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Society of American Foresters

International Society of Tropical Foresters

SAF International Forestry Working Group (IFWG) members and ISTF members,

This Newsletter is looking for general articles, announcements, field practices, and research abstracts.

GENERAL ARTICLES: If you have a story about an international activity or project for the newsletter please send it along. I am usually looking for a one or two page article, but longer articles will be considered. Color pictures are welcomed and encouraged.

ANNOUNCEMENTS AND OPPORTUNITIES: If you have announcements of trainings or educational opportunities, forthcoming meetings, or other international events I will put them in the newsletter.

RESEARCH ABSTRACTS: If you have a recently published article you think may be of interest to other IFWG members send the citation, abstract and information on how to obtain the full article if that is available, either online or author contact information.

FIELD PRACTICES: Short articles on methods that are useful for foresters working in the field, probably something an academic journal would not publish.

SUBMISSION INFORMATION:

- The text should be in a word document.
- We have no required format but beginning with the December 2019 issue we will provide templates with a format for those who wish to use them.
- For figures and photos .jpg is preferred but other formats can probably be converted.
- The manuscripts are sent to blairorr@ymail.com only.

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Content

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NOTES FROM THE EDITORS & CO-EDITORS

We have just over 2,200 subscribers to the newsletter. Thanks to all of you who read the newsletter and a special thanks to all of our contributors.

Feel free to send this newsletter on to others.

The next issue is scheduled for September 2020.

Many thanks to all the contributors to this issue.

If you would like to be added to the distribution list for the newsletter, send an email to Blair Orr (blairorr@ymail.com).

- Blair Orr, IFWG Newsletter Editor

CONTRIBUTED ARTICLE

For institutional strengthening of the Observatory of Central African Forests in COMIFAC member countries

Liboum Mbonayem, Eba'a Atyi Richard

A project that has been implemented for 3 years and which aims to improve the management and sharing of environmental information in the 10 COMIFAC member countries.

General information on the RIOFAC Project

The project for the Strengthening and Institutionalisation of the Central African Forest Observatory (RIOFAC) is a continuation of previous Central African Forest Observatory (OFAC) projects with the support of FORAF, CEOFAC, OBAPAC and OFAC 3 projects (2007 - 2016) and which were a response to the issue raised in Strategic Area 2 of the COMIFAC Convergence Plan. Such an observatory provides the sub-region and its partners with essential tools for directing and sharing knowledge for better governance and sustainable management of forest ecosystems, by promoting a regional approach to the conservation and sustainable enhancement of biodiversity and the strengthening of protected area networks in Central Africa.

The specific objective of the project is to ensure that information made available by OFAC reflects the best and most relevant knowledge on Central African forests and is used by Central African governments and environmental and natural resource management stakeholders in their decision-making.

The geographical scope of the project extends to all COMIFAC countries, i.e. Cameroon, Central African Republic (CAR), Democratic Republic of Congo (DRC), Republic of Congo, Equatorial Guinea, Gabon, Chad, Burundi, Rwanda and Sao Tome and Principe. The target groups and beneficiaries of the project are the policy-makers of COMIFAC countries, technical and financial partners, academics and researchers, economic operators, while the final beneficiaries are the local populations and citizens of COMIFAC countries as well as the world through the preservation of global public properties. The project financed by the European Union (EU) and initially planned for a period of 4 years since June 2017 has benefited from an EU codicil to end in 2024.

Implementing partners of the RIOFAC project

The Center for International Forestry Research (CIFOR) manages the project and the other implementing partners are: the Centre International de Recherche Agronomique pour le Développement (CIRAD), ForêtRessource Management and Engineering (FRMI), the Catholic University of Louvain (UCL), the Joint Research Centre (JRC) and the national groups in COMIFAC member countries.

Importance of FOCA in the RIOFAC project

The FOCA is already playing its role as a tool for implementing the COMIFAC convergence plan. One of the major challenges of the RIOFAC project is to make the OFAC portal (https://www.observatoire-comifac.net) operational and sustainable. The OFAC portal is a decision support tool that defines itself as an instrument of COMIFAC and CBFP members for steering and sharing knowledge in order to promote better governance and sustainable management of ecosystems in Central Africa. Thanks to OFAC, COMIFAC member countries can pool the knowledge and data available for monitoring forests in their economic, social and ecological dimensions. With this in mind, OFAC's mission is to compile, centralise and harmonise environmental and economic information collected from data providers that are made up of the forest administrations of Central African countries, environmental NGOs, private economic operators, civil society actors and conservation projects.

Figure 1. Training on the Integrated Management Effectiveness Tool (IMET) at Edea (Cameroon) in February 2019

Results achieved after 03 years (2017 - 2020) of implementation of the RIOFAC project

The 03 major results achieved are as follows:

Outcome achieved 1*: FOCA's data identification, collection and analysis processes in conjunction with its partners are improved to provide relevant information for decision making on CA forests*

- Regional workshop organized in February 2018 for the harmonization of OFAC indicators with global processes (FAO-ENG, ITTO, Convergence Plan ...)
- Computer forms for encoding national and regional COMIFAC indicators completed, user guide for the indicators developed
- Operational and improved data collection system (about 1000 documents available online)
- Multimedia library developed and integrated into the analytical platform of the FOCA portal
- Platform for visualization and analysis of data from projects/initiatives in the forest/environment sector in Central Africa developed and integrated into the OFAC website. (https://www.observatoire-comifac.net/analytical_platform)
- Data collection campaigns organised by the National Coordination of the 10 COMIFAC member countries with workshops to validate the said data in progress in 2020.
- Compilation of existing high-resolution thematic maps useful for mapping forest types in the Congo Basin through the use of MODIS (250m resolution) temporal data sets achieved
- Protocol for the acquisition and processing of SENTINEL satellite images written and posted on the FOCA website. This protocol was used to assess the state of invasions of the Virunga National Park.
- Several memoranda of understanding have been concluded between COMIFAC and : WCMC, IUCN, WDPA, WRI; the one negotiated with the RAC is being finalized.

***Results achieved 2**: The FOCA identifies or anticipates user needs and responds to them with targeted publications and information systems.*

- Several public policy briefs have been produced (https://www.observatoire-comifac.net/publications/policy_briefs):
  - In the second half of the year on the "***Policy for the promotion of legal timber in national and international public markets in Central Africa***",
  - In the third semester on the "***Contribution of Central African countries to the fight against climate change: urgent need for intersectoral coordination***".
  - In the fifth half of the year on "***International financial flows for nature protection and sustainable forest management in Central Africa***".
- A platform for analysing and visualising forest/environment sector initiatives has been developed and integrated into the FOCA website (https://www.observatoire-comifac.net). A strategy for mobilising COMIFAC partners has been put in place in order to feed this platform.
- As the publication of the State of Forests (SOF) is scheduled for 2021, a structuring of SOF was proposed during the regional workshop on harmonization of OFAC indicators held in February 2018 in Brazzaville.

Figure 2. 3 Policy brief published since the implementation of the RIOFAC project

- The State of Protected Areas (Edap) is expected to be published between March and June 2020 on the margins of the IUCN Congress on Protected Areas. In the meantime, however, there has been:
- 5 webinars were organized on the different stages of the processing chain required to produce regional land cover mapping using SENTINEL satellite images.
- A first COMIFAC regional workshop was organized on decametric mapping of land use and forest types in Central Africa using SENTINEL-2 images in Yaoundé.

***Result achieved 3**: The FOCA evolves into a visible entity, institutionally inserted within the COMIFAC.*

- The terms of reference for setting up a scientific committee have been drawn up and will be revised in line with cross-cutting strategic areas 2 "Research and Development" and 3 "Communication, Awareness, Information and Education" of the Convergence Plan.
- The communication plan of the RIOFAC project is developed and available

Management of the IMET tool

Support by the RIOFAC project to field campaigns for the use of the IMET tool in protected areas was done between 2016 and 2019 through the following results:

- Gradual commitment of the 10 COMIFAC member countries.
- 42 sites already evaluated (some of which have been re- evaluated).
- 8 ECOFAC sites 6 evaluated.
- 10 sites planned (Scalable planning based on partner requests).
- A Network of more than 45 Coaches in Central Africa is active.
- 4 CBSP sites of the Cameroon component have been evaluated.
- Data collection campaigns have enabled field partners in Cameroon to build their capacity to use the IMET tool (AWF, IUCN, WWF, GIZ, ZSL).

Short-term prospects

- Signature scheduled in June 2020 of an amendment to extend the implementation period of the RIOFAC project until 2024.
- Validation of the data collection campaigns in the 10 COMIFAC member countries to update the database of the OFAC portal.
- By June 2020, the project intends to publish the State of Protected Areas, 2020 edition.
- Organisation of the publication of the State of Forests, 2021 edition started in 2020.

A Research Note on Albinism in *Azadirachta indica* A.Juss.

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Abstract

An albino seedling occurs in natural regeneration of *Azadirachta indica*were reported here. These albinic individuals are not able to survival long term due to lack of chlorophyll pigment. In present study wereport neem albino seedlings, among the 34 progenies five progenies viz., TN-MTP-16, TN-MTP-21, TN-MTP-35, TN-MTP-42 and KA-BGL-01 are reported albinism in seedling at 3 percentage. This may due to immature seeds or environmental factors or mutations that have occurred between seed formation and germination stage.

Keywords: Albino, Neem, Progeny, Chlorophyll

Introduction

The neem tree (*Azadirachta indica* A.Juss.) is a tropical evergreen tree native to Indian sub-continent. It is commonly called ‘Indian lilac’ or ‘Margosa’ and belongs to the family Meliaceae. Neem is considered as one of the multipurpose tree, most of the plant parts such as fruits, seeds, leaves, bark and roots contain compounds with proven antiseptic, antiviral, antipyretic, anti-inflammatory, antiulcer and antifungal uses. Neem is one of the plant species that possesses the combination of most of the pest control properties like antifeedant, repellent, chemosterilant, attractant, juvenile and anti-juvenile and anti-juvenile hormone, moulting andanti-moulting hormone, ovicide, nematicide, rodenticide, anti-viral, fungicideand bactericide. These multifaceted biological effects and pest enable neem products to control more than 200 different species of insects. Neem seeds have considerable economic significance due to a variety of commercial usages. Quality of Seed determines the commercial value. One tone of neem seed upon processing generates 1.5 Kg of Azadirachtin 200 kgs of neem oil and780 kg of neem cake.

