

## The Disastrous Effects of Deforestation and Forest Degradation in the Climate Vulnerability Era

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### ABSTRACT

Deforestation and forest degradation have disastrous effects which threaten human life and other species. The main effects of deforestation and forest degradation are desertification, biodiversity loss and climate change. However, the Bonn Challenge, if fully realized, can reduce some of these effects by reforestation and afforestation. Furthermore, forest governance will need to be strengthened by recognizing human rights and building synergies. Since there is no international instrument for forest protection, forest governance will play a huge part in reducing deforestation and forest degradation.

### Introduction

Human pressures on earth are causing an increase in species extinction, estimated to be more than before the industrial revolution. There are various consequences to deforestation and forest degradation, including that of life change globally. The most overt impact of deforestation is desertification, climate change and biodiversity loss. It must be noted that when these impacts of deforestation take effect, life on earth will eventually change. Scientific research has already discovered that these effects will mostly be negative and will change our normal way of life on earth as nature will have altered everything humanity already possesses and knows. Life on earth is interlinked, and the survival of species depends on good fertile soil and a proper climate which is conducive to food growth and reproduction. Life would change without forests. Thus

because of deforestation, there is a need for further analysis of the effects of deforestation.

### 1. Desertification

Desertification<sup>1</sup> is the degradation of terrestrial ecosystems by land-use changes by humans. The ecosystems will deteriorate, and their productivity will be reduced in biomass and diversity of fauna and flora species. This is mainly due to soil deterioration caused by human land use changes in fragile

<sup>1</sup> Warren A and Maizels J K, *Ecological change and desertification*, (1976), London, University College, page 1, stated that, 'Desertification is the development of desert like landscapes in areas which were once green. Its practical meaning is a sustained decline in the yield of useful crops from a dry area accompanying certain kinds of environmental change, both natural and induced'.

ecosystems such as natural forests.<sup>2</sup> If these effects are not reduced or prevented, this can eventually lead to ecological degradation and desert-like conditions.<sup>3</sup> Desertification cannot be reversed and is driven by several connected factors, primarily triggered by an environment that is consumed by human pressure, which results in land-use changes. It usually results from the over-use of fragile ecosystems through human pressure.<sup>4</sup>

Desertification can be seen as climatic variations, moisture deficiency, and loss of water processes (evapotranspiration mainly). In 1994, the United Nations<sup>5</sup> (United Nations Convention to Combat Desertification) recognized that deforestation, land-use, and urban development were the major causes of desertification. They also recognized different aspects of desertification that need to be addressed, namely natural change, variations in the physical and biological components, the eventuality through time and their spatial diversity, and the environmental problems that stem out of desertification affecting different species. Desertification affects an estimated

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<sup>2</sup> Goudie S A, *The human impact on the natural environment: Past, present and future*, (2013), 7<sup>th</sup> Edition, John Wiley & Sons Ltd, United Kingdom, 1-406, page 46.

<sup>3</sup> Sabadell J E et al, *Desertification in the United States: Status and Issues*. Washington DC: Bureau of Land Management, Department of the Interior, (1982), page 7.

<sup>4</sup> Williams M, 'The role of deforestation in Earth and World-System Integration', in Hornborg A, McNeill R J and Martinez-Alier J (eds), *Rethinking environmental history: World-System history and global environmental change*, (2006), 101-122, page 119.

<sup>5</sup> United Nations Convention to Combat Desertification. See website <http://www2.unccd.int/>. Accessed on 17 April 2017. UNCCD, United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa; UN: Paris, France, (1994).

two-thirds of countries internationally and about one-third of earth's surface, therefore threatening the well-being and economic development of at least one billion people.<sup>6</sup>

Deforestation affects the water and heat exchange budget-off the surface of earth. If deforestation increases, desertification and climate change become a greater possibility leading to biodiversity loss. The evapotranspiration reduces temperatures, and the trees provide shade which maintains temperature to a minimum and cools the lower surface of the forests and earth. In addition, desertification causes animals to migrate from one area to another searching for greener pastures and water, or to die of starvation. According to the Millennium Ecosystem Assessment<sup>7</sup> in the 2005 report, about 15 per cent of land is already degraded and ongoing deforestation is threatening ecosystems and the services which they provide. Desertification is therefore seen as one of the greatest current environmental changes that have difficult consequences to terrestrial species.<sup>8</sup>

The causes of desertification range from direct land use changes, wildfires, over-cultivation, poor

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<sup>6</sup> Wang Y and Yan X, 'Climate change induced by Southern Hemisphere desertification', *Physics and Chemistry of the Earth*, (2016). See website

<http://dx.doi.org/10.1016/j.pce.2016.03.009>, 1-8, page 1.

<sup>7</sup> *Ecosystems and Human Well-being: Current State and Trends*, Volume 1 (2005), Hassan R, Scholes R and Ash N (eds). Link to the report website,

<http://www.millenniumassessment.org/en/Condition.html>.

Accessed 12 February 2017.

<sup>8</sup> See website

<http://www.millenniumassessment.org/en/index.html>.

Accessed 12 February 2017.

management of irrigation systems, illegal logging, infrastructure such as roads and dams, population growth, and poor government policies to protect forest lands.<sup>9</sup> The soil's physical structure is affected due to desertification; there is a decline in the soil structure, increased soil erosion, increased flooding and salinization, decreased vegetation cover, biological diversity loss, migration and increase of poverty. As a result, temperatures tend to increase, and climates of given regions eventually change.<sup>10</sup>

Desertification results in loss of ecosystem services and products, thus reducing biological productivity due to several causes of soil erosion, loss of vegetation due to loss of soil fertility and a change in specie variability.<sup>11</sup> Soil erosion becomes a problem after deforestation because trees in a forest hold the soil together, maintain water resources and reduce the prolonged effects of biodiversity loss, desertification, and climate change. It also decreases the soil-holding capacity for water and nutrients. Deforestation makes it possible for soil to be eroded through wind, snow, animals, and water. This is also detrimental for plant and animal species that require good fertile soil for growth and feeding.

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<sup>9</sup> Williams M, 'Deforestation: General debates explored through local studies', (2000) 2, *Progress in Environmental Science*, 229-251, page 233.

<sup>10</sup> Alkama R and Cescatti A, 'Biophysical climate impacts of recent changes in global forest cover', 352 (2016), *Science*, 600-604, page 602-4.

<sup>11</sup> Safriel U and Adeel Z, 'Dryland systems', in Hassan R, Scholes J R and Ash N (eds), *Ecosystems and human well-being: Current state and trends*, Vol 1 (2005), London: Island Press, page 917.

Plants require good soil for growth, there is, thus a need to conserve and protect soil from erosion. Good soil sustains life for species on earth since it delivers various ecosystem services.<sup>12</sup> Soil is responsible for the essential production of raw materials and food.<sup>13</sup> Further, biological communities need good quality soil to grow and feed, and soil provides environmental services. However, these forest services have been affected by ecosystem degradation and transformation imposed by human activities.<sup>14</sup>

Erosion leads to fine soil particles being blown-off and a sandy texture of soil quality being left behind. Fine soil particles usually have the nutrients, and the sandy soil that is left does not have sufficient nutrients for plant growth. Sandy soil does not have the same porosity, water infiltration rate, storage, and nutrient availability as fine soil. Therefore, plants cannot grow in these areas because there are no nutrients in sandy soil. Due to this, the soil fertility and the soil cover decreases, thus the species diversity is reduced. Consequently, soil erosion is seen as one of the most important negative effects of

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<sup>12</sup> Were K et al, 'A comparative assessment of support vector regression, artificial neural networks, and random forests for predicting and mapping soil organic carbon stocks across an Afrotropical landscape', 52 (2015), *Ecological Indicators*, 394-403, page 394.

<sup>13</sup> Ibid.

