UDC 630*6

**Iuliia Shvediuk**
**Ukrainian National Forestry University[1], Lviv, Ukraine**
*[1; ORCID ID: 0000-0001-5337-6173]*

## IMPLEMENTATION OF THE CLIMATE-SMART FORESTRY APPROACH IN THE FORESTRY DECISION-MAKING

Climate-Smart Forestry (CSF) is a holistic approach to increase the climate benefits from forests and to create synergies with other needs related to forests. The CSF concept includes reducing greenhouse gas (GHG) emissions to mitigate climate change, adaptive forest management to enhance the resilience of forests and sustainable forest management (SFM) to provide forest's benefits (ecosystem services and biodiversity) [1]. It considers the whole forest and wood products chain, the carbon balance of the forest ecosystem, substitution effects of energy and material products (additional sink in forest ecosystems and avoided emissions through material substitution effects). More intensive use of forest resources leads to losses of carbon sinks in living biomass in the near future.

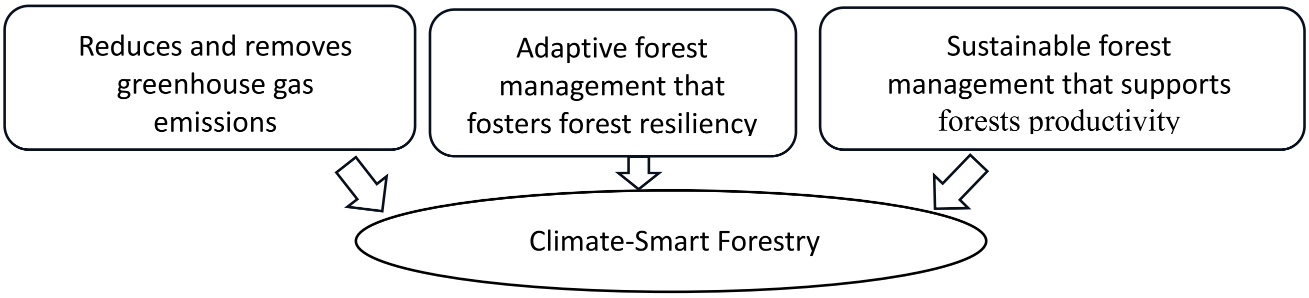


Fig. 1. Key elements of Climate-Smart Forestry approach

One important part of the CSF approach is the reduction and removal of GHG emissions. Greenhouse gases caused by humans have been the dominant influence on the climate system. In addition to the harmful effects on human systems, including human health, climate change cause negative impacts on natural systems - air, biological diversity, freshwater, oceans and land. Global climate change has already had many observable effects on the environment: glaciers have shrunk, the ice cover over the Arctic Ocean has decreased, the frost-free season (and growing season) in the north has lengthened, changes in precipitation patterns.

The European Green Deal is a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. It also aims to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts.

The next key element of the CSF approach is adaptive forest management. It is assumed to develop strategies and planning tools to maintain or improve forest resilience with respect to climate change and its extreme events, and possibly enhance the role as carbon sink. Adapting forest management to climate variability involves different components, e.g., socio-economic and cultural issues, silvicultural management, ecosystem services, wood harvesting, biodiversity conservation, carbon dioxide storage, etc., that work and interact at different levels. Long-term conservation of forest ecosystems and old-growth forests are needed for biodiversity conservation, assisted migration, high-level of carbon dioxide storage, climate impact mitigation and water depuration and supply.

Adaptive forest management includes several stages:

a) data collection, plan – determine management objectives, identify performance indicators, define key desired outcomes;

b) data management, do – develop management strategies and actions, establish monitoring programs for selected performance indicators, implement strategies and actions to achieve objectives;
c) insights and reflection, evaluate – evaluate management effectiveness, report findings and recommendations of evaluation;
d) adapt, iterate and implement, learn – periodically review overall management program.

Sustainable forest management (SFM) as an element of CSF approach is the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment [2]. SFM is the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems. The main criteria for SFM are:

a) conservation of biological diversity;
b) maintenance of productive capacity of forest ecosystems;
c) maintenance of forest ecosystem health and vitality;
d) conservation and maintenance of soil and water resources;
e) maintenance of forest contribution to global carbon cycles;
f) maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of societies;
g) legal, policy and institutional framework.

CSF as management practice advances conservation and restoration of forest ecosystems, removes and stores more atmospheric carbon than conventional practices, and increases resilience to climate change. The capacity of managed forests to absorb additional carbon is a key ecological value. CSF can increase the productivity and reduce susceptibility of forests to disturbances. Forestry is climate-smart when the level of carbon storage exceeds that which could be stored using baseline methods alone. CSF protects all forest values, including biodiversity, social and cultural values. Increasing the protected forest areas contributes to maintaining biodiversity and carbon stocks.