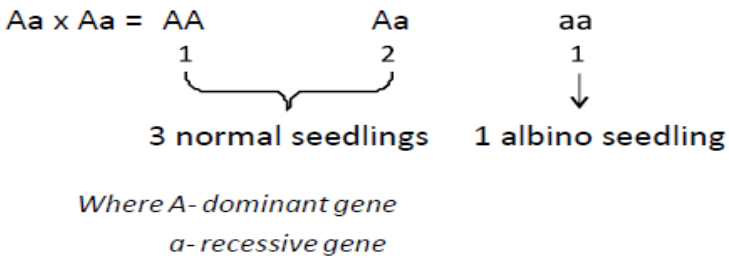
The term 'albinism' is derived from the Latin word 'Albus', which means 'white'. Albinism is defined as a lack of pigmentation, but can take various forms depending on the severity of pigment loss, as well as the nature of the missing pigments. Environmental

conditions such as light, temperature, media composition and culture conditions play some role in determining the frequency of albino plant formation. Genetic factors are even more important, and are major determinants in albinism [1,2].

Result and Discussion

In present study, seeds were collected from various parts of Tamil Nadu and Karnataka during June-July. It was sown in soil substratum based on high azadirachtin content (above 0.8 %) at nursery of Forest College and research institute, Tamil Nadu Agricultural University, Mettupalayam ($11^{o}19'$N, $76^{o}56'$E, 300 meters MSL, Rainfall 800 mm, pH 7.1). Thepolybags were filled with red soil and vermicompost mixture in the ratio of 2:1 and seedling behavior were observed regularly to calculate germination percentage (14 - 25 DAS germination starts). Totally 34 progenies were evaluated out of which five progenies (TN-MTP-16, TN-MTP-21, TN-MTP-35, TN-MTP-42 and KA-BGL-01) reported albinism in seedling at 3%. After 30 days, albino seedlings turned into pale yellow colour and died (Table 1). This may due to partial or complete loss of chlorophyll pigments and incomplete differentiation of chloroplast membranes that in turn lead to loss of photosynthesis process and plant die at young stage [1]. The leaf and shoots shows wide range of coloration to difference in photosynthetic pigment content that may have direct effect on photosynthetic rate. So albino seedlings lacking chlorophyll, they do not survive long time and when the food reserves stored in the endosperm/ cotyledons are exhausted, affected seedlings die[3].

Albinism is normally lethal for the plants as photosynthesis is hampered. Depending on the level of chlorophyll deficiency, the duration of survival after regeneration varies. However, in a rare occurrence, the redwood (*Sequoia sempervirens*) albinos are able to parasitize their parent tree by root grafting to survive andeven reach a height of over 20 m [4]. In ornamental plants, it is considered a novelty and efforts are made to preserve these plants. But most reports include a note on the number of days to which albino seedlings survive making it clear that they ultimately die a premature death.



Albino is largely documented in angiosperms and which a product of recessive trait governed by many loci. Albinism is caused due to the inheritance of recessive alleles

(alternative form of governed by many loci. Albinism is caused due to the inheritance of recessive alleles (alternative form of gene), either from a single parent (very rare) or from both the parents. As the majority of leaf pigments are in plastids, it is clear that albinism involves dramatic alterations to chloroplast biogenesis. Most of the research in this area has found that albino plants have altered plastid ultrastructure as compared to their green counterparts [5]. Besides, mutation whether induced or spontaneous, albino seedlings may be produced either by selling of an albino carrier (Aa) or by mating of albino carriers. In both cases the results maybe as depicted below.

However, under natural conditions, the frequency of such seedlings vary depending on the extent of natural selfing or mating of albino carriers, reduced population size, higher degree of inbreeding, reduction in heterozygosity and spontaneous mutation [2]. Rao *et al*. 1999 [6] noted an interesting observation that the seeds collected from a particular locality showed albinism in resultant seedlings of *Artocarpus integrifolia*. The albinism may be caused due to environmental factors or mutations that have occurred between seed formation and germination stage. Most studies conducted to find the inheritance of albinism have found that it is a recessive trait governed by one or two genes with two alleles; albinism being recessive. The albino mutants may be important material for functional studies and may lead to gene discovery, this is difficult to identify at seed stage unless otherwise seed germination only find it.

Table 1. Comparison between neem normal and albino seedlings 30 days after sowing

Source code	Type of plant						Remarks
	Normal seedling			Albino seedling			
	Shoot length (cm)	Root length (cm)	No. of leaflet	Shoot length (cm)	Root length (cm)	No. of leaflet	
TN-MTP-16	14.50	11.50	3.00	10.50	7.50	2.00	Affected seedling are Abnormal white and pale yellowish leaves, due to absence of chlorophyll
TN-MTP-21	12.00	10.50	4.00	8.00	6.20	3.00	
TN-MTP-35	15.50	9.50	2.00	7.50	7.00	2.00	
TN-MTP-42	15.00	9.00	4.00	8.50	5.50	2.00	
KA-BGL-01	11.50	12.00	3.00	8.00	6.00	3.00	

References

1. Kumari M., Clarke H.J., Ian Small and Kadambot H.M. (2009). Albinism in Plants: A Major Bottleneck in Wide Hybridization, Androgenesis and Doubled Haploid Culture. *Critical Reviews in Plant Sciences*, 28(6):393-409.
2. Kumaran K, JaisankarI, Nesamani K and Paramathma M 2007 Albinism in *Pongamia pinnata* (L.) Pierre. Indian Forester 133(5):709-710.
3. Gunaga R.P., Wange S.S., Mirgal A.B., Rane A.D., Narkhede S.S., Bhave S.G. (2013). A note on albinism in *Saraka asoca* (Roxb.) De Wild. *Indian Forester*, 139(5):471-472.
4. Davis D.F., and Holderman D.F.(1980). The White Red woods: Ghosts of the Forest, Naturegraph Publishers, Happy Camp, CA, USA.45 pp.
5. Clement C., Sangwan R.S. and Sangwan-Norreel B. (2005). Microspore embryo induction and development in higher plants: cytological andultrastructural aspects. In: *Biotechnology in Agriculture and Forestry* (Nagata, T., H. Lorz and J.M.W. Idholm Eds.), Springer Verlag,Berlin, Heidelberg, New York. Vol. 56, pp. 53–72.
6. Rao P.S., Murti S.S.N. and Venkaiah K. (1999). Albinism in *Artocarpus intergrifolia* Linn. F.-A case study. *Indian Forester*, 125 (11): 1095-1098.

Brief note on the 4th World Congress on Agroforestry

Swoyambhu Man Amatya, Nepal

The 4th World Congress on Agroforestry was held in Le Corum Conference Center, Montpellier, France form May 20-23 2019. The theme of the Congress was **strengthening links between science, society and policy. It was hosted by** French Agricultural Research Center for International Development (CIRAD) and French National Institute for Agricultural Research (INRA). This Congress was the follow up of the previous one held in New Delhi, India in the year 2014.

The overall objective of the Congress was to contribute to the strengthening of agroforestry science and practice in order to provide opportunities for strengthening links between science, society and policy and to bridge the science-policy gap. The main themes of the Congress were agroofrestry and climate change, agroforestry, food security and nutrition, adoption of agroforestry and agroforestry policies.

The 4th World Agroforestry Congress is expected to bridge the gap between agroforestry science and its practical implementation especially for food security, biodiversity conservation, mitigating the effect of climate change throughout the world. More than 1,200participants from all over the world attended the Congress. During the open sessionurban and peri-urban agroforestry for food and nutritional security were also discussed.

Dr. Swoyambhu Man Amatya, from Nepal, also presented his paper entitled " What sustains Nepalese agroforestry practices" during the Congress.

Good Governance in Forestry, its role in the SDGs and the reality check at ground-a case of India

Background

Keeping in view the fact that the plethora of actors play role in production/ distribution/ sharing of diverse set of goods and services, emanating from the forest-which makes forest management a complex exercise. Further, "Forest Governance" which has to do, both with the process of how decision are made and implemented about forest,-has also to see- what decisions are made? For what desired outcome? Particularly answering questions like by whom and for whom and in what way are important to decide the "Good" in "Forest Governance", often leading to justify existence and role of "forestry" for "sustainable global well being".

There appears to be a lot of sense that significant scope of improvement is possible in the outcomes of Forest Department/ Agencies, while meeting the expectation of diverse stakeholders, ranging from proximate ones (villages) to distant ones (global people/institutions/society).But also there are such stakeholders which are not at all dependent upon forests for their activities (yet they are impinging the forest in big way by establishing enterprises/ projects etc; seeking forest land and/or environmental clearance etc).

Box-1

What is "Good" for "Forest Governance (FG)" ??

Hence Good Governance(GG) principles; are expected to be helping to even those "distant and not directly related stakeholders" for supporting the growth of their interest in "Non-forestry activities", while upholding the principles of judicious balancing the interest of local/global stakeholders, leading to just, fair and inclusive society.

At the same time, Forest Department/ Agencies have always endeavored to have systemic physical monitoring of its different "Resources" and their developmental schemes and related aspect. In fact "Forest Working/Management Plan"; through its periodical monitoring elements, is a frame work in place for more than 100 years. Incidentally these "Working Plans" have been the earliest attempt for "Sustainable Development" in forestry. But "forestry" is further trying to be in sync with principles of "Good Governance" and SDG (Sustainable Development Goals); has given the newer impetus.

Review of literature

Sharma (2001) believes that good governance is the central issue of sustainability, while Bosselmann et al (2008) also argue that it is prerequisite for achieving "sustainability".

The challenge now is to test the links between a fuzzy concept of Good Governance and very heterogenous dimensions of Sustainable Development (Stojanvic, et al 2016)

Regardless of certain evidences that at first glance it may indicate, there is connection between "Good Governance" and "sustainable development", the existing literature also shows different points of view on the real effects of "good governance". The reason for the critical analysis of the impact of "good governance" on "sustainable development" can be found in over generalization of these without taking into consideration the specific characterics of specific country or region (Stojanovic 2016). This "specificity" for few SDGs for countries like India have been highlighted in this paper.

This paper also attempts to test the "efficacy" of current SDG framework and its assignment which has chosen the "very narrow" and "limited consideration" for "Physical Environmental factors" and thus it is fraught with distorted outcomes of 'SDGs'. This pessimism emanates from the lopsided low weightage given to goals of SDGs, related to "physical environment", particularly under Goals 13 and 15 etc. This "low" weightage need to reassessed, otherwise it will affect the "ecological sustainability" – which is an important pillar of "overall sustainability"; before it is too late.