<sup>14</sup> Santibáñez-Andrade G et al, 'Structural equation modelling as a tool to develop conservation strategies using environmental indicators: The case of the forests of the Magdalena river basin in Mexico City', 54 (2015), *Ecological Indicators*, 124-136, page 124.

desertification since it has detrimental impact on plants and animals.<sup>15</sup>

Soil is an integral part of various ecosystems and plays an important part in forest regeneration. Healthy and fertile soil is important for all ecosystems because that is where trees and crops grow, and nutrients are recycled. Litter on the forest ground also controls carbon decomposition and keeps the land moist.<sup>16</sup> Thus, soil erosion will result in nutrients being washed-off causing river siltation and flooding. This leads to loss of the fertile structure of soil, disturbance of the nutrient cycle, and reduction in biomass nutrient stocks causing poor growth of plants and crops.<sup>17</sup>

Eventually, without restoration of this environment, the soil becomes infertile and less productive. The water resources will also dry up causing water security and water for security concerns. Consequently, lack of vegetation and water resources will result in the hydrological cycle changing to that of lesser rainfall. This results in dry conditions and lack of rainfall immediately defined as periodical droughts. Eventually, the area or region enters the

first stage of desertification, that of a fragile ecosystem with a need for restoration.

Deforestation usually impacts soil in several ways, which include reducing organic nitrogen, exchangeable potassium, and carbon.<sup>18</sup> It also reduces the ion exchange capacity of the soil and nutrients such as iron, chlorine, phosphorus, calcium, magnesium, potassium, and nitrogen.<sup>19</sup> The loss of these nutrients into the river will be detrimental for crop cultivation and for river species which need clean and safe water for survival.

However, forests can stabilize soil by reducing erosion and water loss, and maintaining nutrient cycle.<sup>20</sup> Tree roots bring nutrients from underground for the undergrowth growing on the forest floor, and the falling tree leaves also provide manure and fertiliser for these plants and food for animals. The number of trees and their size will reduce soil erosion, because of the roots that keep soil compact. Further, the falling leaves providing manure allow for regeneration which aids the restoration of trees and plants. Thus, desertification affects the surface features and biology of grassland soils in many regions.

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<sup>15</sup> Vanmaercke M *et al*, 'Sediment yield as a desertification risk indicator', 409 (2011), *Science of the Total Environment*, 1715–1725, page 1715.

<sup>16</sup> Santa R, 'Litter fall, decomposition and nutrient release in three semi-arid forests of the Duero basin, Spain', 74 (2001), *Forestry*, 347–358, page 347-8.

<sup>17</sup> Kurz C, Couteaux M M and Thiery J M, 'Residence time and decomposition rate of *Pinus pinaster* needles in a forest floor from direct field measurement under a Mediterranean climate', 3 (2000), *Soil Biology Biochemistry*, 1197–1206, page 1197-8.

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<sup>18</sup> Fu B *et al*, 'Comparing the soil quality changes of different land uses determined by two quantitative methods', 15 (2) (2003), *Journal of Environmental Sciences*, 167–172, page 167.

<sup>19</sup> Bormann F *et al*, 'Loss accelerated by clear-cutting of a forest ecosystem', 159 (1968), *Science*, 882–884, page 882-3.

<sup>20</sup> Zhou H U, Yizhong L V and Baoguo L I, 'Advancement in the study on quantification of soil structure', 46 (2009), *Acta Pedologica Sinica*, 502–505, page 502-3.

Deforestation also threatens aquatic biodiversity and its ecosystem services. Forests around the world offer water supply and quality ecosystem services.<sup>21</sup> High elevation forests usually collect saturated fog moisture from the atmosphere maintaining the soil dampness for plant growth. This also reduces water evaporation ensuring that streams have abundance and constant flow of water throughout the year.<sup>22</sup> These forests also filter pollutants and debris that can flow into the water through the slopes.<sup>23</sup> It must be noted that the hydrological system can be affected by desertification, and is important for food availability, maintaining water quality and water supply throughout the dry season.<sup>24</sup> Thus, losing ecosystem services that are essential to sustaining life.<sup>25</sup>

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<sup>21</sup> Bruijnzeel L A, 'Hydrological functions of tropical forests: Not seeing the soil for the trees?', 104 (2004), *Agriculture Ecosystems and Environment*, 185–228, page 185-6. Also see Grip H, Fritsch M J and Bruijnzee L A, 'Soil and water impacts during forest conversion and stabilisation to new land use', in Bonnell M and Bruijnzeel L A (eds). *Forests, water and people in the humid tropics: Past present and future hydrological research for integrated land and water management*, (2005), Cambridge University Press, UK, 561-589, pages 561-4.

<sup>22</sup> Postel S L and Thompson B H, 'Watershed protection: Capturing the benefits of nature's water supply services', 29 (2005), *Natural Resources Forum*, 98–108, page 99.

<sup>23</sup> Peterjohn W T and Correl D L, 'Nutrient dynamics in an agricultural watershed: Observations of role of riparian forest', 65 (1984), *Ecology*, 1466–1475, page 1466-7.

<sup>24</sup> Farley K A, Jobbagy E G and Jackson R B, 'Effects of afforestation on water yield: A global synthesis with implications for policy', 11 (10) (2005), *Global Change Biology*, 1565–1576, page 1565-6.

<sup>25</sup> D'Odorico P *et al*, 'Global desertification: Drivers and feedbacks', 51 (2013), *Advances in Water Resources*, 326–344, page 326. Also see United Nations (1994). Elaboration of an international convention to combat desertification in countries experiencing serious drought and/or desertification, particularly in Africa. Final text of the Convention. See website [www.unccd.int/convention/text/pdf/conv-eng.pdf](http://www.unccd.int/convention/text/pdf/conv-eng.pdf). Accessed 07 July 7, 2020.

Desertification directly affects the agricultural, industrial, and healthy sectors of many countries. Furthermore, it can also threaten the sustainability of social and economic development of many countries.<sup>26</sup> Desertification will worsen the cultural life of any community if left to take its full effects. It can also cause widespread failure in crop production resulting in high inflation of food prices and the falling of a country's economy. It increases the likelihood of people having to migrate from their communities because of crop failure and death of animals in desert regions.

In addition, poor agricultural produce will cause food shortages, which usually causes social unrest, migration, and political strife. Migration always causes social tensions because towns and cities with resources will experience increased demand and the influx of people with their animals. This will also cause an increased demand for resources in isolated areas receiving migrants from desert-affected areas. This impacts the lives of many people who need food, increasing food prices, squatting and house prices. Eventually, this can result in civil wars and further migration and social unrest in that country or region. Due to migration, the workforce and resources are reduced; this increases the economic and cultural gap between different ethnicities in the same country or region. This results in the loss of a country's political and socio-economic stability.

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<sup>26</sup> *Ibid*, page 326-8.

Desertification is caused mainly by deforestation and the change of forest land for other human uses. There is surely a link between deforestation and desertification. The international community has therefore promulgated the United Nations Convention to Combat Desertification (UNCCD) which is to forest protection for combating and reducing desertification.

## 2. Biodiversity loss

Biodiversity has been defined as "the variability among living organisms from all sources including, among others, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems".<sup>27</sup> Terrestrial biodiversity loss in the world is driven mainly by the expansion of agriculture lands, illegal logging and wildfire which is mainly to sum up deforestation. Thus, biodiversity loss is due to loss of their natural habitats which is mainly caused by deforestation.<sup>28</sup> Biodiversity consists of different species, a community, genetic makeup, a landscape usually a forest land, and a process or function, which can also be a forest ecosystem.<sup>29</sup>

Furthermore, price-driven land, fuelwood, and food speculation can also increase the demand for land and

<sup>27</sup> Convention on Biological Diversity, Article 2.

<sup>28</sup> Eisner R, Seabrook M L and McAlpine A C, 'Are changes in global oil production influencing the rate of deforestation and biodiversity loss?', 196 (2016), *Biological Conservation*, 147–155, page 147.

