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INNOVATIONS TO PROMOTE THE USE OF WOOD-BASED PRODUCTS FROM SUSTAINABLY MANAGED FORESTS

I. Introduction

1. In the past three *State of the World's Forests* reports (SOFO 2010, 2012, 2014) FAO has raised the importance of innovation in forestry and wood products industry for improving the contributions to sustainable development and greening the economies. The level of interest, readiness and approach of countries on innovations towards a greener economy varies. It depends largely on their natural resource endowment, challenges in national economy, and degree of human development. Additional political motivation may come from the governments' international commitments such as those on mitigating climate change, and on other internationally agreed development goals.

2. This paper discusses innovations mainly around two growing sub-segments of the forest sector, namely bioenergy and green building. A third area, which has been more pronounced recently, is forest sector's contributions to food security (cf. a special COFO item). These are the gravity points for forest products in leveraging solutions for bioeconomy and promoting products from sustainably managed forests.

II. Forest-based bioeconomy

3. Innovations in the forest sector are appealing to policymakers for paving the way to green economy, or on more contemporary terms, bioeconomy. Bioeconomy distinguishes production and consumption of products whose raw materials originate from natural biological processes, such as growing wood biomass for an expanding range of products.

4. Most advanced countries are aiming for an industrial bioeconomy, guided by international agendas on mitigating climate change, and safeguarding the environment and natural resources for future generations. The cutting edge innovators are harnessing e.g. information technology and industrial biotechnology to drive natural resource efficiency to a higher level. In the largest industrial pilot investments (liquid biofuels, biorefineries), public sector financial support and grants are regularly provided.

5. Many developing countries share - unnoticed perhaps - basic characteristics of a bioeconomy, but they struggle to generate tangible benefits for their people. High volumes of fuelwood are used in households, and for agro-processing industries like curing tea and tobacco. The big opportunity for developing countries is to leap-frog over carbon intensive industrial growth phase (thereby avoiding

most of its negative effects) straight into low-carbon bioeconomy which is more knowledge and services oriented. The forest sector could play a strategic role in shifting this development trajectory, and can offer an innovation platform for new livelihoods, entrepreneurship and value chain development.

III. Main drivers of innovations in the forest sector

A. Biofuels

6. International agreements and binding targets on greenhouse gas emission caps, renewable (bio) energy use, and energy efficiency targets have helped in bringing advanced wood energy systems on stream, such as combined heat and power generation (CHP). Such agreements, with associated policies and their implementation mechanisms have created an opportunity to develop new supply chains in harvesting, processing and transporting wood residues from logging sites and forest industries to CHP and household users. They have helped establishing a viable processing industry on energy wood chips, briquettes and pellets. Processed solid wood energy products offer high energy content against weight, what makes them a preferred energy carrier for large-scale local and intercontinental trade.

7. Liquid biofuels benefit from recent policy incentives and agreements, too. The basic chemistry innovations underpinning liquid biofuels and green chemicals date back to the pre-petroleum era, but technologies and economics of second-generation transport biofuels have been much improved in the past decade. Coming into force in 2015, the EU low-sulphur shipping fuel directive (in the Northern European seabed) is a lever to promote the nascent liquid biofuel projects from wood biomass and industrial residues in Europe and in the Russian Federation. Gradual expansion of the EU Emission Trading System (ETS) to cover larger part of the aviation industry in 2017 will further increase the demand for jet biofuel.

8. Unpredictable changes in the operating conditions and conflicting single-issue guidance can, however, lead to a sub-optimal outcomes. For example, some Western and Northern European CHP installations have switched from firing forest biomass to burn coal. This is purely an economic response to a complex tie of climate change targets, energy and forest policies, and financial instruments for curbing non-renewable fuels and promoting bio-based energy. The combined effect of various guidance mechanisms, in the current energy market and carbon trade situation, has turned the cost of forest biomass unfavorable against cheaper fossil fuels in some energy installations.