Analysis and discussion

Is there a nexus between GG and SDG? The "SDG India Index: Baseline report 2018"claims to attempt to foster an environment of cooperative and competitive federalism at national level and yet intending to be advocacy tool to trigger action at the State level (Anon, 2019).

Such "Index reports" are supposed to help every state and UT of India to identify their strengths and area of opportunity, relative to their peers and to identify the step they can take towards achieving the SDG, by 2030.

Preparation of the SDG India Index has also brought to the fore its limitations, as well as highlighted the myriad possibilities for improvement that can help India move ahead on the development path.

One huge but often less emphasized problem that this exercise has revealed is the urgent need for improvement of statistical systems to generate data that helps in effective monitoring of SDGs at the national/stake/ District level on real time basis. The selection of indicators for present exercise has been constrained by the availability of data. Improved data availability and quality in the future will make the "index" more robust. This also requires that the SDG India Index are further refined, data collection and reporting processes are improved and potential for disaggregating data and methodological improvements are explored(Anon, 2019). Hence "choice of indicators" and their "monitoring", both assume important significance.

People believe the maxim "what gets measured gets managed" which dates all the way back to the 1500s. So far with the development of 500 years, humanity has realised that tracking and counting help it achieve what it has set out to do and now the world is attempting it through "SDGs",

The Indian forestry is also emerging in response to, newer "Governance" and "Sustainability" principles, in this background.

A changing vision and expectation of society and also its enhanced expectation in the roles and responsibilities of the government vis-à-vis other stakeholders: makes GG different from the 'old' style of governance, which holds goods for forestry sector too.

Going back to the basics, there are two broad Governance Patterns- which can be called two extremes of "governance" continuum.

BOX-2

The Governance continuum …

Good (enough) governance: which has- Developmental orientation of political leadership/ functional check & balances/ system not highest performing but mutually reinforcing and self-correcting

⇄

Clientelist: which has- Political leaders use authority to maintain their power base or are captured by powerful private interests. Leaders bypass check and balance institutions and use bureaucracy for patronage.

In real life; these is always a struggle to move, to and fro from "clientele list Governance" to "Good Governance"; depending on the context, despite the clear desirability of "Good Governance".

However Governance Systems; can also be appreciated on logic of also "Supply" and "Demand", also.

At a broad level; "Good Governance" can further be summarily differentiated as following–

BOX-3

Balancing the demand and supply ….. to achieve 6.6

- **Supply-side**: Capacities and organizational arrangements – leadership/ skills/ human resource and financial management systems (As embodied in state institutions to deliver public goods and services)

⟶
⟵

- **Demand-side**: Institutions and accountability arrangements/ elections/ political parties/ parliaments,/ judicial systems/ free press/ civil society organizations, accountable local governments – that enable citizens and firms to hold state institutions to account

The above differentiation also indicates the potential and limitation of "forestry sector"; to fit into the expectations of "GG" and "SD".

"Multi stake holders"- a reality in "governance"

It is now more firmly believed that the government does not and can notbear sole responsibility for the all aspects of governance, rather every actor/stakeholder is meant to play its role and assume specific responsibilities.

Important aspects of this model is importance of multi-actor, multi-level (national, international, and local) and multi-goal nature, recognizing the different ambitions of stakeholders (embracing different values, interests and world views)- which makes the task of achieving "Good Governance" and "Sustainable Development" quite complex.

The "fault",if is in the measure; it can not lead us to "GG" nor to "SDG"

Hence; Monitoring – in this context has got a very important purpose. Though, conventionally it is an exercise of periodical assessment of Resources/ processes and is basic to midcourse correction of execution, hence very critical.

BOX-4

Basic elements of "Good Governance"

- Transparency

- Credibility

- Gaining faith of stake holder; /and there are many more parameters beyond these fundamental ones

But; the real test lies in how do we "measure" and "monitor" them.

"Good" in Forest Governance

But, what makes it complex, by putting the qualification 'good' on governance. This makes it a normative approach relating to a certain required quality/performance of governance functions in the sector.

But different stakeholders may have different perspectives, interests and interpretations of what good forest governance means to them and how it should be operationalized. But important principles often mentioned in relation to 'Good Governance' include: participation (stakeholder engagement), fairness, accountability, transparency, efficiency, equity and "sustainability" etc and it holds good in the context of "forestry" as well.

BOX-5

Monitoring the "Governance", whether, it is on track?

Forest governance is a generic term for describing the way in which people and organizations rule, regulate and manage forests. Forest governance is thus a broad concept and requires complex process to achieve its outcome. It need to be monitored/evaluated to achieve benefits of Good Governance.

BOX-6

Monitoring, Indicators & Data; What it does ?

This aspect of assessing the process is very critical; because-

- "Reliable" and "High frequency, "local" data are essential to effective monitoring.
- Also, it helps invisible to become visible.

How it can be done ?

- Analysing the current data ecosystem as, a necessary stage.
- Improving, data management system (Including Integration).
- Disaggregating data (Social / Spatial) to track progress.
- Integration with other related subject/ issues/ concerns.
- Feedback and adaptation of strategies.
- By having, Quality and Outcome based targets.

Is Good Forest Governance, equivalent to "Sustainable Forest Management"

Realizing the full potential of forests to contribute to the "desired" goals, which includes reducing poverty etc ,it can only be achieved if the forest sector is governed in such a way that it ensures sustainable generation of product and services with equality, equitable and efficient access and has benefits sharing mechanism in place; meaning there by following the basic tenets of "Sustainable Development"

Hence It is now broadly understood and appreciated that "Good Governance" in the forest sector is vital for achieving "Sustainable forest management". In a broad sense, "GG" could be precursor or pathway to "SDG".

How do we monitor the "Good" in forest governance (India's context)

India has a very long, strong and scientific tradition of Forest Governence; since olden time. Though, it got its present shape, during the British rule, starting in 1850's. So much so, one of the "highly forested" and most powerful, progressive country of the globe- USA; when wanted to have regular "State Forest Agency" in early 1900s, the nearest best model they found that suited them was the "Indian Forestry". The "Governance" in India forestry has been based on regular monitoring of process/outcomes.

What is "good" for monitoring the governance in forestry; can be seen below and how its different elements have been monitored at federal level or local level as indicated in Table below:

State Level	National Level
• **Annual Administration Report(AAR) of state, on aggregated parameters**	I.C.F.R.E. Annual statistical Reports; which also aggregates the states AARs at national level
• **Regular monitoring reports – from one level to another level of hierarchy**	Also, done at the National level
• Few States came out with their "State of Forest reports"	SFR reports of FSI, GoI
• Few state have started their Geospatial Portal for monitoring	E- Green Watch Portal of GoI for forestry activities
• Third party evaluation; is becoming common for state run projects/schemes in state run projects also	CAMPA/NAEB-use third party evaluation for various GoI schemes.
• **Social Audit is being commonly done by state agencies**	It is also done at National level
• **Assembly Review/ oversight reports**	Parliamentary Review/ oversight reports
• **State AG Audit reports**	CAG Audit reports
• **Third party audit of different project or audit of the**	Third party audit of different project or

same by in house Monitoring Wing	audit or by in house Monitoring Wing
• **Participatory census of wildlife, involving NGOs, state civil society etc.**	
• **Putting all Information in Public domain, which is shared to public, which has feedback mechanism- this is used for monitoring/mid-course correction**	At National level also, it is done, for various forestry schemes
• **Responsive – Knowledge Management portals, at state level**	It is also being done at National level
• **SDG goals, at state level**	At National level (e.g. NitiAyog's SDG India Index, Baseline Report, 2018 and its continuous monitoring

The basic Principles of effective "Good Forest Governence" and its Monitoring- example from the Indian states.

Here if we take an example of a typical State of India i.e.; Jharkhand first we have to see what is purpose of Forestry in Jharkhand, and what is its interest to achieve it.

This has led to identify, what dimensions of "forestry" need to be monitored.

- **As important question, which always guide is- what is supposed to achieved by such monitoring**
- **Forest Protection**
- **Forest Conservation**
- **Forest Products/ Environmental services-sustainable production and Consumption issues**
- **Financial Management**
- **HR Management**
- **SFM**

Other important aspect of FGG monitoring is arriving at economic trade off of this exercise and hence it asks for "prioritization" of parameters, which need to be monitored and be given due relative importance. This assumes significance in Indian context, where "forestry" gets its majority of financial inputs from Government. With inherent limitations of, "low input and extensive forestry management regime". India, at the same time has to conform to internationally accepted norms/principles. With such a contradictory "low input" and "high expectation" scenario, it makes the job of "forest manager" very challenging. In the current era of climate change, where a lot is expected from "Forestry sector", like creating additional2.5 to 3GTonne of C by 2030 (as part of INDC, this is one the very ambitions

expecture). But at the same time under FRA 2006;indiscriminate distribution of “patta’s” to ineligible persons- leading to official diversion of-hectare of forest and its consequent ill effect on quality/quantity of forest like fragmentation, isolation effect on biodiversity is not appreciated by society. Similar kind of “disintegration”, “fragmentation”, “dissection” in even the most in accruable forest areas of forest is happening at massive scale-due to enormous creation of road/rail network etc, which are taking heavy and on health of physical environment.

There are two Approaches to measuring “Governance” in Indian context; which are basic to monitoring- but both these have “qualitative” and “quantitative” dimension attached to it.

- **Broad and Aggregated**: Broad enough to measure governance at more aggregated levels and thus help reveal systematic patterns – and forms basis for monitoring trends over time.

- **Specific and Disaggregated**: Specific measures of quality of key governance subsystems, which includes using “actionable indicators” to benchmark and track reforms.

Forest governance, by nature, is to make influence the process and to achieve expected results which has bearing on –

i. Extent of Forest resources;
ii. Forest biological diversity
iii. Forest health and vitality,
iv. Production functions of Forest resources;
v. Protective functions of Forest resources,
vi. Socio-economic functions of Forest resources

The above activities and their outcomes are just indicative and it is needed to include more of them/when seen from the perception of “GG” and “Sustainability”.

Relation between "Forest Good Governance" and "SFM" is attempted to described in figure 01.