<sup>29</sup> Sachs D J, *The age of sustainable development*, Columbia University Press, New York, (2015), page 447.

deforestation. This has resulted in habitat alteration, loss and fragmentation, overexploitation of species, forest degradation and deforestation, and the introduction of invasive species. In addition, about 12 percent of plant species and 55 percent of animal species are now threatened with extinction.<sup>30</sup>

One of the major reports on the functions of ecosystems was the Millennium Ecosystem Assessment<sup>31</sup> (MEA, 2005); it stated that there are interactions of ecosystems globally, such that a forest ecosystem interacting with the hydrological cycle can affect the regulation of the earth as whole or other ecosystems. A critical biome that suffers major changes, for example, deforestation, these effects can be profound, causing long-distance interactions of earth processes, which might include precipitation, chemical and biological changes, winds, and ocean circulations.<sup>32</sup>

Deforestation causes forest fragmentation, decrease in the size of habitats, increased isolation of animals; and increased chances of extinction, change in species dynamics and inhibits seed dispersal.<sup>33</sup> Forest

<sup>30</sup> CBD Secretariat, (2010). Global biodiversity outlook 3.

Montreal: Convention on Biological Diversity, page 24 and 26.

<sup>31</sup> Millennium Ecosystem Assessment. *Ecosystems and Human Wellbeing: Synthesis*. Washington, DC: Island Press 1-155, page 2. See website for report <http://www.millenniumassessment.org/documents/document.356.aspx.pdf>. Accessed on 20 April 2017.

<sup>32</sup> Sachs D J, *The age of sustainable development*, Columbia University Press, New York, (2015), page 449.

<sup>33</sup> Brook B W, Sodhi N S and Bradshaw C J A, 'Synergies among extinction drivers under global change', 23 (2008), *Trends in Ecology and Evolution*, 453 – 460, page 431. Also see Saunders D A, Hobbs R J and Margules C R, 'Biological consequences of

fragmentation is a process which reduces continuous forests into several patches this eventually leads to environmental modifications.<sup>34</sup> There is isolation of species of the same specie making it difficult for pollination and dispersion, thus changing specie modification sizes.<sup>35</sup> This can also happen to animals, they can be separated making it difficult for them to breed and maintain their population. Moreover, habitat degradation upsets the population ability of species to environmental or natural selective pressures.<sup>36</sup> This also reduces the genetic variability of species populations and affects their adaptiveness to an environment.<sup>37</sup> In many areas affected by deforestation, this has led to species extinction.

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ecosystem fragmentation: A review', 5 (1991), *Conservation Biology*, 18–32, page 19. Also see Sala O E *et al*, 'Global biodiversity scenarios for the year 2100', 287 (2000), *Science*, 1770–1774, page 1770.

<sup>34</sup> Broadhurst L and Young A, 'Seeing the wood and the trees-predicting the future for fragmented plant populations in Australian landscapes', 55 (2007), *Australian Journal of Botany*, 250–260, page 250-1. Also see Young A G and Pickup M, 'Low S allele numbers limit mate availability, reduce seed set and skew fitness in small populations of a self-incompatible plant', 47 (2010), *Journal of Applied Ecology*, 541–548, page 541-2.

<sup>35</sup> Moreira P A, Fernandes G W and Collevatti R G, 'Fragmentation and spatial genetic structure in *Tabebuia ochracea* (Bignoniaceae) a seasonally dry Neotropical tree', 258 (2009), *Forest Ecology and Management*, 2690–2695, page 2691.

<sup>36</sup> Hamrick J, 'Pollen and seed movement in disturbed tropical land-scapes', in DeWoody A J *et al* (eds), *Molecular approaches in natural resource conservation and management*, New York: Cambridge University Press, (2010), 190-211, pages 190-2.

<sup>37</sup> Lowe A D *et al*, 'Genetic resource impacts of habitat loss and degradation; reconciling empirical evidence and predicted theory for neotropical trees', 95 (2005), *Heredity*, 255–273, page 255-6. Also see Willi Y, Van Buskirk J and Hoffmann A A, 'Limits to the adaptive potential of small populations', 37 (2006), *Annual Review of Ecology, Evolution, and Systematics*, 433–458, page 433.

In addition, loss of forest megafauna has had severe impact on plant species and their regeneration, thus affecting forest resilience and the potential capacity of the forests and carbon storage.<sup>38</sup> When forests are cleared, large primates, tigers, elephants, and rhinoceros become the most vulnerable because they are preferred by hunters. In addition, carbon storage in forests depends on the plant and animal species.<sup>39</sup> Most herbivores and other small insects lose their food source when forests are cleared. The carnivores also suffer because they feed on the herbivores, this tempers with the forest food chain. It must be noted that about 80 per cent documented species around the world are found in the tropical rainforest, thus continued runaway deforestation poses a threat to biodiversity.

Furthermore, habitat loss will cause a decrease in biodiversity population abundance, species richness, genetic diversity, and loss of large-sized species.<sup>40</sup> However, it should be stated that the physical environment of an ecosystem determines the richness in species and distribution. Therefore, there is a need to understand the relationship between land use and

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<sup>38</sup> Bunker D E *et al*, 'Species loss and above ground carbon storage in a tropical forest', 310 (2005), *Science*, 1029–1031, page 1029. Also see Cardinale B J *et al*, 'Biodiversity loss and its impact on humanity', 486 (2012), *Nature*, 59-67, pages 59 and 60.

<sup>39</sup> Wright S J, Hernández A and Condit R, 'The bushmeat harvest alters seedling banks by favoring lianas, large seeds, and seeds dispersed by bats, birds, and wind', 39 (2007), *Biotropica*, 363–371, page 363.

<sup>40</sup> Best L B, Bergin T M, Freemark K E, 'Influence of landscape composition on bird use of row crop fields', 65 (2001), *Journal of Wildlife Management*, 442–449, page 442. Also see Fahrig L, 'Effects of habitat fragmentation on biodiversity', 34 (2003), *Annual Review of Ecology, Evolution and Systematics*, 487–515, page 487-488.

biodiversity protection which is key to regional and national plans to forest protection.<sup>41</sup> Forests are important because they create a myriad of community types and mosaics for refuge habitats, which contain a mixture of plants and animals.

The destruction of genetic resources also has greater effects to the medical field, cultural significance, and agricultural productivity. Biodiversity makes a worthy source of food products and pharmaceuticals for medicines. The economic loss should be worth billions of United States American dollars. Most poor communities rely solely on forest services and products; thus, the effects will be severely disproportional because they depend on forest ecosystems for livelihood security. In addition, forest biodiversity's importance includes food security through nutritional balance, employment for income cash, religious and cultural practices, traditional medicine, and drug development.

Forests are well-known habitats for biodiversity. Biodiversity variability is important in an ecosystem for providing goods or services. Many of these ecosystem services are sensitive to biodiversity changes; therefore, loss of biodiversity will lead to loss of ecosystem services and forest products. There is a clear relationship between forest loss and ecosystems to habitat disturbance, nutrient cycling,

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<sup>41</sup> Pianka E R, 'Latitudinal gradients in species diversity', 100 (1996), *The American Naturalist*, 33-46, page 34. Also see MacArthur R H, 'Environmental factors affecting bird species diversity', 98 (1964), *The American Naturalist*, 387-398, page 387.

and ecosystem productivity.<sup>42</sup> In meta-analysis, biodiversity has been seen as vastly important and with functions to cycle nutrients, control erosion, regulation of biodiversity, ecosystem stability and resistance. Thus, the ability of forests to recover from degradation activities, resilience and being resistant to land use changes depends on the biodiversity and genetic makeup of that landscape scales. Tree microhabitats are important as they are key habitat elements and important for birds, insects, and other smaller animals. These habitats are important for promoting biological diversity sustainability in forest ecosystems. Proper and effective forest protection and management mostly improve biodiversity conservation.<sup>43</sup> Consequently, negative consequence such as deforestation affects many species. This will also affect the quality of life of humans since human well-being is closely interconnected to biodiversity.<sup>44</sup>

The nature of forests usually depends on the ecological characteristics of the sites, the diversity of the species present, and how tree species can regenerate. Furthermore, tree species and diversity are fundamental for the conservation of biodiversity since

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<sup>42</sup> Brockerhoff G E *et al*, 'Role of eucalypt and other planted forests in biodiversity conservation and the provision of biodiversity-related ecosystem services', 301 (2013), *Forest Ecology and Management*, 43-50, page 44.

