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Ensuring a sustainable future for forests: The case of Ukraine

Research shows that large parts of forests in the mid-latitude region, including in Ukraine, are under serious threat of being obliterated by the end of the century unless urgent adaptive action is taken.

- The mid-latitude region contains half of the world's population, and has been intensively exploited for agriculture.
- This region includes the mid-latitude ecotone (MLE)–a transition zone from forest to the more arid steppe lands, and as climate change progresses, forests will be pushed further and further back.
- Along with providing wood products and habitats for wildlife, these forests help to stabilize the land and prevent further soil degradation–a key factor for the region.
- In Ukraine, used here as a case study for countries in the region, research by IIASA and Ukrainian partners shows that rising temperatures and lack of water could obliterate a major part of the country's forests by the end of the century unless urgent adaptive action is taken.
- The development of a transition strategy to adaptive sustainable forest management for the country's forest sector is a task of national and international importance–particularly for the MLE.
- It is recommended that national and regional programs for forest protection, particularly against wildfire and pest outbreaks, should be launched.
- Forest managers should aim to create forests containing trees of different ages and a mix of species, as well as increase the amount of drought tolerant species. Seedbanks of indigenous tree and shrub species should also be created to conserve the existing gene pool.
- Landscape specific systems of shelterbelts and other forest stabilization elements should be developed to prevent soil erosion and degradation.
- A national forest inventory and integrated forest monitoring should be put in place.
- Policymakers should have the opportunity to exchange experiences with countries that also have large areas of forests growing in dry and semi-dry conditions.

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The mid-latitude ecotone

Around half of the world's population lives in the "mid-latitude region." Broadly defined, this region is represented by two horizontal belts–between 30°- 60° latitude of the Northern hemisphere and 15°- 45° latitude of the Southern hemisphere, that have four seasons and an average temperature of between 0 and 20°C. A major part of this region is an area of transition from forest to steppe–the mid-latitude ecotone (MLE)–where the trees give way to the drier lands of the steppes. Here, aridity restricts the growth and resilience of forests (Figure 1).

Figure 1: The mid-latitude ecotone. Source: "Mid-Latitude ecotone" Branch at www.geo-wiki.org

Climate change predictions suggest this region will suffer significant increases in temperature combined with a decrease in rainfall, leading to increased water stress for vegetation and a greater frequency and severity of droughts. The MLE has been exploited more intensively for agriculture than any other part of the globe and much of it is already short of water resources. The warmer and drier climate will affect the productivity of both forests and agriculture and provoke natural disturbances such as wildfire and pest outbreaks.

Ukraine as a case study

The vulnerability of forests in the MLE is of particular concern because much of the region is degraded as a result of intensive agriculture, and forests help stabilize the land, reducing soil erosion and preventing desertification. Ukraine is a typical country of the MLE, where agricultural intensification has been swift and acute. The country has the highest share of ploughed land in Europe—53.8% of its total area—and more than half of all agricultural land is threatened by wind and water erosion. Official statistics report dramatic increases in soil degradation, along with estimates that only 11% of the entire Ukrainian territory is in a favorable ecological condition, with 24% having already reached crisis point.

Reforestation and afforestation programs in the 1950s to 1990s increased forest cover in the country by around 40%, demonstrating the importance of forests to sustainable crop yields and ecological stability. However, since then, natural disturbances have been increasing: the area of wildfire has doubled in recent years and the land affected by pests and diseases, which was 4% in 2000, had doubled by 2011.

In a study conducted as part of the *ClimaEast* project, IIASA researchers, together with Ukrainian colleagues, examined the vulnerability of Ukrainian forests to climate change. They used four possible future narratives and associated greenhouse gas emissions pathways to base their predictions on:

- → The 'balanced' scenario envisages a world of very rapid economic growth where the global population peaks mid-century and declines thereafter. There is rapid introduction of new and more efficient technologies and a balance of fossil-intensive and non-fossil energy sources. (This is scenario A1B from the Intergovernmental Panel on Climate Change (IPCC)).
- → The 'warm-dry' scenario is the same as the balanced scenario, but uses the upper estimates of temperature change and lower estimates of precipitation.
- → The third scenario is a world focused on self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, resulting in a continuously increasing population. Economic development is primarily regionally orientated, and per capita economic growth and technological change are more fragmented and slower than other storylines. (This is scenario A2 from the IPCC).
- → The fourth scenario sees a world with rapid change towards a service and information economy, reductions in material intensity, and introduction of clean technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improving equity, but without additional climate change policies. (This is scenario B1 from the IPCC).

The impacts of climate change on Ukrainian forests were assessed for five periods (two previous–1961 to 1990 and 1991 to 2010, and three future periods–2011 to 2030, 2031 to 2050, and 2081 to 2100). Ten Atmosphere-Ocean Global Circulation Models deemed

most appropriate for Ukraine were selected, and supplemented with ten regional climatic models, which gave a more detailed prediction of local climate in different parts of Ukraine. The balanced scenario A1B is considered to be the most likely for future development. The warm-dry scenario was included, as these are the conditions that would render the forests in Ukraine particularly vulnerable.

Together, the models show that Ukraine will suffer significant increases in temperature and decreases in precipitation by the end of century, with southern areas of the country experiencing the most extreme changes. The drought and water stress will very likely obliterate a major part of Ukraine's forests by the end of the century unless urgent adaptive action is taken.

Under the balanced scenario, the area suitable for key forest species, such as oak and pine, will substantially decrease, covering only a small fraction of Ukraine by the end of the century (Figure 2). The warm-dry scenario projects an even more dramatic decline of the country's forests. Under this scenario, by the end of the 21st century the most favorable conditions for forest growth will remain in only 5.7% of Ukraine, and 57.3% of the country will have a dry or extremely dry climate, leading to extreme impoverishment and degradation of forests.