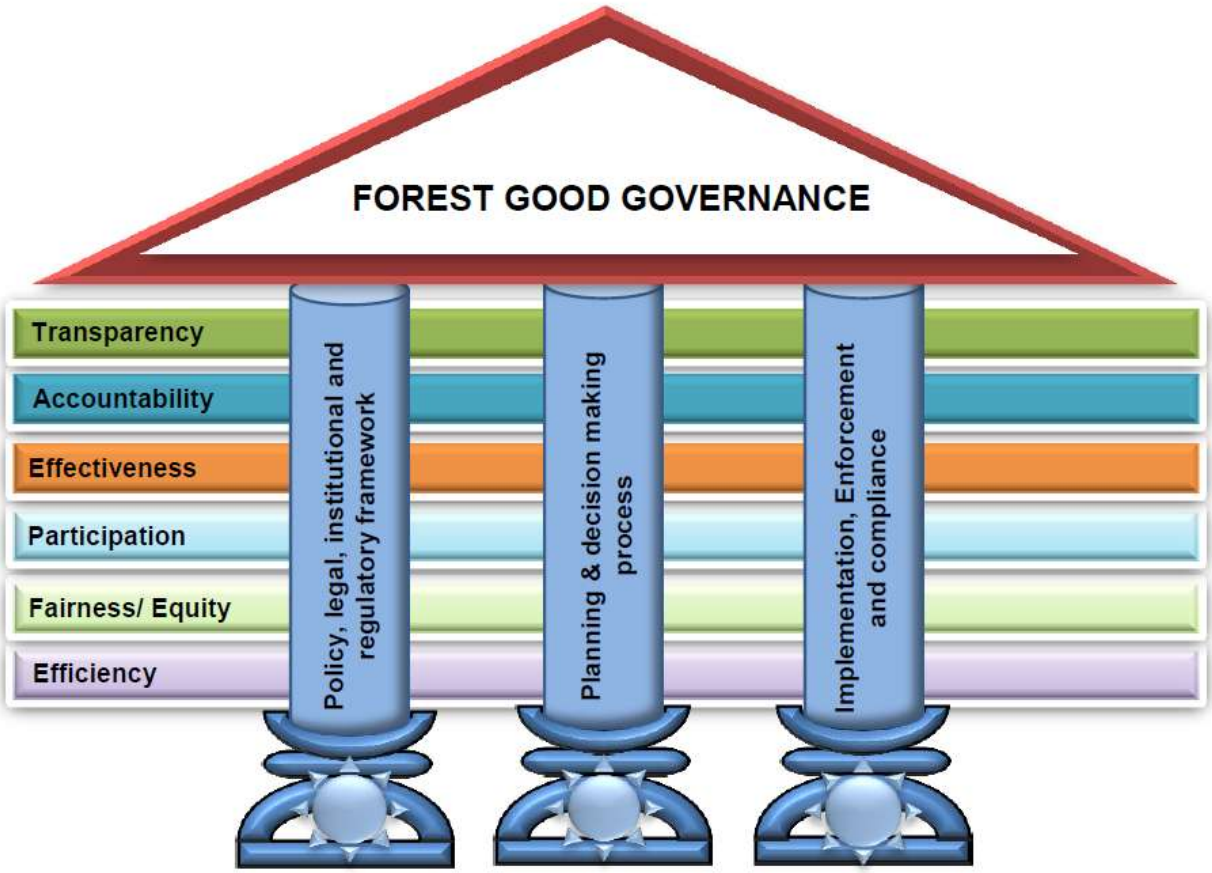


Figure 01 : Pillars and Principles of Forest Governance.

It is achieved in "Forest sector" through action a variety of programs and legal, policy and institutional arrangements; with constant element of "monitoring".

Forest governance monitoring, has got components of forest-related aspect, including **(i) forest bio-physical monitoring, (ii) forest socio-economic monitoring, and (iii) forest governance monitoring**.

The nexus between GGF and SDG.

The SDG are reflection of global attempt to make a sustainable society. India is also trying to confirm to these global efforts.

BOX- 7

SDGs and its noble intentions…

SDGs with 17 Goals and 169 Targets intend for promoting the sustainable, inclusive and equitable economic growth, creating greater opportunities for all, reducing inequalities, raising basic standards of living, fostering equitable social development and inclusion, promoting integrated and sustainable management of natural resources and ecosystems.

The identified and agreed 17 goals of SDGs, came in force in 2016(though not legally binding), but have become de facto international obligations to be achieved during the next years. Countries are expected to take ownership and establish a suitable national framework for achieving these Goals. However, implementation and success will be dependent on countries' own sustainable development policies, plans and programmes. Hence, the Countries should be responsible enough for follow-up and review at the national level, with regard to the progress made in implementing the Goals and targets. Actions at the national level to monitor progress under SDGs will also require quality, accessible and timely data.

Box-8

National Monitoring Framework (NMF) for achieving Sustainable Development Goals in India

For periodically reviewing and refining the National Indicator Framework (NIF) for monitoring of Sustainable Development Goals (SDGs) with associated targets is in place; with following Targets.

1. Statistical indicators of NIF will be the backbone of monitoring of SDGs at the national and state level and will scientifically measure the outcomes of the policies to achieve the targets under different SDGs.

2. Based on statistical indicator, the MoSPI will bring out national reports on implementation of

Major expected impact of NMF:-

1. As SDGs are supposed to integrate economic, social and environmental dimensions, of development. It primarily intends for eradicating poverty and promoting prosperity in a changing world. In India, .also its being attempted with basic motto of 'Sabka Saath Sabka Vikas' (Universal development with co-operation).

2. NIF, attempts to do it with outcome-based monitoring and reporting the progress on SDGs at National level; as reported by the States.

At presents there is no direct financial implication to States on implementation of the National Indicator Framework. However, the respective Ministries will need to re-align and strengthen their data systems to facilitate monitoring of the SDG indicators. May be at later stage; reward based system would be in place.

Thus SDGs are expected to bring change in the lives of people and the monitoring of progress of implementation of SDGs will benefit the entire nation.

Do SDGs fail to see long term picture ? A critique

The recent Sustainable Development Goals (SDGs) index of India, has given low weightage to Forest issues and thus it, leads to infer that SDGs fail to appreciate important complementarities and tradeoffs among goals and their targets. Indicator related to "Forestry", given low weightage are pointer to that.

A more logical and rational review of the SDGs and its targets is needed, for which need to appreciate; the following arguments.

If we simply focus on the Goal 13th and 15th: Sustainable Forest Management, is key to environmental well being; however failure to capture its nuances and poor appreciation of its inter linkages are poorly addressed by the 15other separate SDGs.

The selection of appropriate indicators for the targets and SDG; is right avenue to ensure that tradeoffs and synergies among goals and targets are accounted for. For example "food security and nutrition" indicators are already well-established, but protocols and data collection are insufficient to measure changes in hunger (e.g. calorie availability per capita

per day, dietary diversity score, stunting/wasting with a focus on those below the age of 5 and a specific focus on those below the age of 2, as well as the measuring of micronutrient deficiency indicators keyed to the regions where specific deficiencies are most prevalent).

Similarly appropriate Indicators for "sustainable forest management", however, are much more complex as important tradeoffs even exist among some of the indicators supporting sustainability in forestry, such as emissions per hectare of forestry land; timber and NTFP yields per unit of water; energy intensity of forestry, etc.

The SDGs have to take a significant step forward, by taking into the consideration of complexity of sustainable human development. This complexity requires support and guidance from the scientific community/ practioners by including targeted capacity building for tradeoff analysis, realistic monitoring and logical goal setting.

Box-9

Green report does not mention pollution etc at all…….

The recent Good Governance Index (GGI) on the environment released by the Union government has ignored several important parameters, including pollution. The report was prepared by the Centre for Good Governance (CGG) and in Index deals with the subject in a superficial and customary manner.

As per the preamble of the environment sector mentioned in the GGI — Assessment of State of Governance report, brought out by the Department of Administrative Reforms and Public Grievances (DARPG) highlight— "the growing concerns on global warming, pollution and increase in temperature led to the study of another important sector, the environment."

But the report does not take into consideration air, water and noise pollution when it gave the rankings. The report also does not capture the highly contaminated environs and the failure of the states to contain it. Incidentally, the state of Jharkhand fared very poorly occupying the 16th position.

All that this report have considered only two basic parameters – availability of state-level action plan for climate change and change in the forest cover. DARPG had decided not to take into consideration the pollution levels, be it air or water, as most of the states either do not have measuring stations or have them in inadequate numbers. "In the absence of data from some states, it would be difficult to put them on an equal pedestal and judge their performance," clarified a senior department official.

Report, awarded marks equally to all the states if they had prepared an Action Plan for climate change. It did not even go into how effectively the states were implementing the Action Plans. The ranking among the equals was then decided basing on the cumulative forest cover change in the last three years. Here, too, only the forest cover in the designated forests was taken into consideration, leaving the green drive taken up in the non-forest areas.

"This report uses certain parameters which are outcome and output based and does not need primary or field data,".

This exercise, however everyone hopes it would provide inputs to governments to take corrective action to improve the service delivery.

Source- Srinivas (2020)

How can we move forward?

Its, high time the scientific community, society and Government to work together to identify key tradeoffs and inter linkages and to identify/ devise appropriate indicators to monitor the implementation of the SDG targets.

Thus there are more serious problems with the current version of the SDGs and its measurement. They fail utterly to address nexus issues and the challenges posed by the trends described in the literature on the "Anthropocene". With regard to forest specifically, they fail to address the problem of complexnuance like distribution of forest, disturbance in forest/ fragmentation of forest, accessibility, conservation and consumptive to it for productive purposes at the expense of equal access. Hence, a more rigorous debate is needed urgent, to refine the present "indicators"

BOX-10

A pessimist's perception .....; need to be ignored

History seems to repeat itself and it would be hard to imagine that anything will change drastically in the next 10 years (i.e. until 2030). With this belief, for money it doesn't really matter whether at the end, the indicators used are somewhat meaningless and contradictory.

But "Sustainability" has a deeper meaning and in current struggle or quest for appropriate indicators, giving "Minimum required level" of importance to forest/natural resources- (given their unique characteristics; utility for sustainable well being of man kind is important.

It appears that the "goals" and "targets" have fallen well short of what many have hoped, as there seem to be so many stakeholders in this process and that not every of them can be really happy with the outcome of mega exercise like SDG. It is also clear for that a series of strong constituents might have added lots of unnecessary material while disregarding key issues to measures progress of SDGS. But ignoring issue such as a focus on the "integrity of forest" and "quality of forest", which are basic to "sustainability" is incompressible. But, there is still hope for the improving and revising indicators; which may comprehend and capture the real parameter; leading to "long term sustainability". Yes it is true that the train for goals and targets has left the station but its route chart and prelude should always be connected. It is also argued there that the frequent tradeoff analysis will be

useful to minimise some of the contradictions across goals and targets.; so that "Good Governance", "Sustainability" have a appropriate mix; which leads to better society (with better physical environment).

