FORESTRY

ESTIMATES GLOBAL CARBON IMPACT

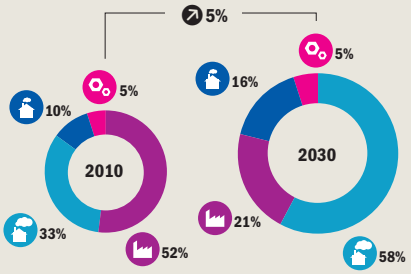
2010 EFFECT TODAY

USD **LOSS** PER YEAR **30 BILLION**

2030 EFFECT TOMORROW

USD **LOSS** PER YEAR **85 BILLION**

ECONOMIC IMPACT



CONFIDENCE **INDICATIVE**

SEVERITY

AFFECTED

MDG EFFECT

- Commercial forestry in countries and regions with high levels of toxic emissions is experiencing productivity losses
- Ozone and acid rain impacts primary productivity and the growth rates of commercial forestry, generating losses in output
- Heavily forested nations especially in Africa and Southeast Asia suffer these effects disproportionately because of the relative significance of their forestry industries

RELATIVE IMPACT

$$$$$$$$$$$$$ 2010
127 6

$$$$$$$ $$$$$$$$$$$$$ 2030
193 6

HOTSPOTS

2010 $ 2030

3,500 **CHINA** 20,000

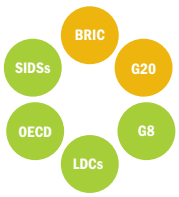
10,000 **USA** 15,000

900 **MALAYSIA** 5,000

1,500 **MEXICO** 4,750

1,000 **INDIA** 4,500

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)

The earth's plant life is susceptible to environmental pollutants released into the air as a by-product of economic activities. Trees are by no means spared these effects, with losses already observable due to problems such as toxic ozone emissions at ground levels (Reilly et al., 2007).

Studies have shown how ambient levels of ozone (O3) in the atmosphere have already reduced tree productivity and will continue to do so rapidly as O3 continues to rise. Critically, this would reduce a major global carbon sink (Wittig et al., 2009). Likewise, acid rain also affects tree productivity, especially where soil acid buffering is low (Likens et al., 1996). In order to significantly reduce the losses these effects produce, particularly for the forestry sector, major economies would need to make synchronized efforts to curtail the heaviest forms of industrial pollution, such as sulphur and nitrogen dioxide emissions generated by coal power and other substances that lead to the production of O3. Trees are more resilient to heightened levels of ground-level O3 and other pollutants than most staple crops, if anticipated losses in other segments of the agricultural sector are taken as reference (Holm Olsen and Fenhann (eds.), 2008).

HAZARD MECHANISM

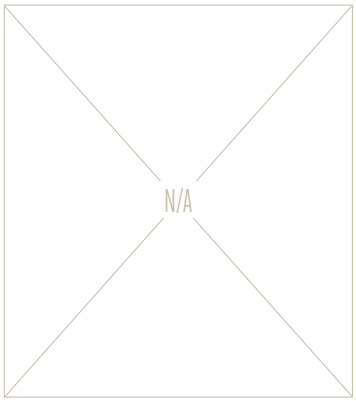
Emissions like sulphur and nitrogen dioxide and other ozone precursors lead to acid rain and high concentrations of O_3 at ground-level, which have long been shown to be toxic for the growth of plants, including trees (Wentzel, 1982; Mustafa, 1990). These effects directly impact plant and tree productivity, harming the growth of trees and forestry sector outputs (Reilly et al., 2007; Likens et al., 1996). In optimal conditions, higher levels of CO_2 in the atmosphere might also favour growth and expanded output (IPCC, 2007).

IMPACTS

The global impact of the carbon economy on forestry, independent of climate change, is estimated to currently cost 30 billion dollars a year. The level of impact is expected to grow modestly as a share of global GDP over the next 20 years, with losses of 80 billion dollars a year in 2030. Some 25 mainly forest countries in the tropics are acutely vulnerable to these effects and will see the most significant impact. Africa and Southeast Asia are generally worst off, with important concerns for poverty reduction efforts that might be compromised through declining agro-forestry productivity.

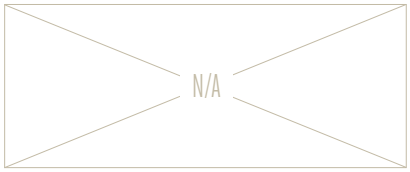
The US, China, Mexico, India and Japan are estimated to incur the largest total losses all at or in excess of one billion dollars per year in 2010, and growing rapidly by 2030.