<sup>43</sup> Putz F E *et al*, 'Biodiversity Conservation in the Context of Tropical Forest Management', Paper No. 75 (2000). Biodiversity Series-Impact studies. World Bank Environment Department Papers, The World Bank, Washington, DC, USA, 1-167, pages 19 and 21. See website on <http://documents.worldbank.org/curated/en/581391468779985927/pdf/multi-page.pdf>. Accessed 20 February 2017.

<sup>44</sup> Cardinale B J *et al*, 'Biodiversity loss and its impact on humanity', 486 (2012), *Nature*, 59-67, page 60.

forests provide resources and habitat for many species. A variance of forests is important for specie richness and fundamentally for all biodiversity. Trees are also responsible for the physical structure of all habitats. They are important as structural complexity and environmental heterogeneity for all species. Biodiversity is also linked to the multiple physical, chemical, and biological effects of the soil.<sup>45</sup>

In addition, biodiversity has a direct economic value, and its protection yields economic and ecological services.<sup>46</sup> These services include carbon sequestration<sup>47</sup>, soil and water protection, hydrological cycle, biodegradation of waste, and sustaining the circulation of carbon, water, nitrogen, and oxygen. However, biodiversity loss can lead to all these services being reduced, extinction of species, overexploitation of other species, pollution of soil and water, habitat loss, alteration, and ecosystem fragmentation. Many rural communities are dependent on forest biodiversity, and their relationship is a multiplex one since their powers are not decentralized by governments in developing nations.

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<sup>45</sup> Lavelle P *et al*, 'Unsustainable landscapes of deforested Amazonia: An analysis of the relationships among landscapes and the social, economic and environmental profiles of farms at different ages following deforestation', 40 (2016), *Global Environmental Change*, 137–155, page 139.

<sup>46</sup> Lubchenco J, 'Entering the century of the environment: A new social contract for science', 279 (1998), *Science*, 491-497, page 492.

<sup>47</sup> Maddahi R, 'A Legal Reflection on the Deployment of Carbon Capture and Storage in Developing Countries: Through the Lens of Differentiation under the Paris Agreement', Fall (2021) (2) (4), *CIFILE Journal of International Law*, 96-113, page 101-3.

Deforestation is also a threat to inland water species as these are affected by flooding, siltation, and soil erosion and water weeds.<sup>48</sup> Land use change has caused change in the hydrology cycle, water warming, nutrient enrichment in water sources and increased sediment load.<sup>49</sup> These impacts will then threaten aquatic biodiversity and inland water ecosystem services. This may also affect fish stocks, water birds, turtles and frogs which live in water sources or feed off small water species.<sup>50</sup> There is a need to uncover the effects of deforestation on inland water species and the development of optimum management strategies to reduce deforestation. Arthropods are the most dominant fauna group in many forests, and they play vital roles in ecosystem functioning.<sup>51</sup> Ants and arthropods occupy an important group of animals that play a crucial part in soil health, energy flow, nutrient cycling, herbivory, and seed dispersal.<sup>52</sup> Many ecosystems are dependent on these species, which

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<sup>48</sup> Sala O E *et al*, 'Global biodiversity scenarios for the year 2100', 287 (2000), *Science*, 1770–1774, page 1771. See also Strayer D L and Dudgeon D, 'Freshwater biodiversity conservation: Recent progress and future challenges', 29 (2010), *Journal of North American Benthological Society*, 344–358, page 344.

<sup>49</sup> Collen B *et al*, 'Global patterns of freshwater species diversity, threat and endemism', 23 (2014), *Global Ecology and Biogeography*, 40–51, page 40-1. Also see Woodward C *et al*, 'The hydrological legacy of deforestation on global wetlands', 346 (2014), *Science*, 844–847, page 844.

<sup>50</sup> WWAP, 2015. The United Nations World Water Development Report 2015: Water for a Sustainable World. UNESCO, Paris, page 14 of Chapter 1. See website on <http://unesdoc.unesco.org/images/0023/002318/231823E.pdf>. Accessed 24 March 2017.

<sup>51</sup> Hamilton A J *et al*, 'Quantifying uncertainty in estimation of tropical arthropod species richness', 176 (2010), *The American Naturalist*, 90–95, page 90-1.

<sup>52</sup> Andersen A N and Majer J D, 'Ants show the way down under: Invertebrates as bio-indicators in land management', 2 (2004), *Frontiers in Ecology and the Environment*, 291–298, page 291.

usually live in sensitive environments and are affected by deforestation. Furthermore, for species to survive there is a need for trees to have a regeneration potential - which is the ability of all species to bring life on earth and complete the life cycle. This allows the existence of species in any given community and under varied environmental conditions.

Deforestation which leads to the destruction of these natural ecosystems services also increases poverty in poor communities.<sup>53</sup> This biodiversity loss has resulted in the Global Biodiversity Outlook (Convention on Biological Diversity 2010) asserting that *"[w]ell-targeted policies focusing on critical areas, species and ecosystem services are essential to avoid the most dangerous impacts on people and societies. Preventing further human-induced biodiversity loss for the near-term future will be extremely challenging, but biodiversity loss may be halted and, in some respects, reversed in the longer term, if urgent, concerted, and effective action is initiated now in support of an agreed long-term vision"*.<sup>54</sup>

Importantly, there is a need for significant expansion of protected areas, reduction of deforestation, the improvement of sustainable agricultural practises, a

<sup>53</sup> Rajvanshi A and Arora R, 'Mainstreaming biodiversity and gender in impact assessment for human well-being', 11 (1-2) (2010), *Biodiversity*, 25-30, page 25.

<sup>54</sup> Secretariat of the Convention on Biological Diversity, (2010), *Global Biodiversity Outlook 3*. Montréal, 1-94, page 9 and 10 and 71-5, See website on <https://www.cbd.int/doc/publications/gbo/gbo3-final-en.pdf>. Accessed on 13 March 2017.

change in meat consumption behaviour, and the reduction of post-harvest losses. The increase of protected national parks and nature conservation areas will also add value to this goal. There is a need to develop biodiversity networks which can incorporate the old and new protected areas, and educational programmes and awareness for community members on the value of biodiversity. It is estimated that dietary changes, specifically reducing the meat consumption, will nearly reduce loss of mean species abundance of about 50 per cent by 2050, and expansion of protected areas to 20 per cent will reduce to about 10 per cent in the same year.<sup>55</sup>

Furthermore, buffer zones can be set up with parameters and multiple use management areas that reduce ecotourism in fragile ecosystems and sensitive areas. However, the most effective way to ensure biodiversity conservation is to protect forests since they are habitats and to strengthen the legal environmental framework on forest protection. It will also be viable to integrate research programmes, conservation and educational activities across areas or regions.

Climate change and biodiversity are interlinked in a way that climatic changes cause a decline in biodiversity. Furthermore, biodiversity is also known as a source of different ecosystem services, including

<sup>55</sup> Pattberg P and Dellas E, 'Assessing the political feasibility of global options to reduce biodiversity loss', Volume 9, Number 4, (2013), *International Journal of Biodiversity Science, Ecosystem Services & Management*, 347-363, page 348.

climate change mitigation regulation that is important for animal and plant societies to survive.<sup>56</sup>

The international community has recognized the importance of forest biodiversity and ecosystem functions and has tried to protect forest biodiversity through multiple multilateral agreements. The Aichi Biodiversity Target 5 states that deforestation needs to be reduced and protect forest habitats, biodiversity, and ecosystems; and Target 11 also emphasizes the protection and management of protected areas to become well-connected ecosystems and represent the local population equitably.<sup>57</sup> Forests are species habitats and are important in the protection, management, and conservation of biodiversity.

