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XIV WORLD FORESTRY CONGRESS

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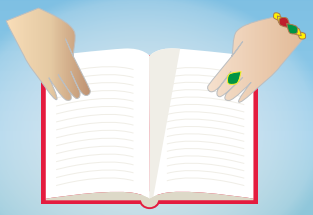

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Cover: Tree-preneur Nikiwe Gcabashe inspects a seedling of *Trichilia dregeana* in a nursery before outplanting as part of the Buffelsdraai Landfill Site Community Reforestation Project, Durban, South Africa
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Contents

EDITORIAL

The content of this edition of *Unasylva* is drawn from the XIV World Forestry Congress, which was convened in September 2015, just before the momentous adoption of the Sustainable Development Goals by the United Nations and the striking of the Paris Agreement on climate change.

The World Forestry Congress is the main global forum for all those concerned with forests and forestry. It takes place every six years, and it offers an opportunity for forest stakeholders globally to exchange views, share experiences and discuss the past, present and future of forests and their conservation and sustainable use. The XIV World Forestry Congress, held for the first time in Africa, covered a great deal of ground, showing both the complexity of forest issues and the enormous potential of forests to contribute to the Sustainable Development Goals and the mitigation of climate change.

Opening the edition, Vähänen and Buszko-Briggs give a general overview of the Congress. They provide basic data on the Congress and canvass its main outcomes; the latter include a statement on the strong connections between the Sustainable Development Goals and forests, a message to the climate-change conference in Paris, a "vision" for forests and forestry to 2050 and beyond, and a list of priority actions that should be taken to achieve the vision.

El-Lakany describes the High-level Dialogue held during the Congress, which featured 14 ministers and several other senior officials representing governments and other international entities. The key point to emerge from the Dialogue was that much more investment is required if forests are to realize their full potential to contribute to sustainable development and the management of climate change.

Tijani reports on the Congress's Africa Day, in which the African Union Commission and partners debated the role of sustainable forest management in addressing climate change and, among other things, called for more investment in African forests.

Brief articles at the back of this edition summarize other special events held during the Congress – the International Forests and Water Dialogue and forums on wood energy, youth, and wildlife.

Other articles are based on papers presented at the Congress. In covering broad territory, they show the immense innovation that is already occurring in forestry, especially in approaches that encourage the involvement of local communities in forest management and the equitable sharing of benefits, but also in product innovation.

Douwes, Rouget, Diederichs, O'Donoghue, Roy and Roberts describe a reforestation project in Durban, South Africa, that is being implemented by a local government in partnership with communities and organizations. Originally established as an initiative to offset greenhouse gas emissions associated with the hosting of the football world cup in 2010, the project is providing important co-benefits, including climate-change adaptation, poverty alleviation and ecosystem restoration. Ingram, Haverhals, Petersen, Elias and Basnett report on the nature of gender differences in forest, tree and agroforestry value chains, as revealed by a comprehensive literature review. Doulton, Mohamed, Shepherd, Mohamed, Ali and Maddison describe a project to improve the sustainability of natural resource management in Comoros, an archipelago off the east coast of Africa. One of the keys to success, they say, is to ensure that interventions generate immediate local benefits while building an evidence base for longer-term conservation. The article by Fava, Arbeletche, Barbosa, Habib, Wlasiuk, Moro, Polotto and Résico reports that the gums of four Argentinian tree species could be used commercially as food additives; the harvesting of such gums, say the authors, would generate reliable employment in local communities and thereby help reduce deforestation pressure.

Kane, Gritten, Sapkota, Linh Thi Bui and Dhiaulhaq report on a study in six communities in Southeast Asia, the main finding of which is that mediation can play a crucial role in transforming forest conflicts, largely by building trust between conflicting parties. The authors recommend mainstream mediation as a way of better addressing forest landscape conflicts. In their review of multinational analyses of REDD+ projects, Fischer, Hargita and Günter express surprise that many key issues are largely unaddressed in the literature – especially reference levels, leakage and permanence. Silva introduces the concept of "new generation plantations", in which planted-forest projects adopt local economic development as a central theme, aim to maintain ecosystem integrity and protect high-conservation-value areas, and are profitable. Finally, Kain, Barbu and Petutschnigg present the results of experiments investigating the use of bark – a high-volume by-product of industrial wood production – as insulation in buildings, and conclude that it has considerable potential.

In their overview article, Vähänen and Buszko-Briggs conclude that, by bringing together forest stakeholders worldwide, strengthening commitment, creating a common vision, and setting out priority actions, the XIV World Forestry Congress provided the forest sector with an opportunity. "If we take advantage of this opportunity by working collaboratively and investing in forest communities and forest knowledge," they say, "forests will make a strong comeback." This would be welcome news to all those striving to achieve the Sustainable Development Goals and limit climate change. ◆

The outcomes of the XIV World Forestry Congress

T. Vähänen and M. Buszko-Briggs

The Congress helped generate momentum for the crucial role of forests in addressing global challenges.

Tiina Vähänen is Deputy Director, Forest Policy and Resources Division, FAO, and Associate Secretary-General of the XIV World Forestry Congress.
Malgorzata Buszko-Briggs is Programme Officer at the UN-REDD Programme, and she was team coordinator for the XIV World Forestry Congress.

The XIV World Forestry Congress was convened in September 2015, in the weeks and months before two historically significant events: a meeting of the United Nations General Assembly to adopt the Sustainable Development Goals (SDGs), and the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC), the aim of which was to set a course by which the world hopes to avert the most severe impacts of climate change. The leadership of the XIV World Forestry Congress was clear in its ambition to provide meaningful inputs to those two looming events.

The World Forestry Congress is the main global forum for all those concerned with forests and forestry. Governmental officials, scientists and professionals in forestry and other sectors, forest owners, companies, students, forest indigenous peoples, family foresters and local communities, among others, meet to exchange views, share experiences, discuss all aspects of forestry, and ultimately make recommendations and calls for action that are applicable regionally or globally.

Above: Participants in the XIV World Forestry Congress, Durban

The World Forestry Congress also has the wider purpose of providing the forest sector with a periodic opportunity (generally every six years) to take stock of the state of forests and forestry, discern trends, adapt policies and create awareness among decision-makers, the public and all stakeholders. It is not an intergovernmental meeting and has no formal constituencies or country delegations.

FAO's involvement in World Forestry Congresses dates to 1945, when the Organization took over the functions of the International Institute of Agriculture, which had organized World Forestry Congresses in Rome in 1926 and Budapest in 1936. Since then, FAO has selected the host country for, and has co-sponsored and assisted in the organization of, 12 more World Forestry Congresses. The most recent of these, the XIV World Forestry Congress, which was hosted by the Government of South Africa and held in Durban in September 2015, helped propel forests to centre stage in major global processes. This article provides an overview of its outcomes.

OUTCOMES OF THE XIV WORLD FORESTRY CONGRESS

About 3 900 people from 142 countries attended the XIV World Forestry Congress, including nearly 2 400 people from Africa (of whom 1 400 were from South Africa), as well as more than 350 young professionals and students. Some 800 voluntary papers were submitted, of which about 200 were presented at the Congress, together with 250 posters and 40 videos. The Congress featured five plenary sessions, six thematic dialogues spanning three days, six special events and 180 side-events. There was also a high-level dialogue involving nearly 20 ministers and high-level officials, who, among other things, called for effective stakeholder and civil-society engagement, gender equality, good governance, and secure land tenure (see article on page 7).

The XIV World Forestry Congress heard good news: after decades of political inattention and global forest loss, forests are coming back, with their role in and links to food security and other forms of land use recognized more strongly than ever. FAO's 2015 Global Forest Resources Assessment, launched at the Congress, reported that the rate of net natural forest loss is declining and the area under sustainable forest management is increasing. Debate and knowledge-sharing at the Congress on innovations in forest monitoring and wood technology, efforts to improve forest governance, building resilience, and recognition of the rights and potential of local forest producers added to a sense of imminent regrowth in the forest sector.

Young people had a strong presence at the XIV World Forestry Congress

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In a "Tree Talk" at the XIV World Forestry Congress, Sekar Ayu Woro Yunita of the International Forestry Students' Association spoke about her involvement in "Youth in Forest Actions", a programme in Indonesia created by young people, for young people

Sustainable Development Goals

Such regrowth would have benefits at a planetary scale. The adoption of the SDGs by the UN General Assembly in New York in October 2015 was an extraordinary global achievement with huge implications for forests. The need to sustainably manage forests is clearly stated in SDG 15 and in the SDG 6 target on protecting and restoring water-related ecosystems. Moreover, because of their multifunctionality, forests have roles to play in achieving many other SDGs, notably those related to ending poverty, achieving food security, promoting sustainable agriculture, ensuring access to sustainable energy for all, and combating climate change.

The XIV World Forestry Congress spelled out the strong connections between the SDGs and forests and made the following statement of intent:

> *"Forestry leaders and practitioners around the world are prepared to step up their efforts to manage forests sustainably ... FAO and other relevant international organizations stand ready to support strengthening the contributions of forests to the SDGs."*

This sort of public rallying call shows the value of World Forestry Congresses as forums for sharing information and knowledge, debating forest issues, and committing to and creating momentum towards the achievement of common goals.

Local and regional benefits

World Forestry Congresses have global reach, but they can also have important local effects in their host countries and regions. Hosting the XIV World Forestry Congress in Durban gave forest stakeholders in South Africa an opportunity to raise the visibility of forests, stimulate policy debate and engage young people in discussions on the future of the country's forests. The XIV World Forestry Congress also stimulated regional-scale talks: the "Africa Day" special event provided a platform for governments, policy-makers, experts, the

private sector and practitioners to come together to share and debate ideas and exchange information in a bid to strengthen common resolve and create partnerships for smart investments in African forests (see article on page 10).

Message to climate-change conference

The XIV World Forestry Congress produced four outcome documents, one of which was the above-mentioned statement on the SDGs. Another was a message to COP21 of the UNFCCC, warning that "climate change poses a serious threat to the planet and to forests and forest dependent people" but also recognizing that climate change presents an opportunity to improve forest governance. Among other things, the message recommended action to increase understanding of climate change among governments and other stakeholders and to promote partnerships and South–South exchanges on adaptation and mitigation actions. Many, including FAO, hailed the Paris Agreement, made at COP21, as a game-changer; among other things, it formally recognized the important role that forests have in addressing climate change.

Vision on the future of forests

The XIV World Forestry Congress articulated a vision for forests and forestry to 2050 and beyond in its Durban Declaration. According to this vision, the forests of the future will be:

- fundamental for food security and improved livelihoods – they will increase the resilience of communities by providing food, energy, fibre and other products, generating income and employment, harbouring biodiversity, and supporting sustainable agriculture and human well-being;
- part of integrated approaches to land use that address conflicts over land use and capitalize on the many benefits to be gained from integrating forests with agriculture; and
- an essential solution to climate change.

We have work to do if this vision is to become a reality. In its fourth output, the Congress set out a number of priority actions that should be taken to achieve the vision. We need more investment in forest education, communication and research, as well as greater incentives for young people to choose forestry as a career. We need new intersectoral partnerships, strong engagement with forest-dependent indigenous peoples and local communities, and a focus on product innovation and the greater inclusion of forest product value chains in the concept of a bioeconomy. Gender equality in forestry is also fundamental – it is essential that women participate equally with men in decision-making on forests. And we need to make sure that planted forests generate as many of the multifunctional benefits of natural forests as possible.

SUSTAINABILITY REQUIRES AN INTEGRATED APPROACH

Broad consensus exists that while we need to strengthen the sustainability of forestry, we also need to look beyond sectoral boundaries and address sustainable land use in a way that harnesses the driving forces behind global development. An integrated approach is required based on the meaningful engagement of stakeholders: the need to ensure food, water, energy and employment for current and future generations should be at the centre of future efforts in forestry, agriculture and watershed management. Sectoral approaches need to be sustainable and integrated approaches need to be encouraged to deliver multiple benefits from land management.

By bringing together forest stakeholders worldwide, strengthening commitment, creating a common vision, and setting out priority actions, the XIV World Forestry Congress has given us an opportunity. If we take advantage of this opportunity by working collaboratively and investing in forest communities and forest knowledge, forests will make a strong comeback. The bidding process for hosting the XV World Forestry Congress will be finalized by the end of 2016. By 2021, when that Congress is convened, we must be well on the way to unleashing the potential of forests for achieving the SDGs and combating climate change.

The XIV World Forestry Congress outcomes are available at: www.fao.org/about/meetings/world-forestry-congress/outcome ◆

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Invited speakers on the stage during the High-level Dialogue, XIV World Forestry Congress

The High-level Dialogue at the XIV World Forestry Congress

H. El-Lakany

Dialogue participants called for a serious political commitment to invest much more in forests as part of global efforts to achieve sustainable development while addressing climate change.

Hosny El-Lakany is Adjunct Professor, Faculty of Forestry, University of British Columbia, Vancouver, Canada, and Chair of the XIV World Forestry Congress Advisory Committee.

Many international organizations and intergovernmental bodies have adopted the principle of convening high-level segments at their major events. Those frequently invited to participate in such segments include top government officials, such as heads of state and government as well as ministers and ambassadors; the senior staff of UN agencies; renowned scientists; private-sector executives; and other civil-society dignitaries. The aims of high-level segments are to show political leadership and commitment at the highest possible level; provide scientific and strategic insights into the subject matter; set the stage for meaningful discussions during the events; and chart courses of action to achieve ambitious and effective outcomes.

The XIV World Forestry Congress was convened in Durban, South Africa, in September 2015 by the Government of South Africa in collaboration with FAO under the theme "Forests and People: Investing in a Sustainable Future". The aim of the High-level Dialogue on the Global Forest Agenda (HLD) was – in harmony with the general theme of the Congress – to explore avenues for investment (such as financial, human capital and infrastructure) in forests, forestry and forest communities that would best contribute to the implementation of the 2030 Agenda for Sustainable Development and maximize the contributions of forests and forestry to achieving the Sustainable Developments Goals (SDGs)[1] and their role in the future climate-change regime.

Before the Congress, and with a view to streamlining discussions at the Dialogue, HLD speakers received a set of topics prepared by the International Advisory Committee of

[1] The General Assembly adopted Resolution 70/1 on the SDGs on 25 September 2015; the outcomes of the XIV World Forestry Congress, including the HLD, were tailored to support that adoption.

the XIV World Forestry Congress[2] and the Congress Secretariat. These topics were:

- Long-term vision for action on forests.
- Critical forest-related investment needs in each country.
- National success stories in the effort to increase forest investment.
- Messages that speakers would like the Congress to send to the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations General Assembly session on the SDGs.

[2] The XIV World Forestry Congress International Advisory Committee was composed of 18 eminent persons appointed in their personal capacities. Its terms of reference included advising FAO on the contents of the Congress's technical programme and supporting efforts to secure wide participation in the Congress.

Fourteen ministers and several other senior officials representing governments and other international entities participated in the HLD, which was co-chaired by the author of this article and H.E. General Bheki Cele, who is the Deputy Minister of Agriculture, Forestry and Fisheries, Government of South Africa. The HLD commenced with short introductions from the co-chairs, who then invited the ministers and other speakers to deliver statements, followed by an open discussion among participants. At the conclusion of the HLD, Mr José Graziano da Silva, Director-General of FAO, and H.E. Senzeni Zokwana, Minister of Agriculture, Forestry and Fisheries, Government of South Africa, delivered short closing statements.

Towards the end of the session, I summarized the important elements, as identified by HLD speakers and other participants, of a long-term vision for action to integrate forests more broadly into the post-2015 development agenda while focusing on the implementation of relevant SDGs. These elements included the following:

- Powerful examples of ways in which forests could help address major global challenges such as poverty eradication and food security. Some speakers dwelled on the role of forests and forestry in food security and cited examples demonstrating the importance of forests to those indigenous and local communities who depend on them for their livelihoods; some emphasized the

FAO Director-General, José Graziano da Silva, centre, makes an intervention during the High-level Dialogue at the XIV World Forestry Congress

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need to ensure that wood energy use is efficient and sustainable.

- The importance of developing synergies between forestry and other land uses, emphasizing the need for the effective integration of forest policies with those pertaining to agriculture, water, energy and urban development.
- Clear calls to promote a stronger role for forests in climate-change mitigation and adaptation, recognizing the global significance of forests in carbon sequestration and the potential role of forests in adaptation planning through, for example, reduced deforestation and forest degradation, maintaining ecosystem services, and providing safety nets and livelihood options.
- The benefits of community-based sustainable forest management and effective stakeholder engagement and participation, as well as the importance of gender equality.
- The importance of FAO's Global Forest Resources Assessment, as well as other monitoring tools.
- The urgent need to address the drivers of deforestation and forest degradation – although there were positive messages from participants about actions being taken in some countries to reduce net deforestation and tackle forest degradation.

Perhaps the key point to emerge from the open discussion was the conviction that, if the world's forests are to realize their full potential contribution to sustainable development and the management of climate change, much more investment is required in technology transfer; product innovation; micro-enterprise development; capacity building, especially at the community level; forest education; and the creation of employment opportunities, especially among the young.

The audience appreciated that many of the speakers gave examples of success stories involving increased investment in forests, forestry and forest communities in their respective countries. In my view, the HLD played an important role in shaping the Congress outcomes; the nearly 4 000 Congress participants built on the foundations laid at the HLD to develop crisp and powerful messages for the UNFCCC COP21,[3] the United Nations General Assembly, and the whole world.

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Congress participants hear interventions during the High-level Dialogue

The Congress Secretariat, with the support of the co-chairs, produced a communiqué on the outcome of the HLD, summarizing the key issues raised by participants in the form of action points for forests and forestry.

The HLD concluded that forests could be part of a transformative change towards a bio-based economy, especially through innovation and the increased use of wood in the construction and building sector. Some high-level participants stressed that national forest programmes could serve as useful platforms at the national level for articulating the important role of forests in meeting future climate-change commitments and implementing the SDGs.

The HLD was a well-organized and well-attended event. It contributed to the success of the XIV World Forestry Congress in general, which sent clear messages to the world on the fundamental role of forests in addressing climate change, poverty and food security. The high-level participants called for a serious political commitment to invest more in forests and forestry, in terms of both financial and human capital, to support global efforts to achieve sustainable development while addressing climate change. ◆

[3] Ultimately, UNFCCC COP21, held in December 2015, reached historic agreement to combat climate change and unleash actions and investments towards a low-carbon, resilient and sustainable future. The outcomes of the XIV World Forestry Congress, including the HLD, were tailored to help inform that agreement.

Towards the implementation of the 2050 Vision for Forests and Forestry in Africa

B. Tijani

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The outcomes of the XIV World Forestry Congress will help orient FAO's forestry work in Africa in the context of the Sustainable Development Goals and the new climate agreement.

Bukar Tijani is FAO Assistant Director-General/Regional Representative for Africa.

South Africa successfully hosted the XIV World Forestry Congress, the first ever World Forestry Congress in Africa, with almost 4 000 delegates from all over the world. Continental leaders, decision-makers, practitioners and stakeholders gathered in Durban in September 2015, putting a spotlight on forests to foster supportive policies and boost investments for sustainable development. Participants discussed ways to unleash the full potential of forests for lifting rural populations out of poverty by expanding economic opportunities, giving rural people more access to forests, and inspiring new technologies and renewable products, thus setting the 2050 Vision for Forests and Forestry.

Hosting the World Forestry Congress in Africa was significant because the continent mirrors many of the most important global challenges and opportunities for forests. The Congress was opportune in enabling Africa to take stock of its experiences, knowledge base and initiatives, especially in the context of fostering people-centred development

Previous page: Panelists at an event during Africa Day at the XIV World Forestry Congress, Durban, South Africa. From left to right: Mr Bukar Tijani; Professor Edith Vries, Director General, Department of Agriculture, Fisheries and Forestry, South Africa; Mr Martin Bwalya, Head of Programme Development Division, NEPAD Planning and Coordination Agency; H.E. Belete Tafere, Minister for Environment and Forest, Ethiopia; Mrs Tumusiime Rhoda Peace, African Union Commissioner for Rural Economy and Agriculture; and Ms Mette Loyche Wilkie, Director at the United Nations Environment Programme

priorities and objectives, as articulated in Africa's Agenda 2063.[1] The Congress also presented an opportunity to reflect deeply on the future of the continent's 624 million hectares of forests and trees outside forests and to help galvanize the responses of governments to the call in the Malabo Declaration[2] for a sustainable forest management programme framework.

Through the Congress's Africa Day, the African Union Commission and partners – including the FAO Regional Office for Africa and the Planning and Coordination Agency of the New Partnership for Africa's Development (NEPAD) – debated the theme of addressing climate change through sustainable forest management. The discussions emphasized the role that sustainably managed forests and trees outside forests can play in reducing vulnerability to climate change and the opportunities they provide for achieving food security, economic development and employment for Africa's people, especially youth and women. Participants in Africa Day called for multisectoral integrated approaches to sustainable forest management and technological innovations and capacity strengthening in the forest sector, and they advocated further investment in and financing of sustainable forest management.

Against this background, it is encouraging to note that the outcomes and messages of the XIV World Forestry Congress served as a useful input to orient FAO's forestry work in Africa in the era of the Sustainable Development Goals and the new climate agreement reached in Paris in December 2015. In this way, the Congress helped in prioritizing work on food security and livelihoods; integrating forests with other land uses; and ensuring that forests continue to provide a range of products and services, including climate-change adaptation and mitigation.

Efforts are being made in Africa to move ahead with firm, achievable programmes. The FAO Regional Conference for Africa, held in Abidjan, Côte d'Ivoire, in April 2016, recommended that FAO enhance its support for countries in three areas – market access and agri-food systems; sustainable natural resource management and governance; and resilience building for effective management of risks.

Ministers of agriculture and heads of delegation attending the FAO Regional Conference discussed the topic of food security and recognized that climate change is a threat to Africa's fundamental human rights. Nevertheless, they shared a common vision that investment in productive and resilient agricultural development is vital for ensuring that African countries – and particularly the poorest and most food-insecure inhabitants of those countries – continue to prosper, despite climate change.

The Conference recognized that well-targeted investments in agriculture can simultaneously improve natural resource management, enhance adaptation to climate change in Africa and help mitigate climate change, regionally and globally, by easing the pressures that drive deforestation and improving soil health and access to water. Africa is set to move forward on a path of sustainable development that ensures growth in agriculture, food security and nutrition, poverty eradication, the provision of energy (wood) and livelihoods, while building resilience to climate change. Sustainable forest management has an important role here. ◆

[1] Agenda 2063 is a call to action to all segments of African society to work together to build a prosperous and united Africa based on shared values and a common destiny. In their 50th Anniversary Solemn Declaration, the Heads of State and Government of the African Union laid down a vision and eight ideals to serve as pillars for the continent in the foreseeable future, which Agenda 2063 will translate into concrete objectives, milestones, goals, targets and actions/measures.

[2] The Heads of State and Government of the African Union adopted the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods at the African Union Summit in Malabo, Equatorial Guinea, in June 2014. The Malabo Declaration is a set of goals showing a more targeted approach to achieving the continent's agricultural vision, which is shared prosperity and improved livelihoods.

The Buffelsdraai Landfill Site Community Reforestation Project

E. Douwes, M. Rouget, N. Diederichs, S. O'Donoghue, K. Roy and D. Roberts

Members of a local community plant trees as part of the Buffelsdraai Landfill Site Community Reforestation Project

A project in Durban, South Africa, is pursuing a new form of urban biodiversity conservation using structured interventions to provide wider benefits for communities.

Errol Douwes, **Sean O'Donoghue**, **Kathryn Roy** and **Debra Roberts** are at the Environmental Planning and Climate Protection Department, eThekwini Municipality, Durban, South Africa.
Mathieu Rouget is at the School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, South Africa.
Nicola Diederichs is at Futureworks, Knysna, South Africa.

Cities have a crucial role to play in climate-change adaptation and mitigation. The majority of the world's people now live in urban areas (UNDESA, 2014), with the result that cities form centres of intense greenhouse gas emissions related to transport, energy and industry. Addressing climate-change mitigation at the city scale is evidently important, but the risks that cities face due to climate change are arguably even more so. Where the impacts of climate-change-related disasters are not planned for appropriately, the combination of high settlement densities, the location of infrastructure in vulnerable places, and urban poverty can have very negative consequences for people. This is particularly true of cities in many African countries, where informal settlements – which lack many basic services – form a large proportion of residential areas. It is imperative that development in these cities is aligned appropriately with projected changes in climate.

To this end, various mechanisms are being pursued globally to address climate-change mitigation and adaptation in urban areas. These include nationally coordinated

mitigation policies to, for example, develop renewable-energy and energy-efficiency building retrofits, as well as local-scale adaptation planning initiatives. Two of the latter considered of high importance for African cities are community-based adaptation (CBA) and ecosystem-based adaptation (EBA). CBA refers to the participatory identification and implementation of community-based development activities that strengthen local people's capacity to adapt to climate change. CBA also builds on the expressed needs and perceptions of communities to address the local development concerns underlying vulnerability (Ayers and Forsyth, 2009; Reid *et al*., 2009; Archer *et al*., 2014). EBA refers to "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change" (AHTEG, 2009). Both CBA and EBA allow the delivery of climate-change adaptation interventions that support economic development, promote poverty alleviation, enhance water and food security, and boost biodiversity conservation (Lykke *et al*., 2009; Cartwright *et al*., 2013; Munang *et al*., 2013). Such benefits can foster much-needed political buy-in; moreover, the integration of CBA and EBA into local decision-making processes (e.g. municipal land-use planning) increases opportunities for risk reduction (Archer *et al*., 2014).

This article discusses the key benefits arising from and lessons learned in a reforestation project implemented by the eThekwini Municipality (the local government responsible for the city of Durban, South Africa) in partnership with local communities and organizations. Although established as a mitigation initiative to help offset greenhouse gas emissions associated with 2010 FIFA World Cup™ matches held in Durban, the Buffelsdraai Landfill Site Community Reforestation Project ("the project") has provided crucial co-benefits, including climate-change adaptation, poverty alleviation and ecosystem restoration. The project builds on a combination of the local economic development and ecosystem service delivery aspects of South Africa's national Working for Water programme (van Wilgen, Le Maitre and Cowling, 1998; Turpie, Marais and Blignaut, 2008) and the eThekwini Municipality's Working for Ecosystems programme (Douwes, 2010).

CLIMATE-CHANGE MITIGATION AND ADAPTATION STRATEGIES IN DURBAN

Durban has a portfolio of synergistic adaptation and mitigation responses that form part of its Municipal Climate Protection Programme. Reviews of this

Tree-preneurs sort saplings received from the community at a "holding nursery" as part of the Buffelsdraai Landfill Site Community Reforestation Project. Seedlings are grown in people's backyards and placed in holding nurseries at the site for hardening before planting

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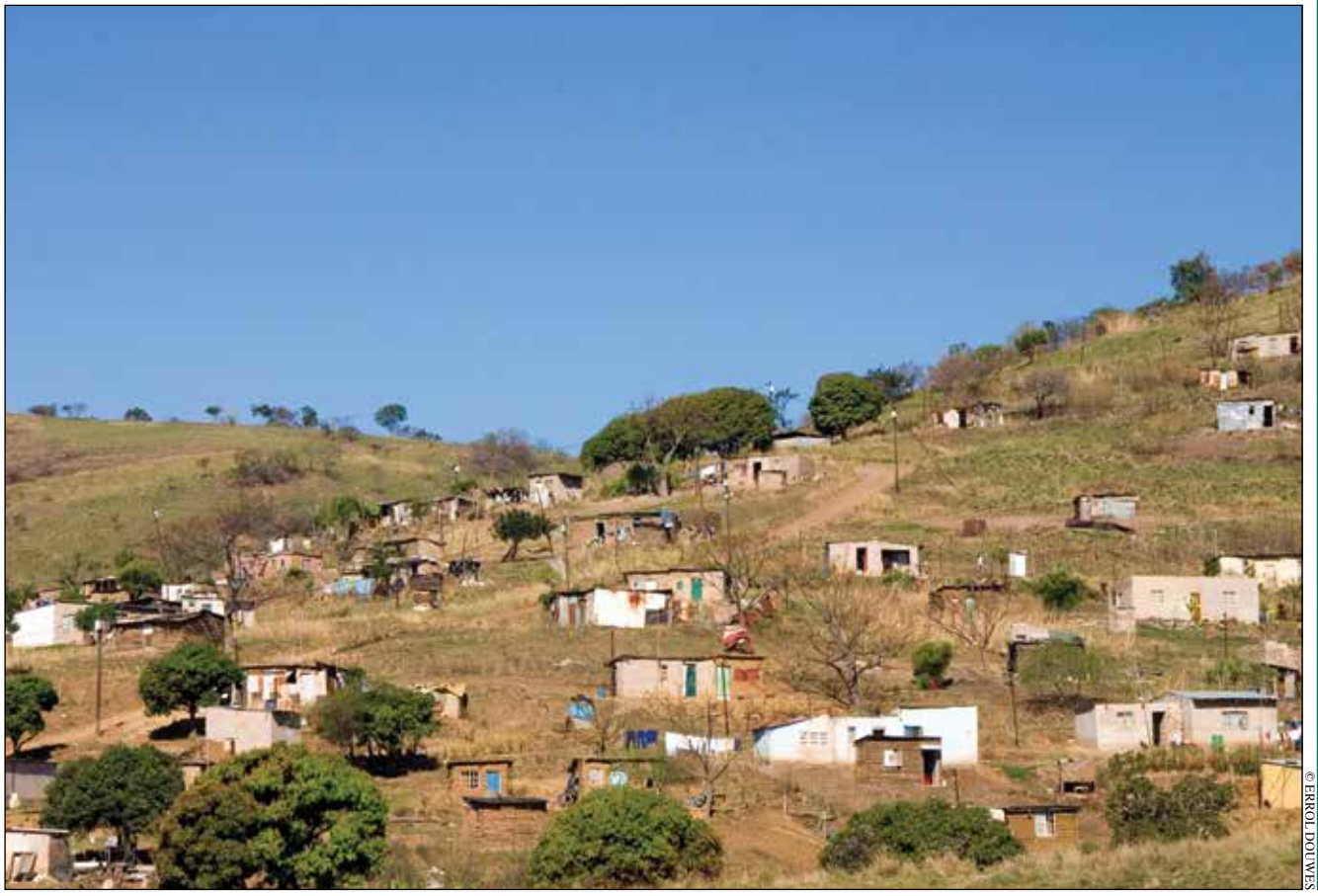
programme (Roberts *et al*., 2012; Roberts and O'Donoghue, 2013) suggest that while adaptation is the immediate priority, mitigation interventions are also crucial for enhancing the city's adaptive capacity through the avoidance of climate change while reducing existing high levels of per capita emissions. In this sense, mitigation may even be viewed as the "surest form" of adaptation. EBA is considered a strategic approach to adaption that maximizes the prospects for long-term sustainability and reduces the vulnerability of impoverished urban communities, which remain dependent on natural capital for survival (Roberts *et al*., 2012).

