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IMPACTS OF TECHNOLOGICAL ADVANCEMENTS ON FORESTS AND FORESTRY

SECRETARIAT NOTE

Background

1. Technology and innovation are important features of sustainable forest management and the forest industry, offering important contributions to achieve the Agenda 2030, in particular, SDG 9 (Industry, Innovation and Infrastructure) and SDG 12 (Responsible Consumption and Production).

2. Advancements in science and technology are revolutionizing forest management, as well as forest products processing and production systems; delivering material efficiency, improving productivity, creating new products and monitoring forest areas – including forest health – in real time. Innovations impacting forestry can be categorized into two types: (i) those developed outside the forest sector, for example, information and communications technologies (ICTs) as well as geospatial technologies; and (ii) those developed within forestry, for example, production of new-generation wood-based materials such as engineered wood products, bioplastics, natural chemicals, bioenergy products, and pharmaceuticals.

Impacts of information and communications technologies on forestry

3. For the past several decades, ICTs have significantly impacted on forests and forestry. ICTs have improved forest management, enhanced productivity and reduced production costs in forestry. ICTs have mainly been applied in mapping and monitoring of forest resources, and in communicating and raising awareness of key forestry issues contributing to sustainable forest management. However, their use for a wide range of other purposes is impacting on many other aspects of forestry. ICT-enabled timber tracking technologies (for example, radio frequency identification labels and chips) and platforms are being deployed to better track timber supplies and prevent illegally sourced timber from entering supply chains. ICT-enabled digital media and e-commerce are changing demand for paper and paperboard. For instance, as people increasingly access news from electronic media, global demand for newsprint has declined from 31 million tonnes in 2012 to 24 million tonnes in 2016. ICT-enabled mobile services, financial services and e-commerce are facilitating the ease of access to information on

weather, pest recognition, transport and shipping logistics, price and market data, service innovations such as payment transfers, financial products (such as insurance, credit payments etc.) and streamlining business to business value chain communications and interactions.

4. ICTs are key enablers for biotechnology, nanotechnology, and emerging technologies such as artificial intelligence, machine learning, drones or unmanned aerial vehicles (UAV), IOT (internet of things) sensors, and block chain. These technologies could potentially transform forest management in the future. Some are already being adopted and deployed in forestry, primarily in developed economies, though also in rapidly industrializing developing countries. As ICTs evolve and develop over time, their impacts on forestry are likely to accelerate and transform the sector. However, the scope and directions of these future impacts on forestry are unpredictable, especially changes at the cutting edge of forestry. The rate of uptake of new technologies, particularly in developing and least developed countries in Asia and the Pacific, will also be a significant factor in the overall development of forestry in the region.

5. Among potentially the greatest beneficiaries from ICT developments in forestry are small, medium and micro enterprises (SMEs) and local communities. SDG target 9.3 aims at the integration of small scale enterprises into value chains and E-commerce potentially holds a key for linking SMEs to global niche markets; thereby increasing revenues and profitability. ICT developments that enable global communications, transactions and financial management to be carried out on a single portable device are offering tremendous prospects for small and isolated rural enterprises and communities to connect with the commercial world. In a separate development, greater use of the internet and mobile devices is empowering local communities to monitor forests and report forest crimes. ICTs also offer significant potential for management and information sharing among private sector and smallholder networks and for provision of rural advisory services.

Geospatial technologies in forestry

6. A distinct class of information technologies are geospatial technologies (remote sensing, global positioning systems and geographic information systems), which continue to play a significant role in forest and landscape management, enabling collation of detailed forest inventory data, monitoring of forest health, wildlife and natural disturbances and assessment of forest structures in support of sustainable forest management. Recent advances in cloud-based geospatial technologies, such as FAO's Open Foris and SEPAL (System for Earth Observation Data Access, Processing and Analysis for Land Monitoring) systems, have led to an increase in open scientific data for use beyond academia, by policymakers and field practitioners.

7. Leveraging these geospatial technologies, countries are developing robust national forest monitoring systems (NFMS) including for REDD+ programmes as agreed at the UNFCCC COP16 in 2010. NFMS have two components: satellite land-monitoring systems (SLMS) and national forest inventories (NFIs). NFIs further entail development of allometric equations and emission factors and incorporate other smaller scale forest inventories that e.g. enable countries to better estimate biomass and carbon stocks of their forests. Efforts to establish such robust and comprehensive systems are, however, still often confronted with several limitations especially for less developed countries. Major challenges include lack of capacities for data analysis and use of information for monitoring, reporting and evaluation, as well as for land use and management planning and decision making. There is also limited exchange of knowledge between countries with similar forest conditions, limited access to innovative technologies for forest monitoring and assessment, and allocation of insufficient budget for comprehensive forest resources assessment.

8. FAO is supporting countries in the development of their NFMS and land-use monitoring systems. As part of this effort, FAO has organized or collaborated in regional exchange workshops and partnerships on forest and land use monitoring and assessment and led major initiatives to develop, share and support software tools that facilitate flexible and efficient data collection, analysis and reporting. Open Foris is one such initiative that was developed to address user needs for accurate and timely information on forests. Open Foris encompasses a suite of free, open source tools such as Collect, Collect Earth, Collect Mobile, Collect Earth Online (CEO), as well as SEPAL, available for use for various monitoring purposes. CEO and SEPAL have been developed using advanced earth observation technologies, cloud computing and machine learning. CEO is a collaborative initiative

between FAO, the National Aeronautics and Space Administration (NASA), the United States Forest Service and Google.