### 3. Climate Change

Deforestation contributes to approximately 25 percent of anthropogenic carbon emissions into the atmosphere, and this plays a huge part in climate change.<sup>58</sup> Deforestation from different causes leads to carbon emissions. If the wood biomass is burned during deforestation, more carbon and other gases are

emitted<sup>59</sup> and cause an increase of carbon in the atmosphere. Carbon is a well-known greenhouse gas (GHG) and causes an increase in temperatures which results in climate changes.

Climate change causes extreme weather conditions which are harmful to plants and animals, and forests are important for the mitigation of climate change. Climate change causes droughts, food insecurity, poverty, flooding, heat waves, and increases in diseases, migration, biodiversity loss and desertification. Importantly, the role of carbon sequestration is now globally recognized, and the Kyoto Protocol recognizes the mitigation role under its international policy arrangements and programmes.<sup>60</sup> In addition, forest soil is important since trees fix some of their carbon into the soil reducing carbon in the atmosphere.

Climate change is one of the significant concerns, especially in land and resource management and has resulted in many countries building socio-ecological capacities which are being used to address uncertain environmental changes. The United Nations Framework Convention on Climate Change (UNFCCC), adopted in 1992, entered into force in

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<sup>56</sup> Anderson-Teixeira K J *et al*, 'Climate-regulation services of natural and agricultural eco-regions of the Americas', 2 (2012), *Nature Climate Change*, 177–181, page 177.

<sup>57</sup> See website <https://www.cbd.int/doc/strategic-plan/2011-2020/Aichi-Targets-EN.pdf>. Accessed 13 April 2017, 1-2, page 2.

<sup>58</sup> Van der Werf G R *et al*, 'CO<sub>2</sub> emissions from forest loss', 2 (2009), *Nature Geoscience*, 737-738, page 739. See also Devaney L J, Redmond J J and O'Halloran J, 'Contemporary forest loss in Ireland; quantifying rare deforestation events in a fragmented forest landscape', 63 (2015), *Applied Geography*, 346-356, page 346.

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<sup>59</sup> Achard F *et al*, 'Estimating tropical deforestation from Earth observation data', 1 (2) (2010), *Carbon Management*, 271-287, page 271.

<sup>60</sup> Canadell J G and Raupach M R, 'Managing forests for climate change mitigation', 320 (5882) (2008), *Science*, 1456–1457, page 1456. See also Maddahi R, 'A Legal Reflection on the Deployment of Carbon Capture and Storage in Developing Countries: Through the Lens of Differentiation under the Paris Agreement', Fall (2021) (2) (4), *CIFILE Journal of International Law*, 96-113, page 101-3.

1994 and its ultimate objectives are to reduce and prevent anthropogenic interference in the climate system of the earth. The UNFCCC seeks to reduce emissions and forest degradation, protect forest carbon stocks; and enhancement of forest carbon stocks. To highlight the issues of climate change other instruments have been bestowed, including the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Kyoto Protocol, the United Nations Convention to Combat Desertification (UNCCD) and the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention). Its objective is to stabilise GHGs in the atmosphere to levels where species and ecosystem's function and can adjust in ways that do not threaten sustainable development. As it is clear from the international framework, climate change is important, and a significant issue to be considered when addressing the issue of forest protection.<sup>61</sup> However, it must be stated that future changes will increase the vulnerability and climate extremes from natural variability, anthropogenic climate change and socio-economic development can potentially alter our natural and human systems.<sup>62</sup>

Climate hazards include warmer winter temperatures, heavy rainfall, and increased frequency of droughts.

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<sup>61</sup> Millar C I, Stephenson N L and Stephens S, 'Climate change and forests of the future: Managing in the face of uncertainty', 17 (2007), *Ecological Applications*, 2145–2151, pages 2145 and 2150.

<sup>62</sup> Mori S A *et al*, 'Reframing ecosystem management in the era of climate change: Issues and knowledge from forests', 165 (2013), *Biological Conservation*, 115–127, page 115.

Many ecosystems will undergo changes, loss of more tree species, major shifts in tree composition in many countries and an increase of insects infecting trees. Further, the agriculture sector will be severely affected by climate change hazards. This is because the summers will become warmer, and hailstorms will destroy crops. Winters could also become warmer, disturbing the planting, growing, and harvesting seasons of crops and breeding patterns of animals.

There will be an ever-increasing pressure on agriculture as plant diseases, insects and weed pressure increase; this will be mainly caused by the lack of water and drought. The heavily affected industries in the agricultural sector will be the fruit and vegetables and the dairy industry, this is mainly because fruits and vegetables require a certain amount of water, and diseases or weather conditions can easily affect them. In the dairy industry, there is a need for greener pastures and adequate water supply to ensure the availability of the volume of water consumed by milk cows.<sup>63</sup>

In the energy sector there will be major changes in the cooling and heating overall degree daily. The hydrological cycle will be affected and thus also the hydropower potential, flooding, and declining stream flow. This will change the electricity generation,

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<sup>63</sup> FAO. 2019. *Water use in livestock production systems and supply chains – Guidelines for assessment* (Version 1). Livestock Environmental Assessment and Performance (LEAP) Partnership. Rome, page 32-4. See website on <http://www.fao.org/3/ca5685en/ca5685en.pdf>. Accessed 16 January 2021.

distribution, and transmission. The potential vulnerabilities will be energy supply impacts ranging from thermal electricity to natural gas. In other regions, snow, increased cloud cover and rainfall will reduce the productiveness of solar panels, thus reducing the capacity of the energy sector from solar energy. Furthermore, transport will also be affected by snow, heat waves, hailstorms, flooding, wind speed, hurricanes, and cyclones. However, several initiatives that focus on sustainable cities and energy are starting to be recognized.

If there is sudden warmth in the Arctic and Antarctic regions the water levels will suddenly increase changing fundamental ocean circulations and submerging many islands. Due to increases in temperatures, the ice glaciers in the South and North Poles will melt quickly. Further, forest ecosystems will also undergo severe changes in structure, composition, formulation, and species as climate change unfolds, according to the Intergovernmental Panel on Climate Change (IPCC).<sup>64</sup>

Respectively, climate change alters ecosystem services.<sup>65</sup> According to the IPCC in 2009, the increase in the average atmospheric temperature has

<sup>64</sup> Intergovernmental Panel on Climate Change. 'Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects', in Field C B *et al*, (eds), *Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, (2014), page 1132.

<sup>65</sup> Van Mantgem P J *et al*, 'Widespread increase of tree mortality rates in the Western United States', 323 (2009), *Science*, 521–524, page 521.

detrimental effects on plants and animal species. The most affected organisms will be those which are range restricted, especially those that live on fragile ecosystems, geographically isolated and endemic species.<sup>66</sup> Unknown changes in the climate system can be varied, but the evidence and scientific research have already pointed to the worst of climatic changes to come. The changes in our atmosphere suggest that the climatic changes will be more detrimental than even expected. Deforestation has affected forests transforming them from carbon sinks to carbon sources.<sup>67</sup> Climate change can result in ecosystems being invaded by non-native species; viruses that are fatal to animals and extinction of key biota, this can impact on other ecosystem services.<sup>68</sup>

In addition, for developing countries, forests are a net and a source of livelihood. They sustain human well-being for billions of people around the world.<sup>69</sup> Many communities depend on forest products such as food, medicine, fuel, house building materials, income, and water.<sup>70</sup> Forests provide these subsistence products

<sup>66</sup> Parmesan C, 'Ecological and evolutionary responses to recent climate change', 37 (2006), *The Annual Review of Ecology, Evolution, and Systematic*, 637–669, page 637.

<sup>67</sup> Baldocchi D D, 'Breathing of the terrestrial biosphere, lessons learned from a global network of carbon dioxide flux measurement systems', 56 (2008), *Australian Journal of Botany*, 1–26, page 1.

<sup>68</sup> Jiménez M A *et al*, 'Extreme climatic events change the dynamics and invasibility of semi-arid annual plant communities', 14 (2011), *Ecology Letters*, 1227–1235, page 1227.