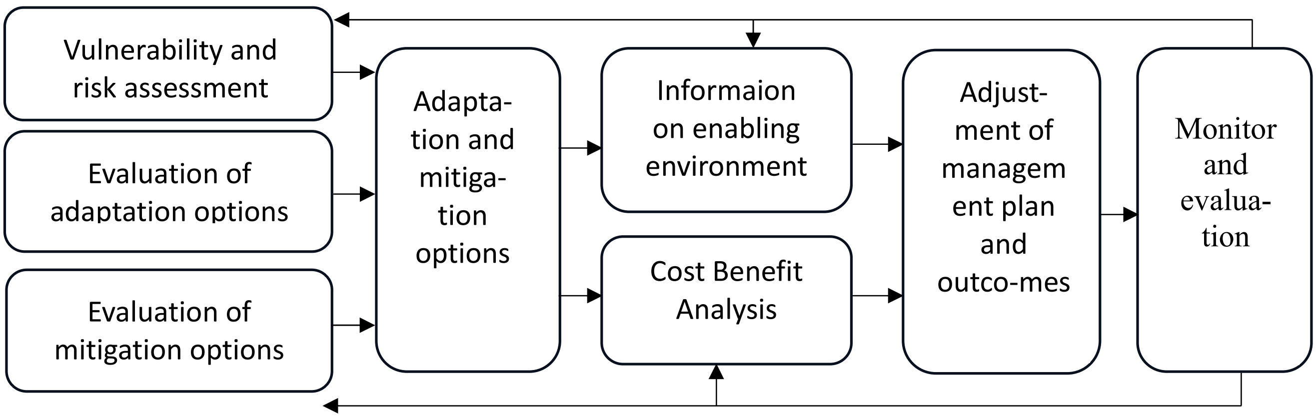


Fig. 2 Algorithm of implementation CSF approach in forestry decision-making

Biomass is usually a by-product of sawlog and pulpwood production, and mostly harvest residues (tops, branches, small-diameter trees) and wood processing residues (sawdust, bark, black liquor) are used for bioenergy. Biomass energy is carbon neutral if growing the biomass removes as much $CO_2$ as is emitted into the atmosphere from its combustion. Biomass energy is carbon neutral only if the net life-cycle emissions are zero.

CSF requires a mix of regionally relevant measures to achieve the full mitigation potential by forests [3]. These measures need to consider both forest ecosystems and wood use simultaneously. It includes management in accessible forests and protecting primary forests and other forests with high biodiversity values. For the Climate Smart Wood Group forestry is not climate smart if there are facts of illegal harvesting and trade, destruction of high conservation sites, including rare old growth and primary forests, conversion of natural forests to plantations or non-forest uses, forestry that violates human rights.

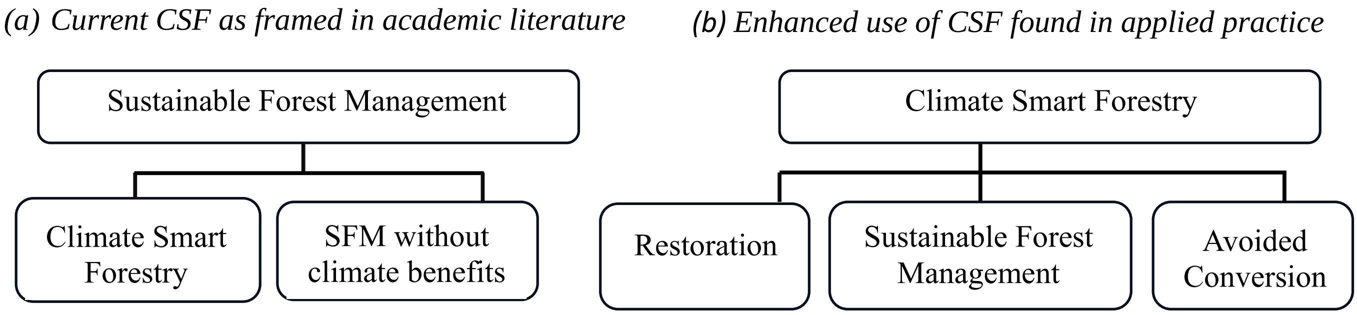


Fig. 3. Climate-Smart Forestry theory examples in literature *(a)* and applied practice *(b)*

Policy makers at various scales, from nation states to local governments, are advancing forest and climate policies with broad implications for society and the environment [4]. A possible forest-management toolkit for enhancing climate-change mitigation:

a) conserve high-carbon-stock densities in old forests;
b) harvest forests that are at high risk of disturbance and already have low productivity;
c) conserve high-carbon-stock forests on sensitive sites and steep slopes;
d) improve the management and protection of fire-prone forests to safeguard their carbon stocks;
e) switch to continuous-cover forest management;
f) optimize the silvicultural techniques (planting, tending and harvesting) in managed forests;
g) use forest residues, biomass from thinning, coppice forests, side streams of the forest industry (saw chips, bark, black-liquor, etc.) and post-consumer wood for bioenergy;
h) continue afforestation and restoration schemes in less-forested sites.

Nowadays climate mitigation is critically alongside the SDGs, such as responsible consumption and production, sustainable cities and communities, affordable and clean energy. Improving forest management and better adapting forests to the changing climate, increasing the resource efficiency of forest products, their circularity and new product innovations, as well as monitoring the environmental sustainability are important.

The CSF scenario illustrates what would be the optimal set of measures to address the three aims under CSF: mitigate, adapt and increase productivity. CSF can help increasing the total forest area and avoiding deforestation, connecting mitigation with adaption measures to enhance the resilience of global forest resources, and using wood for products that store carbon. Forests are a carbon sink, forest-based products can substitute for fossil based-products, and these products can store carbon for a long time. The optimal strategy of CSF needs to be tailored to the regional circumstances and characteristics. It may also need to be adjusted frequently over time as climate change proceeds.

SFM is the management of forests to achieve optimum yield and continuous flow of desired forest products and services, enhancing forest productivity and maintaining economic, social and environmental values of forests. The risks of large-scale disturbances caused by extreme weather events, such as droughts, storms, wildfires, floods and heat waves, must be taken into account when making management decisions to adapt to climate change. The effectiveness of the management measures needs to be assessed in their socio-economic context. Decision-making in forestry is a complex of solving technological, economic, social, cultural and value problems.

*References*


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