Reference:-

Anon, (2019) SDG India Index, Base line Report 2018, NitiAyog.

Bosselmann, Klaus; Engel, Ron; Taylor, Prue (2008) Governance for Sustainability: Issues, Challenges, Successes. Gland (Switzerland) International Union for Conservation of Nature.

Sharma, S.K. (2001) Governance for realising a sustainable society. SAGE publication: social change, Vol-31(a/2) P. 165-173

Srinivas, N.V. (2020) Green report does not mention pollution at all, Deccan Chronicle, 18-01-2020

Stojanovic, I, J.Aleljevic, R.S. Stevic (2016) Good Governance as a tool of sustainable Development, European Journal of Sustainable Development (2016) 5, 4, 558-573

Dual Treasures of the Savanna Forests of Ghana

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Savanna forests are largely characterized by relatively short trees with grass, shrub and scrub undergrowth. This feature is maintained by the decreased mean annual rainfall and repeated annual bush fires rendering these zones sparse of forest resources. However, the amount of vegetation in most cases relies on the level and extent of disturbances. Fortunately, common pool of certain unique natural resources (e.g. Shea and Rosewood) happen to be abundant.

Shea tree (*Vitellaria paradoxa*) covers over almost the entire area of northern savannas, above 77, 670 km² in Ghana and support the livelihood of closely 900,000 rural women involved in the sector (SNV, 2011). It has large rural poor impact due to its richness in the savanna zones where poverty is highest. It offers off season incomes to women and sometimes large number of men actively engaged as middlemen and traders. Shea butter production in the country is roughly 30, 000 mt/year (Lovett, 2004). It is famed for international trade, particularly for use in confectionery, medical and cosmetic industries. Its global demand is about 100, 000 mt/year usually in Europe and North America.

Rosewood (*Pterocarpus erinaceus*) is highly sought after in the West African arid forest for international trade (Bosu, 2013). It has superior wood qualities. The great durability, strength and rich hue makes it perfect for furniture, decorative paneling, flooring, utensils, construction, exterior joinery, doors and windows among many other applications. Its resin dyes traditional fabrics and the tree produces charcoal owing to its outstanding calorific value. The leaves are used as livestock fodder by integration in agro-pastoral systems in local communities (Dumenu and Bandoh, 2014; Anthonio and Antwi-Boasiako, 2017).

In spite of the huge benefits of these resources with great potential to drive economic growth while conserving fragile ecosystems, they have in recent times been dwindling. This has placed them on the verge of extinction. Too often, wealth of renewable natural resources in the northern parts of Ghana results in poverty rather than growth and development. For example, salvage permits granted to extract rosewood from construction sites in the north

turned into its extensive illegal logging and trade (Bosu, 2013; Antwi-Boasiako *et al*., 2018)instigating the wanton destruction of shea trees for commercial charcoal production.

These disturbances endanger shea undergrowth and residual tree stock in the ever-receding savanna forests as both trees usually share habitats. As a result, ban on illegal rosewood logging and trade has been reinforced, which unfortunately still lingers on. It seems virtually impossible to mitigate the fast spread of the overexploitation of these treasures because of their surging global demand. Thus, an increased socio-economic and ecological consciousness aimed at driving efforts towards developing lasting measures to tackle this menace becomes indispensable. This could stimulate economic growth by generating foreign exchange, creating employment opportunities for the teeming youth, alleviating poverty and eventually enhancing environmental sustainability.

Figures Remnants of northern Ghana savanna vegetation"

In the wake of looming threats of irreversible damage to forest resources in the north, the media ought to play a significant role in the fight against this crisis through awareness creation. Recognizing government's interventions to curb this situation, is as though efforts have not entirely mitigated the rapid depletion of rosewood because of its persistent erosion under the guise of salvage permits. Therefore, grant of these permits should be well regulated by duty bearers. Additionally, the CSIR-Forestry Research Institute of Ghana (FORIG)could consider developing innovative approaches by convening all relevant stakeholders along the rosewood value chain to join forces in promoting research ranging from propagation to end-use applications. For instance, coppicing could be encouraged for rosewood renewal; this will

contribute to augment its incessant supply. Last but not least, the Shea Parkland Management project targeting large scale cultivation of shea trees should be given maximum attention.

REFERENCE

Anthonio, F. and Antwi-Boasiako, C. (2017). The Characteristics of Fibres within Coppiced and Non-coppiced Rosewood (*Pterocarpus erinaceus*Poir) and their Aptness for Wood- and Paper- Based Products. *Pro Ligno*, 13 (2):27-39.

Antwi-Boasiako, C., Anthonio, F. A. and Frimpong-Mensah, K. (2018). Mechanical Properties of Coppiced and Non-Coppiced *Pterocarpus erinaceus* Boles and their Industrial Application. *Journal of Forestry Research*, 30(5):1973-1980.

Bosu, D. (2013). Draft Report on the dynamics of Harvesting and Trade in Rosewood (*Pterocarpus erinaceus*) in Bole, Central, West and North Gonja Districts of the Northern

Dumenu, W. K. and Bandoh, W. N. (2014). Situational Analysis of P. erinaceus (Rosewood):Evidence of Unsustainable Exploitation in Ghana? First National Forestry Conference 16-18 September 2014, Kumasi

Lovett, P. N. (2004). The Shea Butter Value Chain: Production, Transformation & Marketing in West Africa. West Africa Trade Hub – USAID, Technical Report No. 2.

Timber Process Innovation Center (TPIC)

University of Sri Jayewardenapura

TPIC is a strategic alliance, through joint ventures between University of Sri Jayewardenapura (Department of Forestry and Environmental Science), University of Moratuwa (Department of Integrated Design & Department of Mechanical Engineering), Ministry of Science Technology and Research and COSTI for development of timber and timber based products as mentioned in the budget speech of 2018.

This will enhance the introduction of Sri Lankan timber and timber based products to high-end global export market and upon successful implementation, in future, this will perform as a fully-fledged self-sustainable center, which is to be established under Center for Sustainability of the University of Sri Jayewardenepura to support the timber sector.

Key activities of TPIC

- Process Innovation of timber and timber based products.
- Waste utilization of timber and timber based products.
- Value chain enhancement of timber and timber based products.
- Involve in cleaner production process of timber and timber based products.

Intended outcomes

- To enhance high-end export market for Sri Lankan timber & timber based products.
- To increase the percentage of contribution to GDP by Timber & Timber base products.
- To increase the timber product exports for the economic growth.

Our Team

- Prof. Hiran Amarasekera, Professor, Forestry and Environmental Science.
- Dr. Priyan Perera, Director, Center for Sustainability.
- R. A. D. R. L. Rupasinghe, Research Officer, TPIC.

Moratuwa Furniture Manufacturing Cluster

There are around 1700 industries in Moratuwa wood based furniture cluster and it has been operational for many decades. This industry has deteriorated over the years and is currently incapable of producing furniture of high quality for the export market. However, large firms in the cluster use advanced technology and have a fully integrated production process with saw mills, timber seasoning and treatment facilities. This indicates that it is an organized cluster that can be upgraded to an innovative cluster by implementing a comprehensive development program.

There have been several initiatives on development of wood working industry and timber utilization research on timber processing which have yielded data towards up-scaling and redefining the small timber manufactures in Sri Lanka. The key options that can be adopted to improve the industry are to improve utilization of available sustainable timber resources to increase the supply of raw materials to the Moratuwa cluster, improve product quality, increase marketability of products and minimize environmental pollution. Selected industries in this cluster can be upgraded into international standards by introduction of new technology and transfer of knowledge, providing systematic training in improving furniture designing, timber preservation, seasoning and machine maintaining capabilities.

However to enhance the quality and the value of the timber products, current situation of the industry should be studied and analyzed. Several visits were made and discussions were conducted with the carpenters' community, timber exporters and machinery suppliers in Moratuwa area.

Small scale and medium scale carpenters are affected because there is no proper market for their products. And they are not very interested in modern technological instruments as they are very expensive. As they are given very low price for their products, they do not tend to develop good quality and finished product. This is the main tragedy that occurred with the Moratuwa carpenter industry. If a good and stable market can be developed for the solid wood products, the carpentry industry of the Mortuwa can be developed easily.

Large scale timber processing industries are profit-oriented and aim to develop the quality of the product and reduce the wastage. They are keen on collaboration with the government authorities and to conduct activities to develop their products. Discussions conducted with the management of the large scale timber processing industries showed that they are highly concerned on their timber wastage and timber supply for the production. Good industrial based researches can be developed with the help of these private industries.

Our Facilities

Timber Process Research Lab

A research lab is being constructed with all necessary equipment. The building will be constructed in collaboration with Center for Sustainability, University of Sri Jayewardenepura. This will be built as per the guidelines of the "Green Building Concept" following energy saving guidelines. Currently the initial construction activities have commenced and the contractors have been advised to complete the building within three months. The purpose of a wood testing lab is to conduct research in the areas of wood anatomy, wood physics, wood chemistry, preservation, seasoning, furniture and wood composites and to use it as a testing body in timber product certification activities.

Research work under TPIC

Current research activities conduct by TPIC is focusing on both small and large scale timber industries. And the objectives of these researches are to develop the quality of the wood products, reduce the wastage and to enhance the timber value chain of the timber industry.

Research 01 – Socio- Technological status of Moratuwa wood working industry.

The identification of the social and technological activities of Moratuwa wood industry is the main purpose of this research. The details and information of the Mortuwa area are also collectedfrom this research. This will lead us to identify what are the barriers that the carpentry communities face in producing, marketing, and selling the timber products they produce. The information collected from these studies will use as the background data for future activities which conducted focusing on above mentioned Moratuwa wood cluster.

Research 02 – Flow of wood waste in Moratuwa furniture manufacturing industry.

The main purpose of this research is to identify quantities of wood waste and varieties in Moratuwa furniture manufacturing. Besides the wood waste from the typical carpentry activities, waste from large scale factories are also considered in this study. Identification of wood waste and their categories will lead to the development of new methods to minimize wastage of the wood resources and to enhance the value chain of the wood products. Collected data and details about wood waste and the quantities will be mapped for easy reference with accurate geographic location etc.