<sup>69</sup> Sunderlin W *et al*, 'Livelihoods, forests, and conservation in developing countries: An overview', 33 (2005), *World Development*, 1381–1402, page 1381.

<sup>70</sup> World Resources Institute (WRI) in collaboration with United Nations Development Programme, United

and reduce poverty.<sup>71</sup> Most forest products are needed by communities who supplement their well-being and livelihoods during dry seasons with such resources when there is a shortfall of other products from the agricultural season.<sup>72</sup>

Many poor communities are restricted from access to resources, less integrated to the cash economy, have much lesser purchasing power, and are therefore more dependent on the natural ecosystem services. Poverty forces people to become reliant on the natural resources and their surroundings. Most forests in developing economies are owned by small communities who depend on forest resources for employment and other goods for consumption. Moreover, in developing countries life would be difficult without these forest products and services as these communities would face hunger and strive during the dry season. Forests perform crucial roles in reducing vulnerability of the environment to degradation, thus playing, and proving opportunity

for adaptation and mitigation strategies to desertification, biodiversity loss and climate change.

Deforestation of forests around these communities will mean severe poverty, flooding, soil erosion, poor agricultural produce, loss of grazing lands, destruction of water resources, and loss of biodiversity. Deforestation and climate change will affect about 70-80 per cent of the developing countries, as many of their communities are reliant on forest services and products. Forest products are the resources which these communities need to improve their lives. Moreover, loss of biodiversity will have devastating consequences for these communities, many of whom will have to migrate to other areas which can cause conflict with other communities.

In short, the effects of climate change will be species extinctions, desertification, decrease in genetic diversity, decrease in agricultural commodities, pollution, rising cost of living, change in weather patterns, resistance of bacteria and inadequacy of water.<sup>73</sup> In addition, climate change will drive and escalate conflicts which are already pressing other countries and regions. These might come in terms of climate change migration and civil war.<sup>74</sup>

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Nations Environment Programme, and World Bank. 2005. *World Resources 2005: The Wealth of the Poor—Managing Ecosystems to Fight Poverty*. Washington, DC: WRI, 1-266, page 12-15. See website [http://pdf.wri.org/wrr05\\_full\\_hires.pdf](http://pdf.wri.org/wrr05_full_hires.pdf). Accessed on 20 March 2017.

<sup>71</sup> World Bank, (2004). *Sustaining Forests: A development Strategy*. World Bank, Washington DC, 1-99, page 3. See website <http://siteresources.worldbank.org/INTFORESTS/Resources/SustainingForests.pdf>. Accessed on 17 April 2017.

<sup>72</sup> Scherr S J, White A and Kaimowitz D, 'A New Agenda for Forest Conservation and Poverty Reduction: Making Markets Work for Low-income Producers', *Forest Trend*, (Washington DC), (2004), 1-99, pages 6 and 33. See website [http://www.cifor.org/publications/pdf\\_files/Books/A%20New%20Agenda.pdf](http://www.cifor.org/publications/pdf_files/Books/A%20New%20Agenda.pdf). Accessed 1 April 2017.

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<sup>73</sup> Cloke K, 'Symposium: Energy and the environment: Preventing and resolving conflicts: Conflict, Climate change, and environmental catastrophe: How mediators can help save the planet', 12 (2011), *Cardozo Journal of Conflict Resolution*, 307-325, page 309.

<sup>74</sup> *Ibid*, page 310.

Climate change will also affect the future forest conditions by changing forest services and processes. Climate change will eventually affect and disturb forests directly or indirectly.<sup>75</sup> Nevertheless, several international instruments have been made to reduce carbon emissions from deforestation. The UNFCCC has been precise and clear that the international community should try and reduce emissions from deforestation and forest degradation; and the REDD has been promoted to try and address or tackle this challenge. Furthermore, at (Conference of Parties) COP-11 (2005) in Montreal, Canada, the UNFCCC started a process of investigating the technical issues around deforestation and reducing carbon emissions to mitigate climate change.

At COP-15 in Copenhagen, the issue of using incentives to reduce deforestation was discussed to stimulate actions to reduce deforestation in developing countries.<sup>76</sup> The Copenhagen Accord was agreed to by parties, and it recognized the effects of carbon emissions from deforestation and forest degradation.<sup>77</sup> It went further in stating that there was

a need to enhance, reduce and remove greenhouse gas (GHG) emissions by deforestation. In addition, it encourages the establishment of mechanisms (including REDD+) that seek to contribute and mobilize financial resources for developed countries which protect their forests and reduce emissions.

#### 4. The Bonn Challenge

The Bonn Challenge launched in 2011, a global endeavour geared toward the rehabilitation of 150 million hectares of deteriorated forest land by 2020 and an additional 200 million hectares by 2030. The Bonn Challenge was initiated by the German government with the support of the International Union for The Conservation of Nature<sup>78</sup> (IUCN) during an event held in Bonn, Germany. In 2014 the target was reviewed and extended during a UN Climate Summit through the New York Declaration<sup>79</sup> on Forests, requesting governments

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<https://www.c2es.org/international/negotiations/cop-15/summary>. Accessed 17 April 2017.

<sup>78</sup> See website <https://www.iucn.org/>. Accessed on January 19, 2021.

<sup>79</sup> New York Declaration on Forests Declaration and Action Agenda, UN Climate Summit, Catalyzing Action (2014), "The associated voluntary Action Agenda (section 2) serves as a guide to governments, companies, and organizations regarding the diverse set of actions that can achieve these transformational goals. It is not meant to be comprehensive. "This includes commodity traders calling for public policies to eliminate deforestation, a pledge by indigenous peoples to protect hundreds of millions of hectares of tropical forests, new commitments from forest country governments to reduce deforestation or to restore degraded lands, new bilateral and multilateral programs to pay countries for reduced deforestation over the next six years and new procurement policies for several of the largest forest commodity importer governments". See website on

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<sup>75</sup> Dale H V *et al*, 'The interplay between climate change, forests, and disturbances', 262 (2000), *The Science of the Total Environment*, 201-204, page 201.

<sup>76</sup> Targets and Actions under the Copenhagen Accord. See website <https://www.c2es.org/international/negotiations/cop-15/copenhagen-accord-targets>. Accessed 17 April 2017.

<sup>77</sup> Fifteenth Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change and Fifth Session of the Meeting of the Parties to the Kyoto Protocol, December 7-18, 2009 Copenhagen, Denmark. This summary was written by Elliot Diringer, Vice President for International Strategies, with contributions from International Fellows Kate Cecys and Namrata Patodia, and Daniel Bodansky of the University Of Georgia School Of Law. See website

and organizations to pledge their support for this renewed target. To date, 74 countries, organizations and regions have pledged their support in restoring over 210 million hectares of forests by 2020, which far exceeded the projected 150 million hectares of land, as it is a recognizable global goal of importance.<sup>80</sup>

The Bonn Challenge is not solely about forest regeneration. It is rather a tool of assistance with regard to the execution of important national objectives such as food and water security and achieving holistic rural development. This, in turn, also helps users positively contribute to biodiversity, climate change and land restoration, which benefits the citizenry and economy. In terms of the Forest Landscape Restoration (FLR) approach, the restoration of forest biomes in line with the 2020 goal will create approximately US\$84 billion in yearly benefits which provide income opportunities for persons living within those biomes i.e., the rural community.<sup>81</sup> This figure has trade-related benefits for the local communities through increased crop yields, better pastoral habits, and trade in sustainable

forest products. It is projected that achieving the 2030 goal would increase the figure to US\$170 billion annually as well as the environmental benefit of reducing up to 1.7 gigatonnes of carbon from the atmosphere annually.