BIGGER PICTURE

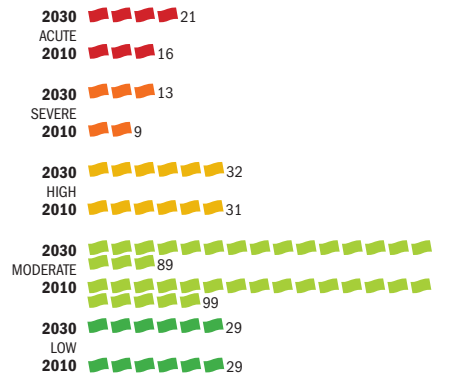


SURGE

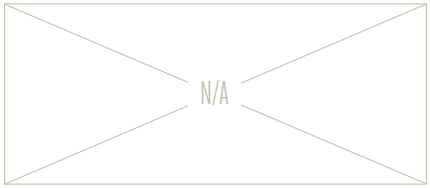
OCCURRENCE



VULNERABILITY SHIFT



PEAK IMPACT



GENDER BIAS

INDICATOR INFORMATION

MODEL: Costanza et al., 1997; OECD, 2012; Reilly, 2008; Wentzel, 1982

BASE DATA: FAOSTAT (2012); Reilly, 2008

= 5 countries (rounded)

Acute Severe High Moderate Low

THE INDICATOR

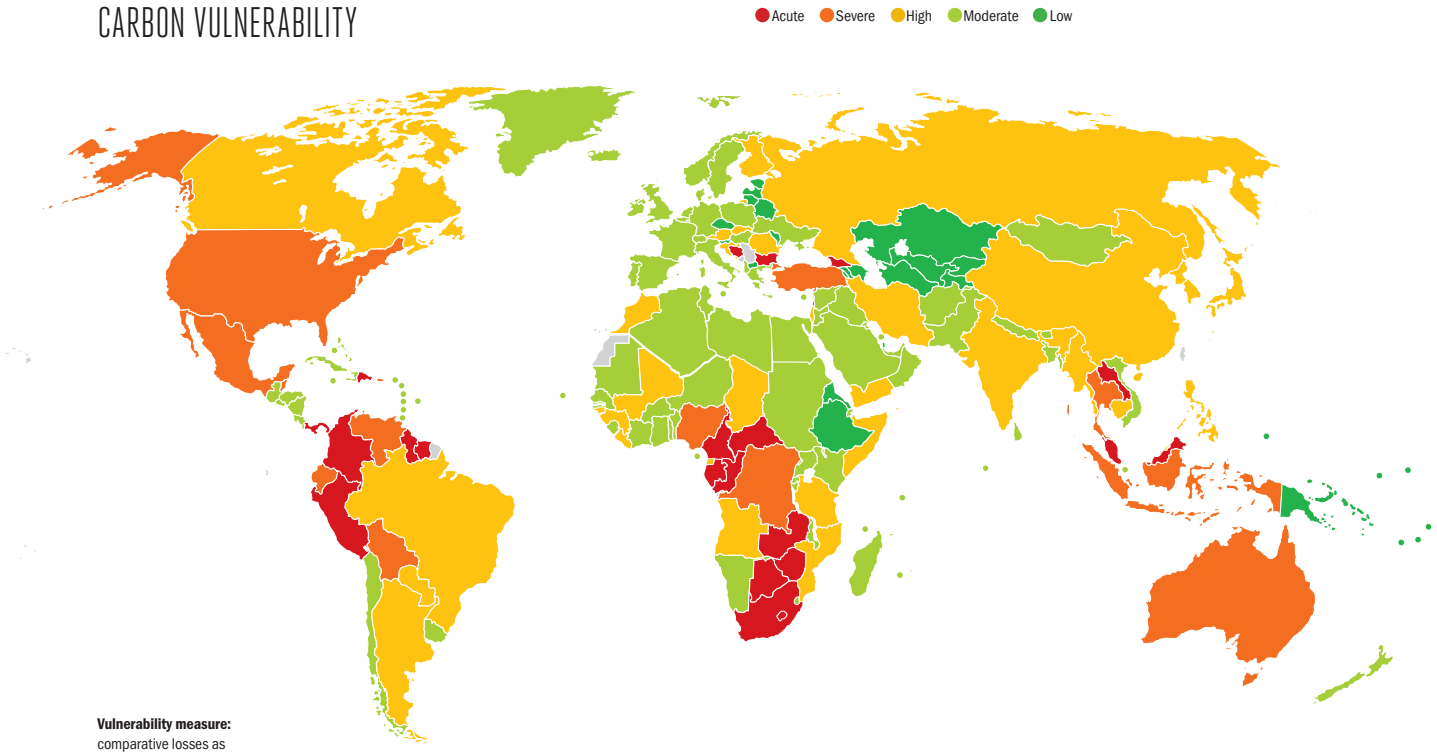
The indicator measures the impact of air pollution on the forestry sector focusing in particular on the extent to which ground-level ozone (O3) and acid rain affect forest productivity. It relies on an ecosystem valuation approach to translate losses into GDP (Reilly et al., 2007; Wentzel, 1982; Costanza et al., 1997). Limitations relate to uncertainties over emissions leading to O3 and acid rain and the regional aggregation of O3 concentrations used (OECD, 2012). Also, research on the effects of acid rain on forests is very out of date. Further investigation is needed since coal energy, heavy in sulphur and nitrogen emissions, is poised to continue to be the world's leading global fuel for power generation well into the 2030s (US EIA, 2011).