Even if the increase in aridity is noticeably lower than predicted by the balanced or warm-dry scenarios, the researchers noted, the impacts on the productivity, health, and resilience of forests will be substantial. The researchers assert that climate change launches a sophisticated mechanism of different intensive pathological processes in the country's forests, and the severity and injuriousness of this integrated intervention is markedly increasing.

Forest adaptation

These results indicate an urgent need for Ukraine to develop an adaptive sustainable forest management (ASFM) strategy. Sustainable forest management supports the entire spectrum of benefits that forests provide, including the supply of wood as only one of many ecosystem services. To succeed, such a strategy must be an inherent part of a nationwide transition to sustainable development involving political, social, scientific, institutional, and financial factors.

Transition to ASFM supposes substantial changes in all forestry operations including reforestation and afforestation, thinning, forest protection, and regulation of final felling, as well as a new understanding of the role of forests in the sustainability of agro-forestry landscapes. Existing forests should be conserved and special measures of protection put in place where they are threatened. In light of the expected increase of water stress, special attention should be paid to the selection and use of drought resistant species and provenances, as well as to the creation of seedbanks for the conservation of the gene pool of native trees and shrubs. The latter can also be used in future reforestation projects. To reduce strain on vulnerable forests, forest managers should carefully plan the timing of planting and logging in such a way as to minimize stress for newly planted trees and those remaining after the logging.

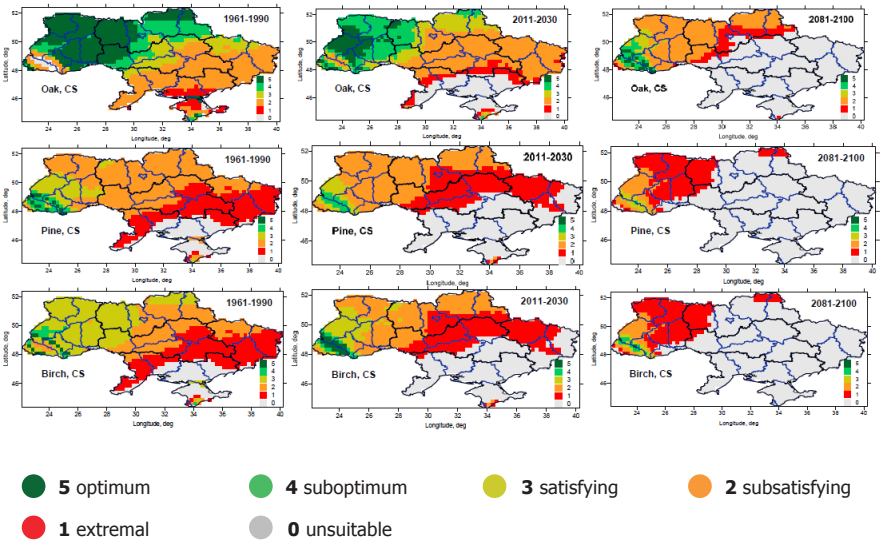

Figure 2: Showing how the suitability of growing conditions for major forest-forming species (oak, pine, and birch) by availability of water will change as climate change progresses (Scenario A1B).

Policymakers can also improve conditions for forests by putting measures in place to reduce natural and human-induced disturbances. National and regional programs of forest fire protection for example, could include raising awareness among the public and an early warning system of fire danger. Monitoring and early warning systems are also needed for assessing feedback of forests to environmental change and extreme climate events, the occurrence of invasive species, and pest outbreaks.

When considering how to build resilience in the forests themselves, policymakers and managers should aim to develop forests that are more diverse and thus better able to cope with climate change.

One important ecosystem service that forests offer is reducing wind-driven soil erosion, a factor that affects agricultural areas in particular. To make the most of this benefit, farmers and forestry managers can work together to create 'shelterbelts' and other stabilizing forest elements. Along with preventing soil degradation, this increases biodiversity, filters water, and contributes to overall ecosystem health.

An important step is to instigate a national forest inventory and system for integrated forest monitoring that could provide early warning information on undesirable changes in forest ecosystems. Taking into account the complexity of optimizing forest management activities in a changing world, the transition to ASFM requires the development of new scientifically based management tools and approaches, among which is the generation of new integrated models. Alongside this, policymakers should use established best practices for transition to sustainable forest management, exchanging experiences with countries that also have large areas of forests growing in dry and semi-dry conditions, such as Bulgaria, Greece, Israel, Romania, and Turkey.

Ultimately, the transition to sustainable forest management might minimize losses of major ecosystem services, or at least slow down the impoverishment of forest ecosystems over substantial areas of the country. However, substantial and urgent efforts are required.

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ClimaEast

ClimaEast is an EU-funded project assisting Eastern Neighborhood Partnership Countries and Russia with climate change mitigation and adaptation. As part of the project, IIASA together with Ukrainian colleagues have been providing scientific assessment and guidance to Ukraine on the future of its forests under climate change.

Under the project, IIASA researchers also identified opportunities for improving greenhouse gas emissions inventories in Ukraine's forest sector to enhance national reporting in accordance with the requirements of the UN Framework Convention on Climate Change and the Kyoto Protocol.

The team endeavored to aid the improvement of the existing information basis for greenhouse gas inventory in the forestry sector; evaluate the possibilities of using alternative information sources for improving the greenhouse gas inventory; and determine ways to improve the monitoring, verification and reporting framework for greenhouse gas record keeping in the forestry sector.

REFERENCES AND USEFUL RESOURCES

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