Research 03 – Developing value added products from waste timber materials

Most of the industries use wood for their boilers as it is much cheaper and easier than other energy sources. From that, a vast wood ash is collected at the bottom of the boilers. This has become a huge problem to the industries which use large tons of wood for their boilers per day.Clay brick and clay tile manufacturing industry are also affected as there are no good raw materials (clay) for their production process. Some of them mix sand as they cannot find suitable clay easily.Designing and testing ash + clay bricks and tiles will be a good solution for both of these industries. Linking the waste ash with the tile and brick industry will develop sustainable new bricks and tiles. But

accurate and good testing should be done prior to promotion of these type of products. Initially preparation of brick samples were conducted and testing activities needed to be conducted in future.

Knowledge sharing and awareness

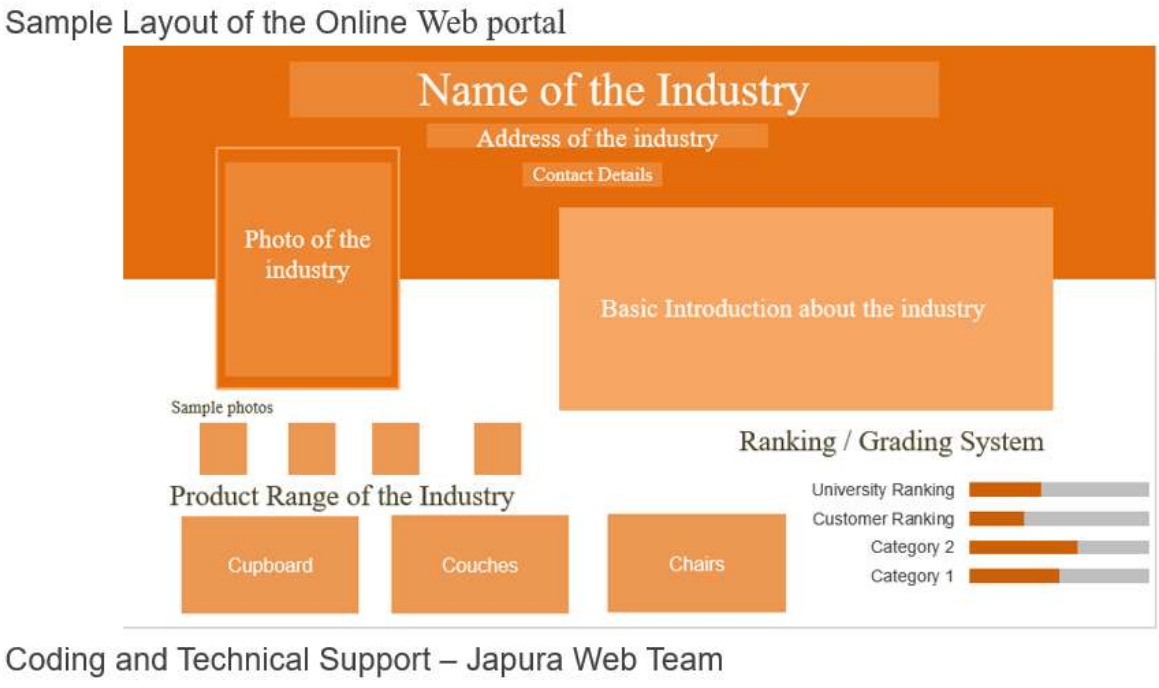
Knowledge sharing sessions among industrial professionals, university children and the school children are conducting by the Timber Process Innovation Center with the help of government and non-government resource persons through workshops, exhibitions, consultancies etc.

Future aims

Establish Better Professional small holder timber industries to achieve Local and International markets

Training and organizing the small scale carpenters to expand their markets by full filling the needed qualification up grading the quality and the quantity of their own products is the main target of this programme. Wood working industries both large and small will be registered into an open web portal where they can display their own products and capabilities to the interested parties. Relevant training and information will be provided by Timber Process Innovation Center to fulfill their knowledge barrios.

Online Web portal– a platform to promote Moratuwa wood based Industries



Further this web portal will act as a platform for providing and marketing the wooden products expanding the opportunities for the industries to build up their companies by providing high end products to the world markets without depending on the intermediaries. This will promote industries to manufacture quality goods and go for the certification processes.

Industry relate innovations to upgrade timber and timber based industries

Better innovations by promoting waste utilization activities and introducing new innovations to build up the quality and the sustainability of the end products. Gaining active enrolment of the university students to find the solution to the issues coming from the wood and timber industry will be expected from this future activities. Mixing students with the industries and allow them to come up new ideas as individuals or as teams will be promoted. Technical and technological support will be provided by TPIC

Testing and share our knowledge

TPIC will act as a research arm in the field of timber. Testing the strength properties of the timber and timber based wooden composites will be conducted in our very own

research lab. And the knowledge extracted from the research will be share among the beneficiary communities.

As wooden products and wood based industries are much prominent whole over the world developing and upgrading the quality and the standard of the local industries. Promoting Certification and providing testing facilities will be an investment for the future.

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Cell Morphological Studies of A*rtocarpus altilis* (Parkinson Ex. Zorn) Forsberg Wood

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Abstract

This study investigated fibre characteristics and morphological indices of *Artocarpus altilis*, a lesser used species (LUS) wood which is fast becoming popular in Nigeria, due to its excellent performance in light structural applications, aesthetic and dimensional stability. Not to limit its uses to furniture production. Axial and radial examinations of fibre characteristics of naturally grown wood of *Artocarpus altilis* were evaluated to determine its suitability as pulp wood. Four matured tree of 45±5 years were purposively selected and felled. Billets of 500cm were obtained from base, middle and top (10,50 and 90%) of the merchantable height of each selected tree, partitioned into corewood, innerwood and outerwood and further processed into *20x20x*20mm^3 wood samples using ASTM procedure. Data were analysed using descriptive and inferential analysis at α0.05. The basic wood density of *Artocarpus altilis* mean is 581kg/m^3. The fibre characteristic showed that mean fibre length, fibre diameter, lumen width and cell wall thickness (CWT) were (1.52±0.28mm, 35.09±7.56µm, 22.95±7.89µm and 6.11±0.68µm) respectively. The derived indices like Slenderness, Flexibility, Runkel Ratio, Rigidity Coefficient, Form factor and Muhlsteph ratio had means 44.79±11.49, 63.59±8.49, 0.60±0.23, 0.18±0.04%, 250.73±53.25 and 58.86±10.62% respectively. The result from this study compared favourably with those of known wood species such as *Gmelina arborea*. This indicates that intra and inter variation between axial and radial direction does not have negative influence on any part of the species from been used. However, all the fibre features considered were observed to be suitable for pulp and paper making.

Keywords *- Artocarpus altilis*, lesser-used species (LUS)**,** cell morphology, density, fibre**.**

Introduction

In Nigeria, the demand for wood and wood-based products, including pulp and paper is on the increase while one of the problems in pulp and paper industry is an inadequate supply of long fibre for paper production (Osadare, 1993 and Oluwadare, 2007). According to (Okojie, *et al*., 1995), about 4,600 plant species were recorded in Nigeria. Akachuku (1997) reported that over 560 tree species in Nigerian forest can attain a height of at least 12m and a girth of 60cm when matured. Akinsanmi and Akindele (2002) also confirm the natural forests consisting of a wide variety of species and sizes of great attraction. However, these enormous resources in the tropical rainforest constituting a vital asset to the country have not been properly assessed. Pressure upon the natural forest which has been the resource-based for this industry has been depleted owing to population explosion and industrialization both in urbanization and economic development (Shakhes *et al*., 2011;Izekor, 2010; FAO, 2001; Fuwape and Fabiyi, 2003). Scarcity of economic species known to be suitable for wood pulp had made pulp and paper industries among other factors none functioning in Nigeria.

However, (Adi *et al*. 2014, Istikowati *et al*. 2014, 2016) reported that utilization of wood resources from several fast-growing tree species is limited because little information is available regarding the properties and anatomical characteristics of the wood. Investigation on wood characteristics and the corresponding pulp properties for three unutilized fast-growing tree species such as terap (*Artocarpus elasticus*), medang (*Neolitsea latifolia*), and balik angin (*Alphitonia excelsa*). However, further research is required to characterize the potential wood resources from other unutilized fast-growing tree species. The wood properties required to evaluate fiber morphology for pulp and paper qualities including anatomical characteristics (Pirralho, *et al*. 2014, Istikowati *et al*. 2016). Thus, analysis of fibre characteristics such as fibre length, fibre diameter, lumen width, cell-wall thickness, and derived morphological factors became important in estimating pulp quality of fibre (Dinwoodie., 1989). One of the first fibre properties related to strength properties was fibre length (Oluwadare *et al*., 2007) while pulp and paper quality, based on wood properties like anatomical characteristics, can be estimated from the derived indices: Runkel ratio (Runkel 1949), Luce ' s shape factor (Luce 1970), flexibility coefficient (Malan and Gerischer 1987), Slenderness ratio (Malan and Gerischer,1987), solids factor (Barefoot, et al.1964). With the wood-fibre-crisis envisaged by experts and the need to meet future fibre supply occasioned by the ever-increasing demand for pulp and paper products globally, it is imperative to beam

searchlight on lesser-used wood species to screen them for pulp and paper making. Moreover, more use of LUS may contribute towards efficient forest management sustainability and utilization of the tropical forest area (Poku *et al*., 2001). Researchers have identified suitable species for pulp and paper products, food plants, medicinal plants and forage plants from an investigation carried out by (Ogunwusi, 1991; Osadare, 1993; Osadare, 2001; Ogunnika, 2001; Ogunnika and Kayode, 2002).

Artocarpus altilis a lesser-used species belonging to the genus Artocarpus (Moraceae) comprises approximately 50 species and is widely distributed in tropical and subtropical regions. The generic name of the species comes from the Greek words ‘artos' (bread) and ‘karpos' (fruit) and the fruits eaten are commonly called breadfruit. It was therefore chosen for evaluation because of its large size of up to 25m (82f) or more in height. The species is popular as an agroforestry species planted as a fruit tree and recently as good construction timber. Recent surveys of the timber market in the southwest zone of Nigeria shows a good representation of this emerging species.

Available information has shown that, despite the abundance of this species, it remained unattended to in terms of properties evaluation and very little research has been carried out on *A. altilis* (Park) Fosberg wood in the Country. This is why the study intends to investigate the wood suitability for various uses to compliment the commercial wood in Nigeria by assessing its cell morphological characteristics.