A practicable community EBA initiative has emerged recently in Durban in response to the recognition that climate-change adaptation needs to involve and benefit local communities for it to be sustainable and meaningful. Natural habitat restoration projects have the advantage of not only achieving climate-change mitigation aims but also increasing climate-change adaptation capacity and reducing the vulnerability of ecosystems and communities. It is acknowledged that mitigation gains are low in Durban's urban-based ecological restoration projects in comparison with gains in adaptive capacity. Preferably, therefore, investments in ecosystem restoration should not seek solely to deliver carbon sequestration but should also prioritize the supply of other ecosystem services (e.g. flood attenuation, sediment regulation, biodiversity refuge conservation and river-flow regulation), thereby increasing and broadening the resilience and adaptation capacity of regional ecosystems, including river catchment systems, with clear benefits for local communities that depend on natural resources.

ESTABLISHMENT OF THE BUFFELSDRAAI LANDFILL SITE COMMUNITY REFORESTATION PROJECT

Following Durban's selection as one of nine South African host cities for the 2010 FIFA World Cup™, the eThekwini Municipality established a target to host a climate-neutral event. The total unavoidable carbon footprint for the Durban component of the event was declared at 307 208 tonnes of carbon dioxide equivalent (CO_2e). A portion of this footprint was to be mitigated through local natural forest restoration that also enhanced the adaptive capacity of local ecosystems and communities. The project was initiated within the 757-hectare buffer zone of

The Buffelsdraai Landfill Site Community Reforestation Project has generated significant socio-economic benefits for the local community



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the municipality's Buffelsdraai Regional Landfill Site in the north of Durban in November 2008. Initial small-scale tree-planting was undertaken in 2009, followed by a larger-scale effort from 2010. All land earmarked for reforestation was previously either under sugarcane production, with limited productive capacity, or infested with invasive alien plants. The carbon to be captured by the project over a 20-year period was estimated initially at some 45 000 tonnes of CO_2e (eThekwini Municipality, 2011).

The eThekwini Municipality appointed a local non-profit organization, the Wildlands Conservation Trust, to implement the project through its Indigenous Trees for Life programme, which assists unemployed people, subsequently known as "tree-preneurs", to set up small-scale indigenous tree nurseries at their homes. Facilitators in relevant communities are appointed to recruit, train and support the tree-preneurs, who trade their trees (at a minimum height of 30 cm) for credit notes, which can be exchanged for food or basic goods or used to pay school fees.

A holding nursery at the reforestation site allows the storage and sorting of trees received from tree-preneurs. Trees are hardened off in the nursery to increase their chances of survival once planted out; this involves the use of local soils without fertilizer or mulch, and watering is minimized. Teams of local people are employed to plant the hardened-off trees and then maintain the forest (including through the control of invasive alien plants). Planting takes place predominantly in the wet season to help increase tree survival. Planted areas are inspected regularly, and dead trees are replaced with new saplings. A stock of "insurance" trees is stored in the on-site nursery to replace trees that have succumbed to wildfire or drought.

The Municipality's Environmental Planning and Climate Protection Department oversees the project, but partnerships with other municipal agencies are also vital. These agencies include the Durban Solid Waste Department, which owns the land; the Coastal, Stormwater and Catchment Management Department, involved in water monitoring; and the municipality's Energy Office, which provides photovoltaics and solar geysers for offices and ablutions. Other partners include the University of KwaZulu-Natal (UKZN) as part of a research partnership, and the Wildlife and Environmental Society of South Africa as part of an environmental education partnership. Members of the local community are considered crucial partners for implementation success.

ASSESSMENT OF BENEFITS

The multiple socio-ecological benefits achieved by the project have resulted in Gold Standard validation by the Climate Community and Biodiversity Alliance, following the regular monitoring of carbon stock, increases in biodiversity, and socio-economic surveys of neighbouring communities. Conformance with the Climate Community and Biodiversity (CCB) Standards is determined through a two-stage process involving validation and verification (CCBA, 2015), which is undertaken by independent accredited auditors. The validation phase, already completed for the Buffelsdraai project, entailed an assessment of the design of the land-based carbon project against each criterion of the CCB Standards. Verification (scheduled for 2017) is to be performed after initial project implementation (and then at approximately five-year intervals) to confirm whether the project has delivered benefits in line with its validated design and monitoring plan. Table 1 lists the various indicators used to monitor the implementation and effectiveness of the project.

The estimated carbon to be sequestered each year was calculated before planting, based on the anticipated accumulation of woody biomass arising from the phased plantings in initial years and growth over a 20-year period. Knowles (unpublished) modelled carbon accumulation rates using the Century Ecosystem Program for the

TABLE 1. Indicators used to monitor carbon stocks, biodiversity and the socio-economic benefits of the Buffelsdraai Landfill Site Community Reforestation Project

Indicator type	Measurement	Frequency	Notes
Carbon stock	Area planted (ha)	Annually	Calculated for areas previously under sugarcane
	Number of trees	Annually	Trees planted in the living fence were not included in initial carbon calculations
	Accumulated carbon sequestered to date (tonnes CO_2e)	Annually	These values were calculated before project inception
Biodiversity	Indigenous trees (species richness)	Annually	Only woody tree species sampled
	Invertebrates (species richness)	Every five years	Limited to snails and millipedes
	Vertebrates (species richness)	Every five years	Small mammals, birds and reptiles were sampled
Socio-economics	Number of temporary jobs	Annually	Measured for people directly employed
	Number of permanent jobs	Annually	Measured for people directly employed
	Disposable income	Every five years	Within families of tree-preneurs or employees
	Food availability	Every five years	Within families of tree-preneurs or employees

various vegetation types sampled by Glenday (2007). Field surveys of extant forest and woodland patches (Macfarlane, Harvey and Hamer, 2011) were undertaken early in the project. The resulting inventories and associated data allowed the calculation of importance values (IV) for each tree species as a way of guiding future selections of species for planting (Macfarlane, Harvey and Hamer, 2011). The IV methodology (see DWAF, 2005) uses the relative abundance, relative frequency and relative basal area (biomass) of each species in each habitat type. The exercise was repeated four years after the initial survey and calculation (Bertolli, Teixeira-Leite and Macfarlane, 2013) to confirm the targets set for species richness. Macfarlane, Harvey and Hamer (2011) also collected baseline data on vertebrate and invertebrate species richness. Roy (2015) determined the species richness, diversity and composition of the newly planted areas at Buffelsdraai through extensive sampling of 60 plots (each of which was 200 m^2 in area). These plots were compared with an established forest in Durban to determine whether the project was on a trajectory that would allow the establishment of a phytosociological assemblage similar to that of a natural forest.

A socio-economic baseline study of project beneficiaries (Greater Capital, 2011) was undertaken to help the eThekwini Municipality understand the long-term benefits of the reforestation process that would accrue to the 6 309 households in the Buffelsdraai, Osindisweni and KwaMashu settlements. These areas are acknowledged to suffer from poverty and unemployment.

TABLE 2. Anticipated greenhouse gas removals to date, through woody biomass accumulation, during phased planting at Buffelsdraai

Year	Cumulative area planted (ha)	Carbon sequestration rate per unit area (tonnes of CO_2e/ha/year)	Carbon sequestration rate per year (tonnes of CO_2e/year)	Accumulated carbon sequestered to date (tonnes of CO_2e)
2008	1.1	1.4	5.6	5.6
2009	44.1	1.4	226.4	232.0
2010	82.1	1.4	421.4	653.5
2011	182.1	1.4	934.8	1 588.3
2012	282.1	1.4	1 448.1	3 036.4
2013	382.1	1.4	1 961.4	4 997.8
2014	482.1	1.4	2 474.8	7 472.6

Source: eThekwini Municipality (2011).

RESULTS

The results presented below are for the first five years of tree-planting (2010–2014) and relate broadly to the indicators listed in Table 1.

Carbon stock

Table 2 shows the carbon anticipated to be sequestered in each year from inception. This is an estimate based on the cumulative area planted; actual measurements are being conducted through the research partnership with UKZN.

Biodiversity

A total of 51 locally indigenous tree species were recorded at Buffelsdraai in 2013, including species found in newly reforested areas as well as in extant forest patches at the site (Bertolli, Teixeira-Leite and Macfarlane, 2013). As of January 2015, 442 hectares had been reforested at Buffelsdraai at a rate of about 100 hectares per year and an average density of 1 000 trees per hectare (certain riparian areas were planted at an average of 2 000 trees per hectare). A total of 595 476 trees had been acquired since project inception through the treepreneurs programme, as of January 2015 (Douwes *et al.*, 2015). The planted trees include 46 locally indigenous species, of which the most common are *Acacia natalitia*, *Erythrina lysistemon* and *Bridelia micrantha* (Roy, 2015).

The Buffelsdraai landfill site in 2015

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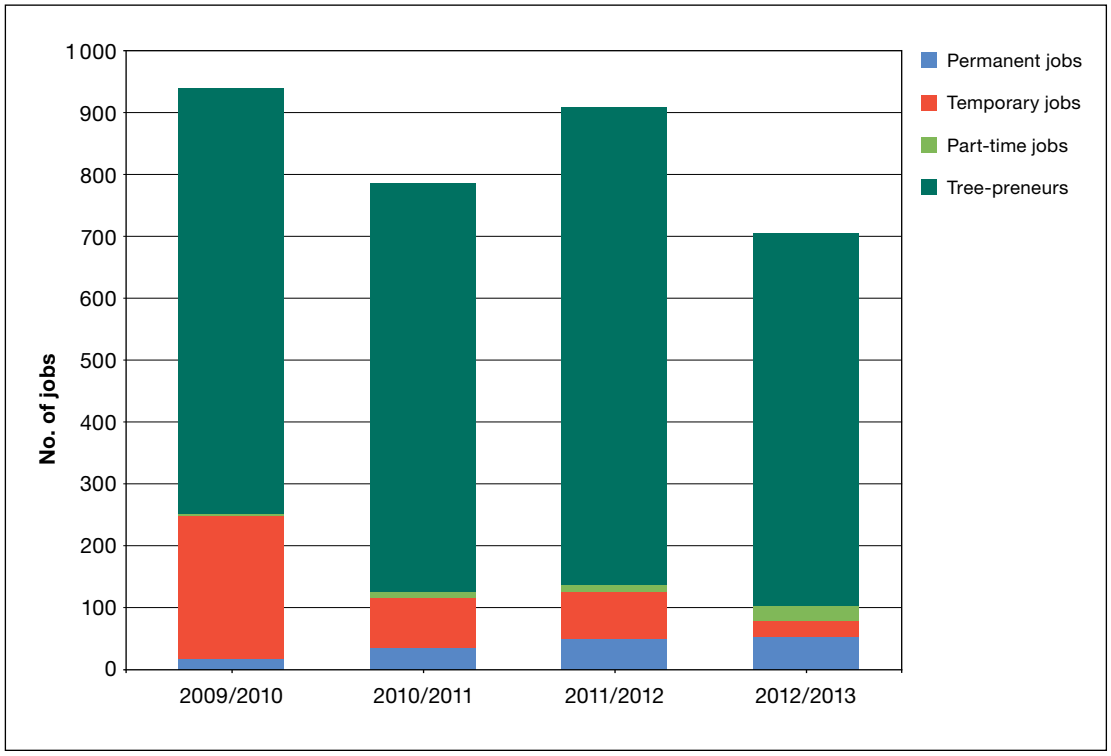

1 Socio-economic upliftment of neighbouring communities through job creation (2009/2010–2012/2013)

Compared with a forest reference site, the planted areas at Buffelsdraai had lower species richness (an average of 28 species per 0.4 hectares at Buffelsdraai compared with 37 species per 0.4 hectares at the reference site) and lower species diversity (a Shannon exponential mean of 21.6 effective species per 0.4 hectares at the reference site and 12.3 at Buffelsdraai) due to the dominance of a few pioneer nitrogen-fixing species that are generally quick and easy to grow (Roy, 2015).

Eighty bird species were recorded at the Buffelsdraai site at project inception (Macfarlane, Harvey and Hamer, 2011); ongoing quarterly records indicate that the number was 145 in December 2014 (Spence and Wood, 2014). Although the number of bird species appears to have increased, Spence (personal communication, 2015) has suggested that 145 might be a more realistic baseline, given that all species cannot be confirmed in one count, and species lists must cover all seasons. Nine millipede and 22 mollusc species were recorded at the site (Macfarlane, Harvey and Hamer, 2011).

Socio-economics

The project has generated more than 50 full-time, 16 part-time and 389 temporary jobs for local community members, and more than 600 active tree-preneurs have been engaged (Figure 1). Local people who gained employment in the project were found to have higher disposable incomes and increased availability of food, and many families reported improved educational opportunities for their children. All communities demonstrated a high reliance on the use of natural resources for food, energy, water and primary health care (Greater Capital, 2011).

DISCUSSION

This case study provides a number of lessons that could inform the development of community-based reforestation elsewhere. The project inclines heavily towards local job creation and the active upskilling of community members, achieved primarily through ongoing interactions between facilitators and tree-preneurs. The development of entrepreneurial skills is also a focus, and tree-preneurs who produce large quantities of trees are rewarded with additional training courses and experiential learning opportunities. An education and outreach initiative has been established to help local communities develop an understanding of climate change, as well as of how forests and ecosystems deliver beneficial ecosystem services.

The project has demonstrated some measure of climate-change mitigation and adaptation, although the adaptation benefits (especially with respect to biodiversity and socio-economic aspects) are far more tangible than originally envisaged. The composition of planted trees indicates a likelihood of high resilience to climatic change due to the prevalence of generalist species (Roy, 2015); socio-economic benefits include the increased availability of food and improved education opportunities for schoolchildren (Greater Capital, 2011).

The benefits generated by the project led to its nomination and selection in 2011 as one of the UN's "Momentum for Change" initiatives, which recognize projects for addressing climate change through climate-resilient and low-carbon

mechanisms while ensuring optimal benefits for local communities (UNFCCC, 2015). It is acknowledged, however, that, while initial results hold promise, further interrogation of the project benefits is required. For example, the full extent of ecological and ecosystem service benefits – such as increases in biodiversity refuges, water quality, river-flow regulation, flood mitigation, sediment control, visual amenity, and fire-risk reduction – is unknown.

Another aspect in which the project has shown promise is in the engagement of a broad spectrum of stakeholders, which has ensured widespread buy-in and transparency and, in the case of a research partnership with UKZN, created opportunities for investigating the impacts of the project on ecosystem services. Buy-in and support for the project from local leaders has helped drive the establishment of two additional reforestation projects in Durban – iNanda Mountain and Paradise Valley – using the same model.

This project emerged opportunistically as a result of the 2010 FIFA World Cup™, pointing to the need for cities and countries to exploit such moments because they have the potential to provide long-lasting legacies (Diederichs and Roberts, 2015). This is especially relevant for projects implementing green economy principles, as seen in the example discussed here. The combination of local economic development and the delivery of ecosystem services, which is also used in South Africa's national Working for Water programme (Buch and Dixon, 2009), could feasibly be replicated in other parts of Africa, especially in cities, as a way of mainstreaming climate-change adaptation measures (Bourne *et al*., 2016). The goal of low-carbon-emissions development (UNDP, 2011) can also be addressed in parallel with the development of socio-ecological needs. The Indigenous Trees for Life model has already been extended to other environmental sectors, such as solid waste control, at Buffelsdraai and other sites (Bender, 2016), providing opportunities to implement a range of transformative programmes that target vulnerable communities. Such opportunities, if sensitive to local ecosystem threats and needs, could be pursued in cities throughout Africa with the potential to put African countries on a development path in keeping with the Sustainable Development Goals.

The above-mentioned partnerships and project components all aim to yield positive co-benefits and outcomes, but they also highlight the vulnerability of the project, which could fail if long-term management commitments from local government are not forthcoming. There is a clear need for a systematic risk management approach that highlights positive interdependencies and evaluates and exposes problematic trends over time.

CONCLUSIONS

Although initiated to offset the local carbon footprint of the Durban 2010 FIFA World Cup™, the benefits achieved by the Buffelsdraai Landfill Site Community Reforestation Project have already far exceeded the single objective of creating a tree-based carbon sink, including the enhanced restoration of biodiversity and the delivery of ecosystem services, a range of social upliftment and economic opportunities for local communities, and important research efforts. The project is indicative of a new form of urban biodiversity conservation, in which structured and deliberative interventions in biodiversity management can create new socio-ecological systems. Going forward, it is recommended that the project builds on the partnership and research platform approach. This will help optimize co-benefits and grow the portfolio of coordinated, synergized and constantly re-evaluated responses to the need for climate-change adaptation and mitigation.

ACKNOWLEDGEMENTS

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Gender and forest, tree and agroforestry value chains: evidence from the literature

V. Ingram, M. Haverhals, S. Petersen, M. Elias and B. Basnett

What is the role of gender in the harvesting, processing and sale of forest and tree products?

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A forest, tree and agroforestry (FTA) value chain (also known as a market, supply or commodity chain, or a production-to-consumption system) concerns the activities involved in bringing a wood or non-wood product from a tree or forest, through processing and production, to delivery to final consumers and ultimate disposal. Such a chain can range from local to global, and it comprises activities such as harvesting, cleaning, transport, design, processing, production, transformation, packaging, marketing, distribution and support services that generally all add value to a product as it moves along the chain. The activities in an FTA value chain may be implemented by various individuals or organizations, termed "actors" here, such as harvesters, processors, traders, retailers and service providers.

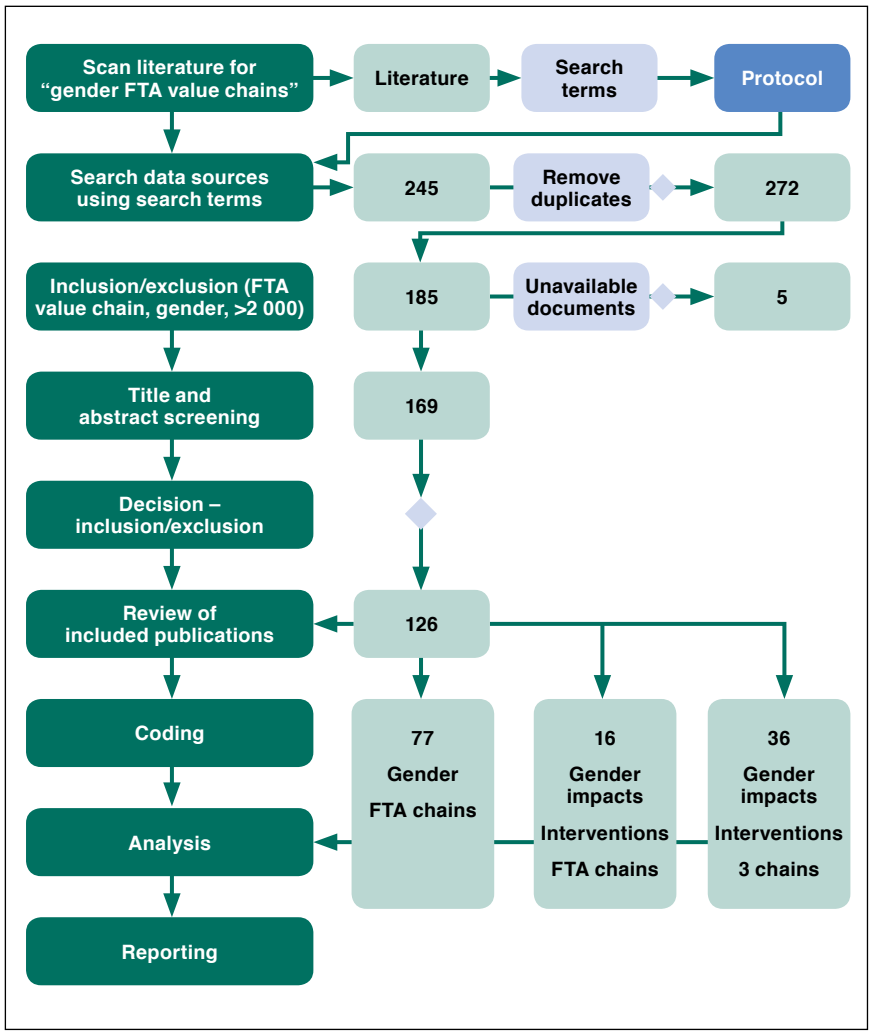
Above: Women display shea butter at a market in Burkina Faso. Numerous interventions in recent decades have sought to increase the inclusion and incomes of female producers and processors in shea export chains

The relationship between actors and the control of chains is known as chain governance (Gereffi, Humphrey and Sturgeon, 2005; Helmsing and Vellema, 2011). Chains and products embody multiple relations of value, which are often explicitly economic but also social, cultural and environmental. Because forest products are based on natural – often wild-sourced – resources, the sustainability of harvesting is a core aspect that differentiates forest product chains from those of agriculture.

"Gender" refers to the socially constructed differences between women and men (Kabeer, 2005), how society gives meaning to differences in femininity and masculinity, and the power relations and dynamics that characterize how women and men interact (Laven *et al*., 2009). The crucial link between gender and forest and tree-based livelihoods is gaining recognition, with a growing body of research highlighting the role of gender in shaping access to and the management and use of FTA resources and markets and their associated benefits (Mai, Mwangi and Wan, 2011).

This article examines the nature of gender differences in FTA value chains; where those differences are concentrated in value chains; the factors that explain the differences; and the prospects for generating gender-equitable and sustainable outcomes from participation in FTA value chains.

1
Literature review methodology



METHODOLOGY

A search of literature available on the internet following the steps shown in Figure 1 produced 126 studies dated from the year 2000 onwards[1] concerning FTA value chains and gender. The studies referred to one or more value-chain cases and covered a wide variety of product chains involving fruits, seeds, nuts, gums, resins, barks, stalks, leaves, timber, branches, fungi and roots sold for food, feed, medicinal and cosmetic uses, perfumes, energy, tools and utensils. Many products also had subsistence uses. The majority (63 percent) of the 126 publications were peer-reviewed scientific articles, 8 percent were book chapters, and 14 percent were working papers and reports. Other products included theses, case studies and policy briefs. Most studies (65 percent) were descriptive in nature, 18 percent were conceptual and 17 percent described external interventions in value chains. All studies concerned FTA chains originating in developing countries, with most (58 percent) based in Africa, 26 percent based in Asia, and 16 percent located in Latin America. The publications were read and coded according to the types of gender differences, where these differences were located along the value chain, the factors explaining differences, and the types of interventions and their impacts. This evidence was then synthesized.

WHERE ARE GENDER DIFFERENCES IN FTA VALUE CHAINS?

Most of the studies reviewed did not clearly identify or quantify the sex of those involved in different stages of the value chain. Where this aspect was mentioned, 21 cases clearly identified the sex of the actors in the harvesting stage, with women dominating in 43 percent of those cases and men 29 percent, and both sexes participating in 23 percent of cases. In processing, women dominated in 25 percent of the eight cases, men dominated in 5 percent,

[1] A full list of the publications reviewed and the review methodology is available from the Center for International Forestry Research.

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A woman processes newly harvested cacao in Sulawesi, Indonesia. Empowered female cacao farmers with access to farm inputs can influence decisions on cacao production, improve bean quality and quantity, and increase incomes from cacao farming

and both participated in 5 percent. In trading, women dominated in 38 percent of the 13 cases, men in 19 percent, and both sexes were active in 5 percent. It is notable that relatively few studies concerned gendered participation in activities other than harvesting.

Trends in gendered benefits identified by Sunderland *et al*. (2014) were broadly replicated in other studies. Globally, FTA income from unprocessed products collected by men contributed to total household income to the same level as that contributed by women. Women were only the main collectors of FTA products in Africa; men contributed a greater income share than women from unprocessed FTA products, especially in Latin America. In Asia, the contributions of women and men were equal. Shackleton *et al*. (2011) found that, in many FTA value chains in South Africa, even though both men and women are involved (either independently at different stages or together for certain activities), women are often subordinate to men or carry out their activities with limited visibility. A general trend indicated in 13 percent of the studies reviewed was that men participate more in chains as the value of products increases and that men typically participate to commercialize products, whereas women participate both to gather goods for their own and family use, and to generate income. Non-monetary benefits arising from women's participation in FTA chains were: increased independence, self-esteem and physical well-being; improved self-identity; a sense of purpose; new and extended social networks; the perpetuation of traditions; and the reduction of vulnerabilities and risks associated with food and income security.

WHAT CONTEXTUAL FACTORS CONTRIBUTE TO GENDER DIFFERENCES?

The frequency with which specific factors were mentioned in the reviewed literature suggests that they explain differences between men and women's participation at different stages of value chains. We attribute the inconsistency with which these factors were mentioned with respect to different products and geographical regions to the differing emphases of the various studies.

Sociocultural factors such as cultural norms and customs, which are generally

Processed beeswax in Oku, Cameroon, for export to a cosmetic company. Processing adds value to raw non-wood forest products that benefits both men and women

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geographically and ethnically specific, were the most frequently stated explanations for gender differences (51 times in 24 percent of the studies).[2] Such norms and customs establish acceptable social, economic and familial practices and taboos for men and women, which determine participation (where, how and what) in value chains. Several studies stressed that gender is just one component of sociocultural and demographic variables that socially differentiate men and women in value chains.

Economic factors were mentioned 12 times in 13 percent of the studies. Specific mention was made of the effects of globalization and reforms implemented in response to economic crises; factors referred to included structural adjustment plans, migration, urbanization, and the resultant changes in social roles. Economic factors affected (positively or negatively) not just markets for FTA products, but also the demand for and consumption of FTA products more generally.

Governance and political and institutional factors were seen generally as complex and interlinked, with plural governance arrangements noted in many value chains and countries. Institutional and governance factors were mentioned 16 times in 17 percent of the studies reviewed and generally concerned overlapping customary and formal regulatory arrangements. Societal norms can result in the under-representation of women in the institutions that mediate formal governance – government policy-makers and law-makers. In some customary and market-based governance arrangements, however, women have developed strategies to increase their representation and participation in the institutions governing value chains. Political factors such as participation rights and political empowerment were mentioned five times in 5 percent of studies.

Environmental factors were cited five times in 4 percent of studies, referring to resource degradation (due to anthropogenic or natural causes) affecting the quality and quantity of the FTA resources available. In some cases, women were shown to be more vulnerable than men to the effects of resource degradation; the main reasons cited for this were that women are often poorer and more dependent on forest ecosystems threatened by degradation and

[2] Note that because some studies referred to more than one value chain, the total number of mentions may not coincide with the total number of relevant reviewed studies.

climate change, and women's socially and politically driven lack of participation in decision-making and power.

WHAT ARE THE DIFFERENCES IN MALE AND FEMALE PARTICIPATION IN FTA CHAINS?

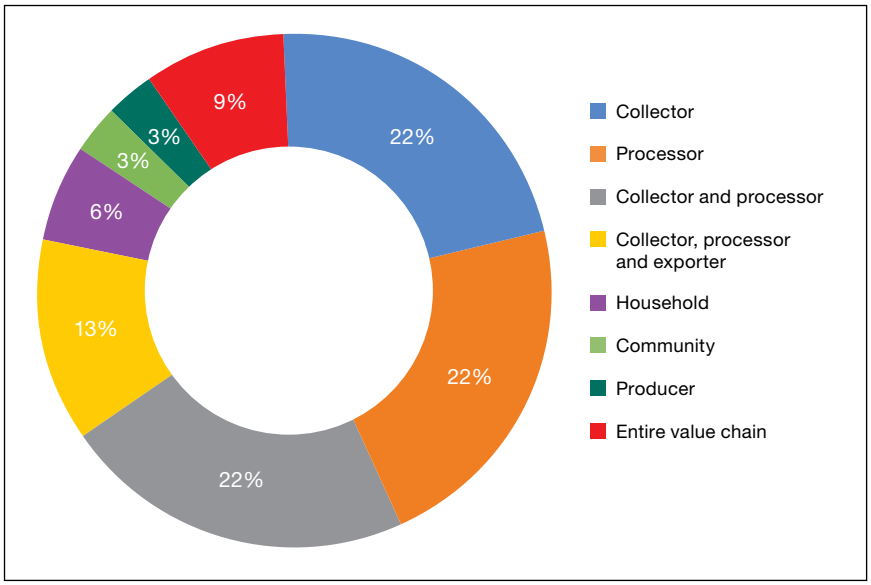
The reviewed studies indicated that there are four main types of difference in where, how and when men and women participate in FTA value chains:

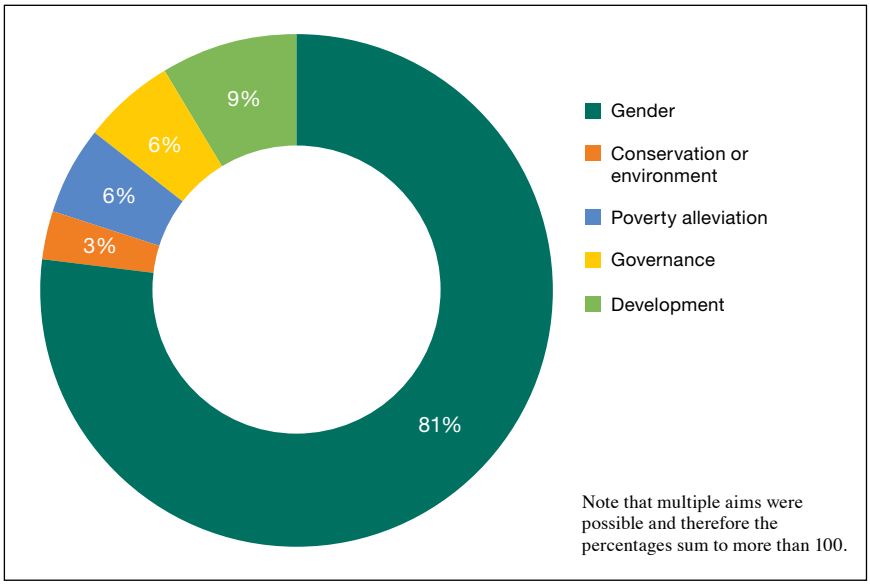
1. Social and cultural differences influence how chains are governed. Governance institutions often comprise gender-differentiated access rights to and responsibilities for land, tree species, the FTA products themselves, labour, technology, credit, information, and FTA product markets. Women in the studies often had fewer or less favourable access rights than men, and those rights were not well defined or enforced. Moreover, sociocultural factors strongly influenced the work performed, the division of labour in chains and (other) household and economic responsibilities, and the activities of those participating in FTA value chains. A general pattern in the reviewed studies was that women tend to be disadvantaged. The literature makes clear that participation in FTA chains can be just one part of often-diverse livelihood strategies, or it can form a major source of a man or woman's livelihood. This is emphasized by the differences observed between geographical regions and cultures for chains concerning the same product, such as fuelwood or cacao.
2. Different benefits were apparent in the revenues and profits gained by men and women in FTA chains and how they spend FTA-related incomes. Generally, but not always, men sell a higher proportion of FTA products (both processed and unprocessed) than women and thus have higher FTA-based incomes. Regional differences were apparent in the amounts earned by men and women, particularly from processed products, and the extent to which the sexes were engaged in specific activities in the chain. Poverty cut across gender as an influence on people's dependence and engagement in value chains. Benefits were often co-determined by socio-cultural customs and socio-economic characteristics, such as the sex of the household head. Spending the benefits derived from FTA products was influenced by the other sources of income of the person involved in an FTA value chain, the nature of the household, and the specialization of individuals, households and businesses in specific value-chain activities. Many of the studies noted that increases in women's incomes from participating in FTA chains led to higher expenditure on food, health and education, and therefore on overall household well-being, than did increases in men's incomes.
3. Political differences arise due to gendered power relations, particularly within households but also within enterprises, and these can determine participation in value-chain activities and their outcomes (especially incomes and profits). Women were often described in reviewed studies as being disadvantaged compared with men, or subordinate to men; some papers noted strategies – such as collective action – by which women could increase their power.
4. Differences due to the nature of the product and activity arise because of the physical demands of value-chain activities, notably harvesting and primary processing, and the time taken to conduct those activities, such as long forage distances or extended periods away from home. Such factors were strong determinants of the participation of women and men in the value chains of certain products.