B. Green building

9. Although a shift to low-carbon economy has been accepted in many countries by a political consensus, promoting local wood products for green building is not always seen as an imminent or equitable solution. National green building programmes, which are usually based on a performance-based criteria and accreditation system, are often not promoting wood over other materials. In some forest-rich countries the calculated climate change benefits of wood are made more concretely known to architects, builders, and house buyers. Main arguments are built around wood's carbon sequestration during the growth of trees, lower embodied energy during manufacturing, and higher carbon storage into long-life wood structures. Wooden houses (and similarly also those made of bamboo) are manufactured more efficiently from pre-fabricated components, and marketed with positive health and energy efficiency messages. Green building with wood is often backed by joint public and private promotion campaigns, which use innovative techniques and channels to reach targeted groups of decision-makers and consumers.

C. Value chains and competitiveness

10. Underpinning both bioenergy and green building industries are small and medium-sized enterprises (SMEs), which are feeding forest raw materials and semi-finished wood products into the value chains. Under enabling market and policy conditions companies seek to obtain higher returns by moving up in the value chain or producing goods and services more efficiently (in bulk). They try to

meet the buyers' demands with higher revenue per unit of output, and for lesser input costs. In competition for raw material and customers, wood product industries can move to use alternative tree species, improve logistics and production processes, and engineer better marketable products. In that context innovation is driven by a continuous process to build enterprise level competitiveness.

D. Future importance of innovations in the product value chains

11. Five main types of innovations occur in forestry and forest industries. Advances in satellite and other remote sensing methods are significantly improving the real-time knowledge of the resource base and land-use changes and natural disasters. Some product and process innovations are quite revolutionary, such as using wood-based materials in the manufacture of electronics, pharmaceuticals, vehicle components, etc. These are not significant in volumes but are considered high-value niches for the future. Most innovation volume-wise is done on incremental improvements, i.e. to cut costs, revive the competitiveness of existing products, and to prolong their life span in the markets (cf. Table1).

1) Resource innovation

- Examples: mobilizing wood from less active forest owners, or of lesser-used tree species, enhanced forest productivity with more intensive management methods, trees improved by biotechnology (molecular marker assisted selection for productivity, CC resistance, etc.), micropropagation, genetic modification of forest trees, advanced remote sensing methods, cloud computed and open source tools for entire forest inventory process.

2) Product innovation: new or significantly improved product or service

- Examples: pellets, wood composites, engineered wood products (EWP), nanocellulose, biodegradable food packaging, arabinogalactan from larch, soil remediation and bio-fertilizers from biomass, bio-plastics.

3) Process innovation: new or significantly improved production process or delivery method

- Examples: timber-tracking and legality assurance systems, visual detection and remote process controls, modernised biorefinery, combined heat and power, wood waste fermentation or pyrolysis to liquid biofuels, rearing insects on wood waste to produce protein for animal feed.

4) Marketing innovation: new marketing methods supported by product design, packaging, product placement, promotion and pricing

- Examples: Do-It-Yourself (DIY) product families, eco-labels and carbon and water footprints, biobased packaging for easy recycling and disposal, use of Internet and social media for marketing, e-commerce.

5) Organisational innovation: new organisational structure, improved business practice, operations planning, or upgrading the skills of workforce

- Examples: advanced use of Information and Communication Technologies (ICT), outsourcing of semi-finished products, supply chain efficiency enhancement, virtual aids in factory and warehouse operations, crowd-sourcing of product design.

12. Innovations in large forest companies are often guided by focused applied research, benchmarking, proprietary inventions, or buy licenses to manufacture new products innovated elsewhere. Protecting IPR (intellectual property rights) is not a particular strength of the SMEs, which are the backbone of wood industry in many countries. Often wood SMEs innovate under the pressure to compete with larger firms, and usually manage to capitalize on new innovations up to three years in production before the large firms take over. There are both formal and informal innovation approaches, and most successful ones are based on proper value chain assessment and a genuine market pull. Enterprise incubators and clusters may be useful in concentrating innovation capacity in a competitive environment.