Objective

The objective of this study is to examining the fibre dimension characteristics and properties of derived morphological indices of *Artocarpus altilis wood to* explore the possibility of using this LUS species as a substitute for paper production material.

Materials and Methods

Four matured trees of *Artocarpus altilis* were purposively selected based on the absence of reaction tendencies, fairly straight and free from natural defects as well as excessive knot are harvested. Age and diameter sizes of the trees were considered based on the farmer’s information and growth ring counts at Longe village, Gambari Forest Reserve, Oyo State. It lies within latitude 7°10'37" N to 7°10'34" N and longitude 3°52'50" E and 3°50'59" E. Three billets of 500cm were obtained from base, middle and top (10, 50 and 90%) of the merchantable height of each selected tree making a total of (12) bolts.

Sample preparation

Test sample representatives were taking from the Central planks obtained from all the bolts to give 12 planks from where test samples were obtained. The central planks were further partitioned into corewood, innerwood and outerwood along the radial planes according to the method used by Ogunsanwo and Onilude (2001) and Shupe *et al*, 1995. Wood samples were further processed into standard dimensions for determination of wood properties. 20x20x60mm dimension was used for basic wood density determination while 20x20x20mm dimension for fibre characteristics and its derived values determination according to ASTM, 1991.

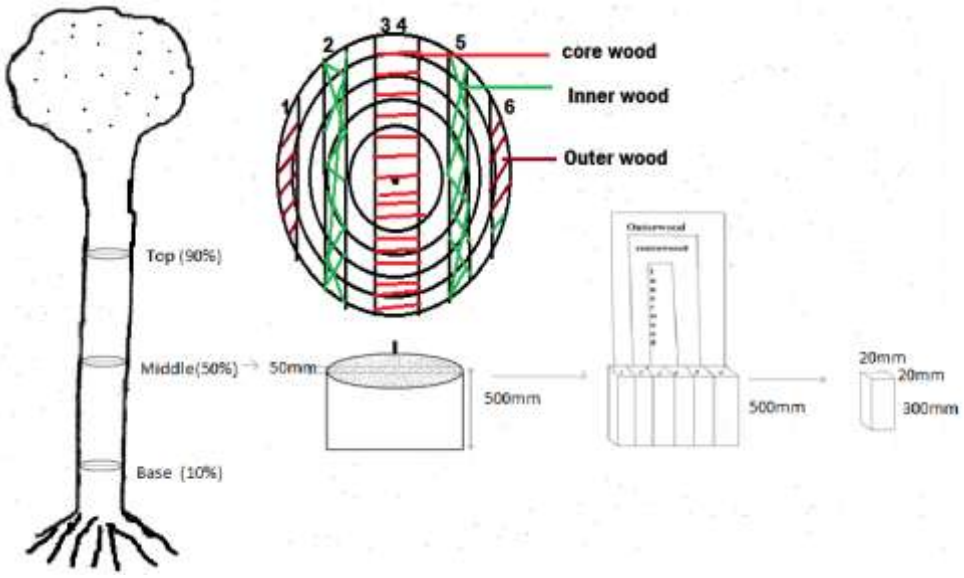

Fig 1: Showing schematic sampling procedure for obtaining test samples for basic density and fibre characteristics

Physical properties

Basic Density Determination

360 test sample of dimension (20x20x60) mm^3 were produced from the central planks obtained at each sampling height (base, middle and top) for each trees and partitioned from pith to bark to make five (5) test samples from each of the sampling position. Therefore, 30 test samples were obtained for each replicate to make 90. Samples were oven-dried at 103±20C to a constant weight temperature, after which the oven dried weight was measured

and also the oven dry volume was determined as prescribed by Smith (1954) on a sensitive G and G Measuring scale following ASTM D 2395-17 (2017).

Where:

$$D = \frac{\text{oven dry weight}}{\text{oven dry volume}} \qquad 1$$

Cell Morphological Determination

Fibre characteristics and its derived values

Small wood slivers were obtained each from different sampling height. The slivers were placed in an equal volume (1:1) of 30% hydrogen peroxide and 10% glacial acetic acid, boiled in the oven for 16hours at 105ºC until it bleached white and soft (ASTM D 1413-61 2007). The slivers was decanted and then washed, placed in 30ml-test tubes with 20ml-distilled water and shaken vigorously to separate the fibre bundles into defibrised fibres. The macerated fibre suspension was carefully aligned on a slide using a rubber teat. Fibre dimensions were measured in swollen condition using X10 magnifications on Rheichert Visopan microscope screen to measure twenty five fibres for fibre length (L), fibre diameter (FD), lumen width (LW) and cell wall thickness (CWT), this were further calculated using appropriate formulae based on Oluwadare (2007) while the derived morphologies followed the method used by Saikia *et al* 1997; Ogbonnaya *et al*., 1997; Ververis *et al*. 2003: Oluwadare and Sotannde 2006: and Tutus *et al.* 2010). Thereafter, it was compared with standards from softwoods and hardwoods as related to that of *Gmelina arborea* which is the reference material in determining the suitability of a material for pulp and paper making based on (Anon, 1984 and Fuwape, 1991) observations. Hence, the fibre characteristics and their derived morphologies are presented in Table 1.

Table 1 Showing the derived morphologies parameters and formulas

Slenderness Ratio	$\text{Slenderness} = \frac{\text{Fibre length}}{\text{Fibre diameter}}$	(2)
Flexibility power	$\text{Flexibility power} = \frac{\text{Lumen width}}{\text{Fibre diameter}} \text{ x} \frac{100}{1}$	(3)
Runkel Ratio	$\text{Runkel ratio} = \frac{2 \text{ x cell wall thickness}}{\text{lumen width}}$	(4)
Coefficient of rigidity	$\text{oefficient of rigidity} = \frac{\text{Cell wall thickness}}{\text{Fibre diameter}} x \frac{100}{1}$	(5)

Form factor	$F - factor = \frac{Fibre\ \ length}{Fibre\ \ cell\ \ wall\ \ thickness}$ (6)
Muhlsteph ratio	$Muhlsteph\ ratio = \frac{Fibre\ \ width^{2} - lumen\ \ widt\ h^{2}}{Fibre\ \ widt\ h^{2}} x\ 100$ (7)

Results and Discussion

Basic density obtained in this study was 581.48±57.61 kg/m^3 and slightly higher than Chudnoff (1980) (400–480kg/m^3), Ajala and Ogunsanwo (2011) (430 kg/m^3) obtained for *A. robusta.* The result obtained followed the research findings reported by (MTC, 2018) 400-560 kg/m^3, (Rincon, *et al*. 2004; Orwa *et al*.2009 and Ragone, 2011) and in line with what observed for *A. altilis*, 505-645 kg/m^3 at 15% MC, Richter and Dallwitz (2000). The basic wood density decreases from base (602.74±64.48kg/m^3) to top (570.70±56.02kg/m^3) and decrease from corewood to outerwood as presented in Fig 5. This corroborate Tsoumis (1991) who stated that as moisture content increases, the density of wood also increases and as the density of wood in axial direction has a tendency for reduction from base to top of the tree stem (Tsoumis 1991). A greater density at the base of a tree is contributed by the formation of heartwood where the proportion of heartwood is higher than the proportion of sapwood. The basic density at the upper of the tree is lower because of influence by the presence of juvenile wood around the pith in vertical variation. Philips (1941) reported that density is a measure of the cell wall material per unit volume and as such gives a very good indication of the strength properties and expected pulp yields of timber

Fibre Dimensions

Table 2 shows the fibre characteristic values that variations existed in fibre dimensions both radially and axially. The mean Fibre length *(*1.52±0.28mm), Fibre diameter *3*5.09±7.56µm), Lumen width (22.95±7.89µm) and cell wall thickness *(CWT) (*6.11±0.68µm*)* while FL,FD and CWT significantly decreased from base *(*1.58±0.28mm, 37.03±9.22µm, 6.23±50.75µm*)* to top *(*1.48±0.19mm, 34.70±7.67µm, 5.88±0.53µm*)* respectively and ranged from corewood *(*1.53±0.23mm, 44.77±10.29µm, 6.52±0.17µm*)* to outerwood *(*1.37±0.18mm, 37.16±3.48µm, 6.08±0.26µm*)* but lumen width increased from base *(*22.49±8.54µm*)* *to top (*23.36±7.53µm*)* and ranged from corewood *(*18.80±4.96µm*)* to outerwood *(*20.18±6.28µm*)* as presented in Fig (a-d).

Mean fibre length was 1.52mm, *A altilis* show short fibre length based on the mean fibre length that was lower than 1.60mm because any fibre below 1.60mm are classified as short while that above 1.60mm are considered long (Anon, 1984). Some authors also observed similar fibre lengths of less than 1.60mm in some Nigerian hardwood timbers. Oluwadare (2007) reported 0.65mm for *Leucaena leucocephala* and Ogunjobi *et al*, (2014) for *Vitex doniana.* According to Oluwadare, (2007), reported that 1.60mm is an acceptable range of values for hardwoods for papermaking.

In this present study, fibre diameter along the sampling height decreases from base to the middle and marginal increase to the top, likewise, increase at the core wood to the inner wood and decreases to the outer wood, hence, both sampling height and radial position did not exhibit a specific pattern of variation. Roger, *et al.*, (2007) reported that the average fibre diameter increase with an increase in tree age. The decrease in fibre diameter as the tree growing to maturity might be due to the molecular and physiological changes that occur in the vascular cambium during the tree aging process and increase in wood cell wall thickness. (Plomion, *et at.*, 2001).