WHAT KIND OF FTA VALUE-CHAIN INTERVENTIONS HAVE BEEN MADE, AND HOW CAN INTERVENTIONS BE MORE GENDER-EQUITABLE AND SUSTAINABLE?

One-third of the reviewed studies discussed interventions in FTA value chains generally or gave details of the results of actions in specific chains. Most interventions, shown in Figure 2, were made at the community and harvester levels.

2
Stage at which interventions occurred in FTA chains





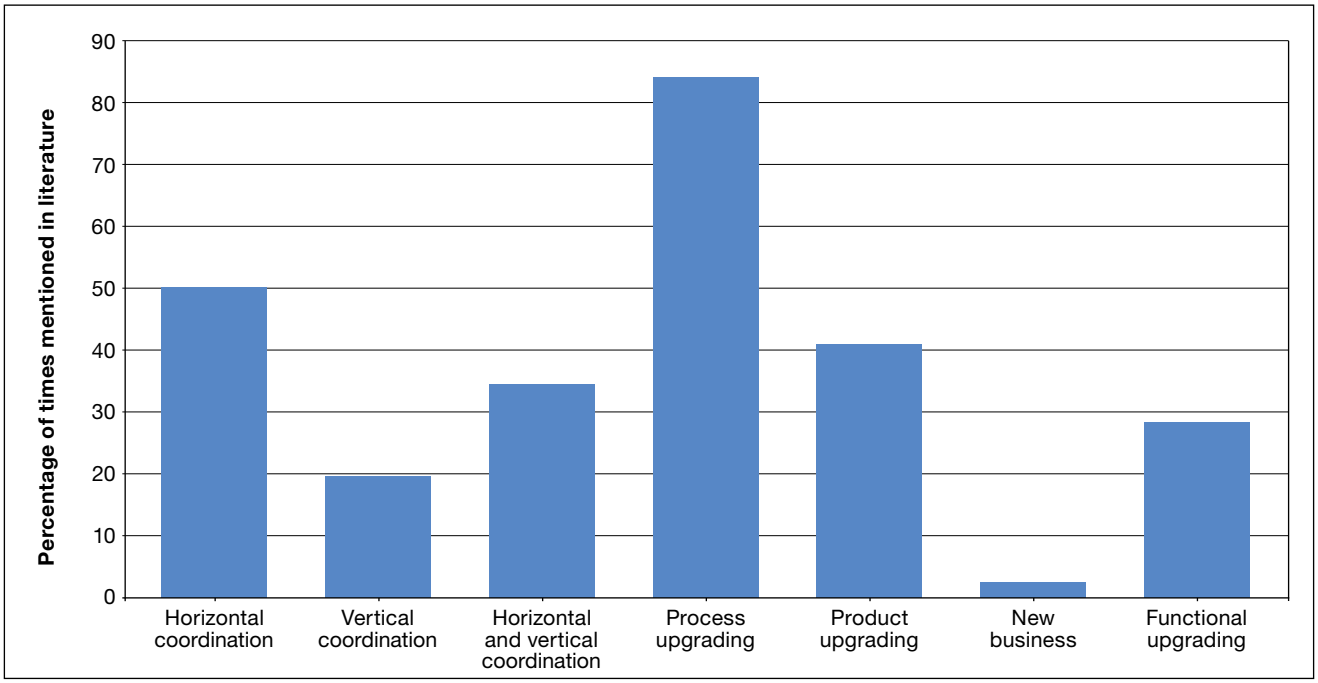
3
Focus of FTA value-chain interventions

The majority of studies (81 percent; Figure 3) that provided detail on interventions indicated that gender was a specific focus; most (84 percent) of those focused on women and sought to improve the position of women in FTA value chains. The remaining 19 percent of studies addressed both men and women.

The most successful interventions in the reviewed studies were those attempting to combine horizontal and vertical upgrading (Box 1 describes various upgrading strategies). Horizontal upgrading, which was more common, was used in half the interventions (Figure 4), and over one-quarter of the interventions used both strategies. Most (84 percent) interventions resulted in process upgrading (in which a reorganization of productive activities led to the more efficient transformation of inputs into outputs); 41 percent of interventions upgraded products – that is, they supported the development of new or more sophisticated products with increased unit value. Over one-quarter (28 percent) of interventions had functional upgrading outcomes, with new functions created to increase the skill content of activities. Around one-third (34 percent) of interventions used multiple strategies for upgrading – most commonly the upgrading of processing, products and functions; our assessment was that this combination of strategies was most successful.

Interventions in cacao – a commodity often cultivated in mixed agroforestry and farm systems – and shea (which is largely wild-harvested) provide insights into the types of interventions and their impacts. Cacao is presented as a typical "male crop" due to the physical work involved, because it is a cash crop, and because

4
Types of interventions in FTA value chains



Box 1
Upgrading strategies

Horizontal coordination between the same types of actors – e.g. harvester groups and trader cooperatives.

Horizontal integration. A strategy whereby a company creates or acquires production units that are similar – either complementary or competitive.

Vertical integration. An arrangement in which a company owns activities up and down a value chain. Often, each component of the chain produces or engages in different product or market-specific activities.

Vertical coordination. Actors in different chain positions coordinate (e.g. individual women or women's groups coordinate with their buyers or providers of services).

Product upgrading. Products become more sophisticated, with an associated increase in their unit value (e.g. products complying with buyer requirements for higher quality, certification, food safety standards, traceability or packaging).

Process upgrading. Processes transform inputs into outputs more efficiently by reorganizing productive activities (e.g. applying new processing technologies, delivering on schedule, or reducing wastage).

Functional upgrading. New functions are acquired in the value chain (moving downstream) (e.g. grading, primary processing, bulking and storage, transporting, or provision of services, inputs or finance).

New business actors. Actors who produce new products and product chains from a given primary material (e.g. developing cosmetics from shea nuts, or selling mushrooms that were previously collected for subsistence use).

Sources: Riisgaard, Escobar Fibla and Ponte (2010); GTZ (2007); Bolwig *et al*. (2008); Keane (2008); Mitchell, Keane and Coles (2009); Coles and Mitchell (2011).

most cacao farms are male-owned. Male cacao farmers generally benefit more from both the institutional context (e.g. access rights to credit, land and markets) and the social context (e.g. control over revenues, decision-making and bargaining power) than their female counterparts. The role played by woman in farming, post-harvest processes and quality enhancement has been highlighted only recently (e.g. Enete and Amusa, 2010; Kumase, Bissseleua and Klasen, 2010). The literature suggests that empowered female cacao farmers with access to farm inputs can influence decisions on cacao production, improve bean quality and quantity and increase incomes from cacao farming (Vigneri and Holmes, 2009).

Major chocolate-manufacturing multinationals and non-governmental organizations (NGOs) have increasingly acknowledged gender gaps – particularly in access to programmes such as training and certification and to credit and other inputs (Banerjee, Klasen and Wollni, 2014; Barrientos, 2013; Kumase, Bisseleua and Klasen, 2010; UTZ, 2009). Such programmes are generally in the early stages of design and implementation, however, and their impacts are either not yet apparent (Ingram *et al*., 2014; Waarts *et al*., 2013) or are only just becoming so (International Institute of Tropical Agriculture, 2006).

Numerous interventions have been made in the last two decades to increase the inclusion and incomes of female producers and processors in shea export chains in West and Central Africa. Such interventions – mainly by donor and NGO projects – were reported to improve women's access rights to shea nuts, increase shea butter quality and volume, and enhance women's influence in household decision-making and bargaining power (Banye, 2012; Greig, 2006; Hatskevich, Jenicek and Darkwah, 2011; Konate, 2012; Perakis, 2009; Sidibé *et al*., 2012; Traoré, 2002). The literature often lacks independent, detailed impact analyses, however: it generally presents outcomes for women as a homogenous group that is positively influenced by inclusion and upgrading strategies. Poudyal (2009) and Elias (2010) indicated that some interventions have been captured by elites at the expense of marginalized groups, limiting empowerment to specific groups of women. Elias (2010) also cautioned that interventions have led to household and societal changes related to power, income and household tasks that have been perceived negatively: the "success" of such interventions has led to men encroaching on what were previously female activities, thereby shifting power dynamics, increasing social differentiation, changing household consumption patterns, and ultimately leading to a loss of livelihoods, particularly for women (Baden, 2013; Wardell and Fold, 2013).

IMPROVING THE IMPACT OF INTERVENTIONS

Lessons drawn from the reviewed studies on interventions to improve gender equity in FTA chains include the following:

- An integrated view of technical and sociocultural practices is best when making interventions. Changing established practices may require a multipronged strategy and will take time. The use of role models and pilots can help demonstrate the benefits of gender equity and further stimulate social change.
- Technological changes (e.g. training in agroforestry or beekeeping) that benefit certain groups of people were more successful and sustained when complemented with market-orientated activities such as marketing and quality-improvement campaigns, networking with traders, and trade fairs, or with economic capital (e.g. credit) for investment in (new) FTA value-chain activities and to sustain

enterprises during initial phases of process or product upgrading.
- Collective action and self-help groups are often effective in stimulating change but need substantial initial support from local institutions and leaders as well as intervening projects and programmes.
- Increasing women's benefits through interventions can have both positive and negative short-term sociocultural repercussions.
- Interventions with a combination of vertical and horizontal upgrading are most successful.
- Raising awareness of the position of women and subsequently empowering them through training, technology, increased negotiating capacity, business skills development and market information are common strategies for enabling both women and men to implement their own successful upgrading initiatives.
- Few studies predicted any gendered impacts of their interventions; generally there was only ex-ante documentation of impacts. Some impacts differed from the aims of the interventions.
- Women are disadvantaged by general societal factors that hinder their ability to operate effectively in value chains, compared with men. The most frequently mentioned factor was women's unequal access to education, resulting in lower levels of literacy.
- Interventions to introduce labour-saving technologies (e.g. nut-cracking machines, mills, cultivation to reduce forage time, energy-efficient stoves, and biogas plants) were notable in freeing up women's time and thereby enabling them to engage in higher-value activities, upgrading and other economic activities.
- Regulations that counter discrimination and support collective action and equal labour rights can help set a foundation for more equal gender relations.
- "Out of the box" interventions can address difficult-to-change governance and political contexts. For example, rules on land ownership were circumvented when an intervention or project encouraged women to use marginal and barren lands to grow and market new agroforestry products.
- Pilots and demonstrations that (for example) involve unprecedented female leadership in FTA value-chain activities can support change by demonstrating the possibility of new gender relations in value chains, and the benefit of these.
- A "gender-sensitive" approach in interventions can be a crucial criterion for success. It must go hand-in-hand with well-selected beneficiaries and intervention partners and the development of the gender-mainstreaming capacities of implementing agencies.

CONCLUSIONS

The absence of gender-disaggregated data on male and female activities higher up in FTA value chains is notable in the reviewed literature; rather, the focus is on harvesting and primary processing in developing countries. Few of the reviewed studies mentioned the gender-disaggregated impacts of interventions on the sustainability of the resource – that is, the species or ecosystems that ultimately supply the FTA products. Most studies did not include a baseline situation, making it difficult to compare the "before" and "after" situations in value-chain interventions, particularly for projects spanning long periods. The majority of studies reported on a short period, often during or directly after an intervention, and few examined changes in gender relations over a longer time scale. In the reviewed studies, interventions often had a strong female bias, most notably in the shea and apiculture product chains, in which men were excluded to the advantage of women. Indicators of successful gender-equitable interventions need to include both economic metrics (e.g. profit, revenue and the number of women and men participating in a chain) and sociocultural metrics (e.g. women and men's perceptions of changes, roles and social acceptability).

Our review suggests that participation in FTA value chains is gendered not only because of the sociocultural, economic, governance, political, institutional and environmental contexts but also because of other factors of social differentiation, such as education, age and ethnicity. Gendered constraints on women's participation in and benefits from FTA value chains occur mainly due to sociocultural, political, economic and environmental factors. The influence of each factor varies depending on the product, geographic region and cultural setting. "Gender" is often used in the literature as shorthand for a focus on women in FTA value-chain interventions rather than on relations between women and men. Men were cast in a negative light in some studies; for there to be positive prospects for gender-equitable and sustainable outcomes, however, the impacts on both women and men, and the ways such impacts interact, should be addressed in value-chain interventions.

These findings suggest that future research and interventions should pay more attention to the following four areas:

1. **The long-term impacts of interventions on gender relations for participation in and the benefits derived from FTA chains.** Such impacts need to be monitored and evaluated and could also be predicted before interventions (e.g. by using intervention logics developed in a participatory way with value-chain actors). Effecting real change, for example in customs and tenure, takes time; policy-makers, the private sector, development practitioners and the research community should understand this and not expect short-lived interventions to bring about enduring change.
2. **Greater understanding of the impact of single-sex bias in interventions.** For example, if women are

supported, what are the impacts on men, and what longer-term changes in societal and market dynamics might this bring about?

3. **The impact of gender on product and resource sustainability.** For example, do women and men manage the wild and cultivated resources used in value chains differently, and do interventions affecting roles and benefits in chains influence this?
4. **Indicators of impacts.** Pragmatic, easy-to-use indicators are needed to set pre-intervention baselines and measure the economic, social, environmental and governance impacts of FTA value-chain interventions. Ideally, such indicators would also enable comparisons between FTA chains in different geographical regions.

ACKNOWLEDGEMENTS

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Addressing forest degradation in a Small Island Developing State: a landscape approach in Comoros

H. Doulton, M. Mohamed, G. Shepherd, S. Mohamed, B. Ali and N. Maddison

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A worker tends seedlings in a tree nursery at Adda, Anjouan

An initial focus on natural resource management for immediate local benefit while building an evidence base for conservation is helping this project succeed where others have failed.

Hugh Doulton, **Misbahou Mohamed, Siti Mohamed** and **Badroudine Ali** are with Dahari in Mutsamudu, Comoros.
Gill Shepherd is an advisor to IUCN's Commission on Ecosystem Management.
Neil Maddison is with the Bristol Zoological Society.

Although Small Island Developing States (SIDS) face many of the general challenges of developing countries, it is recognized that they share specific characteristics that increase both the complexity and severity of those challenges. Various global assessments (e.g. United Nations, 2005) highlight their: limited natural resources, which are under pressure due to high population densities; low institutional capacity; dependence on international trade despite high costs and the difficulty of accessing markets because of their isolation; and greater vulnerability to climate change due to the concentration of people and economic activities in coastal zones.

Such challenges are evident in Comoros, an archipelago in the Western Indian Ocean and one of the poorest countries in the world (UNDP, 2014). The challenges are especially evident in Anjouan, the country's poorest and mostly densely populated island: approximately 275 000 people live there, of whom more than 90 percent are dependent on agriculture; the population density averages more than 550 people per km^2 and continues to rise. Guy, Yao and Ibrahim (2015) estimated that Anjouan lost 80 percent of its forest cover from 1995 to 2014, and about 30 of 45 formerly

permanent rivers on the island have become intermittent in the 40 years since decolonization (ECDD, 2012). Efforts to develop natural resource management are complicated by very low institutional capacity at all levels.

Two factors differentiate Comoros and particularly Anjouan from many other SIDS. First, rather than low-lying, the islands are composed of extremely steep volcanic slopes. Heavy deforestation has therefore led to severe erosion, resulting in topsoil loss and the silting of coastal reefs. Second, the island of Mayotte, 60 km from Anjouan, remained under the control of France at independence in 1975 and became the 101st department of France in 2011 (although the Government of Comoros still contests its sovereignty). Because of heavy French investment, Mayotte has become a magnet for impoverished Comorians, who risk their lives to enter the island illegally.

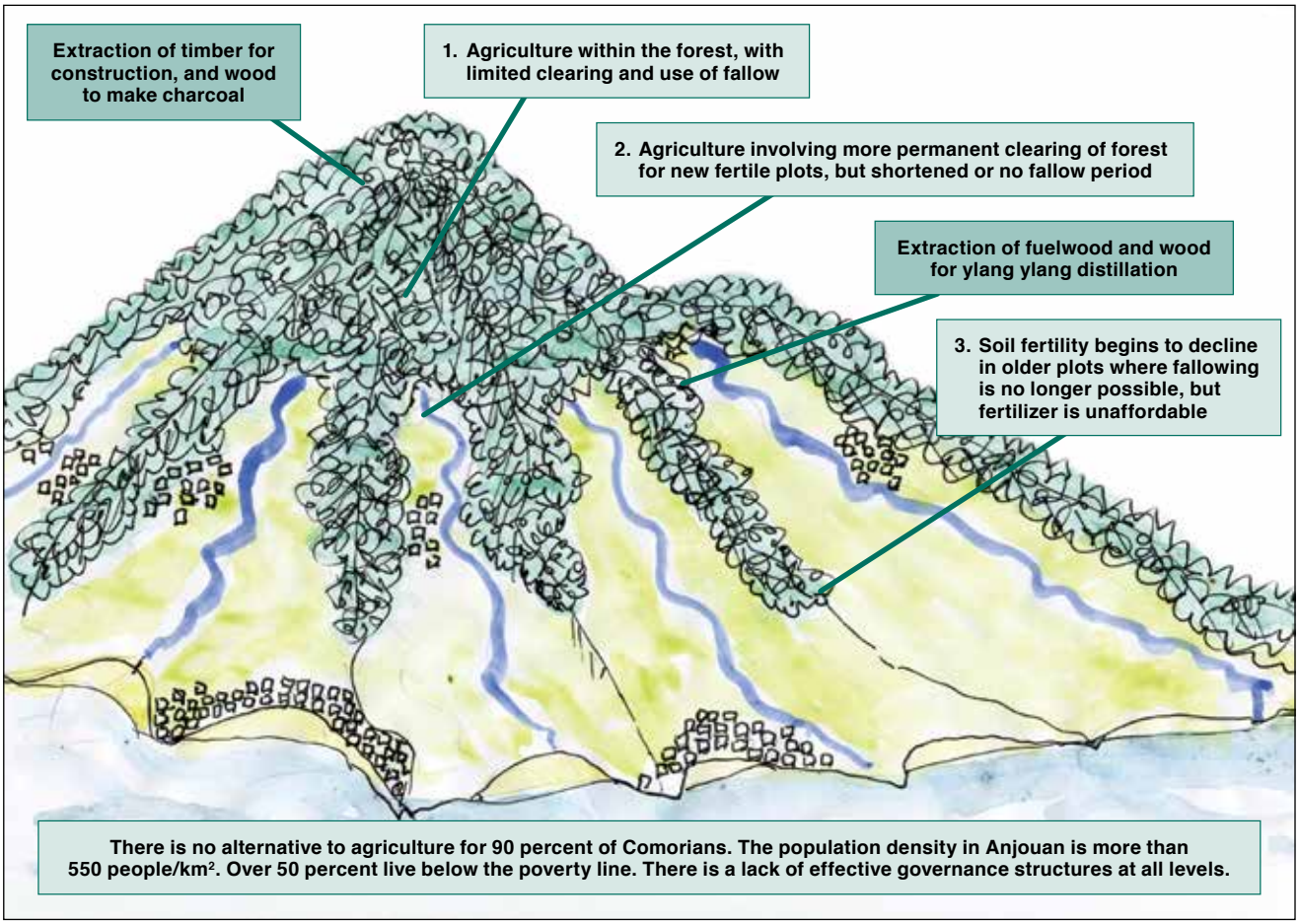
Since 2013, the Comorian non-governmental organization (NGO) Dahari ("Sustainable")[1], which grew out of the project "Engagement Communautaire pour le Développement Durable" (Community Engagement for Sustainable Development, ECDD), has been working with Comorian communities to shape sustainable and productive landscapes. Dahari's core interventions address rural development, terrestrial natural resource management and biodiversity conservation.

The overall aim of Dahari's work is two-fold: 1) to improve the economic conditions of rural Comorians; and 2) to protect the remaining natural resources and endemic biodiversity. Dahari is attempting to break the vicious cycle of poverty and natural resource degradation, as illustrated in Figure 1. Agriculture is largely extensive, using techniques that are often poorly suited for conserving soil fertility on steep slopes, thus pushing farmers further up the slopes to cut new fertile fields. Natural resource management efforts are complicated by a breakdown in social cohesion and traditional governance structures at the village level, as well as by weak state capacity.

From the start, Dahari's interventions have attempted to tackle these problems as an interdependent whole through the adoption of an integrated landscape management approach.

[1] www.daharicomores.org.

1
The problems leading to deforestation in Anjouan



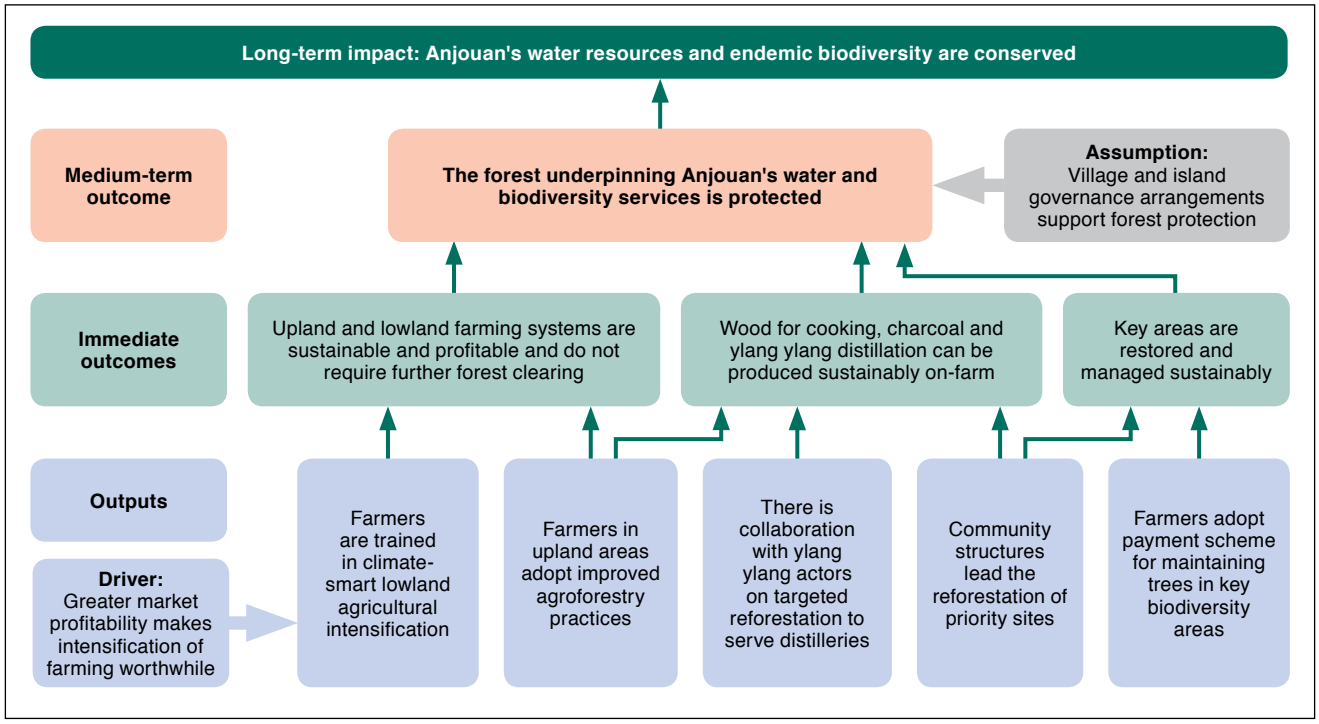
METHODOLOGY/APPROACH

Dahari's approach to achieving its goals is based on six principles, described below.

1. The initial priority was natural resource management in the context of economic development, rather than biodiversity conservation for its own sake. Prioritizing development enabled Dahari to gain the trust of local communities and to identify ways of improving their livelihoods before looking at conservation measures that might impact negatively on livelihood opportunities.
2. The initial participatory approach led to Dahari ceding too much power to the communities it was working with, and Dahari was caught in a web of manipulation and interests at the village level, often a result of previous, largely failed development interventions. Dahari continues to look to develop participatory decision-making structures but maintains a certain level of control to ensure that its interventions achieve community goals.
3. Previous proposals (e.g. the 2006 Conservation Action Plan for Livingstone's Flying Fox) for protecting endemic biodiversity in Anjouan, notably the flagship Livingstone's fruit bat (*Pteropus livingstonii*), advocated the creation of small areas of protection. From the beginning, Dahari felt that the long-term protection of biodiversity could only be secured if the root problems leading to natural resource degradation were tackled; therefore, a landscape-scale intervention was chosen.
4. Dahari's discussions with local communities led it to believe that most people were well aware of the problems they were facing because of deforestation; people felt that the loss of water resources and soil fertility was markedly greater than that experienced by the previous generation. Dahari decided that improving access to water was more likely than environmental education to increase support for conservation measures.
5. Who pays for activities depends on who benefits. Activities that benefit individuals are paid for by those individuals – in contrast to several previous projects, which gave out agricultural inputs for free, leading to skewed motivations for participation. The costs of collective management projects are divided between the collective beneficiaries and Dahari, with community contributions being made in kind, where possible. International conservation funders and Dahari's ecotourism programme pay for biodiversity conservation activities.
6. The intervention takes an adaptive management approach. Dahari's activities and approach are constantly being appraised and re-orientated based on experience and the results of studies that Dahari commissions or undertakes itself.

Dahari's theory of change (Figure 2) and these six guiding principles led Dahari to focus the majority of its work and resources in the past seven years on agricultural development, a focus that enabled it to

2
Simplified theory of change supporting Dahari's current and planned interventions



A Dahari technician leads a participatory forest management planning exercise on Anjouan

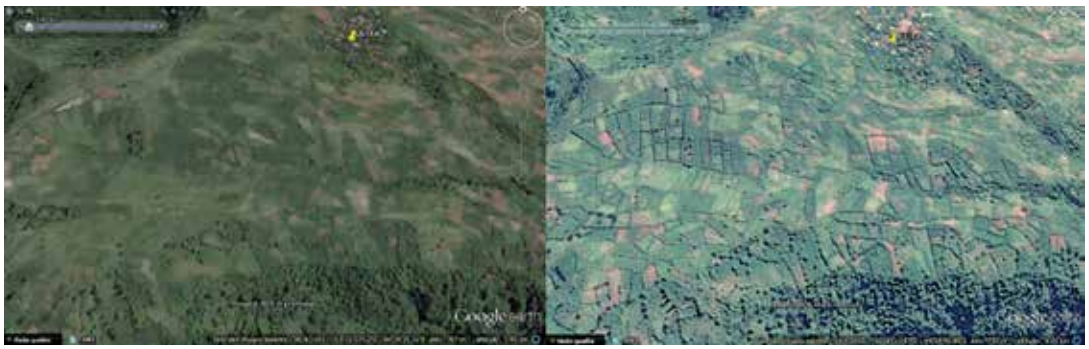
concentrate on improving livelihoods in a way that reduced pressure on natural resources. Dahari first worked to improve the delivery of both revenue-generating and agro-ecological techniques that had already shown results in Comoros: market gardening for trade; the installation of anti-erosion bunds and plot hedging; the distribution of improved food-crop varieties; improvements in the integration of livestock management and agriculture; and techniques for improving soil fertility. Training was delivered initially on an individual basis but is now given through farmer field schools, with the long-term aim of developing cooperatives.

From 2012, and with the support of international partners (first Agronomes et Vétérinaires Sans Frontières – AVSF – and then Centre International pour la Recherche Agronomique pour le Développement – CIRAD), the project has introduced to Comoros innovations that have proved successful elsewhere in the region. These include improved cattle stalls; drip irrigation; improved rotations and crop associations according to the principles of no-till farming; and improved crop varieties and better techniques for their propagation.

On the natural resource management front, the protection of water resources was used as an entry point for wider forest management. An initial hydrogeological study commissioned by Dahari and AVSF identified the loss of mist forest in the highlands – which international studies suggest can add as much as 20 percent to water retention – as the proximate cause of water loss, although the study also suggested that enough water could still be made available to the population if delivery networks were improved (Charmoille, 2012).

Dahari worked with five communities to improve piping systems for delivering drinking water, identified highland sources with potential to provide water for agriculture, and developed irrigation sites. A constant challenge throughout has been the difficulty of identifying or creating village institutions capable of managing these types of collective projects, a result of the social structures of the villages.

On the biodiversity front, Comoros lacked basic ecological data to enable the scientific identification of conservation priorities; from 2009, therefore, Dahari undertook a wide programme of forest mapping and biodiversity surveys on the islands of Grande Comore, Mohéli and Anjouan. The challenge now is to integrate these ecological data with social realities. In areas that are important for biodiversity but of less tangible value for the provision of ecosystem services that directly benefit Comorian communities, a logical and practical approach has been to develop a payment system for ecosystem services. Dahari is working with farmers to develop strategies that will support biodiversity conservation in the long term, based on the understanding that opportunity costs should be met by conservation funders, including partner zoological societies that hold Livingstone's fruit bat – a Comoros species that Dahari studies have shown is under severe threat – in their zoos.