Table 1 Selected innovations to promote the use of wood-based products from sustainably managed forests

| Challenge | New product/process | Type of innovation | Technology | Low-carbon economy plus |
|---|---|--|--|--|
| Waste in logging Renewable energy targets | Forest residue bale harvesting Stump harvesting | Full-tree / biomass harvesting business model | Adjusted harvesters Adjusted soil preparation | Increase wood biomass flows to energy use Substitute fossil fuels |
| Bulky and localized fuelwood use | Torrefied chips Pellets Briquettes | New product, transport concept of wood fuel Increase calorific content per volume | Torrefaction Pellet and briquette extrusion | More wood biomass for carbon-neutral energy Substitute fossil fuel Lower emissions |
| Slow, low-quality, wasteful building with wood on-site | Cut-to-size stock Building systems Pre-fabricated houses EWP and CLT | Business model change Just-in-time delivery Sub-contracting | Modular CAD design, pre-fab component building / mounting | Substitute non-renewable building materials Lower waste & rejects Carbon storage in buildings |
| Low profitability of old pulp mills Decarbonize transport sector | Biorefining valuable chemicals & 2nd generation liquid biofuels | Process rebuild Improved refining Business model change | Recovery boiler replacement Biomass fractionation, refining, hydrolysis, cracking, polymerization | Green chemical industry Substitute petrochemicals Lower fossil transport fuels Lower emissions |

E. Creating framework conditions for innovations in the wood-based products sector

13. The producers of wood and wood-based products face many practical challenges which affect their operations and call for innovations. Competition for land and natural resources is bound to intensify due to population growth. Consumer preferences change, alternative materials develop, and ownership of forests is in a transition towards closer local control.

14. Encouraging innovation is a stated policy objective in many countries because innovations create much of the economic growth, instead of simply increasing inputs for production. Policy, legal and institutional reforms are needed to create an enabling environment that supports awareness, learning, research and development, and entrepreneurship. For example, it has been amply demonstrated that unclear forest tenure discourages long-term investments, making sustainable forest management very difficult. Among the most important factors for an enabling environment for innovation are:

- good science and knowledge bases, networking, and research & development institutions;
- flexible regulatory frameworks, organizational adaptation, and consultative policy processes;

- functional infrastructure (transport, ICT, energy);
- ease of doing business and accessing markets and finance;
- adherence to product standards and Intellectual Property Rights (IPR);
- educated and skilled workforce with entrepreneurship and culture for innovation.

15. The forest products industry undergoes transformations through innovative processes managed by people, and for the people (consumers). Cultural, regulatory and practical reasons may impede wood products becoming more popular. Increased networking and communication through multiple channels of new media is a powerful tool to change some of the impeding perceptions.

F. Points for discussion

16. The Committee may wish to encourage **countries** to strengthen their efforts in:
- recognizing the potential contributions of forest products and bioenergy from sustainably managed forests in the post-2015 Sustainable Development Goals (SDGs);
 - creating an enabling environment for fostering higher innovation, productivity and efficiency in implementing sustainable forest management and inclusive forest product value chains;
 - engaging stakeholders in various discussion fora to instigate effective public-private partnerships for transferring knowledge, best practices and environmentally sound technologies, and for improving the performance of wood-based products to facilitate transition towards a bioeconomy;
 - promoting positive perceptions in the society towards developing and using a wider range of innovative forest-based products as contributors to bioeconomy.
17. The Committee may wish to recommend that **FAO** supports countries particularly in:
- establishing inclusive value chains of innovative and competitive wood and bamboo based products which bring benefits to local communities;
 - promoting sustainable production and consumption of wood-based products in bioenergy and green building, through life cycle assessment (LCA) and similar studies;
 - strengthening forest-based industries, producer associations, and community-based forest organizations, in order to raise the productivity and efficiency of the entire forest sector, and thereby promoting innovations and cross-sectoral planning (agriculture, energy and food security);
 - promoting sub-regional, inter-organizational and public-private cooperation, for capturing better comparative advantages in producing innovative forest products and bioenergy.