The Bonn Challenge creates a centralized database for all initiatives relating to the restoration of degraded and deforested forests globally to ensure standardization in work done on forest landscape restoration. Therefore, although established first, Global Partnership on Forest Landscape Restoration (GPFLR)<sup>82</sup>, works directly with the Bonn Challenge by fostering global political support for restoration with its members. Furthermore, the GPFLR assists the Bonn Challenge with the provision of policy and technical support in the implementation of its commitments to pledge countries.<sup>83</sup> One such GPFLR member assisting on the ground is the IUCN's Forest Landscape Restoration Regional Hubs in Kigali, Yaoundé, Bangkok, San Jose, Quito, Suva, and Washington DC. In addition, the IUCN partnered with UNEP and FAO to create multi-country initiatives known as the High-level Forest Landscape Restoration Initiative, whose purpose is to provide models for collaboration and galvanize the implementation of policies. Such Bonn Challenge-inspired initiatives have encouraged the creation of more high-level "homegrown" country-specific processes through political will within

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[https://www.nydfglobalplatform.org/wp-content/uploads/2017/10/NYDF\\_Declaration.pdf](https://www.nydfglobalplatform.org/wp-content/uploads/2017/10/NYDF_Declaration.pdf). Accessed on 19 January 2021.

<sup>80</sup> The Bonn Challenge, See website on <https://www.iucn.org/theme/forests/our-work/forest-landscape-restoration/bonn-challenge>. Accessed 19 January 2021.

<sup>81</sup> Dave, R., Saint-Laurent, C., Moraes, M., Simonit, S., Raes, L., Karangwa, C. (2017) Bonn Challenge Barometer of Progress: Spotlight Report 2017. Gland, Switzerland: IUCN, 36pp, page 8. See website on <https://portals.iucn.org/library/sites/library/files/documents/2017-060.pdf>. Accessed 19 January 2021.

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<sup>82</sup> See website on <http://www.forestlandscaperestoration.org/>. Accessed on 13 January 2021.

<sup>83</sup> *Ibid.*

member countries and their regions such as (Africa) AFR100, (Europe, the Caucasus, and Central Asia) ECCA30 and (Latin America and the Caribbean) Initiative20x20.

Despite all these pledges and initiatives made to the Bonn Challenge for the restoration of forests, targets have been achieved or are on track. The forest fires of 2019 and 2020 have set back multiple accomplishments, especially in Spain, Australia, Brazil, and the USA.

With the work undertaken by the pledges and initiatives from member organizations, the IUCN notes that 71.11 million hectares were being restored by 2018. Commendably, the US surpassed its pledge through silviculture practices by restoring 17 million hectares of forest land as of June 2019. In addition, El Salvador reported the restoration of more than 120,000 hectares of forest land as of 2014 through a diverse range of interventions embracing a focus on key biodiverse areas, agroforestry, and protected lands.

A Bonn Challenge database website for sharing and reporting on the protocol was created. This was piloted by Brazil, El Salvador, the Mexican state of Quintana Roo, Rwanda and the United States of America who provided detailed reports on the protocol. These reports are fed into the Barometer of Restoration Success which tracks country specific implementation progress. These include the quantity

and quality of jobs created through land cultivation and forest restoration, enrichment and/or expansion of biodiverse regions through interventions, allocation, and use of funds for the planned programmes as well as the government enacted policies.

Tracking the success of the above-mentioned five countries through their submitted country reports on the Barometer of Restoration Success shows that they collectively brought 27.835 million out of 30.7 million hectares of forest land under restoration as of 2018 – thus merely ten percent shy of their collective pledge goal. Due to the forest restoration programme implemented, a total of 354,000 jobs were created and generated investment<sup>84</sup>. The greatest accomplishment of the forest restoration efforts is that about 1.379 billion tons of carbon were sequestered from the earth's atmosphere by these restored forests.

The Barometer's reporting protocol played a big part in the successes of these countries as it helped them better anticipate problems during planning phases, thus ultimately becoming better equipped to solve them. Radhika Dave, IUCN's senior programming officer, stated that "*the Barometer fills a key gap in reporting on progress against commitments and has brought countries to the table to openly share data and information on their efforts, flag implementation hurdles, and identify ways forward to achieve their*

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<sup>84</sup> Rasi A S, 'Examining Environmental Obligations in International Investment Law', (2021) (2) (4), *CIFILE Journal of International Law*, 44-51, page 49.

targets".<sup>85</sup> This was confirmed by the USA forest service which used the system, Shira Yoffe their senior policy advisor stated the following that "*the Barometer was a catalyst for us to take a more robust look at our restoration reporting, helping us identify strengths and weaknesses in our approach*".<sup>86</sup> In addition to the Barometer's usefulness for detailed reports, it has been seen through reporting that even the use of the more 'rapid application' yields positive results. Thirteen countries, including Cameroon, Guatemala, India, and Kenya, have used this rapid application, which resulted in the restoration of 43.7 million hectares of land, totalling 56 percent of their Bonn Challenge pledge commitments.

Due to the reporting success of these 19 users of the Barometer, there are 38 country/regional pledges that have voiced their interest in using the Barometer to track their success as well as assist in policy implementation. However, this does not negate the success of those not using the Barometer for tracking purposes. With a closer look at their biodiversity, climate change and desertification, and other international (such as the SDGs) reports, it can be gauged how much work they have done in line with their pledges. According to Radhika Dave, the

demand from the remaining pledges is not only overwhelming but also highlights the different ways in which the Barometer can be used more efficiently, particularly in the provision of technical support to its users. This includes in the form of online resources on how to use the Barometer, personal capacity-development exercises, and identifying other ways to provide real-time assistance for its users.

The Barometer has created better lines of communication on climate change and forestry policies between sectors, ministries and other stakeholders who would not normally communicate, as they realize they all have a common goal using the protocol. It is not only about assisting those who use the Barometer but also necessary to provide a demonstrable and realistic database of all the forest and landscape restoration processes globally and for learning or finding out about the different methods used during the process taken by the pledges. The Bonn Challenge is not a new global commitment but rather a practical means of realizing many existing international commitments, including the CBD Aichi Target 15, the UNFCCC REDD+ goal, and the Rio+20 land degradation neutrality goal. It is seen as an implementation vehicle for national priorities such as water and food security and rural development while contributing to the achievement of international climate change, biodiversity, and land degradation commitments.

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<sup>85</sup> See website on <https://www.iucn.org/news/forests/201907/report-captures-achievement-us-bonn-challenge-pledge-restoration-progress-19-countries>. Accessed 13 January 2021.

<sup>86</sup> See website on <https://www.iucn.org/news/forests/201907/report-captures-achievement-us-bonn-challenge-pledge-restoration-progress-19-countries>. Accessed 13 January 2021.

## 5. Recommendations

Deforestation has hugely detrimental effects on the environment and human life.<sup>87</sup> As detailed, it causes desertification, climate change and biodiversity loss. These effects affect all species, including human well-being. The loss of biodiversity, desertification and climate change have international implications, and global solutions are required in all dimensions of forest protection.<sup>88</sup> The world is concerned with the state of deforestation because it has brought detrimental effects to the environment. Thus, there is a need to protect natural forests by a binding instrument to reduce deforestation and its effects.

In addition, degraded forest lands should be identified, recognized, and restored. Natural regeneration should be reviewed and encouraged; thus, reforestation and afforestation programmes should be undertaken and well managed. Management plans, monitoring of conservation programmes and building of effective quantitative databases should be properly implemented for all protected areas. In short, forest protection will help reduce biodiversity loss, mitigate climate change, and reduce or prevent desertification.

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<sup>87</sup> Tayebi S and Mazinianian Z, 'Environmental Impact of Climate Change on National Security', (2020) (1) (2), *CIFILE Journal of International Law Journal*, 14-23, page 15-18.

<sup>88</sup> Pattberg P and Dellas E, 'Assessing the political feasibility of global options to reduce biodiversity loss', Volume 9, Number 4, (2013), *International Journal of Biodiversity Science, Ecosystem Services & Management*, 347-363, page 348.

However, the importance of forests and the effects of deforestation have gained international recognition. It is these positives and negatives that have been written and documented in international instruments. Thus, it is important to align how forests relate to these instruments and how it came about. These instruments usually relate to and recognize one function of forests as they are necessary for other environmental issues. Forests have become a means to deal with other environmental issues without these instruments providing forest protection.