© GOOGLE EARTH

3
Images from Google Earth of part of Dahari's intervention zone 17.127'S and 44° 29.712'E; 2003 (left) and 2015 (right), illustrating the impact of hedging and bunding

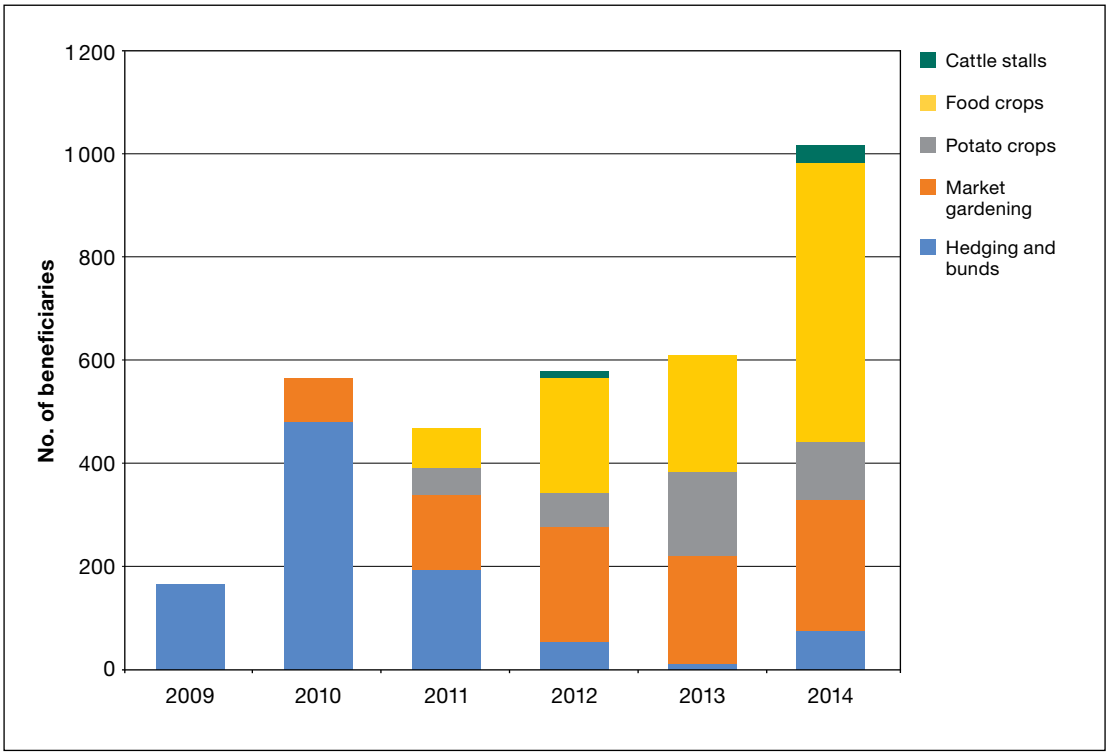
RESULTS

Agricultural development

Dahari's efforts towards agricultural development are focused on improving yields in fields lower down the slopes to reduce pressure on upland areas, where most of the remaining forest is situated. The first step is to re-establish the fertility lost due to soil erosion and the failure of agricultural techniques to adapt to change, such as increased population density. Hedges and anti-erosion bunds composed of fast-growing tree species have been established, with cuttings provided as loans; the terms of these loans require beneficiaries to give back, within two years, 1.5 times the number of cuttings they received, to be passed on to other farmers. Figure 3 shows the impact of this approach on the landscape.

Other agricultural support is focused on improving the yields of food crops essential for food security – with excess sold in local markets – and increasing revenues from market-garden crops while reducing the overuse of chemical fertilizers and pesticides that have negative impacts on soil fertility in the long term and leach into water supplies. Anti-erosion measures form part of all Dahari's agricultural interventions, with farmers trained to plant across contour lines and to develop ridges to protect root crops. Integrating livestock management with agriculture is another key way of improving fertility in the long term: farmers with cows or goats are supported to improve their productivity by introducing improved forage species and installing improved cattle stalls that capture rainwater and facilitate manure management.

Additional techniques for improving the yields of food crops include the use



4
Number of beneficiaries of various agricultural campaigns since the start of intervention

Livingstone's fruit bat – a critically endangered species in Comoros

of organic compost and the provision of seed varieties of bananas, manioc and yam – grown in Dahari's two agricultural centres – that produce higher, faster yields than existing varieties. As for hedge cuttings, farmers must give back a quantity of the improved seeds within one year to be passed on to other farmers.

Support for market gardening is provided in the form of training and the delivery of high-quality seeds and other agricultural inputs. A network of entrepreneurs selling agricultural inputs has been developed throughout the intervention zone, with Dahari importing seeds and potato tubers. Figure 4 shows the number of beneficiaries of agricultural campaigns over the intervention period.

The agricultural revenues of a subset of 50 beneficiaries have been monitored since January 2014 to evaluate more closely the impact of these actions on livelihoods. By the beginning of 2016, 48 percent of this subset had increased their agricultural revenues by 25–750 percent.

Natural resource management

Early on in Dahari's intervention, communities identified water as the key ecosystem service; conserving water supplies is thus an important mechanism for motivating people to support natural resource management. Dahari worked initially to improve the drinking-water supply for five villages while supporting reforestation around rivers and water collection points. Efforts expanded to tapping upland water sources to develop agricultural irrigation. Members of the communities undertook all manual work without payment, and further community contributions were made in the form of building materials and small amounts of money.

Building on the lessons learned about the complexity of delivering collective management projects, Dahari is now focusing on supporting committed and influential individuals engaged in the long-term future of their communities to manage and reforest water catchment areas. Dahari has mapped out three water catchment areas with local communities, discussed management actions with them, and put in place community-managed tree nurseries for replanting programmes that began at the end of 2015. The strategy for rollout is that visible success on a small scale will encourage people to look at wider forest protection.

Dahari technician Inzou (right) teaches a technique to village outreach agents

Biodiversity conservation

Dahari concentrated initially on developing an evidence base for conservation in Comoros. Forest maps based on satellite images were produced to help in understanding the extent of the forest resource and to provide a baseline for monitoring change; field surveys enabled the development of distribution models of key taxa to identify biodiversity hotspots and species under particular threat; and detailed population and distribution studies were conducted on the endangered Livingstone's fruit bat and the critically endangered Anjouan scops owl (*Otus capnodes*).[2]

The work showed the importance of undertaking detailed research before implementing a conservation programme: the Anjouan scops owl population was found to be much larger than previously reported, leading to a recommendation for the downgrading of its conservation status to "endangered". On the other hand, the Livingstone's fruit bat was found to be under great threat, leading to a recommendation for the upgrading of its status to "critically endangered", which was subsequently achieved.

Dahari is now developing its first conservation programmes around the protection of roost sites of the Livingstone's fruit bat. A payment scheme for ecosystem services is being developed to compensate farmers for changing their land-use practices; European zoos and conservation funders have been approached to provide long-term financing for the scheme. Discussions are underway with relevant landholders, many of whom are already being supported in their agricultural development.

Integrating results into a landscape management system

Figure 5 illustrates Dahari's activities in Ouzini, one of the prioritized upland villages. Discussions and planning sessions in this community and others showed that attempts to develop large-scale management plans as a participatory guide for intervention would not be successful due to low local capacity and cohesion. The approach is thus activity-focused, with different intervention programmes planned

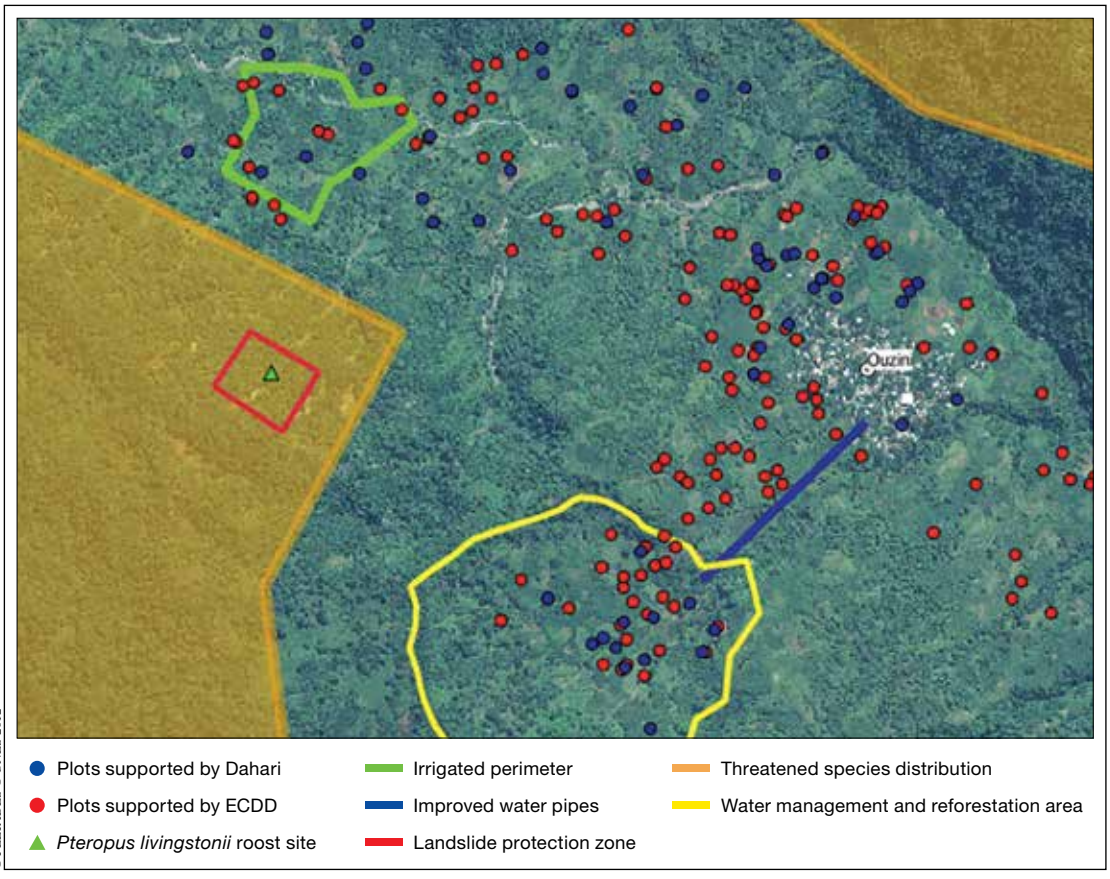
[2] The results of this work are available at: www.ecddcomoros.org/resources/reports-and-publications

separately with relevant members of each community (either individually or in small cohesive groups). As natural resource management actions progress, the aim is to mobilize more villagers around this work and to undertake wider landscape management planning exercises to draw results together into long-term plans managed by local community groups.

DISCUSSION

This is the first time that a landscape management approach has been applied in Comoros, and the strong pressure on agricultural land and natural resources, coupled with low institutional capacity, has brought major challenges. Although the work is far from complete, Dahari's success to date can be traced to its original philosophy of intervention. The key elements are as follows:

- Previous interventions in Comoros with conservation aims lost the trust of villagers, who felt that their needs were not prioritized. Foregrounding natural resource management for immediate local benefit while building an evidence base for conservation has avoided these issues.
- In the context in which the intervention is taking place, "participation" has often led to the creation of illegitimate community bodies whose members are adept at siphoning off the benefits of "development" to a small subset of the community. The in-depth knowledge of Dahari's field technicians of community structures and individuals, as well as the learning gained from various collective projects, has enabled the identification of local leaders to support in collective work, while at the same time maintaining a level of control over interventions to ensure they achieve their own end goals.
- A desire to tackle the root causes of problems means that interventions must take place at the landscape scale. This is the only way of achieving sustainable outcomes in Comoros, but it requires long-term investment.
- Breaking the poverty–deforestation cycle, rather than environmental education, has been the key to getting conservation buy-in from villagers, who talk nostalgically of a time when there was more forest, greater productivity, more water, and more wildlife.
- Dahari spent a long time working to avoid the mistakes of previous intervention models, which paid people to work on collective projects and even for activities in their own fields but achieved long-term impacts only rarely. The best (and possibly only sustainable) way of ensuring that beneficiaries are committed and will maintain activities is to convince them



5
Activities forming a landscape management approach illustrated for the village of Ouzini, including plots supported by the ECDD project from 2009 to 2013 (red) and those supported by Dahari (blue) since 2014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Dahari ecological technician Ishaka looks for owls at dusk on Anjouan, Comoros

to invest their own time and resources, even if this slows implementation.
- Testing interventions, undertaking studies, evaluating their effectiveness and reformulating or abandoning those that have failed have been essential parts of the process.

OUTLOOK

In searching for a holistic approach that tackles the various pressures on landscapes, Dahari is working with partners to explore a variety of new interventions in line with its theory of change (Figure 2). A detailed study on wood use is being undertaken with the aim of identifying ways of reducing the extraction of timber and woodfuel from old-growth forest. The export of market-garden crops to the capital Moroni and to Mayotte is being developed as a way of providing producers with a stable and substantial increase in revenues; one approach could be to tie contracts for such markets with the sustainability of farmer practices.

Other activities being explored in the medium term include tackling poor health outcomes and increasing access to family planning services; improving education services; improving marine management to revitalize reef systems and restock coastal fisheries; and increasing revenues from the cash crops of ylang ylang essence, cloves and vanilla.

Such challenges might seem beyond the remit of a conservation-led organization, but it may be the only way of achieving long-term sustainability in Comoros.

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Using gums from Argentinian native forest species in the food industry

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The sustainable extraction of natural edible gums has the potential to provide local people with reliable employment in native forests.

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Argentina's forest regions host a wide diversity of species for non-wood uses, many of which are barely used. As a result of the enactment of National Law No. 26.331 on minimum standards in the environmental protection of native forests, major efforts are being made to promote the multiple use of native forests and to reverse land-clearing in the face of an advancing agricultural frontier. Forest-based employment has increased in recent years, highlighting the economic benefits generated by well-managed forests and their potential to contribute to sustainable development and promote food security.

Among the wide diversity of non-wood forest products (NWFPs), gums of plant origin are of great importance worldwide because of the variety of uses they have in the manufacturing, chemical, pharmaceutical and food industries.

Natural gums can be extracted from land or aquatic plants and from micro-organisms. They are highly polymerized

A dwelling in a community of Wichi people in Parque Chaqueño, Department of Rivadavia, Province of Salta, Argentina. A natural gum industry could provide reliable employment for local people in the region

carbohydrates – insoluble in alcohol and other organic solvents but highly soluble in water. Natural gums are also known as hydrocolloids because they behave like hydrophilic colloids, which have the ability to form viscous gels or solutions when combined with an appropriate solvent. They are composed of monosaccharides linked by glycosidic bonds, which may or may not have branches. Gums differ from natural resins in their composition and solubility (Whistler and Daniel, 1985; Whistler, 1973).

The food-processing industry has a high demand for gums of plant origin for their role in controlling the textural properties of foods and increasing shelf life. The physical properties of natural gums mean that many can be used as thickening, stabilizing and emulsifying agents (Considine and Considine, 1983; Pasquel, 2001).

Gums obtained from tree species can be extracted from seeds: examples are galactomannans like guar gum, derived from the seeds of *Cyamopsis tetragonolobus*, and locust bean gum, derived from *Ceratonia siliqua*. Gums can also be obtained from trunk and branch exudates, such as gum arabic from an exudate of *Acacia senegal*, gum tragacanth from *Astragalus gummifer*, and gum karaya from *Sterculia urens* (Verbeken, Dierckx and Dewettinck, 2003; Pasquel, 2001).

Natural gums are used mainly in the food industry as food additives, where they perform a technical role in the food preparation process. Food additives are classified according to their function and are assigned an INS [International Numbering System] number that can be searched in the Codex General Standard for Food Additives (Codex STAN 192-1995).

The overall objective of the study reported in this article was to collect and consolidate information generated in various scientific disciplines contributing to knowledge on the sustainable use of species for gums (e.g. the biological sciences, forestry and agricultural engineering); employment in native forests (e.g. economic and social sciences); and gum processing for innovative applications in the food industry (e.g. chemical sciences and food engineering). Specifically, in this article we identify those species in Argentina's native forests from which gums may be derived for use as food additives, about which there is sufficient knowledge to develop projects that incorporate their use and application in the food industry. In addition, we present information on the phenological characteristics of those species, their distribution by province, and the harvesting and processing of their gums.

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Brea gum is collected from* Cercidium praecox*. It has multiple uses in the food industry

METHODOLOGY

To identify species that produce gums with potential use as food additives, we reviewed the proceedings of scientific meetings on food and international food science and technology held in Argentina in the past ten years. Based on the papers found, the search was expanded to national and international scientific publications.

The Catalogue of Vascular Plants of the Southern Cone (Zuloaga, Morrone and Belgrano, 2008) and the website available at www.darwin.edu.ar (accessed December 2014) were consulted for the nomenclature and distribution of the species.

For each species, the state of knowledge was noted on the methods for obtaining and processing various gums, their physical and chemical characteristics, and possible applications in the food industry. The Código Alimentario Argentino (Argentine Food Codex – CAA) was consulted to determine which products obtained from the various species were included in it.

RESULTS

Gums obtained as exudates from terrestrial plants

Cercidium praecox

Cercidium praecox has two subspecies that produce gums as exudates:

1. *Cercidium praecox* (Ruiz and Pav. ex Hook.) Harms ssp. *praecox* ("brea"), in the provinces of Catamarca, Chaco, Córdoba, Formosa, Jujuy, Salta, Santiago del Estero, Santa Fe, San Luis and Tucumán; and
2. *Cercidium praecox* (Ruiz and Pav. ex Hook.) Harms ssp. *glaucum* (Cav.) Burkart & Carter ("brea"), in the provinces of Catamarca, La Pampa, La Rioja, Mendoza, Neuquén, Río Negro, Salta, Santiago del Estero, Santa Fe, San Juan, San Luis and Tucumán (Zuloaga, Morrone and Belgrano, 2008).

Cercidium praecox is a tree that reaches 3–8 m in height. The *glaucum* subspecies is smaller than the *praecox* subspecies and adopts shrubby forms. *Cercidium praecox* has compound leaves and yellow flowers 1–2 cm in size, which occur in clusters. The fruits are dehiscent pods with 2–5 seeds. The tree has a smooth bark and a texture that is grainy to the touch and light green. The species reproduces through seed multiplication. It behaves as a colonizer in degraded areas, and it commonly occurs in high densities in burnt, cleared or abandoned areas. The main use of the species is for the water-soluble gum exuded by its trunks and branches when cut (accidentally or intentionally). The plant secretes this gum, known as brea gum, as a mechanism for healing wounds. The exudate can be induced by making 1–3 incisions 1.5 cm deep; gum exudation begins within 15–30 days and gum is collected manually after some weeks. The exudate is purified by a simple process of dissolving it in water, then drying and grinding it into a fine powder. An adult tree can secrete 100–300 g of gum per year, with most gum production occurring in spring and summer. Brea gum production in the central-east region of Chaco Árido varies greatly between individual trees, sites and site conditions (von Muller, Coirini and Karlin, 2010). Most of the gum produced is obtained from individuals 5–20 cm in diameter at breast height (Coirini, Karlin and Reati, 2010).

Specimens of* Cercidium praecox*, an abundant species in the Parque Chaqueño forest region, Argentina

Brea gum is composed mainly of polysaccharides with a high percentage of protein; it has similar structural and functional characteristics to gum arabic, and it is used as a thickener, gelling agent, emulsifier and stabilizer (Castel *et al*., 2012). In one experimental application, the incorporation of *Lupinus mutabilis* (a protein-rich South American lupin) into fresh breads was supplemented with brea gum to help maintain rheological properties; the resultant bread had a high content of essential amino acids but otherwise similar characteristics to traditional bread (López, 2014). Brea gum is listed in the CAA in Article No. 1398 of Chapter XVIII, Section No. 72.1, as a thickener, stabilizer and emulsifier.

Prosopis alba

Prosopis alba has two varieties that produce gums as exudates:

1. *Prosopis alba* Griseb. var. *alba* ("white carob tree"), in the provinces of Buenos Aires, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, Jujuy, Salta, Santiago del Estero, Santa Fe and San Luis; and
2. *Prosopis alba* Griseb. var. *panta* Griseb. ("white carob tree"), in the provinces of Chaco, Córdoba, Corrientes, Entre Ríos, Jujuy, Salta, Santa Fe, San Luis and Tucumán (Zuloaga, Morrone and Belgrano, 2008).

The white carob tree grows to 18 m high and 1.5 m in diameter, with a grey to brown-violet bark. It has pinnate compound leaves and inflorescent spikes, and yellowish indehiscent fruits that are 12–25 cm long and 1.2–2 cm wide, semispherical and somewhat flat; the seed has a very hard testa. The species is a heliophile, mesoxerophile and xerophile (Tortorelli, 2009). The flowers are meliferous. The fruit provides excellent fodder and can be used as a constituent in many foods and beverages, including flour obtained from milling (Mom, 2014). The species produces a water-soluble glycopolysaccharide, "white carob gum", which flows through wounds in the bark of the trunk and branches and eventually hardens into amber tear-shaped drops and nodules (Giménez and Moglia, 2003). Gum production increases when the trees are subject to high temperatures and water stress (Vilela and Ravetta, 2005; Lima, 1994). Natural yields can remain constant even if the number of wounds increases, and it has been observed that exudate production is associated with fungal infection. Various chemical treatments have also been effective in increasing gum production (Tewari and Harsh, 1998). Some studies of other *Prosopis* species indicate that young trees produce less exudate; mature trees produce an average of 1 kg of gum per year (with the production of individuals ranging from 0.25 to 2.5 kg).

For extraction and purification, the collected gum is dissolved (20 percent weight to volume) in hot water (at 75 °C) for one hour and the solution clarified by filtration, frozen at -18 °C and lyophilized. White carob gum shows similar physical and chemical characteristics to gum arabic, although gum arabic has a higher protein content, which may affect functional properties. The tannin content (a recognized indicator of toxicity) of white carob gum is lower than that found in other botanically related species (Vasile, Judis and Mazzobre, 2012a).

White carob gum has antioxidant and emulsifying properties. Satisfactory results have been obtained from efforts to encapsulate oils of high nutritional value and prevent their oxidative deterioration as a strategy for increasing shelf life and for use in the development of functional ingredients (Vasile, Judis and Mazzobre, 2012b).

Gums extracted from seeds of terrestrial plants

Gleditsia amorphoides

Gleditsia amorphoides has two gum-producing varieties:

1. *Gleditsia amorphoides* (Griseb.) Taub. var. *amorphoides* ("espina corona") in the provinces of Chaco, Corrientes, Entre Ríos, Formosa, Jujuy, Misiones, Salta and Santa Fe; and
2. *Gleditsia amorphoides* (Griseb.) Taub. var. *anacantha*, Burkart ("espina corona") in the provinces of Formosa and Misiones (Zuloaga, Morrone and Belgrano, 2008).

Gleditsia amorphoides is a leguminous tree of 12–15 m in height, with a straight trunk and branches with large ramified needles up to 8 cm in length. It has small, light-green flowers that are bundled together in clusters. The fruits are 8–12 cm long by 2–3 cm wide, and they bear albuminous brown seeds that are 10–12 mm long by 7–8 mm wide and contain galactomannans as a reserve material. *G. amorphoides* is a mesoxerofile species that occurs in the wetter areas of Parque Chaqueño (Tortorelli, 2009). It was first studied when searching for binder compounds that could replace the locust bean gum used in the food industry. An interdisciplinary group consisting of botanists, chemists and food scientists found "espina corona gum", which can function as a thickening or gelling agent; after performing a physical–chemical characterization, the group successfully tested its incorporation into food production (Rothman and Riqué, 1959). Espina corona gum is listed in the CAA in Article No. 1398 of Chapter XVIII, Section No. 73, as a thickener and stabilizer.

Espina corona gum is obtained by grinding the endosperms (free of germs and integument) of seeds. Several recent studies have been conducted on the rheological characterization and stabilization of emulsions of espina corona gum and others, including mixed systems of xanthan gum and espina corona gum (Perduca *et al*., 2011; Ibarra *et al*., 2012; Perduca *et al*., 2013a, 2013b; Masó *et al*., 2013). Some results indicate a synergistic effect, thus obtaining more viscous mixtures with fewer polysaccharides (Perduca *et al*., 2012).

Prosopis ruscifolia

Prosopis ruscifolia Griseb. ("vinal") occurs in the provinces of Chaco, Córdoba, Formosa, Salta, Santiago del Estero, Santa Fe and Tucumán (Zuloaga, Morrone

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Wichi producers receive training on the sustainable use of brea gum in Morillo, Department of Rivadavia, Province of Salta, Argentina

and Belgrano, 2008). It is a tree of up to 14 m in height and 45 cm in diameter. A legume and heliofile, it takes the form of dense bushes called *vinalares*, and it can grow in salty clay soils; it has potential as a pioneer species for forest restoration in harsh environments.

Prosopis ruscifolia has green to dark brown twisted trunks and large straight solitary needles up to 35 cm in length (but usually 10–15 cm). The leaves are compound and bipinnate. The fruits are compressed, yellowish red-violet, 12–18 cm in length and 2–4 cm in width. Seeds are dark brown with a very hard testa and up to 1 cm in diameter (Tortorelli, 2009). The fruits, which are available between November and February, have great nutritional importance for animals and humans, and they can be milled to produce flour. The seeds contain galactomannan as a reserve material; "vinal gum" has similar characteristics to locust bean gum and can be used as a food additive (Freyre *et al*., 2003). Busch, Santagapita and Buera (2013) found some differences in the rheological behaviour of vinal gum and locust bean gum. Busch *et al*. (2014) characterized the physical and chemical properties of vinal gum and found similarities with guar gum. Busch, Santagapita and Buera (2011) and Aguirre Calvo (2013) examined applications of vinal gum as a thickening agent and stabilizer.

DISCUSSION

Four tree species of the Fabaceae family in Argentina's native forests produce gums with potential use as food additives – *Cercidium praecox* (brea gum), *Prosopis alba* (white carob gum), *Gleditsia amorphoides* (espina corona gum) and *Prosopis ruscifolia* (vinal gum). These species are distributed in the centre and north of Argentina in the Monte and Espinal and especially in the Parque Chaqueño forest region.

Studies indicate functional similarities between: brea gum and gum arabic; white carob gum and gum arabic; espina corona gum and locust bean gum; vinal gum and guar gum; and vinal gum and locust bean gum.

CONCLUSIONS

Basic and applied information on the distribution, phenological characteristics, periods and conditions of exudate production and fructification of the four species, and knowledge of gum extraction, purification and applications such as food additives, are essential for the sustainable use of these resources and the development of effective strategies for bringing the gums into domestic food production. The commercial use of these species would generate reliable employment for local people in native forests, thus helping reduce deforestation pressure.

Tests should be carried out at an industrial scale on the extraction, purification, processing and use of tree gums as food additives. The value chains of each of the species should also be assessed. ◆

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Getting the positives out of forest landscape conflicts

S. Kane, D. Gritten, L.M. Sapkota, Linh Thi Bui and A. Dhiaulhaq

Mediation is an effective way of achieving win–win outcomes.

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The Asia-Pacific region is a hotspot for forest landscape conflicts (Gritten *et al*., 2013), which are often played out between local communities (including indigenous peoples) and outsiders such as government agencies and private companies. Increased competition for limited natural resources, rapid sociopolitical change, and expanding markets for forest products and land have heightened tensions and intensified conflicts over resource-use priorities (de Koning *et al*., 2008).

A conflict can arise when an actor feels impaired or restricted by the behaviour of another actor with differing perceptions, goals, values or interests (Lewicki, Gray and Elliot, 2003). The impacts of conflict can be both positive and negative. Positive outcomes – such as reaching win–win agreements and improving resource management via better collaboration – can

Above: Villagers in Kampong Speu, Thailand, attend training on forest law as part of a conflict-mediation process

emerge if the conflict is managed appropriately (Yasmi, Guernier and Colfer, 2009). Potential negative impacts of conflict include anxiety and fear, disharmony and division among social groups, distrust, high costs, and environmental degradation (Gritten, Saastamoinen and Sajama, 2009; Patel *et al*., 2013). Severe conflicts over resources can result in violence, resource degradation, the collapse of local livelihoods, and the uprooting of communities.

On the positive side, some conflicts can enhance collective action and increase awareness of those conflicts in affected communities; this may lead to pressure to clarify tenure (Castro and Nielsen, 2001; Hares, 2009). Additionally, some conflicts lead to the increased participation of local people in forest landscape management, including through inclusive negotiation processes and enhanced learning opportunities (Castro and Nielsen, 2001). Conflicts can therefore be constructive by helping increase understanding of the differing perceptions of and competing needs for natural resources and bringing urgency to the development of appropriate and sustainable solutions.

There are numerous methods for addressing conflict, including negotiation, arbitration, adjudication and mediation. The aim of this article is to examine the role of mediation as a tool for maximizing the positive outcomes arising from forest landscape conflicts. The article, which focuses on the Asia-Pacific region, provides recommendations for scaling up and mainstreaming mediation and other conflict transformation approaches.

APPROACH

The research reported in this article builds on previous research conducted by RECOFTC in 2009–2010, which provided an overview of forest landscape conflicts in the region and used eight case studies in six countries to examine how the conflicts were managed. One of the findings of that research was that mediation, where applied, appeared to be an effective approach for addressing conflict; another finding was that, recognizing this potential, research should be conducted on the use of mediation as a transformative approach for addressing conflicts. This was the basis for the research reported here, which was conducted at six sites in three countries in 2012–2014 (Table 1). The research methods included semi-structured interviews (314), focus-group discussions (19), and an international expert workshop.

TABLE 1. Description of the conflicts covered in research conducted in 2012–2014

Case study	Underlying causes	Principal conflict actors
Chiang Mai, Thailand	Contested tenure rights	Highland and lowland communities in watershed
Kampong Speu, Cambodia	Contested tenure, poorly regulated private sector	Rock-mining company and local communities, including indigenous peoples
Kampong Thom, Cambodia	Contested tenure, poorly regulated private sector	Rubber plantation company and local communities, including indigenous peoples
Kanchanaburi, Thailand	Contested tenure, top-down forest conservation efforts	National park and local communities
Jambi, Indonesia	Contested tenure, poorly regulated private sector	Oil-palm plantation company and local communities, including indigenous peoples
Riau, Indonesia	Contested tenure, poorly regulated private sector	Pulp and paper company and local communities, including indigenous peoples

See Dhiaulhaq, De Bruyn and Gritten (2015) for more information on these conflicts.

CONCEPTUAL AND ANALYTICAL FRAMEWORK

Conflict mediation

Mediation is a process for addressing conflict through the intervention of a third party (Wall, Stark and Standifer, 2001). The third party can be a mutually agreed individual, a team of mediators, or an organization. A common role of a mediator is to help the parties involved in a conflict ("the conflict parties") improve their communication and reach a better understanding of their conflict situation and, in so doing, help them identify and develop an agreement that meets the interests and needs of all parties (a "win–win" solution) (Engel and Korf, 2005). Although the conflict parties reach the final agreement themselves, the mediator's interventions, characteristics and behaviour (including strategies and techniques) can influence the conflict situation, the interactions among conflicting parties, the parties' motivations and expectations, and the mediation's outcomes (Bercovitch and Houston, 1993).

Conflict transformation

Conflict transformation refers to an outcome, process and structure orientation that promotes long-term cooperative relationships (Reimann, 2004). Augsberger (1992), for example, focused on changing attitudes (including so that the parties come to view each other in a spirit of goodwill and mutual respect) and behaviours (focusing on collaborative behaviour by, for example, removing incompatibilities to enable the pursuit of mutual gains). Lederach (1997) took this further, emphasizing changes not only at the personal and relational levels but also at the structural, institutional and societal levels, implying impacts beyond the conflict site. In practice, conflict transformation may include tools and processes similar to those associated with conflict prevention, management and resolution, with an emphasis on obtaining the most positive outcomes from a conflict and showing sensitivity towards issues of justice and rights.

