
Iceland		
India	10	80
Indonesia	30	350
Ireland	1	1
Italy	15	50
Kazakhstan	5	75
Kenya	5	30
Kyrgyzstan	1	5
Lesotho		
Morocco	5	75
Nepal		1
Nigeria	25	200
North Korea	1	5
Pakistan	1	15
Philippines	1	30
Portugal	5	20
Russia	150	850
South Korea	1	15
Spain	35	100
Sri Lanka	1	15
Sweden	10	25
Switzerland	1	1
Tajikistan		1
Turkey	5	20
Ukraine	1	10
United Kingdom	5	10
Vietnam	1	20
LOW		
Afghanistan		
Algeria		
Argentina	-950	-10,000
Austria	-1	-10
Bahamas		
Bahrain		
Bangladesh		-1

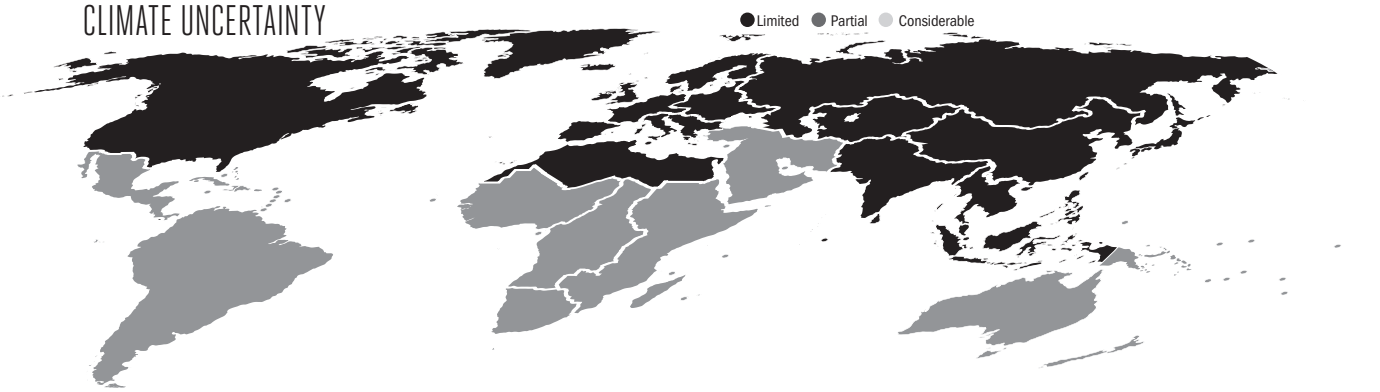
$ Additional economic costs due to climate change (million USD PPP) - yearly average

CLIMATE VULNERABILITY



Vulnerability measure: comparative losses as a share of GDP in USD (national)

CLIMATE UNCERTAINTY



COUNTRY	2010	2030
Belarus	-1	-15
Belgium		
Belize		
Bhutan		
Bosnia and Herzegovina		
Botswana		
Brunei		
Burkina Faso		
Burundi		
Cape Verde		
Chad		
Comoros		
Cyprus		
Czech Republic		
Denmark		
Djibouti		
Ecuador	-40	-500
Egypt		
Equatorial Guinea		
Eritrea		
Estonia		-1
Ethiopia		
Fiji		
Finland	-5	-15
Gabon		
Gambia		
Germany	-1	-10
Guinea-Bissau		
Guyana		
Hungary	-1	-10
Iran		
Iraq		

COUNTRY	2010	2030
Israel		
Jamaica		
Japan	-10	-30
Jordan		
Kiribati		
Kuwait		
Latvia		
Lebanon		
Liberia		
Libya		
Lithuania	-1	-5
Luxembourg		
Malaysia		
Maldives		
Mali		
Malta		
Marshall Islands		
Mauritania		
Mauritius		
Micronesia		
Moldova		
Namibia		
Netherlands		
New Zealand		
Niger		
Norway	-1	-5
Oman		
Palau		
Papua New Guinea		
Peru	-70	-800
Poland	-5	-40
Qatar		

COUNTRY	2010	2030
Romania		-1
Rwanda		
Samoa		
Sao Tome and Principe		
Saudi Arabia		
Senegal		
Seychelles		
Singapore		
Slovakia		
Slovenia		
Solomon Islands		
Somalia		
South Africa	-5	-60
Suriname		
Swaziland		
Syria		
Tonga		
Trinidad and Tobago		
Tunisia		
Turkmenistan		
Tuvalu		
Uganda	-1	-10
United Arab Emirates		
United States	-90	-300
Uruguay	-5	-80
Uzbekistan		
Vanuatu		
Yemen		
Zimbabwe		