It is important throughout to note the sectors that are causing deforestation and impeding forest protection as the efforts will need to be pluralistic. The international and national efforts must set out legal science initiatives to deal with the issue of forest protection. However, such efforts can be reduced by a state's economic goals. States have continued to cut down forests because of their development goals. Thus, to reduce deforestation, states will have to include environmental protection matters in their national development goals and plans.<sup>89</sup> There is a need to enhance the partnership between socio-ecological and economic goals. However, this is due to the issue that forests are valued less, and this can be reduced through education and raising awareness.

Forest valuation in developing countries is less, however, developed countries with huge financial

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<sup>89</sup> Sahar Zarei S and Madani M N, 'International Cooperation for Environmental Protection in the 21st Century', (2020) (1) (2), *CIFILE Journal of International Law Journal*, 1-7.

interests seem to be the ones at the forefront of degrading the environment in the global South. This linkage has been emphasized in that many of the international companies that are partaking in deforestation in the global South seem to be coming from the global North or with links thereof. There is a need for a global goal and effort to reduce deforestation. In the same vein, developing countries have poor implementation of laws, and this has been exposed by corporations who continue to abuse this weakness. Importantly, forest certification will play an important part in reducing trade and illegal logging in the global South. The global North needs to embrace this initiative to reduce these negative efforts being applied by corporations.

Furthermore, there is a need to build human rights synergies to recognize the rights of forest communities and indigenous people. There is a need to recognize their land tenure and land ownership rights to reduce deforestation. Historically, these groups have played a part in a supervisory mandate and sustainable forest management. Once they lose their land rights, governments in the global South give contracts to corporations that overexploit forests and illegally log forests. There is a need to recognize forest leaders in these communities since they play a part in advocating for forest protection. Their culture is also intrinsic to the environment; thus, it needs to be protected.

Moreover, forest governance<sup>90</sup> can play a huge part in increasing capacity in these forest communities and amongst indigenous people. The FAO states that good governance includes "*adherence to the rule of law; transparency and low levels of corruption; stakeholder participation in decision-making; adequate equal rights for stakeholders; accountability; a low regulatory burden; a coherent set of laws and regulations – both within the forest sector and in other sectors that influence forest management; the proper implementation of laws; political stability; and sound capacities to govern efficiently and effectively*".<sup>91</sup> There is also a need to

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<sup>90</sup> "Forest governance is defined as the way in which public and private actors, including formal and informal institutions, smallholder and indigenous organizations, small, medium-sized, and large enterprises, civil-society organizations, and other stakeholders negotiate, make, and enforce binding decisions about the management, use and conservation of forest resources. The concept of forest governance has evolved to engage multiple (public and private) actors at multiple scales, from local to global. It may include: rules about how forests should be governed, governmental regulations about who benefits from forest resources, and traditional and customary rights; the use of private-sector mechanisms such as voluntary certification to support SFM and legal timber supply; and international measures to support timber legality and promote good governance, such as the European Union's Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan and payment schemes for environmental services, such as REDD+".

See website on <http://www.fao.org/sustainable-forest-management/toolbox/modules/forest-governance/basic-knowledge/en/#:~:text=Forest%20governance%20is%20defined%20as,enforce%20binding%20decisions%20about%20the>.

Accessed on 27 December 2020. See also Poorhashemi A, 'International law and global governance', (2022) (3) (5), *CIFILE Journal of International Law Journal*, 70-74, page 73-4.

<sup>91</sup> See website on <http://www.fao.org/sustainable-forest-management/toolbox/modules/forest-governance/basic-knowledge/en/#:~:text=Forest%20governance%20is%20defined%20as,enforce%20binding%20decisions%20about%20the>.

Accessed on 27 December 2020. See also Poorhashemi A, 'Emergence of "International Environmental Law": As a new branch of International Public Law,' (2020) (1) (2), *CIFILE Journal of International Law Journal*, 33-39.

improve public awareness and participation in decision-making. These groups need to be heard, and their rights need to be respected. However, it can be said that there are several sectors that affect natural forests, and these must be brought in line with forest governance. There must be cooperation, coordination, and integration at all levels of governance.<sup>92</sup> The ministerial institutions must also be integrated to recognize forest protection. It is important to always advocate for sustainable agriculture as it is one of the sectors that substantially affects forest protection. The cooperation with human rights NGOs and other organizations to alleviate poverty can help achieve Sustainable Development Goals (SDGs), which are also important to forest protection as a cross-sectoral protection measure.

### Conclusion

Deforestation has a devastating impact globally, due in part to how important forests are for the efficient functioning and survival of the world. Deforestation results in the following ecological harms, namely landslides, desertification, increased rate of climate change, soil erosion, flooding, decreased water quality, increased greenhouse gasses, loss of biodiversity, and mass extinction. All these effects (most of which are the result of human activity under the guise of development) have a negative impact on the quality of human life broadly and specifically within the forest environment. Flooding, landslides,

soil erosion, and water quality go hand in hand and are often only seen during the final stages when desertification has occurred.

Deforestation impairs the quality of the soil because it results in a huge loss of organic materials that feed the soil, such as fauna and flora, both alive and dead. A loss of this biodiversity means the soil is not only exposed to the elements but is also not being nourished or given a chance to regenerate when it has been used too much. Soil is not a renewable resource, as some may assume; once damaged and eroded, there is no use in trying to "fix" the land or replenishing the soil as it will have lost all of its minerals and means to "feed" itself. The eroded soil has a ripple effect, and firstly the weak soil cannot absorb heavy rains, thus landslides in areas impacted by deforestation; the unabsorbed water also causes mass flooding in these new dessert regions, and this results in less arable land (affecting water and food security) all because of humanity's so-called hunt for better and productive land.

The loss of habitat for the many species that live in these forests are under constant threat of harm from the methods used in deforestation as well as exposure to elements to which they are not adapted to living in. Examples include rare amphibians and insects in forests as well as rare mammals under threat such as tigers in the Philippines and jaguars in the Amazon. These animals play a vital role in the forests which they inhabit by protecting the life of and helping

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<sup>92</sup> Sahar Zarei S and Madani M N, 'International Cooperation for Environmental Protection in the 21st Century', (2020) (1) (2), *CIFILE Journal of International Law Journal*, 1-7.

maintain a balance in the ecosystem. They rely equally on the plant and water in these areas, which deforestation has a negative impact on, without strong soil, water bodies are endangered and the species that live on them cannot sustain life and ultimately the quality of that water is negatively impacted.

It is truly an all-round devastating effect: the removal of just one tree to make space for monoculture crops impacts negatively on the diversity in the forest which leaves the soil exposed. This becomes a vicious cycle where ultimately, we end up with a warmer planet, because it has lost its lungs to feeding over consumption in "developed" countries. Thinking that "planting" new forests will help us is incorrect because the loss of ecosystems and biodiversity means that the plantation-like forests can never do nearly as much as what old forests have and were doing in protecting the environment and absorbing most of the greenhouse gasses to keep overall climate temperature low.

Many international instruments recognize the importance of forests and how forests as a broader field can help achieve a sustainable environment. The importance of biodiversity is recognized in the CBD, mitigation of desertification by the UNCCD, and how we can combat climate change is recognized by UNFCCC. Thus, the various importance of forests has cooperated into different international instruments. The effects of deforestation have also been recognized by several different international

instruments. To understand how international instruments, recognise and have encompassed forests in their goals, such clarification must be made.

There are several alternatives that must also be looked at to enhance the global forest protection goal. The recognition of forests as a common global and common concern of mankind will help unify the global South and North on forest protection. Importantly, the developed countries must recognize the negative roles they have played in increasing resource exploitation in the global South. They are also with the corporations with a huge financial muscle; thus, recognizing forest protection in their regions and countries will go a long way. Nationally, it is always important to recognize forest governance, although not the best of options, as it relies on political will. However, it is one of the most important legs that can help enhance forest protection now.

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