RESULTS

Contested tenure and overlapping claims over forests and land were prominent causes in all the conflicts studied, often exacerbated by a lack of coordination among state agencies. The existence of contested tenure reflects the fact that, in much of the region, the state retains ownership of the land and largely adheres to top-down decision-making in forest landscape management. Increased demand for food, and hikes in commodity prices, have led governments to support agricultural expansion, including by handing over land claimed by local communities to companies as concessions.

Our research found that, at all six sites, mediation was not the first approach employed by the parties to address the conflicts. In some cases, the conflict parties initially avoided efforts to address the conflict directly. When it persisted, the conflict parties attempted direct communication and negotiation but often failed to produce agreements; they then chose mediation. In all cases, the conflict parties entered mediation voluntarily. Non-governmental organizations (NGOs) mediated four of the cases; in the two cases in Cambodia, the conflict was mediated by the Provincial Division of the Forestry Administration, a government office. In all the cases presented here, and especially in the Cambodian context, the mediators made significant efforts to be impartial and to openly address any risk of bias.

Consensual agreement was achieved at all sites (Table 2). Mediation not only achieved agreement; it also had additional positive perceived economic, social and environmental impacts that are directly attributable to the use of mediation in addressing the conflicts due to the emphasis it placed on strong social relations and empowerment in achieving agreement. At many of the sites, for example, improved social relations between the conflict parties, and the increased confidence of local communities in their rights and sense of empowerment, were manifested in the willingness of the local communities to invest in livelihood opportunities. In Kanchanaburi, for example, members of the local community were able to use the land for agriculture and other income-generating activities without disruption. This made them more confident in investing time and money in their agricultural activities, and now they grow their crops

A mediator presents information on community forestry in Kampong Thom, Thailand

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throughout the year, giving them a more stable and secure income. In the Chiang Mai case, the mediation led to the establishment of a watershed management committee that remains active. Among other things, the committee provides a platform for people from different villages in the watershed to meet, communicate and address issues in an inclusive manner.

The research suggests that mediation can work well for various types of forest and land conflicts, and even in high-intensity contexts (including significant violence, in the case of the conflict in Jambi). Numerous features contributed to the success of mediation. The research showed that the participatory nature of the mediation process was a key because it fostered a sense of belonging and trust while ensuring inclusive solutions that are acceptable to the conflict parties. This participatory orientation can be seen in the mediation process pursued in all cases (Figure 1). The mediators believed that their mediations obtained agreement partly because they (i.e. the mediators) possessed the requisite skills (e.g. facilitation) and worked as a team; they felt that the team aspect was important because of the complexity of the conflicts. The mediators acquired their skills and knowledge from their previous work and through training. Their confidence and strategies drew on previous experience, while formal training provided them with the analytical, planning, communication and management skills to facilitate the mediation process in a systematic and effective manner. The mediators felt unanimously, however, that mediators in their country required further capacity development, as well as a more conducive environment for their work, including increased understanding of the value of mediation in addressing conflicts.

TABLE 2. Agreements reached at case-study sites

Case	Conflict intensity; mediation length	Agreement content
Chiang Mai, Thailand	Medium; 6 years	• The Watershed Network Committee was established with representatives of all 23 villages in the watershed
Jambi, Indonesia	High; 6 months	• Villagers can manage the contested oil-palm plantations • Villagers must sell the oil-palm bunches to the company, and the company will keep some part of the payment to cover costs accrued
Kampong Speu, Cambodia	Medium–high; 3 years	• Company will stop clearing surrounding parts of the community's forest and land • Villagers can continue to manage their forest
Kampong Thom, Cambodia	Medium; 2 years	• Company will stop its operations in the two affected community forestry areas • Company will reserve the forestland blocks for community forestry, as requested by each community forest management committee
Kanchanaburi, Thailand	Medium; 2 years	• Park officials and the community agree on rules and regulations about forest utilization • Agreed boundary demarcation
Riau, Indonesia	Medium; 2 years	• Compensation to be paid to community members for the land planted by the company • The contested land will be categorized according to uses (i.e. community-based forest management, oil-palm plantation and rubber plantation) that can accommodate the demands of both parties

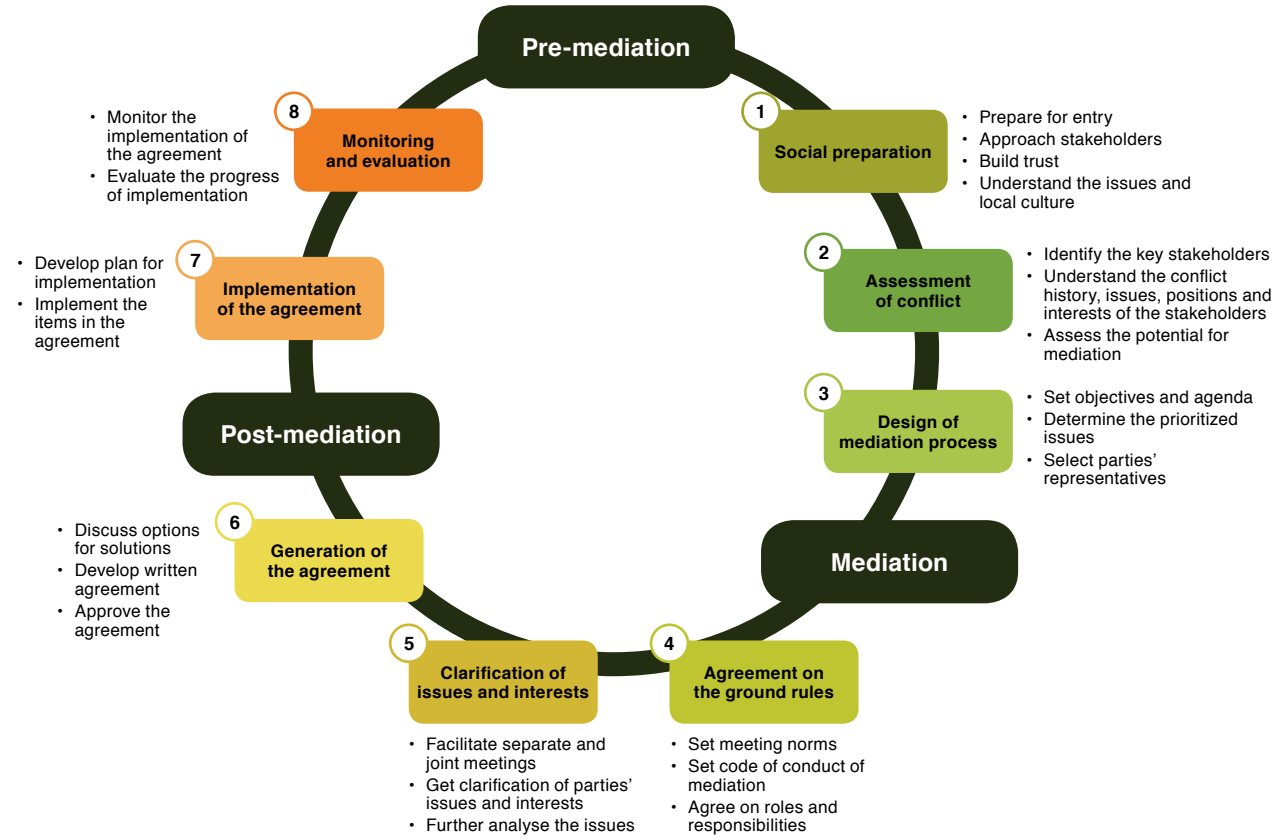
See Dhiaulhaq, De Bruyn and Gritten (2015) for more information. High-intensity conflicts involved physical violence; violence was not present in medium-intensity conflicts.

DISCUSSION AND CONCLUSIONS

Our study found that mediation played a crucial role in transforming conflicts in the cases examined. Such mediation was based largely on improving relationships between the parties, which significantly increased levels of trust. The research also showed that reaching an agreement is dependent on numerous variables, including the commitment and participation of all the conflict parties, trust by all parties in the process, and the capacity and teamwork of the mediators. Additionally, the implementation of the agreement reached will be at risk if institutions are not in place or existing institutions are insufficiently incentivized or strong (i.e. do not have the capacity) to respect, implement and monitor agreements.

The outcomes of the mediation largely meet Augsberger's (1992) criteria for transformation. Lederach's (1997) definition, however, would indicate that mediation as practised in these cases has limitations as a tool for conflict transformation: in particular, it is restricted in its ability to deal with the underlying causes of conflicts, specifically structural inequalities and their manifestation in the formation and implementation of policies. This limitation is important because many conflicts over forests and land are ultimately policy-driven. In the Kanchanaburi case, for example, agreement was reached that the community could continue to live in the national park, but this has no legal standing because Thailand's National Park Act (1961) strictly prohibits settlement and livelihood activities in national parks. Policy changes will require long-term engagement and trust-building with government offices in collaboration with NGOs at the subnational and national levels, which is typically beyond the scope of mediators.

A key determinant of the impact of mediation is the mediators themselves – their skill, and how they perceive their roles in the mediation and the outcomes for which they are striving. Inexperienced mediators may downplay the sustainability dimensions of agreements or underestimate the



Source: Dhiaulhaq, Gritten and De Bruyn (2014).

1
Mediation process followed in the conflict sites

importance of developing capacities among the conflict parties to participate effectively in the mediation process. In some cases, steps may need to be taken to empower and build the confidence of weaker parties, along with resources to ensure that all parties have access to information.

Our research gives rise to the following recommendations:

- Governments should accelerate reforms and clarify tenure arrangements that respect local resource management, including by further mainstreaming the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGT). Technical instruments and capacities are needed to assist governments in ensuring that the private sector operates in accordance with its obligations, as identified in the VGGT.
- Also as emphasized in the VGGT, private-sector and state actors should employ free, prior and informed consent (FPIC) with local residents regarding land-use changes that affect them. The application of FPIC also helps ensure that communities benefit equitably from land investment. Companies and government departments need to recognize the value of FPIC, not just in minimizing disruptions to their operations by reducing conflict but also, for example, for its role in incorporating local knowledge and garnering community support – FPIC makes good business sense.
- Coordination among government agencies with overlapping mandates needs to be improved. International initiatives such as the voluntary partnership agreements created under the European Union's Forest Law Enforcement, Governance and Trade initiative can help improve the coordination of intragovernmental processes and develop platforms and norms for the involvement of civil-society and private-sector actors.
- Local livelihood strategies should be integrated into national forest management policies, including the establishment and management of protected areas. It is important to ensure that such policies are developed in a participatory manner.
- Governments should support the mainstreaming of mediation in

The underlying causes of conflict in Kampong Thom included contested tenure and a poorly regulated private sector

addressing forest landscape conflicts. This includes ensuring that there is a pool of sufficiently skilled mediators with appropriate institutional backing and resources, and that mediation and other dispute resolution processes have the requisite support, including in the legal system.

To support governments, companies, civil society and communities to implement these recommendations and to promote the transformation of forest landscape conflicts, RECOFTC is taking a comprehensive capacity-development approach, including the following elements:

- **Research – with an emphasis on participatory action research – to gain practical insights and produce actionable recommendations**. This includes in-depth case studies to elucidate context-specific mechanisms and capacity gaps and to influence policy-makers through accessible language and theoretical frameworks. Participatory action research seeks to develop the research capacities of key stakeholders, especially in community-based participatory approaches.
- **Creating new and strengthening existing training curricula for capacity development**. These curricula are conceptualized by subject experts using the latest research and drafted in collaboration with specialists in participatory adult-learning processes. Training focuses on relevant target groups identified through capacity-development needs assessments that detail the roles of different stakeholders within the conflict map. Advanced and topically specific training curricula are developed to address specific conflict contexts and skill sets.
- **Regional and national learning networks that include field visits, learning groups and research collaboration, among other activities, to foster professionalism and ultimately develop a community of dedicated conflict transformation practitioners, including mediators**. This approach is intended to underpin and sustain a long-term strategy of capacity development, continuous learning, norm-shifting and regional ownership of the processes and

concepts being promoted. The use of "training of trainers" and other cascading approaches is leveraged for broader impacts, integrated within existing institutions, and supported by follow-up guidance and close monitoring and evaluation.

- **A diversified and proactive communication strategy based on up-to-date research and developed in collaboration with communities and other stakeholders** to address frequent misconceptions and the lack of information on conflict issues, including, for example, the options and processes for conflict transformation that lie outside, or complement, the formal legal system.

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Groundbreaking news? Analytical insights and lessons learned from a review of multinational REDD+ studies

R. Fischer, Y. Hargita and S. Günter

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A forest officer measures the diameter of a tree in Nicaragua. Robust forest monitoring and reporting systems are key aspects of the REDD+ mechanism

Multinational analyses of REDD+ projects have paid surprisingly little attention to some key REDD+ issues.

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The REDD+ process[1] was launched in Bali in 2007 under the United Nations Framework Convention on Climate Change (UNFCCC, 2007). REDD+ has been designed, developed and promoted as an innovative approach to reducing deforestation based on broad cooperation and shared responsibilities between developing and developed countries. The core idea is that developed countries will financially compensate developing countries for avoided deforestation and degradation.

A wealth of expertise and experiences has become available through readiness phases, preparation activities and pilot projects on various aspects and functionalities of the REDD+ mechanism. In this article, we review scientific publications and reports that summarize results from a large number of such formal and informal

[1] REDD+ = reducing emissions from deforestation and forest degradation, including the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

REDD+ activities to provide insights into the advances made and gaps that remain in REDD+ implementation on the ground and to draw lessons for the further development and implementation of the REDD+ mechanism. The aim of the results and conclusions of this review is to support policy-makers globally as well as practitioners in REDD+ countries.

BACKGROUND

Numerous REDD+ projects have been installed in developing countries. They include REDD+ pilot projects linked to national REDD+ strategies as a response to a call through the UNFCCC for demonstration activities (UNFCCC Decision 2/CP.13). Simonet *et al*. (2014) showed that 23 percent of all REDD+ projects are pilots that are formally integrated into national REDD+ strategies. There is also a wide variety of informal approaches, concepts and projects labelled as REDD+ by their proponents. Most activities, therefore, are not operating formally under the REDD+ mechanism of the UNFCCC, even though they all aim to cover the key elements of it. The main differences of such REDD+ projects compared with those undertaken as a formal part of the UNFCCC process are that they: are based mostly on other standards, such as the Verified Carbon Standard; often aim to obtain financing from the international voluntary carbon market; and are subnational, whereas REDD+, by definition, is a national exercise (with a few "interim" exceptions). Nevertheless, interest is high in learning from project experiences to assist in the development of the formal REDD+ process, and these initiatives can indeed be regarded as "the laboratory in which the REDD+ experiment is being conducted" (Sunderlin in Sills *et al*., 2014).

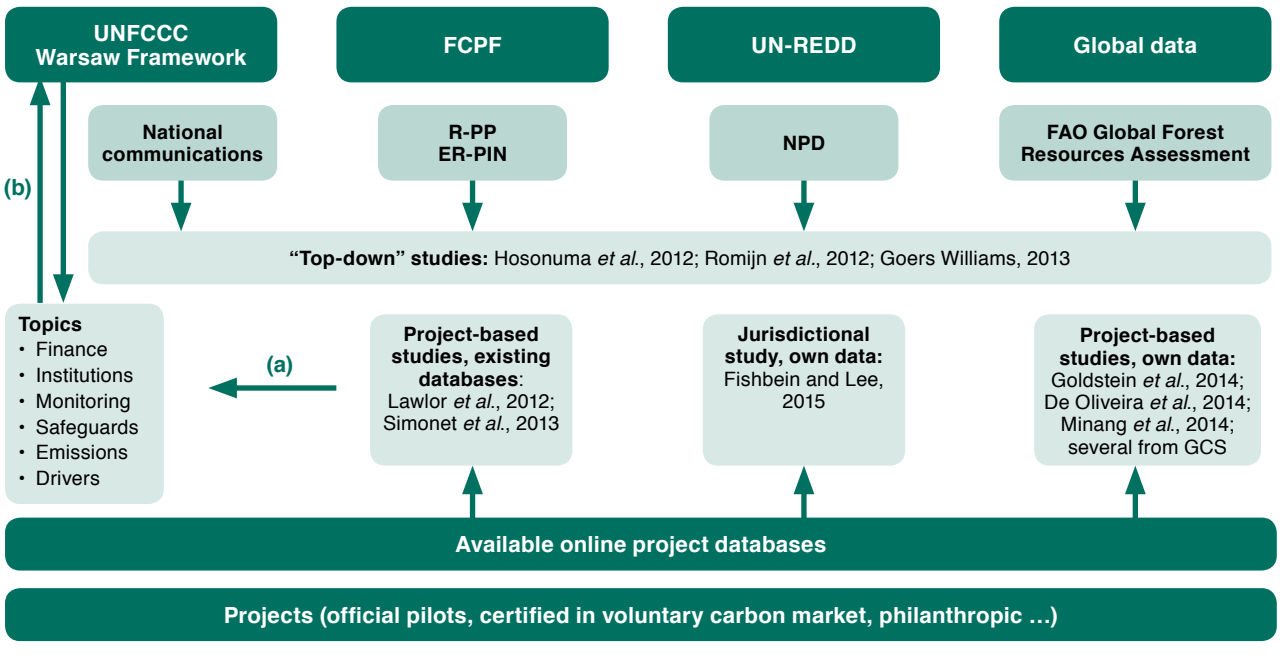
DEFINING A REDD+ PROJECT

The definition of what constitutes a REDD+ project varies substantially between studies. This variation influences the basis and results of the studies – each of which has its own selection of projects – and needs to be taken into account in comparing their findings. In the studies reviewed, it is often unclear whether afforestation/reforestation (A/R) projects are included. Sills *et al*. (2014) define REDD+ projects as initiatives that "aim to reduce net carbon emissions primarily by: (a) reducing deforestation/degradation; or (b) implementing forest conservation/restoration/management. That is, they do not derive most of their carbon benefits from afforestation/reforestation outside of existing forest". Lawlor *et al*. (2014) explicitly include A/R projects. Simonet *et al*. (2014) explicitly distinguish REDD, A/R and "improved forest management" projects but include them all in their study. A number of studies do not specify the criteria used in selecting projects.

STUDIES AND SOURCES USED FOR THE REVIEW

Our review (see also Fischer *et al*., 2016) relies on published literature from various sources compiled following the structure

1
Conceptual framework of the review



Notes: Top-down studies are based on official documents or global data. Bottom-up studies are based on projects or available project databases. (a) Results from different studies are summarized and structured according to the topics of the Warsaw Framework. (b) Serving as inputs at the policy level. Further explanations in the text. R-PP = readiness preparation proposal; ER-PIN = emission reduction preparation idea note; NPD = national programme document.

of the Warsaw Framework for REDD+[2] in order to provide input to UNFCCC policy development (Figure 1).

We identified literature using a basic search in Science Direct,[3] searching "REDD" and "project" in the title, abstract or keywords and with a publication date after 2010. In a second query, we searched for "REDD" and "readiness" in titles, abstracts and keywords. These searches yielded 92 results. In the Web of Knowledge,[4] we searched for the same words in topics and found 420 articles. From all identified publications we removed those that mentioned a specific country in the title because our focus was on multinational studies. From the remaining articles we selected those containing results from REDD+ activities in at least three countries in order to focus on overview studies and generalizing conclusions that reached beyond single case studies. We only selected studies providing conclusions from REDD+ activities pertaining to at least one of the topics of the Warsaw Framework. Grey literature was added based on our own literature databases. Overall, we found 20 studies that matched our selection criteria (Table 1). We grouped these according to the information sources they relied on, as follows:

- Publications that relied on national REDD+ documents under the UNFCCC, the Forest Carbon Partnership Facility (FCPF) and the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD), or on global data, were classified as "top-down" studies. We found four such studies.
- Studies based on publicly available online databases and maps of REDD+ projects, including project descriptions and design documents, were classified as "bottom-up" studies. There were four such studies.
- Research projects with their own field assessments – of which we found 12 – were classified as "bottom-up" studies.

THE WARSAW FRAMEWORK

The UNFCCC has specified in the Warsaw Framework the fields relevant to the implementation of REDD+ (Table 2). Scientific input, therefore, needs to deal with and discuss these topics if it is to be relevant to the formal REDD+ process. The

TABLE 1. Studies reviewed

Publication	Year of publication	No. of projects	No. of countries	Scientifically reviewed?	Main topic
"Top-down" studies based on REDD+ documents					
Cerbu, Swallow and Thompson*	2011	179	64	Yes	Factors influencing geographical distribution
Hosonuma *et al.*	2012		46	Yes	Drivers of deforestation and degradation
Romijn *et al.*	2012		99	Yes	Forest monitoring systems
Goers Williams	2013		32	No	Several
"Bottom-up" studies based on existing online databases					
Nguon and Kulakowski*	2013		36	Yes	Natural disturbances
Caplow *et al.**	2011	20	15	Yes	General project impacts
Lawlor *et al.*	2013	41	22	Yes	Community participation and benefits
Simonet *et al.*	2014	329	47	No	Several
"Bottom-up" studies with own assessments					
Goldstein, Gonzalez and Peters-Stanley	2014	417	39	No	Carbon market
Fishbein and Lee	2015	8	7	No	Jurisdictional approaches
De Oliveira *et al.*	2014	6	6	No	Several
Minang *et al.*	2014		4	Yes	Several
FCPF & UN-REDD*	2012		22	No	Several
Sills *et al.*	2014	23	6	No	Several
Sunderlin *et al.*	2014a	23	6	No	Several
Sunderlin *et al.*	2014b	23	6	Yes	Tenure
Murdiyarso *et al.*	2012	23	6	Yes	Several
Jagger *et al.*	2014	16	3	Yes	Safeguards
Luttrell *et al.*	2013	20	6	Yes	Benefit-sharing
Joseph *et al.*	2013	21	6	Yes	Monitoring, reporting and verification

Note: Studies shaded grey are part of the Center for International Forestry Research's Global Comparative Study on REDD+ (see text).

* Excluded from further evaluation despite matching the formal selection criteria.

[2] The Warsaw Framework is a collection of seven decisions made at the 19th Conference of the Parties to the UNFCCC to provide guidance on the implementation of REDD+ under the UNFCCC.

[3] www.sciencedirect.com

[4] www.webofknowledge.com

Sunset over the forest-covered mountains in the Province of Bac Kan, Viet Nam

Warsaw Framework topics (subdivided into 19 subtopics) provided the structure for our summarization of the information and conclusions made in the reviewed studies. Most studies had a specific focus and did not provide results and conclusions on all topics of the Warsaw Framework; based on the sum of the studies, however, our review covers all topics.

TABLE 2. Topics of the UNFCCC REDD+ Warsaw Framework

Topic
Results-based finance
Institutional arrangements
National forest monitoring systems
Monitoring, reporting and verification
Safeguard reporting
Forest reference emission levels and/or forest reference levels
Drivers of deforestation and forest degradation

Source: Climate Law and Policy (2014).

RESULTS

The most frequently considered topics in the reviewed studies were drivers of deforestation (tackled in 11 of the publications) and tenure (ten). In contrast, none of the reviewed studies drew conclusions on permanence and leakage. Reference levels – which are the benchmarks for results-based payments – were discussed in only four studies. Monitoring systems, financing, institutions, benefit-sharing systems and questions of participation were tackled in 6–8 studies each (Table 3). Some studies, like Hosonuma *et al*. (2012) and Romijn *et al*. (2012), focused on a narrow range of subtopics; others, such as Sills *et al*. (2014), De Oliveira *et al*. (2014) and Minang *et al*. (2014), canvassed a much broader set of subtopics. Comprising several publications, the Center for International Forestry Research's Global Comparative Study on REDD+ (GCS) provided statements relevant to nearly all topics. It was not possible to distinguish systematic differences in topics depending on whether the study was bottom-up or top-down. Moreover, there were no systematic differences in the relevant conclusions when the same topic was covered in top-down and bottom-up studies, although this may have been because the number of studies, and the number of topics covered in most studies, was too low to detect such differences.

TABLE 3. Statements in studies referring to single topics

	No. of studies addressing topic	Hosonuma *et al.*, 2012	Romijn *et al.*, 2012	Goers Williams, 2013	Lawlor *et al.*, 2013	Simonet *et al.*, 2013	Goldstein *et al.*, 2014	Fishbein and Lee, 2015	De Oliveira *et al.*, 2014	Minang *et al.*, 2014	Sills *et al.*, 2014	Murdiyarso *et al.*, 2012	Sunderlin *et al.*, 2014a	Sunderlin *et al.*, 2014b	Jagger *et al.*, 2014	Luttrell *et al.*, 2013	Joseph *et al.*, 2013
Finance																	
Present role of conditional and results-based payments at project and/or jurisdictional level	**5**					X	X	X			X		X				
Possible future role of conditional and results-based payments at project and/or jurisdictional level	**6**					X	X	X	X		X		X				
Institutions																	
Institutional responsibilities related to REDD+ implementation	**6**			X				X	X	X		X				X	
Monitoring																	
Status of monitoring systems	**8**		X	X					X	X	X	X		X			X
Options for technical cooperation on monitoring, reporting and evaluation systems	**4**		X						X		X						X
Jurisdictional approaches	**6**					X	X	X		X	X						X
Safeguards																	
National forest programmes																	
National forest programmes and/or international agreements	**1**														X		
Governance/tenure																	
Present status of tenure rights	**10**			X	X		X	X	X	X	X	X	X	X			
Options to clarify tenure rights within REDD+	**7**				X		X	X	X		X		X	X			
Indigenous peoples and stakeholder participation																	
Involvement of indigenous peoples and stakeholders in general	**7**			X	X	X		X	X	X	X						
Level of participation	**5**				X	X			X	X	X						
Permanence and leakage																	
Experience with permanence and leakage	**0**																
Social safeguards and benefit-sharing																	
Experience with social and/or biological safeguard reporting	**4**			X					X	X					X		
Experience with socio-economic co-benefits in general	**5**				X	X	X				X		X				
Definition of procedures for benefit-sharing	**6**			X					X	X	X				X	X	
Implementation of benefit-sharing	**4**			X						X	X					X	
Natural forests, biodiversity																	
Role of conservation and biodiversity services	**4**					X	X	X					X				
Forest reference (emission) levels																	
Experience with reference levels in projects	**4**									X		X	X				X
Drivers of deforestation and forest degradation																	
Exploration of project-specific drivers for deforestation and degradation	**11**	X			X	X	X	X	X	X		X	X	X			X
Number of topics dealt with in study		**1**	**2**	**7**	**6**	**8**	**8**	**9**	**11**	**11**	**12**	**5**	**8**	**4**	**3**	**3**	**5**

Note: X indicates that the topic was dealt with in a given study.

DISCUSSION

Finance

All studies addressing finance consistently showed that conditional payments based on carbon transactions at the project level are implemented to only a very limited extent; most projects were driven by official development assistance and not by results-based payments (Fishbein and Lee, 2015). Of 329 projects assessed globally, only 21 percent were engaged in carbon transactions (Simonet *et al*., 2014); of the 23 projects examined in the GCS, only four were selling carbon credits (Sills *et al*., 2014).

The low level of implementation is due partly to the insecure and ambiguous political and economic future of REDD+; moreover, most projects need more time to develop a suitable framework on the ground. Sunderlin *et al*. (2014a) mentioned that "Conditional incentives at the site level are still experimental" and that current results "suggest some possible doubt about its centrality". The hybrid approach – with a mixture of input-based and results-based payments – is a widespread reality. This situation has emerged partly because many projects are former integrated conservation and development projects (ICDPs) that simply took on board a REDD+ component later without changing the complete set of incentive tools (Simonet *et al*., 2014).

Institutions

With the exception of Minang *et al*. (2014), the authors of all studies examining institutional development are sceptical of (or do not assess) the capacity of the responsible institutions to implement REDD+ and consider that there is a lack of clarity on institutional responsibility. Jurisdictional approaches were seen, however, as a platform for at least involving local governments and stimulating institutional development (Fishbein and Lee, 2015).

A capacity-development initiative in a forest-dependent indigenous community in Chhindwara, Madhya Pradesh, India. REDD+ projects must ensure that benefits from such projects are transferred to the communities that maintain and protect forests and their biodiversity. Capacity development in those communities and their involvement at all stages of project development and implementation are imperative

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Monitoring and jurisdictions

None of the eight studies dealing with monitoring systems reported that the status of those systems was satisfactory, although some studies pointed out that monitoring, reporting and verification (MRV) was a fruitful field of collaboration. De Oliveira *et al*. (2014) noted that "the MRV component of forest-carbon initiatives generally involves external agencies and consultants", which can create dependencies.

None of the authors reporting on jurisdictional approaches had a clear vision of how to integrate the project and national scales of REDD+ implementation. Sills *et al*. (2014) identified scale as one of the greatest uncertainties because the links between local project-based systems and the national scale were unclear. A number of projects were engaged with government entities to integrate project baselines with regional efforts (Goldstein, Gonzalez and Peters-Stanley, 2014); these were individually negotiated solutions, however, and there is no harmonized approach under the UNFCCC.

National forest programmes, international conventions and agreements

Only Jagger *et al*. (2014) mentioned the relationship between REDD+ projects and national forest programmes.

Governance, tenure rights and transformational change

Of the various aspects of governance, tenure was the most widely studied. Tenure is high on the agenda in most projects, but perceptions of the situation vary between the more critical situations in projects examined in the GCS (Sunderlin *et al*., 2014a) and the more positive results documented by Fishbein and Lee (2015). Independent of the status of tenure, REDD+ projects are helping populations gain tenure rights, which Lawlor *et al*. (2013) considered to be an "important, transformational effect that projects can have – and likely more enduring than carbon payments".

FAO Director-General José Graziano da Silva attends a tree-planting ceremony to mark Earth Day and the signing of the Paris Climate Agreement. Mr Graziano da Silva planted an ash tree (*Fraxinus ornus*) at FAO headquarters in Rome as part of a campaign by the Earth Day Network, the aim of which is to plant 7.8 billion trees by Earth Day 2020

Indigenous peoples and stakeholder participation

The need to involve and empower indigenous peoples and enable stakeholder participation is widely perceived and taken into account in REDD+ projects. All but one of the studies dealing with this issue reported on participatory processes. REDD+ has had positive impacts in this respect, but the extent of such participation is controversial in some studies, based on the perspectives of authors.

Permanence and leakage

The risk of reversals (i.e. the "permanence" of carbon gains) and actions to reduce the displacement of carbon emissions (i.e. "leakage") are not considered in any of the reviewed studies.