ESTIMATES COUNTRY-LEVEL IMPACT

COUNTRY	2010	2030
ACUTE		
Bosnia and Herzegovina	45	100
Botswana	90	400
Bulgaria	150	450
Cameroon	50	250
Central African Republic	1	10
Colombia	450	2,500
Congo	70	300
Dominican Republic	150	750
Gabon	30	200
Georgia	45	100
Guyana	5	35
Laos	10	100
Lebanon	70	350
Lesotho	5	20
Malaysia	900	5,000
Panama	200	1,000
Peru	250	1,250
South Africa	500	2,000
Suriname	5	25
Zambia	50	250
Zimbabwe	10	45
SEVERE		
Australia	750	800
Belize	1	5
Bolivia	15	100
DR Congo	5	40
Ecuador	55	300
Indonesia	550	2,750
Mexico	1,500	4,750
Nigeria	150	750
Thailand	350	2,000
Timor-Leste	1	10
Turkey	500	1,000
United States	10,000	15,000
Venezuela	200	1,000
HIGH		
Angola	25	150
Argentina	250	1,250
Austria	150	200
Brazil	650	3,250
Brunei	5	25
Cambodia	5	70
Canada	350	500
Chad	1	15
China	3,500	20,000
Croatia	35	95
Equatorial Guinea	5	35
Finland	35	70
Guinea	1	5
Guinea-Bissau		1
India	1,000	4,500
Iran	200	1,000
Israel	70	200
Japan	950	1,000
Liberia		1
Mali	1	10
Morocco	30	150
Mozambique	5	35
Myanmar	10	75
Paraguay	5	25
Philippines	65	350
Romania	60	150
Russia	450	1,750
Slovakia	45	100
Somalia	1	5
South Korea	200	1,000
Tanzania	10	50
Yemen	10	50
MODERATE		
Afghanistan		
Albania		1
Algeria	20	100
Antigua and Barbuda		
Bahamas	1	5
Bahrain		
Bangladesh	10	55
Barbados		
Belgium		1
Benin	1	5
Bhutan		1
Burkina Faso	1	5
Burundi		
Cape Verde		
Chile	5	40
Comoros		
Costa Rica	1	10
Cote d,Ivoire	1	10
Cuba	1	10
Cyprus		
Denmark		1
Djibouti		
Dominica		1
Egypt		
El Salvador		1
France	250	300

$ Additional economic costs (million USD PPP) - yearly average

CARBON VULNERABILITY



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

COUNTRY	2010	2030
Gambia		1
Germany	550	650
Ghana	1	15
Greece	35	40
Grenada		
Guatemala	1	10
Haiti		
Honduras	1	20
Hungary	1	5
Iceland		
Iraq	10	40
Ireland		1
Italy	200	250
Jamaica		1
Jordan		
Kenya	1	5
Kuwait		
Libya		
Luxembourg		1
Madagascar	1	10
Malawi	1	1
Maldives		
Malta		
Mauritania		1
Mauritius		
Mongolia	1	5
Namibia		1
Nepal		1
Netherlands	60	70
New Zealand	1	5
Nicaragua	1	10
Niger		1

COUNTRY	2010	2030
North Korea		1
Norway	10	25
Oman		
Pakistan	10	65
Poland	150	350
Portugal	1	5
Rwanda		
Saint Lucia		
Saint Vincent		
Sao Tome and Principe		
Saudi Arabia		1
Senegal	1	10
Seychelles		1
Sierra Leone		1
Singapore		
Spain	250	300
Sri Lanka		1
Sudan/South Sudan	1	10
Swaziland		
Sweden	40	90
Switzerland	40	50
Syria		
Togo		1
Trinidad and Tobago		1
Tunisia		1
Uganda	1	5
Ukraine	45	100
United Arab Emirates		
United Kingdom	1	5
Uruguay		1
Vietnam	25	200

COUNTRY	2010	2030
LOW		
Armenia		
Azerbaijan		
Belarus		
Czech Republic		
Eritrea		
Estonia		
Ethiopia		
Fiji		
Kazakhstan		
Kiribati		
Kyrgyzstan		
Latvia		
Lithuania		
Macedonia		
Marshall Islands		
Micronesia		
Moldova		
Palau		
Papua New Guinea		
Qatar		
Samoa		
Slovenia		
Solomon Islands		
Tajikistan		
Tonga		
Turkmenistan		
Tuvalu		
Uzbekistan		
Vanuatu		