Innovation in the forest sector

9. Major drivers of innovation in wood-processing technologies and wood-based materials include: reduced demand of paper products due to electronic media, consumer demand for low-cost end products; intense market competition from non-wood-based materials; a forest resource base that is rapidly moving towards fast-grown, small-diameter trees; and ongoing discourses on climate change and low-carbon circular economies. Until recently, the inherent structural properties of wood – strength, durability and workability – were crucial for determining end use and value. Increasingly, however, the chemical characteristics of wood have become paramount, paving the way for the development of a wide range of new products, processes and value chains. Technology is helping the forest products industry produce more with less: less waste, less pollution, less impact on the environment and less raw material input. In recent times, the forest sector has developed a broad range of engineered wood and fibre products – including various laminated and composite products – and chemical derivatives. Processing technologies have improved with less energy use and faster through-put; for example, black liquor processing in pulp and paper for biofuel production. The region is advancing in material efficiency, including minimization of wood waste and increasing attention to recycling.

10. Increasing evidence of climate change urging development of low carbon economies with minimal greenhouse-gas emissions are stimulating interest in tall mass timber buildings not only across Europe and North America but also in the Asia-Pacific region. Innovations are creating new opportunities for using wood in large-scale construction. In New Zealand for example, new engineered wood products and new building systems, such as post tensioning, are providing new opportunities for disaster resistant timber construction. China and Singapore are also among countries pursuing the use of tall mass timber in construction as part of shifts towards low carbon economies and climate change mitigation efforts. Development of industrial capacities in products such as glue laminated timber and cross laminated timber have been critical in positioning wood products as a feasible alternative to concrete and steel.

11. New and more efficient wood energy conversion technologies are producing more energy using less wood. Wood pellets are an example of a new wood energy product developed from improved wood energy conversion technologies. Wood pellets have emerged as an important form of woodfuel globally and a potential low-carbon substitute for coal in thermal power-generation plants. A number of countries in Asia and the Pacific are utilizing wood pellets in electricity generation, or are in the process of developing biomass energy plants including several Pacific island countries, notably Papua New Guinea and Fiji. However, the extent to which wood pellets may be regarded as a “clean” energy source remains a source of debate. Some studies suggest, for example, that wood pellets may not be carbon neutral given the energy consumed in densification and transport. Nevertheless, wood pellets are likely to generate much lower carbon emissions than fossil fuels per unit energy generated if produced from sustainably managed forests.

12. With a decrease in many types of paper consumption, a focus for innovation has been on diversifying the use of cellulose; with key developments including in the fields of bioplastics, biofuels, and textiles. Such developments will help contribute to building a bio-based economy whereby global demands for food, fuel and fibre are increasingly met from biological sources. In this regard, biorefineries are anticipated to be a key pathway towards a global bioeconomy, displacing fossil fuels and supplying clean, renewable, and carbon neutral energy.

Risks and challenges to uptake of new technologies

13. Technological advances will continue to provide opportunities and offer novel solutions to challenges in the Asia-Pacific region's forest sector. However, the benefits and trade-offs arising from potential transformations (brought about by technological advances) in forestry, especially for the developing and least developed economies in the region, are yet to be fully analyzed. There is significant potential for new technologies to rapidly change labour markets, creating jobs in some areas and unemployment in others. For example, in many developed economies, especially, job losses in forestry 'mill towns' have eroded whole communities, often because forest resources have been depleted, but also where automation has substituted for human labour.

14. The continuing rise of social media may similarly pose opportunities and challenges for sectors such as forestry. As social media has become a primary news source for literally billions of people, new ways of communicating on forestry aspects are available. This allows sharing of evidence-based information, to help shape and change public opinion, including the social acceptance of forestry management practices.

Technology training for youth and gender-sensitive capacity development

15. Young people are usually among the first in line to embrace new technologies. They are also often the most affected by risks such as instability in labour markets, which may detrimentally affect the rate of technology uptake in forestry. In a youth survey conducted as part of the Asia Pacific Forest Sector Outlook Study III, youth (262 respondents from 32 countries from forestry and non-forestry) respondents expressed the need for opportunities to learn new technology relevant skills such as remote sensing, artificial intelligence and machine learning. Respondents strongly agreed that the slow pace of uptake of technologies in forestry in the region is a significant constraint to forestry development.

16. By providing opportunities to youth and women to learn and develop relevant technology skills, forestry could indirectly contribute to SDG target 4.4 that aims to increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship and SDG target 5B, which aims to enhance the use of enabling technology in particular ICT to promote empowerment of women. Progress in gender-sensitive capacity development requires *inter alia* development of specific environments to share and learn including provision of gender-sensitive thematic content, as well as developing new networks and partnerships.

Points for consideration

17. There have been major technological advancements in forestry during the past 30 years. However, access to and uptake of new technologies has been uneven, with some countries that could substantially benefit from application of advanced technologies constrained by lack of resources and capacities. In this regard, the Commission may wish to:

- consider how member countries and FAO can work together to raise awareness and share knowledge of and experiences with innovations that will contribute to shaping the future of forests and forestry, and recommend concrete actions in this regard;
- discuss how FAO might support countries to assess and improve policies and enabling environments to promote innovation in forestry, including access to advanced technologies, skills and knowledge;
- discuss how to support small, medium and micro enterprises and local communities to access new tools and technologies, with a view to helping them link with value chains and more broadly progress towards sustainable forest management.