Social safeguards and benefit-sharing

In the four studies addressing this topic, reporting on social safeguards received little attention. Jagger *et al*. (2014) showed that social and ecological safeguard reporting is complex and that "national-level assessment of social impacts and biodiversity co-benefits is a significant challenge". De Oliveira *et al*. (2014) suggested that there are simply "too many social and environmental safeguards and different organizations use different processes to guarantee the safeguards". Nevertheless, there are clear public expectations that carbon projects will address poverty alleviation and nature conservation (Simonet *et al*., 2014). Goldstein, Gonzalez and Peters-Stanley (2014) pointed out that buyers demand to know the "story" behind the offset they pay for.

None of the five studies dealing with co-benefits concluded that these were clearly provided. Lawlor *et al*. (2013) found "material benefits, in terms of jobs and income, to be, thus far, modest". The socio-economic benefits mentioned by Simonet *et al*. (2014) were mostly not provided as co-benefits of the REDD+ procedure but through development aid inputs by the same project.

The situation does not seem to be much brighter for benefit-sharing. In most of the six countries studied by Luttrell *et al*. (2013), and in readiness proposals (Goers Williams, 2013), there was a lack of clarity on arrangements for the transfer of REDD+ finance.

Biodiversity

Biodiversity conservation and watershed protection play important roles in many REDD+ projects, partly because many such projects were former conservation projects that developed a REDD+ component later on. Thirty percent of the globally analysed projects were located in protected areas (Simonet *et al*., 2014), and forest protection activities were deployed at 20 of the 23 GCS sites (Sunderlin *et al*., 2014a).

Reference emission levels, reference levels

The reviewed studies provided little evidence on the status of, or lessons learned from, previous activities on reference (emission) levels. Murdiyarso *et al*. (2012) detected large capacity gaps in the development of reference levels, and Joseph *et al*. (2013) complained about "ambiguity in methodological guidelines on how to set reference emission levels in REDD+ projects".

Drivers

Eight of the eleven studies mentioning specific drivers reported that project-specific drivers were taken into account; the ranking and importance of single drivers varied between projects and studies. Hosonuma *et al*. (2012) provided a widely accepted summary of the relevance of single drivers. Projects may perceive drivers differently, however, and the most common deforestation driver at the project scale is local livelihoods (Simonet *et al*., 2014).

Representativeness

The interpretation and use of diverse studies as a basis for policy conclusions needs to take into account the fact that – with the exception of projects in the GCS – neither the reviewed studies nor the projects in the studies were selected based on criteria that took representativeness into account. Rather, the projects and studies need to be regarded as a "found sample" (Overton, Young and Overton, 1993) that does not justify extrapolation and generalization. The results of this review are a descriptive compilation of presently available information, which nevertheless obtains its relevance and justification through the large number of projects and authors involved and the need to make the wealth of existing information available in a condensed format.

CONCLUSIONS

Principles have been developed for reducing carbon emissions from deforestation and degradation, including results-based financial transfers, the use of reference levels as benchmarks for emission reductions, the permanence of reductions, and the need to avoid leakage in order to guarantee climate effectiveness. Astonishingly, however, reference levels were discussed in only four of the reviewed multinational studies, and leakage and permanence were not dealt with at all. In addition, results-based finance has been implemented to a rather low extent, and most authors are sceptical of its future potential and implementation. Based on our review, it is hard to understand why these core themes of the REDD+ approach were not covered in the multitude of projects in the "REDD+ laboratory".

Various studies identified barriers to results-based finance, as follows:

- more time is needed to gain experience;
- the insecure political and economic future of REDD+ is preventing project proponents from making more promises; and
- there is a need for the further technical development of financial tools.

On the other hand, as long as the lessons gained at ground level are ambiguous, it might be hard to mobilize the funds needed for concrete actions towards climate effectiveness.

In addition to the "new" specific REDD+-related topics, the Warsaw Framework includes "old", more general topics of tenure rights, participation, institutional development, livelihood and biodiversity co-benefits, and the specific drivers of deforestation. These old topics are well-known in ICDPs and multiple other global initiatives, but, surprisingly, they received more attention than the specific REDD+ topics in the reviewed studies. Is REDD+ on the ground consequently just a new framework for tackling such issues? How much of REDD+ is new, beyond the safeguards and co-benefits?

There is evidence that REDD+ projects have had some positive impacts on tenure rights, participation, biodiversity and deforestation drivers, but our review suggests that these impacts are not necessarily due to the REDD+ components of those projects, which in many cases are not (yet) operational. According to Simonet *et al.* (2014), the socio-economic benefits of projects arise not as co-benefits of the REDD+ procedure but from inputs provided by the original ICDPs. The reviewed studies reveal, therefore, that in addition to creating new financing and accounting tools, REDD+ offers a platform for continuing to address longstanding development issues.

The pressing questions around financing are important for donors, who need accounting and justification for their payments. The most crucial point from the perspective of REDD+-hosting countries might be different, such as whether development and emission reductions are based on transformational change (Fishbein and Lee, 2015; Sills *et al.*, 2014; Sunderlin *et al.*, 2014a; Murdiyarso *et al.*, 2012) and ownership (OECD, 2005). There are indications that the balance in the hybrid approach is swinging towards more "aidification" (Angelsen *et al.*, 2012). But as long as countries view the sustainable management and protection of high-value forests as integral to achieving their long-term development goals, the question of whether the support of developed countries will be results- or input-based may be secondary (Fischer *et al.*, 2016). ◆

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New generation plantations: towards sustainable intensification

L.N. Silva

A eucalypt plantation in Parque das Neblinas restored to lush rainforest on a steep slope, with the dark green, glossy leaves typical of native forest in the area

Well-managed tree plantations in the right places can help conserve biodiversity and meet human needs.

Luis Neves Silva is at WWF International.

The WWF Living Forest Report (WWF, 2011) projects that wood harvesting could triple by 2050 to approximately 10 billion m^3. It is not enough, however, simply to produce more. If the combined needs of global food security, poverty reduction and environmental sustainability are to be met, production must be integrated, inclusive and sustainable. The past paradigm of input-intensive production cannot meet this challenge; productivity must be achieved through sustainable intensification (Godfray *et al*., 2010). This means, among other things, conserving, protecting and enhancing natural resources and ecosystems while improving the livelihoods and well-being of people and social groups and bolstering their resilience. Mechanisms are needed to develop and ensure sustainable forest management practices while preserving or enhancing social and environmental

values in landscapes in an environment of constantly increasing and diversifying demand for forest biomass.

Scientific and technological innovations are core elements in developing such mechanisms, as is open dialogue with all stakeholders on appropriate governance frameworks for the uptake and deployment of approaches to raising forest productivity. Equally important is system-wide planning and zoning, involving cross-sectoral cooperation to maximize the efficiency of production by all land-users while reducing competition for land and water. Any approach must ensure that local stakeholders are included in relevant planning and implementation processes, using tools such as free, prior and informed consent.

THE NEW GENERATION PLANTATIONS APPROACH

To achieve the greater intensification of productivity required, existing performance standards, which were designed to manage linear, incremental change, will not suffice. Future standards must be designed to respond to the complexity of systemic transformational changes that comes with the highly disruptive process of further intensification. Such standards must ensure a governance framework that provides social safeguards, achieves inclusive local economic development, provides effective ecosystem stewardship, and stimulates preferential procurement and increased consumer awareness.

It is within this new paradigm that the principles of the "new generation plantations" (NGP) concept (Figure 1) carry particular significance. Well-managed tree plantations in the right places can help conserve biodiversity and meet human needs while contributing to sustainable economic growth and local livelihoods if they:

- Adopt inclusive local economic development and forestry as an increasingly central theme. Engaging with stakeholders means far more than carrying out consultations and obtaining the consent of communities affected by plantations. It is about building relationships with stakeholders, talking and listening to them, and empowering them to meet their needs and achieve their aspirations.
- Maintain ecosystem integrity and protect high-conservation-value areas, making sure that plantations don't disrupt natural cycles – for water, nutrients, carbon and biodiversity – and increasingly look beyond individual operations towards maintaining and restoring ecosystems on a broader landscape scale.
- Are profitable. Plantations create jobs, often in poor rural areas, but they have the potential to do far more than that. Plantations should be a means for achieving inclusive green growth, and the benefits should be shared with the local communities who are sharing the landscape.

The NGP concept, therefore, provides a strong, inclusive model and approach for implementing sustainable intensification as a contributor to the functioning of socially and ecologically resilient landscapes.

An existing significant contributor to the functioning of resilient landscapes is the family farmer. FAO's *The State of Food and Agriculture* published towards the end of the International Year of Family Farming (FAO, 2014) makes a compelling case for concerted efforts to bring innovation to family farming. Five hundred million family farmers – managing 90 percent of all farms in the world and occupying around 70–80 percent of farmland – produce more than 80 percent (in value terms) of the world's food. The overarching view of FAO is that family farms must be supported "to innovate in ways that emphasize sustainable intensification

1
The principles of the new generation plantations concept

Source: NGP Platform (2011).

of production and improvements in rural livelihoods" (FAO, 2014). Sustainable intensification can be achieved through a cohesive multistakeholder innovation system to develop new technologies and practices suited to stakeholder needs and local conditions or by overcoming barriers and constraints to the adaptation and adoption of existing technologies and practices and access to relevant markets.

Forestry should follow a similar route. Given that the environmental issues of plantation forestry are well known and there are well-developed tools for addressing them, multistakeholder processes are the new frontier for evaluating process-based technological advances and ensuring inclusive local economic development. These will reconcile stakeholder perspectives and priorities and clarify how to bring innovation to family farmers at the local level.

CASE STUDIES

NGP is an aspirational concept for a new era of production landscapes incorporating sustainable intensification. It brings a vision in which plantations contribute positively to communities and ecosystems through a combination of best-available knowledge on land-use planning; precision forestry operations (e.g. silviculture); ecosystem protection, management and active restoration; and local community empowerment. Since its creation in 2007, the NGP Platform[1] has collected and shared knowledge and experiences worldwide on how NGP principles are being integrated and implemented in practice. Examples are given below.

Uruguay

Land-use planning implies crop–livestock–forestry integration as a precondition for innovation in agriculture, forestry and conservation. An example is in Uruguay, where cattle-ranching is deeply embedded in the culture of rural areas. Forestry, as a relative newcomer there, is competing for land with cows and soy. The discomfort of farmers at the increasing presence of forestry was becoming apparent in rural communities, with this competing sector putting at risk long-established ways of life and local cultural values. Far from seeing forestry and cattle as competing sectors, NGP shows how new forms of partnership can be developed that benefit both communities and companies by realizing the value of actively managing synergies between sectors. In Uruguay, NGP participants Stora Enso, UPM and Arauco are, among other things, leasing land to local cattle herders for grazing and introducing forestry components to integrated crop–livestock systems that improve carbon stock, diversify revenues and reduce risks.

South Africa

Precision forestry integrates accurate monitoring with measures to avoid planting in natural ecosystems and to protect areas with high conservation value. Plantation companies in South Africa demarcated wetlands and riparian zones and removed plantations from these sensitive ecosystems; in so doing, they were able to mitigate one of the main impacts of plantations: water use. This is best seen in the iSimangaliso Wetland Park World Heritage Site, where NGP participant Mondi helped transform a long history of dispute into a successful partnership that has minimal impact on natural ecosystems. There had been bitter disputes over the years at Lake St Lucia (in the World Heritage site) between the forest industry, environmentalists and local people because poorly sited plantations were having a negative impact on the lake and its wildlife by reducing freshwater flows. Mondi worked with the government, environmental non-governmental organizations and the park authority to determine which areas were suitable for commercial plantations and which should be returned to their natural state. A 120-km-long "eco-boundary" was mapped out that divided mostly wetland areas and other important ecosystem components to be set aside for conservation from the dry mineral soils that were best suited for plantations and where impacts on natural ecosystems would be minimal. The plantation trees were removed from the wetland side of the ecoboundary and the land restored to wetlands and savannah. Certification of forest operations provides an independent means of verifying the sustainability of forest management practices.

Brazil

It is estimated that there are more than a billion hectares of degraded and deforested land worldwide (GPFLR, 2016), and land restoration is therefore a major global need. NGP can achieve active restoration at scale while responding to the productivity challenge. Brazil's Mata Atlântica (Atlantic rainforest), a global biodiversity hotspot, has been devastated by past agricultural practices; today, only 8.5 percent of it exists in its original state (WWF, 2016), often in isolated fragments. Two Brazilian participants in the NGP Platform, Fibria and Suzano (both pulp and paper companies), have established partnerships with international and local conservation and social non-governmental organizations in the Mata Atlântica. Building on the requirements of the Brazilian Forest Code, they have invested in plantation development and ecosystem restoration, ensuring that 50 percent of their land is maintained or restored as forest ecosystems in a mosaic landscape approach. Along the way, they have selectively bred tree clones in their nurseries and research units to intensify production. The productivity of wood-fibre production has more than doubled in 40 years through the breeding of better-performing tree varieties and clonal selection (Gonçalves *et al*., 2013), and there is potential to increase yields by a further 20 percent (May and Hirsh, 2014). This increase in productivity significantly reduces the pressure on natural forests and other land. The work by Fibria and Suzano demonstrates that by applying NGP principles, well-designed, well-managed

[1] http://newgenerationplantations.org

A eucalypt plantation/Atlantic rainforest landscape mosaic – an example of a new generation plantation approach

plantations can be valuable for ecosystem restoration while ensuring high-yield production on a minimal area of land.

THE IMPORTANCE OF TRUST

Local community empowerment can bring forest companies and civil society together in multistakeholder processes that develop mutual trust and lead to shared understanding and collaborative approaches to sustainable forest management. In NGP, dialogue is the basis for exploring and reconciling local stakeholder perspectives and priorities with process-based technological advances. The aim is to determine practical ways to enable inclusive local economic development for those sharing their land with production companies; for example, smallholders can be supported in obtaining certification for their operations and thereby supply plantation companies with certified wood grown on their own land.

In March 2015 in Santiago, Chile, 130 people from 25 countries and four continents, representing governments, companies, communities and civil-society organizations, gathered at the NGP annual meeting to debate how to make plantations work for people (NGP Platform, 2015). Historically, there has been a loss of trust in Chile between smallholders and plantation corporations; this is also true in Brazil and South Africa. Although progress has been made in all three countries and others, such as Paraguay, it is clear that restoring trust is a long-term process and must be earned. Participants at the meeting heard that Fibria has turned years of conflict around in the Brazilian states of Bahia and Espirito Santo, where the company and communities are starting to work together to achieve common goals. In South Africa, Mondi has developed a model for engaging and settling with land-claimant communities and assisting them to develop sustainable forest enterprises. Trust is a journey and, with NGP, the journey has begun.

DISCUSSION, CONCLUSIONS AND OUTLOOK

Well-placed, well-managed plantations can be important components of sustainable landscapes, providing opportunities to restore degraded land, spare natural forest and enhance local socio-economic values while increasing productivity (WWF, 2011). Mosaics of new plantations, forest (and other ecosystem) restoration and responsible farming (NGP Platform, 2014) can restore essential ecosystem services by effectively blending crops, livestock and forestry as an integrated system (Bungenstab and Almeida, 2014). System-wide, cross-sectoral planning and zoning in mosaic designs is essential for maximizing the efficiency of production while reducing competition for land and water.

NGP also offers the potential for a new era of sustainable intensive silviculture. It enables robust land-use planning that dynamically integrates optimized productivity in production areas through precision silviculture with the protection of high-conservation-value forests and the active restoration of rezoned degraded land and forest. This creates landscapes of diverse, resilient ecological infrastructure that offer improved prospects for the livelihoods of local communities. Transforming conflict into cooperation, and land claims into business opportunities, is part of the change envisioned in the NGP approach.

The question WWF and its partners want to explore in the NGP Platform is:

if innovation-driven, technology-rich, sustainable intensification is an option for the future, can we design a framework to drive research in the right direction, bring innovations to family farmers at the local level, and resolve the constraints on market access?

The fundamental challenge and opportunity of our times, therefore, is to develop leadership in the formulation of such a framework that masters production efficiency in transformative ways. Within this, the physical challenge is to develop and deploy innovations for the sustainable intensification of forest commodity production. The socio-economic challenge will be to ensure that technology reaches those who need it most.

Production intensification in forestry can ensure that there is sufficient land for other uses, such as food production for local markets and biodiversity conservation, while also diminishing logging pressure on natural forests and their associated communities, ecosystem services and biodiversity.

For the NGP approach to be adopted widely, the following three key findings of the NGP Platform will be crucial (NGP Platform, 2015):

1. To make plantations work for people, forestry companies need to work with local communities and civil society. For that to happen, trust is essential.
2. However well plantations might be managed at the site level, they are part of a wider ecological, socio-economic and governance landscape. To generate social and environmental benefits at a meaningful scale, collaboration is essential at the landscape scale. Two key words – "resilience" and "inclusivity" – must shape any discussion of how this can be achieved. Landscapes need to be resilient – meaning that ecological and socio-economic systems will continue to function and provide the full range of ecosystem services in the face of changes and shocks, such as those brought about by climate change. And the approach needs to be inclusive – that is, developed with the participation of all stakeholders and delivering benefits for all.
3. Creating shared value involves companies working with other stakeholders in landscapes to address social and environmental objectives while building long-term business competitiveness – it is about finding opportunities for mutual socio-economic and ecological benefits. For this to happen, partners must identify shared objectives and values, thereby reinforcing trust-building approaches for long-term resilience.

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Insulation material made from tree bark

G. Kain, M.C. Barbu and A. Petutschnigg

Low-density bark-based composites could make an important contribution to the growing market for environmentally friendly insulation in buildings.

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The general trend towards energy-efficient buildings has increased the need for insulation materials. There are two main types: organic and inorganic; the first type (e.g. polystyrene) is dominated by petroleum-based products and the second type by mineral wool. Both these insulation material groups have reasonably poor ecological performance because they are composed of non-renewable resources and their production process is energy-intensive.

Tree bark is a promising new insulation material. Manufactured into a low-density composite product, it is especially attractive because it makes use of natural "tree insulation", and large quantities are potentially available at a low cost (Kain *et al.*, 2012).

Worldwide, approximately 1.6 billion m^3 of solid wood is used industrially each year, although this accounts for only 43 percent of the total yearly harvested volume (because the majority is used as fuel) (Barbu, Irle and Reh, 2014). Considering that bark comprises approximately 10 percent of any given tree, the theoretically available bark volume from industrial processing worldwide is 160 million m^3 per year. There is a long history of bark use in various wood-based products, but the primary focus has been on replacing wood with cheap bark in established composites (e.g. Volz, 1973; Nemli and Colakoglu, 2005; Kraft, 2007; Xing *et al.*, 2007; Yemele *et al.*, 2008). Even though tree bark is already used in products like bark mulch and absorbers and as raw materials in tannin production and fertilizers, there have been calls for alternative products

1
Above: Cross-section of larch bark

Untha Golling four-shaft shredder (6 ≤ x ≤ 10 mm)

Larch bark particles (diameter 6–10 mm): a resource for insulation panels

TABLE 1. Experimental design for density and resin content (based on the oven-dried weight of bark particles) (two specimens for each combination)

Target density (kg/m³)	Tannin resin content (%)	Mass of resinated particles (g)
500	15	996
	10	972
	5	948
400	15	797
	10	778
	8	770
350	15	697
	10	680
300	15	597
250	20	510
	15	498

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Bark panels could be used as decorative cladding elements

with higher value added (e.g. Naundorf, Wollenberg and Schubert, 2004).

Bark is the boundary layer of trees, protecting them from physical and biological exterior attacks (Figure 1). It has ideal properties, therefore, as insulation, such as low density, a high concentration of extracts, good thermal insulation properties, and relatively low flammability (Fengel and Wegener, 2003). Bark not only has relatively low thermal conductivity, it also has very good heat-storage capacity – a combination that makes it especially suitable for heat-storage insulation layers (Kain *et al*., 2013).

Bark is also a promising resource economically because it is a by-product in timber manufacturing and is rarely used for products with higher value added. An analysis of the Austrian timber market showed that, in the period from January 2005 to May 2012, softwood bark was, on average, 38 percent cheaper than softwood chips and 14 percent cheaper than sawdust in quantities referred to as "loose cubic metres" (Kain, 2013).

The study reported here was conducted to help understand how to produce low-density (≤ 500 kilograms per cubic metre (kg/m^3)) bark panels and the most suitable design for use as a thermal insulation material (Kain *et al*., 2012, 2014a,b).

METHODOLOGY

Larch bark (*Larix decidua* Mill.) was collected at a sawmill in Salzburg County, Austria. The wet bark was crushed in a four-shaft shredder (RS40 of Untha Co.; see top image on page 68) and successively sieved; only the fraction with a diameter of 6–10 mm was selected for production (see bottom image on page 68). This fraction was dried in a vacuum dryer at 60 °C and an absolute pressure of 200–250 millibars until a final average moisture content of 10 percent was obtained. Quebracho tannin extract (Colatan GT 10

Test specimen (50 × 50 × 20 mm³) for IB testing

Larch bark insulation panel bonded with tannin resin (thickness = 20 mm, density = 350 kg/m³)

of Markmann Co.), hexamethylenetetramine (Merck Schuchardt Co.) and sodium hydroxide solution (Carl Roth Co.) were used for the resin; the resin comprised 50 percent (by weight) of tannin-extract powder mixed with 50 percent (by weight) water using a mechanical stirrer at a variable stirring rate (700–1500 revolutions per minute). Ten percent (by weight) of hexamethylenetetramine was added using a 33 percent solution and the pH was adjusted to 9 with the addition of sodium hydroxide solution. Bark particles were mixed with the tannin resin in a laboratory ploughshare mixer. A particle mat (240 × 350 mm^2) was formed manually out of the resinated particles (i.e. particles impregnated with resin) and pressed with a Höfer laboratory press for eight minutes at a temperature of 180 °C (target thickness 20 mm). Table 1 shows the target characteristics of the panels produced.

Mechanical properties of the bark panels such as modulus of rupture (MOR), modulus of elasticity (MOE) and internal bond (IB; see top image on page 70), and physical properties such as thermal conductivity (TC), thickness swell (TS) and water absorption (WA) after 2 and 24 hours were evaluated according to European norms (EN 310, 1993; EN 319, 1993; EN 317, 1993; EN 12667, 2001).

RESULTS

The bottom image on page 70 shows an example of the insulation boards produced in the experimental process, and Table 2 shows the main properties of the panels.

Variations in panel properties can be explained satisfactorily by a regression analysis. Models had coefficients of determination greater than 0.70 and were statistically highly significant ($p < 0.001$) for all properties except TC, for which the model was very significant ($p < 0.01$) (Kain *et al*., 2014a). Panel density and resin content have a significant influence on panel properties, which is known from various studies on mechanical board properties (e.g. Gupta, Yang and Feng, 2011).

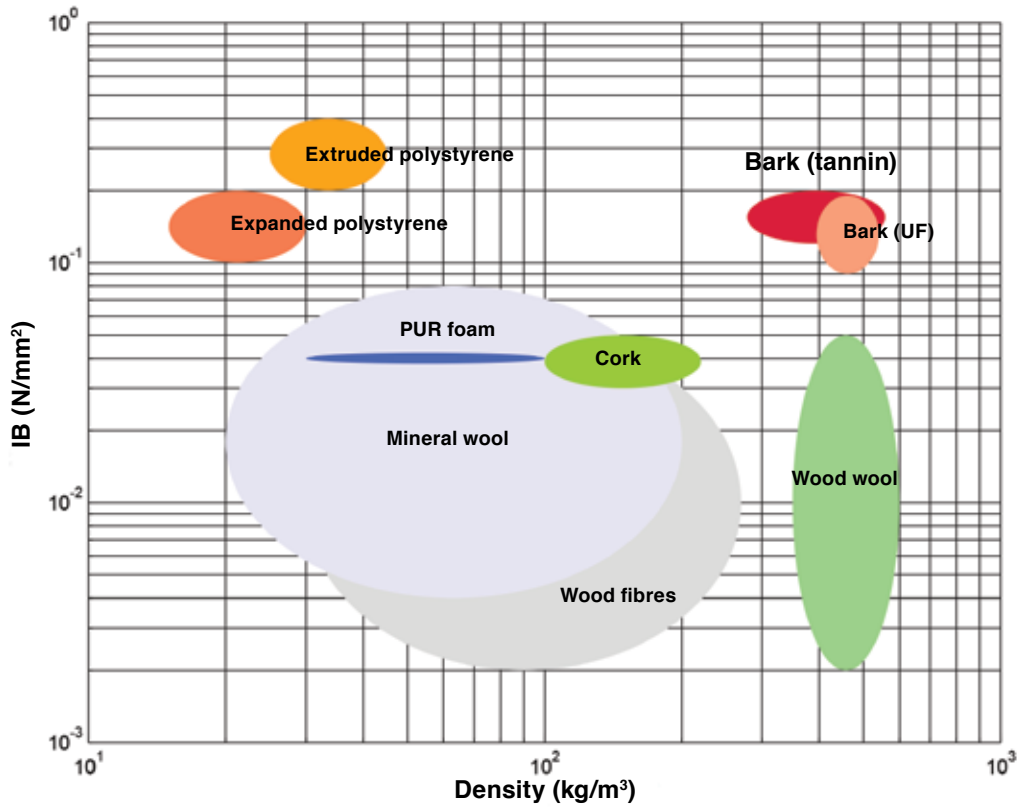
This influence was also shown for the investigated bark-based tannin-glued panels. Both density and resin content had a highly significant influence on MOR,

TABLE 2. Board characteristics (with standard deviations in brackets)

Target density	Amount of adhesive	Density MOR/MOE	MOR	MOE	Density IB	IB	Density TS/WA	TS 2 h	TS 24 h	WA 2 h	WA 24 h
(kg/m³)	(%)	(kg/m³)	(N/mm²)	(N/mm²)	(kg/m³)	(N/mm²)	(kg/m³)	(%)	(%)	(%)	(%)
500	15	565	2.94	502.02	507.65	0.32	514.87	8.41	12.83	34.95	58.69
		(21.21)	(0.43)	(73.43)	(75.70)	(0.10)	(61.08)	(1.54)	(1.12)	(7.22)	(8.69)
	10	565	2.19	384.46	514.77	0.21	534.19	13.46	21.08	45.41	70.11
		(21.21)	(0.18)	(33.83)	(65.51)	(0.08)	(74.12)	(2.17)	(1.65)	(9.24)	(8.94)
	5	555	1.72	254.54	533.38	0.16	535.10	20.52	27.10	56.23	77.17
		(7.07)	(0.12)	(43.44)	(23.99)	(0.01)	(29.50)	(1.11)	(1.72)	(3.08)	(2.96)
400	15	475	1.71	239.55	457.63	0.24	452.62	8.97	12.16	45.64	67.13
		(7.07)	(0.23)	(10.42)	(31.05)	(0.02)	(23.25)	(1.52)	(1.79)	(1.99)	(2.32)
	10	435	1.09	165.55	402.27	0.14	408.16	12.68	16.80	52.12	79.12
		(7.07)	(0.21)	(6.67)	(58.29)	(0.06)	(67.69)	(0.93)	(2.05)	(6.52)	(4.57)
	8	455	0.85	140.11	440.34	0.14	442.45	15.56	19.76	56.76	80.39
		(7.07)	(0.02)	(0.28)	(14.93)	(0.01)	(9.75)	(1.27)	(2.02)	(1.31)	(0.78)
350	15	405	0.86	149.70	384.68	0.16	386.37	10.39	14.04	51.11	78.32
		(7.07)	(0.11)	(27.62)	(22.91)	(0.03)	(40.10)	(1.86)	(2.98)	(3.62)	(3.62)
	10	400	0.67	121.46	387.29	0.12	387.09	13.37	17.34	54.93	82.60
		(14.14)	(0.11)	(9.59)	(23.24)	(0.02)	(39.00)	(1.10)	(1.95)	(3.07)	(4.20)
300	15	345	0.45	67.80	340.64	0.10	325.21	10.27	12.21	57.68	83.06
		(7.07)	(0.04)	(8.45)	(28.42)	(0.05)	(35.79)	(0.79)	(1.07)	(1.45)	(2.62)
250	20	320	0.37	41.94	293.24	0.07	293.83	9.62	11.81	55.87	83.79
		(14.14)	(0.01)	(6.21)	(23.73)	(0.03)	(31.12)	(1.07)	(1.06)	(1.82)	(2.05)
	15	305	0.27	46.39	293.53	0.06	282.14	8.80	12.31	59.81	85.96
		(21.12)	(0.01)	(15.32)	(29.84)	(0.03)	(31.50)	(2.12)	(3.35)	(2.32)	(10.24)

Note: MOR = modulus of rupture, MOE = modulus of elasticity, IB = internal bond, TS = thickness swelling, WA = water absorption.

2
Ashby chart of the internal bond strength of various insulation materials



Source: Except for bark, data are according to Pfundstein *et al.* (2007).

MOE, IB and WA; TS was statistically significantly influenced only by resin content, and TC was statistically significantly influenced only by density. The influence of panel density on MOR was nearly three times greater than the influence of resin content, and the same was true for MOE.

Average MOR ranged from 0.32 newtons per square millimetre (N/mm^2) (standard deviation [SD] = 0.06 N/mm^2) for panels with a density of 250 kg/m^3, to 2.28 N/mm^2 (SD = 0.59 N/mm^2) for panels with a density of 500 kg/m^3, and average MOE ranged between 44.2 N/mm^2 (SD = 9.88 N/mm^2) and 380.3 N/mm^2 (SD = 118.08 N/mm^2).

The influence of density on IB was double that of resin content. Average IB ranged from 0.06 N/mm^2 (SD = 0.03 N/mm^2) for panels with a density of 250 kg/m^3, to 0.23 N/mm^2 (SD = 0.10 N/mm^2) for panels with a density of 500 kg/m^3.

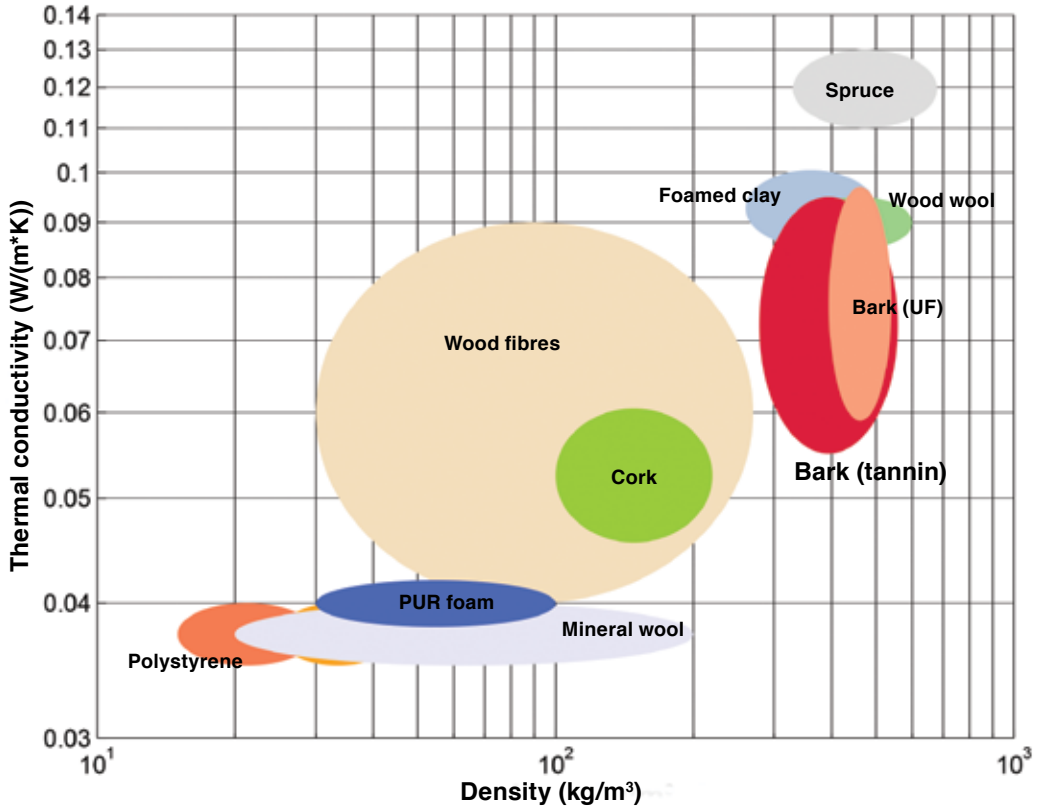
TS after water immersion for 2 hours and 24 hours was statistically highly significantly influenced by resin content but not by density. The highest TS was observed for panels with a resin content of 5 percent – at 20.52 percent, on average (SD = 1.11 percent), after 2 hours and at 27.10 percent (SD = 1.72 percent) after 24 hours.

WA was influenced 1.5 times more strongly by density than by resin content after 2 hours of water immersion and 1.8 times more strongly after 24 hours. WA was highest for the lightest boards (250 kg/m^3), with 57.8 percent (SD = 2.86 percent) after 2 hours of water immersion and 84.9 percent (SD = 7.06 percent) after 24 hours.

There was a very significant ($p < 0.01$) positive correlation between panel density and TC (coefficient of determination = 0.82). Panels with a target density of 250 kg/m^3 had, on average, a TC of 0.069 watts per metre kelvin (W/(m*K)) (SD=0.0007 W/(m*K)), and boards with a density of 500 kg/m^3 exhibited a TC of 0.093 W/(m*K) (SD=0.002 W/(m*K)).

DISCUSSION

Low-weight bark-based panels glued with a condensation resin (8–12 percent urea-formaldehyde, based on the oven-dried weight of particles) showed sufficient mechanical strength for parameters such as MOR, IB, compressive resistance and tensile strength, as well as sufficient TS for insulation purposes (Kain *et al.*, 2013, 2014b). The boards glued with tannin-based resin were, on the one hand, much lighter than the panels studied previously and, on the other, had similar properties to bark panels made using urea-formaldehyde resin (Kain *et al.*, 2012). The investigated panels had a density of 250–550 kg/m^3.



3
Ashby chart of thermal conductivity of insulation materials by comparison

Source: Except for bark, data are according to Pfundstein *et al*. (2007).

The MOR of a standard wood-fibre insulation panel with a density of 230–400 kg/m³ and a thickness of more than 20 mm should be more than 0.8 N/mm² (according to EN 622-4). This requirement was met by panels with a density of 350 kg/m³ glued using 15 percent of tannin-based resin (average 0.86 N/mm², SD = 0.11 N/mm²). The heavier boards were even stronger, but the lighter boards did not meet the requirement and their potential use is limited to applications where they are not subject to bending.

For IB (an important characteristic for insulation panels because it describes the cohesion of single particles, especially in the core), the studied panels showed superior properties compared with most other commonly available insulation panels due to their higher density (Figure 2).

Schwemmer (2010) developed insulation panels out of reed mace and limited the TS after 24 hours of water immersion at 20 °C to 15 percent. This standard was achieved in the bark panels examined here with resination of 15 and 20 percent; a resination of 10 percent resulted in an average TS of 18.4 percent (SD = 0.6 percent).

Bark-based tannin-glued panels showed the same relationship between density and TC as did the pine bark (*Pinus sylvestris*) panels pressed by Kain *et al*. (2012). TC was 0.069 W/(m*K) (SD = 0.00070 W/(m*K)) for larch-bark-based panels with a density of 250 kg/m³, and 0.093 W/(m*K) (SD = 0.0021 W/(m*K)) for panels with a density of 500 kg/m³, which was not as low as the TCs for very light insulation materials such as polystyrene and mineral wool but competitive with wood wool and heavier wood-fibre materials (Figure 3). A potential benefit of the larch-bark-based panels is their low thermal diffusivity (ranging from 1×10^{-7} to 2×10^{-7} m²/s), resulting in a high phase shift in hot surroundings and thereby providing an excellent indoor climate in hot weather (Kain *et al*., 2013).

CONCLUSIONS

This study has shown that larch bark (*Larix decidua* Mill.) is a suitable raw material for the manufacture of insulation panels. Just as importantly, a natural, highly adhesive system based on tannin resin could be applied successfully to particle bonding, thereby enabling manufacturers to produce insulation panels that are free of synthetic resins.

As expected, density and resin content significantly influence the mechanical properties (MOR, MOE, IB) of panels; interestingly, however, resin content explains only one-third of the variance that can be explained by panel density and has therefore much less explanatory power than previously assumed. This raises

A model bedroom lined with bark panels

questions about the nature of the chemical bonding prevalent in the particle–resin matrix and whether reactive groups in the bark play significant roles in particle bonding. Further investigations are required to answer these questions.

The heat transfer mechanisms within the investigated panels also require detailed study, because large cavities in the relatively thin panels (20 mm) are likely to produce poorer results for TC than those in thicker boards. The interaction between particle size, panel density, particle orientation and TC is also a worthy subject of further research. Greater knowledge of panel structure, especially pore size distribution, could help in optimizing TC (Kain *et al*., 2016a, b).

The use of bark as an insulation material is promising, but it is also feasible to use bark panels as decorative interior wall elements, as shown in Austria's winning contribution at an international competition for low-energy houses in California (Solar Decathlon Team Austria, 2013), in which rooms were lined with bark-wall cladding (see image above).

Our research indicates that bark is a low-cost raw material with suitable properties for use in the booming insulation-manufacturing industry. Moreover, further study of this natural thermal insulator could lead to improved materials for meeting future insulation requirements and providing a means for efficient value adding to an industrial by-product.

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International Forests and Water Dialogue

There is increasing consensus on the important roles that trees and forests play in the hydrological cycle. With a greater understanding of the gaps in knowledge, it is important to integrate science, practice and policy to inform and guide the management of forests for the provision of water-related ecosystem services, including through economic incentives and institutional mechanisms. Land managers and policy-makers need to manage the trade-offs between the ecosystem services provided by forests and trees and the impacts of forests on water availability.

The International Forests and Water Dialogue, a two-day special event held during the XIV World Forestry Congress, was conceived to encourage discussion on forest–water interactions and the integration of science, practice and policy, and to launch the Five-year Forests and Water Action Plan. The Dialogue was the latest milestone in the Forests and Water Agenda, and it represented the transition from discourse to action. The event was co-organized by FAO, the International Union of Forest Research Organizations (IUFRO), the World Agroforestry Centre (ICRAF) and the International Network for Bamboo and Rattan (INBAR).

The Dialogue featured a range of speakers, breakout sessions, the launch of the Forests and Water Action Plan and a review panel. There was also a "world café", which showcased examples of forest–water interactions from various countries and engaged participants in an information exchange on best practices and lessons learned on topics such as mangroves, ecosystem services, participatory governance, watershed management and integrated landscapes.

The Dialogue generated ten key messages, from which the following three top-level messages were distilled and presented to the XIV World Forestry Congress plenary:

1. The interaction between trees, forests and water and the role this plays in addressing critical issues, such as food security, access to quality water, climate change and landscape resilience, deserves greater recognition at the national, regional and international levels.
2. The Dialogue reaffirmed that there is a strong demand and need for, and willingness to participate in and contribute to, a newly established network of partners that will consolidate, synthesize and share knowledge, best practices and common methodologies, as well as build the capacity of scientists, practitioners and policy-makers, on the interactions between forests and water.
3. There is a need for decision-makers to allocate greater resources for research on forest–water interactions and the translation of this research into policy action and practical implementation, including at the community level.

The proceedings of the Forests and Water Dialogue are available at: www.fao.org/about/meetings/world-forestry-congress/programme/special-events/water

Participants discuss a poster during the world café on forests and water

© ICRAF/DAISY OUYA

Zaituni Ramadhani cooks using a fuel-efficient stove in Kiroka, United Republic of Tanzania. The stoves require much less firewood than traditional three-stone stoves and have proven very successful in the area

More than heat! Wood energy for the future

More than half of all wood produced worldwide is used for energy. In developing countries, wood is often the only energy source for poor people in both urban and rural areas. One-third of households – mostly in developing countries – use wood as their main source of fuel for cooking, and about 765 million people use woodfuel to boil their drinking water.

There are many challenges to the sustainable production and consumption of wood energy, including illegal production; indoor air pollution due to the inefficient use of woodfuel; the disproportionate burden that woodfuel collection imposes on women and children; and the cross-continental trade and large-scale use of wood pellets for power generation and district heating in industrialized countries, which has led to concerns regarding the sustainability of production. If woodfuel becomes scarce, people may cook fewer meals or be unable to sterilize drinking water, affecting human health and food security.

The main purposes of this half-day special event at the XIV World Forestry Congress on wood energy for the future, which featured ten speakers and a wide-ranging interactive discussion, was to showcase the potential of wood energy for sustainable development and greener economies and to highlight ways of making wood energy use more sustainable and efficient. It produced the following six key messages:

1. Wood energy is not “the poor man’s fuel”. It is a renewable, climate-friendly and available form of energy when produced sustainably and used efficiently.
2. Wood is a high-value product, and woodfuel may not always be the highest value-added end use. In some circumstances, however, it may be the best option for energy production.
3. A comprehensive approach addressing the full value chain for fuelwood and charcoal as well as governance issues is needed to improve sustainability and efficiency, especially for charcoal production and trade.
4. Special attention needs to be paid to women and children, who bear most of the burden of woodfuel collection and use, including by reducing the health risks.
5. As countries embark on a sustainable development path in the context of the post-2015 development agenda, wood energy should be considered as a viable, renewable alternative to fossil fuels for a wide range of industrial purposes in industrialized as well as developing countries.
6. In sub-Saharan African countries, where a large proportion of the population relies on wood energy, enhancing the sustainability and efficiency of woodfuel production and consumption should be a priority for development policies and strategies.

A "flash mob" of young attendees at the XIV World Forestry Congress, International Conference Center, Durban, South Africa

Youth event: forests for the future

This event was organized by young people for young people, with the specific aim of bringing the youth perspective to the World Forestry Congress. As vital stakeholders in the process of sustainable development, participants in this special event debated the forestry issues of greatest concern to young people and generated actionable ideas, helping define the way forward for forests and forestry. The event produced the following statement framed as a youth "vision" and "commitment to change".

- Youth, as a collective, envisions forests as resources that are managed in ways that enable continuous provision for the needs of current and future generations. We see forests that:
  - > are managed based on multistakeholder engagement and acceptance;
  - > serve people – provision of food, water, shelter, energy and employment;
  - > are maintained as a spring of inspiration, spirituality and culture; and
  - > protect nature and the climate, and ultimately sustain life.
- By respecting different perspectives, beliefs and cultures and bringing people together rather than setting them apart:
  - > framing actionable policies at all levels;
  - > implementing policies at the local, national and global levels;
  - > actively engaging in our communities;
  - > breaking barriers and contributing to integrated solutions across sectors, regions and generations;
  - > partnerships and alliances for a green economy; and
  - > leading change today for tomorrow.
- We urge decision-makers to provide:
  - > investment in innovative education for developing skills, including
    - – social and intercultural awareness
    - – communication
    - – practical capacity building
    - – critical thinking; and
  - > platforms for the meaningful engagement of young people and social equity in local/national/global decision-making processes.

Additional actionable points submitted by participants in the Youth Forum:

- Let us, the youth, be outcomes- and results-orientated. Let all youth who attend World Forestry Congresses go with the idea that they are going to actively band together to deliver a project. Let's propel the youth to have a single, simple, medium-to-large project that is shared, no matter which part of the world they reside in. This will provide a platform for progress from theoretical discussions to quantifiable project outcomes.
- Young people should be meaningfully engaged in forestry platforms (e.g. programme implementation, policy formulation, processes, project design and formulation).
- Critical reforms are needed in the forest education sector, from theory-based to practical-based approaches, with better and practical learning approaches to attract young people to the concept of forestry and sustainable forest management.
- Support youth initiatives in sustainable forest management as a way of creating livelihoods and jobs for rapidly growing young populations.
- Build capacity and create mentorship programmes to enable the young to develop skills, exposure and expertise in forestry and sustainable forest management.

Wildlife Forum

Sustainable wildlife management practices help conserve native fauna and their natural habitats and improve the livelihoods of rural communities. Wildlife resources are threatened, however, by deforestation and the conversion of forested habitats to agriculture and other land uses; forest fragmentation and degradation; wildlife habitat encroachment; overgrazing; human–wildlife conflict; and the unregulated, unsustainable exploitation of wildlife and its products.

The first Wildlife Forum provided a unique opportunity for forest policy-makers, managers and other stakeholders to exchange information and knowledge on initiatives on the sustainable use and conservation of terrestrial and semi-terrestrial wildlife. It generated the following five key messages:

1. The sustainable management of wildlife is an important part of integrated approaches to the multipurpose use of natural resources and can play a meaningful role in addressing the Sustainable Development Goals. Done sustainably, wildlife management can provide benefits for food security, livelihoods, natural heritage, and biodiversity and ecosystem conservation.
2. Multidisciplinary approaches with strong community participation are needed to combine knowledge on the sustainable use and trade of wild meat and other non-wood forest products, strengthen legal frameworks and health protocols, and promote law compliance, multisectoral collaboration, innovative market approaches, and best practices. Foresters should be encouraged to ensure that sustainable forest management takes wildlife and non-wood forest products fully into consideration.
3. The role of indigenous and local communities in wildlife management is essential and must be strengthened through participatory approaches, including in wildlife monitoring and the eradication of poaching and wildlife crime.
4. It is possible to sustainably harvest wild meat and other non-wood forest products, and this is compatible with conservation, improved livelihoods, food security and nutrition. Better understanding of the causes and consequences of human–wildlife conflicts, including analyses of local situations, is needed in order to create models for mitigating conflicts and increasing the tolerance of indigenous and local communities towards co-existence with wildlife.
5. Combating the illegal trade in wildlife requires:
   - a coordinated effort at all levels, treating such crimes as serious, and deploying the same tools and techniques used to combat other serious crimes;
   - the involvement of indigenous and local communities, recognizing that basic levels of security must first be in place for communities to benefit from the legal use of wildlife;
   - stronger interagency and cross-border collaboration; and
   - the deployment of novel and innovative approaches and tools for the monitoring of wildlife populations, use and trade, including new identification and traceability tools.

The Wildlife Forum was organized by the Collaborative Partnership on Sustainable Wildlife Management, a voluntary partnership of 13 international organizations, including FAO.

Actors in a play on human–wildlife conflicts performed during the Wildlife Forum take a well-deserved bow

© FAO/SOFÍA ALVAREZ CAPUÑAY

"FORESTS AND PEOPLE" **PHOTO CONTEST**

Sofía Alvarez Capuñay of Peru won the XIV World Forestry Congress Forests and People photo competition. Her photo, *Eres una hoja* (You Are a Leaf) (above), features a woman standing in a Peruvian forest covering her face with a leaf.

"We live in a world full of traffic, buildings, smoke, factories and so much noise," Alvarez Capuñay said of her entry. "We are so focused on our daily problems that we forget that we are part of a whole, and we are as fragile as a leaf. We should remember that we are very small compared to the power and grandeur of nature."

FAO launched the photo contest to highlight the importance of forests to people in the run-up to the XIV World Forestry Congress, which took place in Durban, South Africa, on 7–11 September 2015.

Renowned photographer Stuart Franklin of Magnum Photos chose six finalists from over 900 submissions received from 78 countries. The six finalists were published on FAO's Facebook page and received over 4 000 votes, with Alvarez Capuñay's photo the runaway winner with over 2 100 votes. She won a trip to the Congress and a portfolio review by Stuart Franklin.

Sofía Alvarez Capuñay
(Peru)
Eres una hoja
(You Are a Leaf)

Somennath Mukhopadhyay
(India)
Gathering Gold

Tsigie Befekadu
(Ethiopia)
Wood for Livelihood

© FAO/ADITYA SINUGRAHA PAMUNGKAS

◀
Aditya Sinugraha Pamungkas
(Indonesia)
Small Gifts for the Earth

© FAO/TOLOJANAHARY RANAIVOSOA

▶
Tolojanahary Ranaivosoa
(Madagascar)
Cuisson des briques au feu du bois (Firing Bricks on Woodfire)

▲

Liliana Vanegas
(Gabon)
Los ojos de Jean Pierre
(Jean Pierre's Eyes)

View more entries at:
www.flickr.com/photos/faoforestry/albums/72157655112907678/with/19129967888

TREEHOUSING WOOD DESIGN COMPETITION

Housing for the world's growing urban population is a major challenge for global sustainability. The Treehousing Wood Design Competition, held as part of the XIV World Forestry Congress, challenged architecture students, architects and designers to develop innovative and sustainable wood-housing and urban building solutions.

There were two open categories:
- Category 1 – Treehousing Durban: Tall Wood Housing
- Category 2 – Treehousing Global: Affordable Wood Housing.

More than 200 projects by teams in 60 countries were submitted to the competition, which was organized jointly by FAO and the Canada-based Design Build Research School.

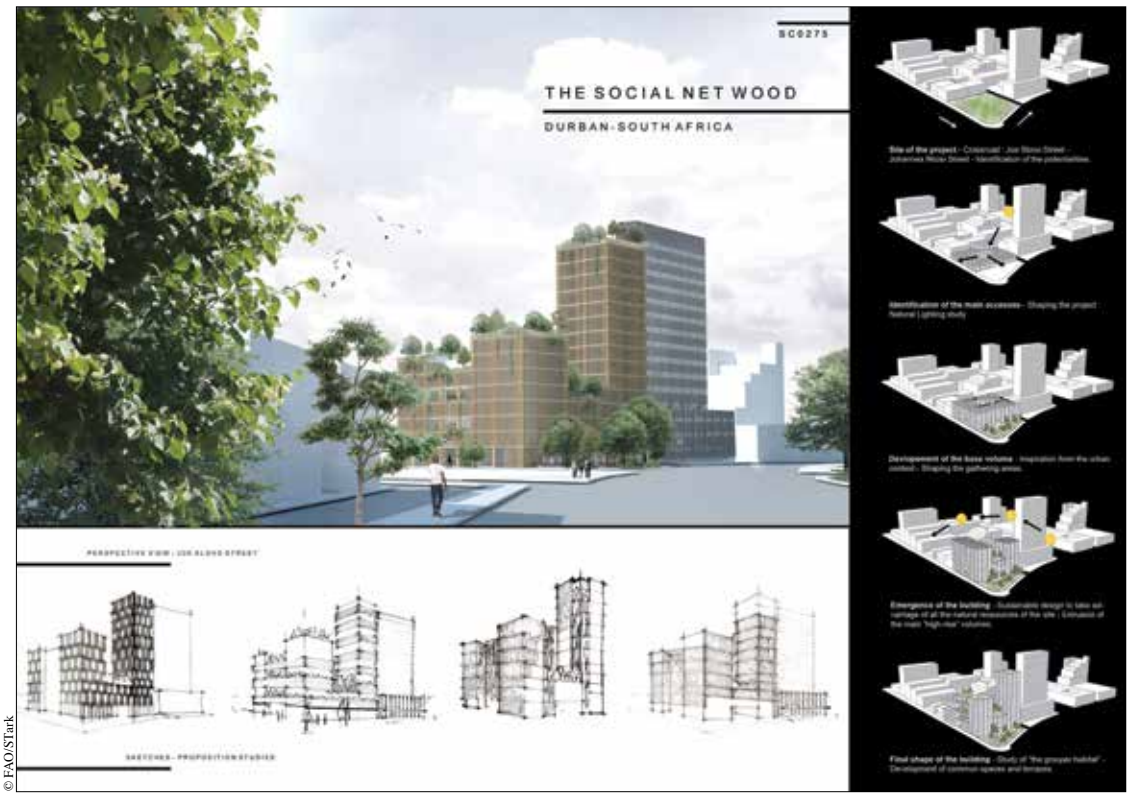
Category 1

The Grand Prize in Category 1 was shared by two entrants: architecture student Ayla Harvey from South Africa for her community "Jungle Gym", which was praised by the jury for capturing the dynamic spirit of urban life; and Koura Studios and ARUP Seattle, in the United States of America, for their "Nkosi Market", which the jury said showed a good understanding of South African forestry and forestry products.

The Student Award in Category 1 went to STark (France/Germany) for "The Social Net Wood", which the jury considered "entirely buildable".

Ayla Harvey
(South Africa)
Jungle Gym

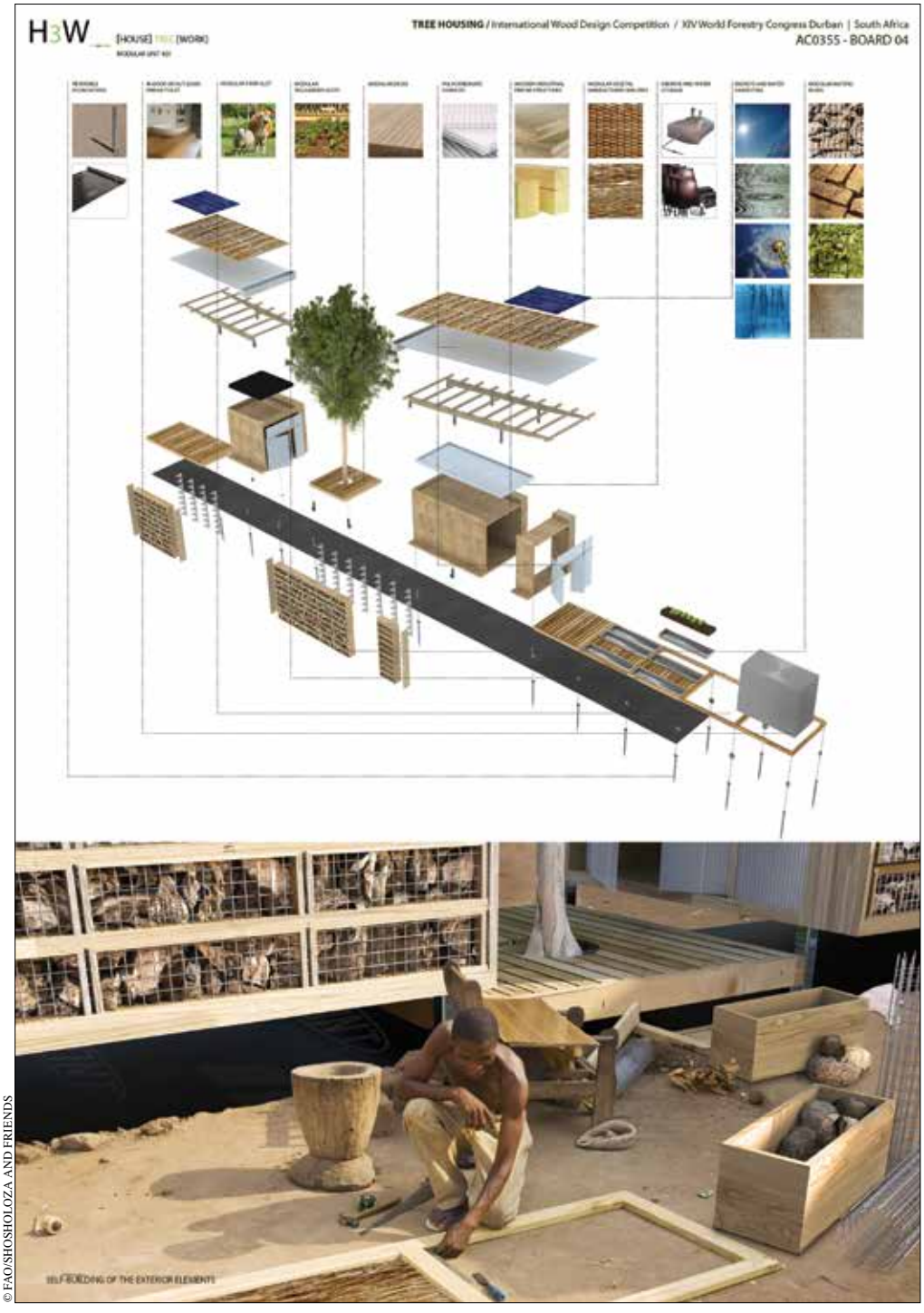
Koura Studios and ARUP Seattle
(United States of America)
Nkosi Market



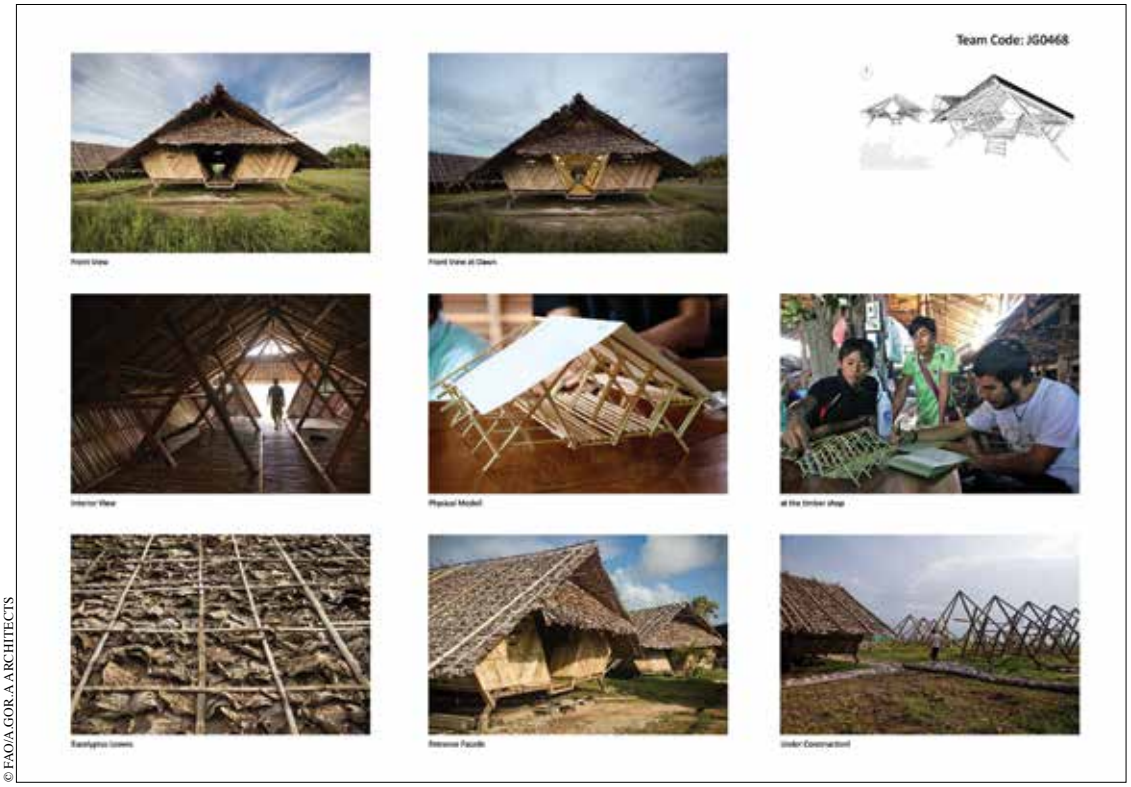
STark
(France/ Germany)
The Social Net Wood

Category 2

In this category, applicants were challenged to design affordable wood housing for a site anywhere in the world. The Grand Prize winner in this category was Shosholoza and Friends (Italy) for its design "(HOUSE)TREE(WORK)", imagined for a sustainable rural community site in Ethiopia and praised by the jury for its clarity and simplicity. Second prize went to a.gor.a architects (Thailand) for "Temporary Dormitories for Mae Tao Clinic" in Thailand, commended for its practical affordability. Monika Wozniak (Poland) won the student prize for her "Natural Wood Skin", a design for Hong Kong that the jury appreciated for its ambitious large-tower formats.

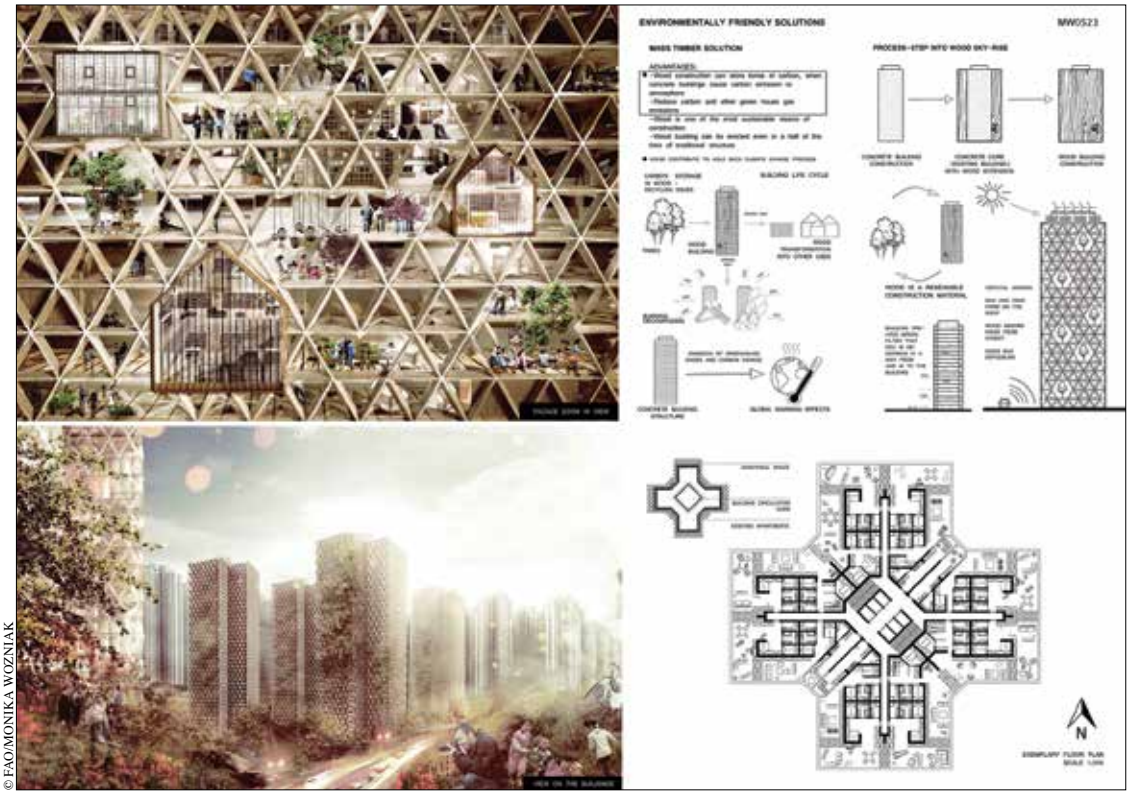


◀ **Shosholoza and Friends**
(Italy)
(HOUSE)TREE(WORK)



© FAO/A.GOR.A ARCHITECTS

◀ **a.gor.a architects**
(Thailand)
Temporary
Dormitories for
Mae Tao Clinic



© FAO/MONIKA WOZNIAK

◀ **Monika Wozniak**
(Poland)
Natural Wood Skin

These images are also available online at:
www.flickr.com/photos/faoforestry/sets/72157656081986493

FAO and Slow Food launch voluntary product label for mountain goods

FAO's Mountain Partnership and Slow Food recently launched a new voluntary label for mountain goods with the aim of improving market access for small mountain producers from developing countries and highlighting the quality of their products.

The new label informs buyers that the products marketed under it have been manufactured in mountain areas by small producers and that the purchase of those products supports local biodiversity and respects the cultural traditions of local communities.

Two pilot products were identified for the start of the Mountain Partnership Products initiative: apricots grown in the remote mountainous region of Batken in Kyrgyzstan; and rare black amaranth grain produced in the Bolivian Andes. A variety of other goods from mountain areas in developing countries, such as coffee, tea and spices, will also be marketed under the new label. The label will be available free of charge to mountain producers following a review of their products and production methods.

The scheme is designed to ensure fair returns for producers and the equitable distribution of profits along the entire value chain.

The mountain label is not mandatory for mountain producers, and nor does it replace other labels that their products may have to carry under national laws. It is an easy way in which small-scale producers and associations can set their wares apart in a positive way. Those wishing to apply for the label can contact the Mountain Partnership Secretariat directly or through local Mountain Partnership focal points. Requests will be evaluated based on a set of criteria that addresses factors such as the size of production, the impact on the environment, and the altitude at which the goods are made.

The Partnership will also oversee a verification system through which an appointed expert or authorized entity will periodically monitor a random sample of products carrying the Mountain Partnership Product label to ensure the goods continue to meet the guidelines.

For a select number of products, including those in Kyrgyzstan and the Plurinational State of Bolivia, FAO is providing additional support. This ranges from teaching producers new ways to scale up and add value to their existing production – such as in the case of the Kyrgyz apricots – to helping start an entirely new production and distribution chain – such as in the case of the revival of black amaranth in the Plurinational State of Bolivia.

The initiative merges the strengths of the Mountain Partnership in addressing highland-specific challenges through its global network with the experience of Slow Food in supporting traditional crops and products that otherwise might be at risk of disappearing, while protecting unique ecosystems and recovering traditional processing methods.

The collaboration is part of a three-year agreement between FAO and Slow Food to promote more inclusive food and agriculture systems at the local, national and international levels. Slow Food joined the Mountain Partnership – the UN alliance dedicated to improving mountain livelihoods and environments – in March 2016.

More information: *www.mountainpartnership.org/our-work/regional cooperation/climate-change-and-mountain-forests/mountain-products*

The first batch of labelled mountain products

© FAO/ALESSIA VITA

Participants in a workshop on forest concession systems in September 2015 visit a forest concession in the Jamari National Forest, Rondônia, Brazil

Making forest concessions work

FAO, in partnership with the International Tropical Timber Organization, the Brazilian Forest Service, the Center for International Forestry Research and the French Agricultural Research Centre for International Development, launched the Forest Concessions Initiative in 2015 to explore the future development of tropical forest concessions and propose alternative models to (traditional) concession systems. The initiative aims to promote tropical forest concessions as a means of incorporating the best practices of sustainable forest management (SFM) while also increasing the contributions of forests to socio-economic development, biodiversity conservation and carbon sequestration.

In many countries, forest concession systems are important approaches to the management of public forests. They are a legal instrument through which the state establishes agreements with third parties (typically private companies or communities), transferring forest-harvesting rights in exchange for payments or the provision of management services in the areas under concession. Concessions generally refer to rights related to the harvesting of timber or other forest products and the long-term management of forest resources.

The goal of the Forest Concessions Initiative is to work with governments and the private sector to create concession systems that are sensitive to the needs of local communities, enable operators to obtain reasonable profits and provide stable and attractive jobs, and maintain the integrity of forest resources.

FAO estimates that 76 percent of forests worldwide are publicly owned; between 1990 and 2010, the percentage of privately managed

public forests under concessions increased from 3 percent to 15 percent. Forest concessions are adopted in all parts of the world in boreal, temperate and tropical forests. In most of the developing world, however, information on the area of forest under this type of contractual arrangement is scarce and unreliable. Recent studies commissioned by FAO in selected countries in West and Central Africa, Latin America and Southeast Asia reported at least 122 million hectares of forest concessions. In 20 selected countries, industrial forest concessions accounted for 14 percent of all public forests and 60 percent of public forests designated for production. In recent years, concessions have been established with forest communities, especially in some countries in Latin America.

If well managed, concessions have the potential to mainstream SFM and provide local communities with economic, social and environmental benefits. Small and medium-sized concessions granted to communities seem to work best, with wider positive repercussions for the livelihoods of those communities. In Brazil, for example, forest concessions generate more than 6000 direct and indirect jobs for every 1000 cubic metres of harvested logs; in the Plurinational State of Bolivia, rural families participating in the community management of forests increased their incomes by an average of 23 percent, much of which was reinvested in basic community education projects, infrastructure and health.

As part of the Forest Concessions Initiative, a workshop was held in Porto Velho, Rondônia, Brazil, in September 2016 to discuss the role of forest concessions as an important tool for SFM, especially in the tropics.

The international workshop, "What Future for Forest Concessions and Alternative Allocation Models for Managing Public Forests?", was an intense and productive four-day event. It comprised presentations, discussions in working groups and plenary, and other forms of interaction among participants, including a field visit to the first area allocated as a concession in the Jamari National Forest. The workshop proposed two actions for the work of the Forest Concessions Initiative:

1) The creation of a community of practice or network of practitioners and policy-makers interested in regularly sharing experiences, good practices and specific actions on concessions and other public–private arrangements for managing public production forests.
2) The production of updated guidelines for the effective management of public production forests in tropical countries through forest concessions in the context of the 2030 Agenda for Sustainable Development. The aim of the guidelines would be to advise policy-makers, forest entrepreneurs and forest communities on the management and governance of forest concessions and economic, social and environmental aspects, including good practices and innovative approaches. The guidelines would build on reports already prepared as part of the initiative, the results of the workshop, and additional information and consultations at the regional level.

More information: *www.fao.org/forestry/sfm/92208*

22nd Conference of the Parties to the United Nations Framework Convention on Climate Change

A statement issued by world leaders at the 22nd Conference of the Parties (COP22) to the United Nations Framework Convention on Climate Change, held in Marrakech, Morocco, on 7–18 November 2016, confirmed their continued support for the Paris Agreement on climate change.

In the "Marrakech Action Proclamation for Our Climate and Sustainable Development", which was read to the plenary at COP22, the heads of state, government and delegations said they welcomed the rapid entry into force of the Paris Agreement and that "we affirm our commitment to its full implementation". Under the Paris Agreement, which was adopted in 2015, all nations have agreed to combat climate change and to unleash actions and investments towards a low-carbon, resilient and sustainable future. Among other things, the Paris Agreement formally recognizes the important role of forests in addressing climate change.

The Marrakech Action Proclamation contains a number of other important statements by the heads of state, government and delegations, among which are the following:

"We call for the highest political commitment to combat climate change, as a matter of urgent priority.

"We call for strong solidarity with those countries most vulnerable to the impacts of climate change, and underscore the need to support efforts aimed to enhance their adaptive capacity, strengthen resilience and reduce vulnerability.

"We call for all Parties to strengthen and support efforts to eradicate poverty, ensure food security and to take stringent action to deal with climate change challenges in agriculture.

"We call for urgently raising ambition and strengthening cooperation amongst ourselves to close the gap between current emissions trajectories and the pathway needed to meet the long-term temperature goals of the Paris Agreement.

"We call for an increase in the volume, flow and access to finance for climate projects, alongside improved capacity and technology, including from developed to developing countries.

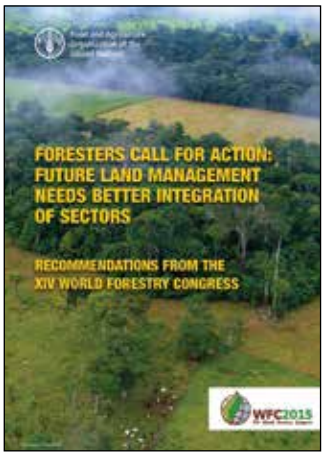
"We the Developed Country Parties reaffirm our US$100 billion mobilization goal.

"The transition in our economies required to meet the objectives of the Paris Agreement provides a substantial positive opportunity for increased prosperity and sustainable development.

"As we now turn towards implementation and action, we reiterate our resolve to inspire solidarity, hope and opportunity for current and future generations."

Read the *Marrakech Action Proclamation for Our Climate and Sustainable Development* at: *unfccc.int/files/meetings/marrakech_nov_2016/application/pdf/marrakech_action_proclamation.pdf. News on other developments at COP22 is available at: newsroom.unfccc.int*

Participants in UNFCCC COP22 in Marrakech, Morocco, show their support for implementing the Paris Agreement on climate change

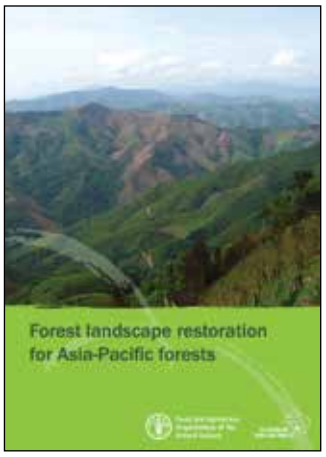


Integrating forests and other land uses

Foresters call for action: future land management needs better integration of sectors. Recommendations from the XIV World Forestry Congress. Brochure. 2015. Rome, FAO.

The XIV World Forestry Congress delivered a strong message: global challenges require increased efforts to better manage land by integrating forests and other land uses. Why is it essential to better integrate forests and other land uses? What barriers on the ground must be overcome to simultaneously increase agricultural output and boost the productive and protective functions of forests? How can policy-makers, the private sector, stakeholders and researchers contribute to a more integrated and sustainable approach to land use? This brochure explains how these questions were addressed at the World Forestry Congress in South Africa in 2015. It aims to stimulate discussion as well as collaborative and cross-sectoral planning and action at the landscape scale.

Available online: *www.fao.org/3/a-i5227e.pdf*

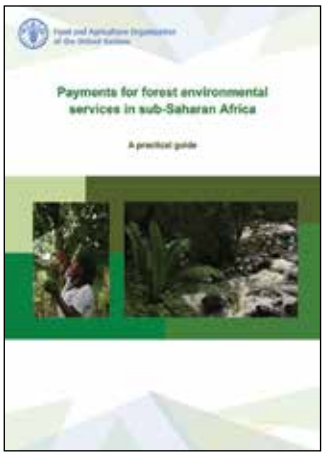


Landscape restoration in Asia and the Pacific

Forest landscape restoration for Asia-Pacific forests. S. Appanah. 2016. Bangkok, FAO and Center for People and Forests – RECOFTC. ISBN 978-92-5-109094-7.

The need to restore forests is increasing in Asia and the Pacific, and there are large areas of degraded forests and lands. Forest landscape restoration (FLR) is an innovative approach that integrates forest restoration with other activities across landscapes to achieve optimum productivity in both commercial and ecological terms. Many practitioners are not fully aware of the concepts behind the FLR approach, however. With a view to strengthening FLR in the region, the FAO Regional Office for Asia and the Pacific and RECOFTC undertook a multicountry study to review the status of forest and land degradation, commonly used restoration approaches, and the policy and institutional environments capable of supporting the introduction of FLR.

Available online: *www.fao.org/3/a-i5412e.pdf*



Paying for forest services in sub-Saharan Africa

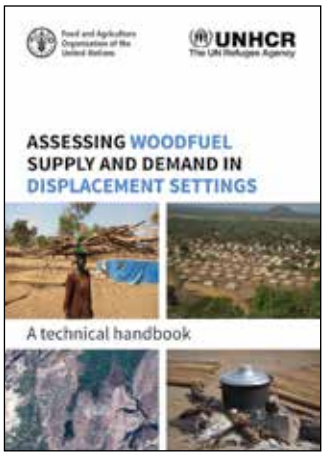
Payments for forest environmental services in sub-Saharan Africa: a practical guide. P. Nantongo Kalunda. 2016. Accra, FAO. ISBN 978-92-5-109201-9.

This publication responds to calls in various regional and global forestry forums to strengthen capacity for effectively developing and implementing payment schemes for environmental services in sub-Saharan Africa. It focuses on forest-based environmental services such as carbon sequestration, watershed protection and biodiversity conservation. It comes at a time when forests are at the centre of global responses to the challenge of climate change and when payment schemes for forest environmental services are increasingly seen as a valuable means of generating revenues for local economic development from sustainable forest management.

The publication compiles lessons applicable in sub-Saharan Africa generated by initiatives in the subregion and in other regions relevant to sub-Saharan Africa. It is designed as a practical reference covering all the main topics related to payment schemes for forest environmental services, from the basics of quantifying and valuing those services to the arts of market development and stakeholder engagement. FAO hopes that a better understanding of these dimensions and associated practical lessons will facilitate the growth of payment schemes for forest environmental services, from the few existing local and small-scale initiatives to large-scale self-sustaining programmes at the national level.

The long-term objective of this capacity-building effort is to mobilize more financial resources for sustainable forest management by increasing the recognition and appreciation of the benefits of trees, forests and forestry.

Available online: *www.fao.org/3/a-i5578e.pdf*



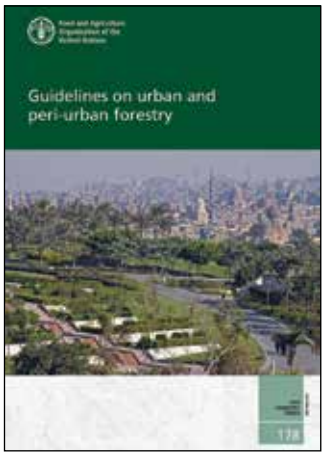
Woodfuel: vital for displaced people

Assessing woodfuel supply and demand in displacement settings: a technical handbook. R. D'Annunzio, A. Gianvenuti, M. Henry & A. Thulstrup. 2016. Rome, FAO and the Office of the United Nations High Commissioner for Refugees. ISBN 978-92-5-109284-2.

In densely populated areas, such as those found in the context of forced displacement, ensuring access to natural resources, including woodfuel, can be highly challenging. In protracted crises, camps for refugees and internally displaced persons are often established in locations where natural resources are already scarce and where limited resource access can increase food insecurity and social conflicts. The environmental damage caused by the unsustainable extraction and use of woodfuel can be long-lasting.

The sustainability of woodfuel extraction can be evaluated by assessing: the standing woody biomass available for use as fuel (woodfuel supply); consumption over a given period (using woodfuel consumption as a proxy for woodfuel demand); and the interrelationships and gaps between demand and supply. This evaluation method determines whether the rate at which wood is harvested outpaces the natural or managed rate of woody regrowth in nearby areas and can help identify options for improving energy use. The manual presents a methodology for assessing woodfuel supply and demand at the level of the displacement camp through the collection of primary data in the field and remote sensing analysis. The methodology uses a multisectoral approach to assess the energy-related needs and challenges of people in both displaced and host communities.

Available online: *www.fao.org/3/a-i5762e.pdf*



The world's fast-growing cities need more trees

Guidelines on urban and peri-urban forestry. F. Salbitano, S. Borelli, M. Conigliaro & Y. Chen. 2016. FAO Forestry Paper No. 178. Rome, FAO. ISBN 978-92-5-109442-6.

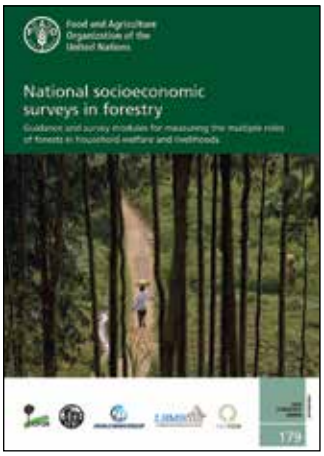
Although cities occupy only 2 percent of the planet's surface, their inhabitants use 75 percent of its natural resources; by 2050, 70 percent of the global population will live in cities and towns. Sustainable urban development is crucial, therefore, for ensuring the quality of life of the world's people.

Forests and trees in cities, if properly managed, can make important contributions to the planning, design and management of sustainable, resilient urban landscapes. They can help make cities more pleasant, attractive and healthy places in which to live, as well as safer, wealthier and more diverse.

A few years ago, FAO initiated a collaborative process to develop voluntary guidelines aimed at optimizing the contributions of forests and trees to sustainable urban development. Scientists, practitioners and public administrators from cities worldwide were brought together to discuss the elements and key challenges of urban forestry, and a smaller team of experts was assembled to distil this vast knowledge.

This document is the ultimate result of that process. Intended for a global audience comprising urban decision-makers, civil servants, policy advisors and other stakeholders, it will assist in the development of urban and peri-urban forests that help meet the present and future needs of cities for forest products and ecosystem services. These guidelines will also help increase community awareness of the contributions that forests and trees can make to improving quality of life, and of their essential role in global sustainability.

Available online: *www.fao.org/3/a-i6210e.pdf*



Measuring the role of forests in households

National socioeconomic surveys in forestry: guidance and survey modules for measuring the multiple roles of forests in household welfare and livelihoods. R.K. Bakkegaard, A. Agrawal, I. Animon, N. Hogarth, D. Miller, L. Persha, E. Rametsteiner, S. Wunder & A. Zezza. 2016. FAO Forestry Paper No. 179. Rome, FAO, World Bank, Center for International Forestry Research and International Forestry Resources and Institutions Research Network. ISBN 978-92-5-109438-9.

Forests play an important role in the livelihoods of rural households, and many of those who live in extreme poverty rely to some degree on forests for their livelihoods. Products from non-cultivated ecosystems such as natural forests, woodlands, wetlands, lakes, rivers and grasslands can be a significant income source for rural households, providing energy, food, construction materials and medicines for both subsistence and cash. FAO estimates that forest products contribute to the shelter of at least 1.3 billion people and that about 2.4 billion people cook with woodfuel. Data on the benefits that people receive from forests are often weak at the national level; collaborating with public organizations undertaking surveys to collect such data at an aggregate scale is one important way forward.

The primary users of this sourcebook will be national statistical offices responsible for the implementation of national household socio-economic surveys, including their "living standards measurement studies" designed to measure household welfare and livelihoods. Interest should be especially strong among forest-rich developing countries that want to generate more accurate measures of the contributions made by forests and other non-cultivated ecosystems to national economies.

Other intended users are other government agencies, donors, non-governmental organizations and research organizations interested in collecting comparable data on the use of forest and wild products by households and local communities, particularly at the national scale but also at more aggregated scales.

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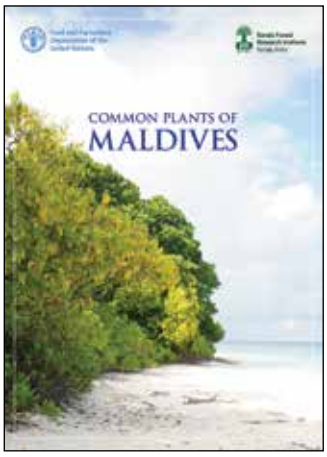
BOOKS



The green treasure of Maldives

Common plants of Maldives. P. Sujanapal & K.V. Sankaran. 2016. Bangkok, FAO, and Kerala, India, Kerala Forest Research Institute. ISBN 978-92-5-109295-8.

Over the past century, island biodiversity worldwide has been subjected to extreme pressures due to habitat change, overexploitation, invasion by alien species, climate change and pollution. It is common knowledge that small island countries are ecologically fragile and highly vulnerable to such challenges, and Maldives is no exception.

The natural habitats and biodiversity of most tropical islands are increasingly affected by cyclones, storms and hurricanes associated with climate change. According to recent estimates, of the 724 animal extinctions recorded worldwide in the last 400 years, about half were island species. Such global estimates are unavailable for plant species, however, pointing to a significant information gap that could be crucial in coming decades. More information on extinctions is essential for evaluating the risks of species losses due to environmental challenges and to reduce such risks in the face of present and future threats.

This book includes information on 270 species of vascular plants observed during surveys conducted on more than 50 islands in Maldives. It deals with the common native plants, as well as all alien plants now found on the islands.

Available online: *www.fao.org/3/a-i5777e.pdf*

The challenge of pastoral land tenure

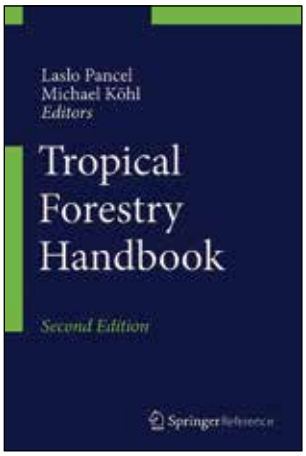
Improving governance of pastoral lands: implementing the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security. J. Davies, P. Herrera, J. Ruiz-Mirazo, C. Batello, I. Hannam, J. Mohamed-Katerere & E. Nuesri. Rome, FAO. ISBN 978-92-5-109292-7.

Pastoralism has been defined as extensive livestock production on rangelands, a broad description encompassing many herding practices and production systems found worldwide. It has been clearly demonstrated that the planned herding of livestock is vital for the sustainable management of rangelands. Managed herd movements are essential for sustainable pastoralism, and they also pose the single greatest challenge to securing pastoral tenure.

This technical guide presents detailed arguments for herd mobility. Herd movements can take place on very different scales, however, from long-range nomadism to seasonal transhumance of different distances, to relatively localized herd movements and pasture rotations. Historically, the mobility of pastoralists has been used as a justification for not securing their land rights: because pastoralists are constantly wandering, the argument goes, they do not lay claim to any particular piece of land. This argument has been used in places where pastoralists have followed the same transhumance routes for centuries and where there is clear evidence of their historic use and management. Yet even in the most nomadic of pastoralist communities, herd movements rely on natural and human infrastructure that has been protected and maintained by pastoralists since time immemorial.

Mobility is a response to the uncertainty and heterogeneity of rangeland resources; communal tenure practices are another. Together, these create complex customary tenure arrangements, the upholding of which requires sophisticated responses from governments and other agents. This technical guide helps generate solutions to securing pastoral governance and tenure without undermining the inherent, necessary complexity of customary arrangements. It also provides potential solutions in a rapidly changing context in which traditional practices and crucial patterns of livestock mobility are being transformed.

Available online: *www.fao.org/3/a-i5771e.pdf*



Tropical forestry in an era of climate change

Tropical forestry handbook. L. Pancel & M. Köhl, eds. 2016. Second edition. Berlin Heidelberg, Springer-Verlag. ISBN 978-3-642-54600-6.

This book provides a cross-section of outstanding experiences in all fields of tropical forestry in a drastically changing environment induced by climate change. The book sheds light on existing knowhow, presenting it concisely and efficiently for scientists and professionals in charge of planning, implementing and evaluating forest resources. The handbook provides proven and promising concepts that can be applied to solve the organizational, administrative and technical challenges prevailing in the tropics. It presents state-of-the-art methods in all fields related to tropical forestry, emphasizing methods adapted to – and which safeguard – environmental conditions.

More information available at: *www.springer.com/us/book/9783642546006*

Empowering forest communities in the American tropics

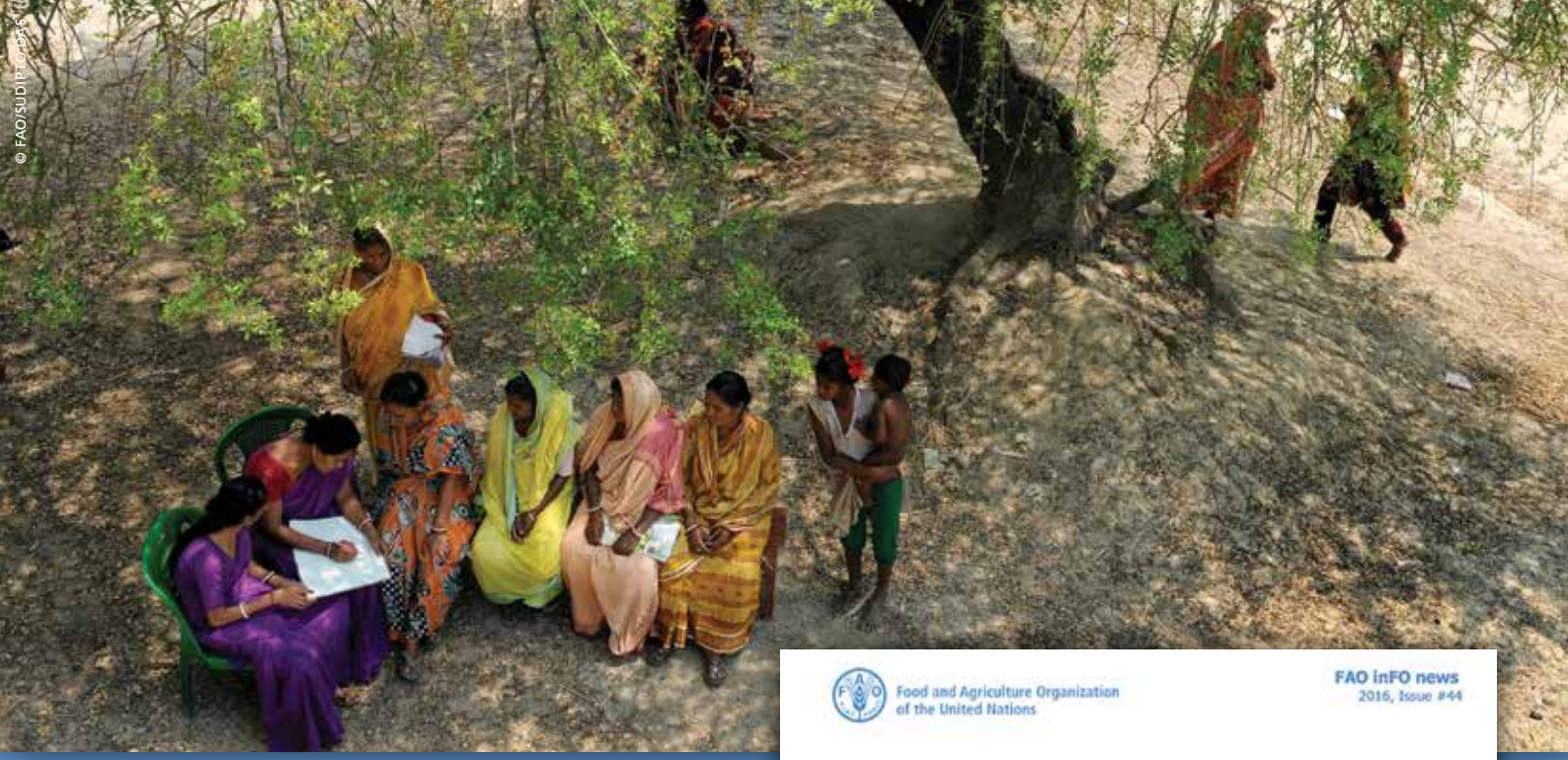
Desarrollo forestal empresarial por comunidades. Guía práctica para promotores forestales comunitarios en los trópicos americanos. J. Eke, S. Gretzinger, O. Camacho, C. Sabogal & R. Arce. 2016. Santiago, FAO and Centro Agronómico Tropical de Investigación y Enseñanza (CATIE). ISBN 978-92-5-309356-4 (FAO).

The management of forest resources by indigenous or mestizo local communities is promoted worldwide as one of the best strategies for developing sustainable, equitable and participatory forest management. Community forestry (CF) plays a central role in forest management in Latin America. FAO and CATIE have joined forces to develop this guide to help communities overcome obstacles and limitations and design their own CF initiatives as business opportunities with the potential for triggering economic and environmental benefits.

This is a practical guide that collects lessons learned and experiences gathered while supporting the implementation of CF initiatives in several Latin American countries. It is expected to serve as an effective reference framework, to encourage the greater exchange of experiences and knowledge, and to promote training, support and communication, taking into account the differences and challenges of various production systems. The guide is designed for communities already involved in forestry enterprises and also for those not yet engaged in such businesses but who are interested in becoming so.

As well as supporting CF implementation, the guide can serve other purposes, such as: the implementation of projects; training activities for various audiences (e.g. promoters, public officials, and university and technical school teachers); the design of financial mechanisms; and the formulation of public policies and the institutionalization of CF.

Available online in Spanish: *www.fao.org/3/a-i5984s.pdf*



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Editorial *COP22 main outcomes: implications for FAO and its future work on climate change*

By Martin Frick, Director, Climate and Environment Division, FAO

Just over three weeks ago, the 22nd session of the Conference of the Parties (COP22) to the United Nations Framework Convention on Climate Change held in Marrakech, Morocco, ended. The international community reaffirmed the importance of multilateral climate diplomacy and underlined that the Paris Agreement is irreversible. Most importantly, COP22 was the first COP with a strong focus on implementation and climate action. In this context, agriculture and food security featured more prominently than ever before.

Read more...

FORESTS, MOUNTAINS AND CLIMATE CHANGE

FAO Forestry at COP22: Forests and mountains also integral to success of Paris Agreement

The overriding key message of FAO and its partners at COP22 was simple but clear: without harnessing the huge potential of agriculture, forestry and fisheries, the Paris Agreement imperative to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels..." will be challenging. At several events, FAO advocated a greater role for forests and mountains in climate change adaptation and mitigation, including action articulated by the COP22 Forest Champions in a set of "Priorities for Action for Forests".

Read more in the key outcome summaries of:

- Forest Action Event (8 November)
- UN System Side Event: "Joining Forces to Achieve SDG15: Delivering on the global agenda for forests, climate and development" (16 November)
- UN-REDD Programme: REDD+ Forest Reference Emission Levels and REDD+ results reporting
- Resilient landscapes in Africa's drylands: seizing opportunities and deepening commitments: (16 November) - African Union, World Bank, FAO and other key organizations

International Mountain Day
11 December 2016

Mountain Cultures: celebrating diversity and strengthening identity

FAO Forestry at COP13 to the Convention on Biological Diversity

4–17 December, Cancun, Mexico

Read more in this issue's Forests and Biodiversity section

5th Mediterranean Forest Week

Morocco, 20–24 March 2017

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