Lumen width increases from base to the top and this could largely due to increasing in lumen width with decreasing age of the tree be due to a decrease in cell size and physiological development of the wood as the tree grows in diameter and be a fruit tree, this is similar to observed variations reported by Izekor, (2010) in *Tectona grandis* wood, Ogunjobi *et al.* (2014) in *Vitex doniana* .and, (Oluwadare and Sotande, 2007) in *Leucaena lencocephala* wood. This similar observation was reported by (Ogunsanwo, 2000) for *Triplochiton scleroxylon*. This increase in cell wall thickness in the axial direction and decrease at radial direction of *A. altilis* wood could be as a result of the rapid cell division of cambium as the tree grows in girth (Roger *et al*, 2007). The CWT positively affects the bursting and tensile strength and folding endurance characteristic of the paper, hence, *A. altilis* would have high strength from the paper produced

Table 2: Mean values of Basic Density, FL, FD, LW and CWT along sampling height and radial position

Sampling Height	Radial Position	Density Mean±SD (kg/m^3)	FL (mm)	FD (µm)	LW (µm)	CWT (µm)
Base	Corewood	590.41±59.4	$1.53±0.23_b$	$44.77±10.3_a$	$27.12±10.84_a$	$6.52±0.17_a$
	Innerwood	581.28±64.9	$1.63±0.34_a$	$34.76±4.67_{ab}$	$21.54±8.24_b$	$6.12±0.49_b$
	Outerwood	629.28±54.3	$1.58±0.32_{ab}$	$31,57±7.02_b$	$18.80±4.96_c$	$6.05±0.33_c$

Pooled Mean		**602.67±59.47**	**1.58±0.28**	**37.03±9.22**	**22.49±8.54**	**6.23±0.75**
	Corewood	572.67±49.93	$1.33±0.23_c$	$36.23±5.34_a$	$25.34±3.85_a$	$6.07±0.67_c$
Middle	Innerwood	569.56±58.57	$1.63±0.41_a$	$32.60±4.58_b$	$20.16±5.74_c$	$6.27±0.56_b$
	Outerwood	570.79±44.02	$1.52±0.36_b$	$31.84±4.61_b$	$23.55±10.55_b$	$6.37±0.68_a$
Pooled Mean		**571.01±47.36**	**1.49±0.35**	**33.55±5.09**	**23.01±7.89**	**6.23±0.71**
Top	Corewood	570.52±86.45	$1.37±0.18_c$	$37.16±3.48_a$	$27.22±8.23_a$	$5.72±0.68_b$
	Innerwood	562.56±30.57	$1.49±0.13_b$	$32.13±5.86_c$	$22.67±4.67_b$	$5.87±0.43_b$
	Outerwood	579.02±54.33	$1.58±0.20_a$	$34.84±8.94_b$	$20.18±6.28_c$	$6.08±0.26_a$
Pooled Mean		**570.70± 56.02**	**1.48±0.19**	**34.70±7.67**	**23.36±7.53**	**5.88±0.53**
Mean		581.48±57.61	**1.52±0.28**	**35.09±7.56**	**22.95±7.89**	**6.11± 0.68**

Means± standard error of the mean of 5 replicate samples. Values with the same alphabet in each column are not significantly different at α = 0.05 using Duncan multiple range test.

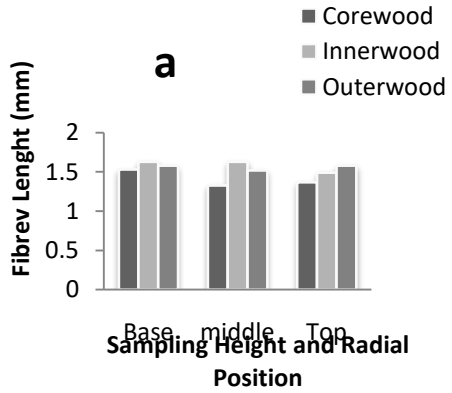

Fig 1a

Mean values of FL along SH and RP

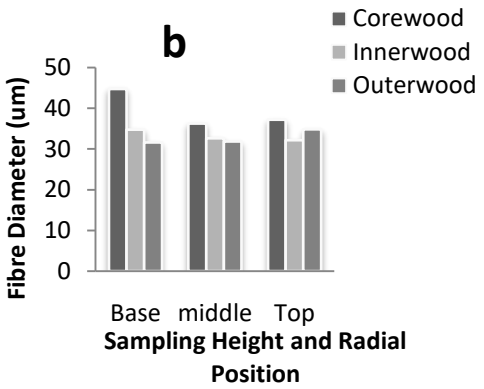

Fig 2b

Mean values of FD along SH and RP

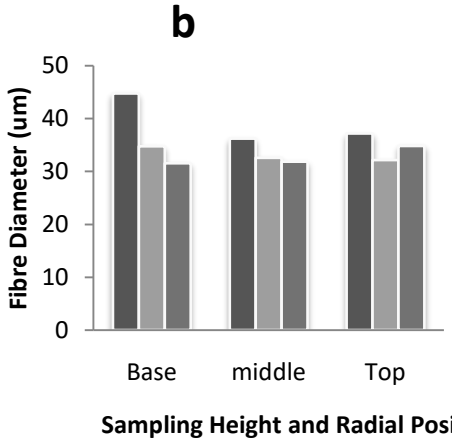

Fig 3c

Mean values of LW along SH and RP

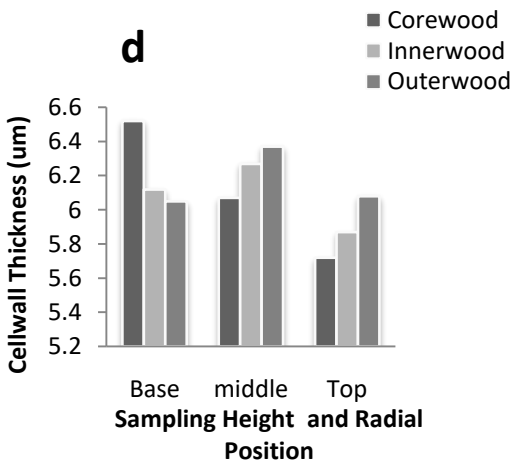

Fig 4d

Mean values of CWT along SH and RP

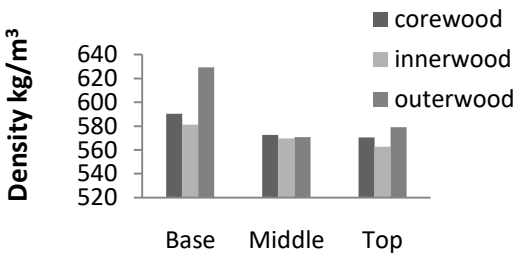

Fig 5 Mean values of density along SH and RP

Derived Morphology

Table 3 shows the mean values for derived morphology assessed *are Slenderness, Flexibility, Runkel Ratio, Rigidity Coefficient, F-factor and Muhlsteph ratio with* 44.79±11.49, 63.59%, 0.60±0.23, 0.18±0.04%, 250.73±53.25 and 58.86±10.62% respectively.

Slenderness ratio is a factor that determines the fitness of wood material to paper manufacturing which is evaluated by relating fibre length to fibre diameter Akgul, (2009). According to Sharma *et al.* (2013) opined that for a suitable pulp and papermaking, the slenderness ratio must be more than 33 because high SR in fibre will produce a higher rate of tear resistance in a paper (Akpakpan *et al*., 2012). However, the values for SR fibres in this study is more than required slenderness ratios of 33, therefore, *A. altilis* wood can produce good and strong papers.

Flexibility is one of the most important derived parameters in determining the strength properties of paper and is the ratio of lumen diameter and fibre diameter. Flexibility defines the degrees of fibre bonding in paper sheet produced (Akpakpan *et al.*, 2012). Smook, (2003) classified suitable flexibility coefficient values for both hardwood and softwood is between 55-70% and 55-75% respectively. The fibres that have flexibility coefficient of more than 75% are usually categorized as highly elastic while those falls between 55-75% are considered to be elastic (Bektas, *et al*, 1999). Singh *et al*., (2011) reported that fibres with high flexibility coefficient values will readily collapse during paper manufacturing, having a large surface area for bonding and consequently produced paper with good strength. Hence, the flexibility coefficient values obtained in this study is considered to be flexible and satisfies requirements for pulp and paper manufacturing.

Runkel ratio is considered to be a significant parameter for pulp and paper properties in expressions of similarity and pulp yield (Ohshima *et al.* 2005). It measures the proportion ratio of cell-wall thickness to the lumen width of the fibre. Runkel ratio across and along the wood always varied. When the ratio is less than 1 is a suggestion that such wood is suitable for papermaking. Hence, the lower this value, the thinner the fibre cell walls and the better is the fibres for papermaking (Istek, 2006 and Oluwadare and, Sotannde, 2007). The outer-wood recorded higher Runkel ratio which is within the accepted limit to manufacture absorbent papers (Dutt and Tyagi 2011). This is in line with the research report for *Leucaena leucocephala* (0.59) (Oluwadare and Sotannde, 2007), *Vitex doniana* (0.84) (Ogunjobi, *et al*.2013), *Anogeissus leiocarpus* (0.85) (Ogunjobi *et al*., 2014) *Eucalyptus camaldulensis*, (0.65) (Manahil and Abdelazim, 2015) and in *F. exasperata* (0.79) (Anguruwa,2018).

Rigidity coefficient is an important factor that controls flexibility and coarseness of the wood fibre. Dutt and Tyagi, (2011) reported that fibres with low rigidity coefficient give a higher degree of conformability within the sheet, which produces the sheet of lower bulk or higher density with resultant effects that paper produced from such fibres will give good physical strength properties with high brightness and low porosity and appropriate for printing, writing, packaging and wrapping purposes. Rigidity coefficient of *A. altilis* was 0.18, compared favourably with the report of Oluwadare and Sotannde, (2007) 0.19 for *Leucaena leucocephala* and Anguruwa, (2018) 18.84 for *Ficus .exasperata*. This makes *A. altilis* wood more suitable and appropriate raw material for pulp and papermaking.

In this present study, F-factor was 250.73; this value is in line with the research report of Akgul and Tozluogu (2009) for *Fagus orientalis* and *Pine nigra* wood was 140.38 and 240.55 respectively. F-factor is determined by dividing fiber length to wall thickness; this shows that flexibility of papers obtained from fibers with bigger F-factor is considered to be good. According to the criteria of fiber quality and quality class II reported by Agul and Tozluogu (2009).

Muhlsteph's proportion of *A. altilis* is 58.86% which falls within this class. Muhlsteph values slightly lower than what was obtained 61.2 for Pinus brutia (Bektas *et al*., 1999), 76.68 for Fagus orientalis, (Agul and Tozluogu, 2009), but slightly higher than what was obtained in *Pine nigra* wood 47.28, (Agul and Tozluogu, 2009), 52 obtained in *Shorea mujongensis* (Listya and Supartini, 2011). Similarly, 46.17 for Acacia hybrid, 45.85 for *A. margium* and 55 for *A. auriculiformis* (Yahaya *et al*., 2010) and 57.39 obtained for *F.exasperata.* (Anguruwa, 2018)

When a lower value is obtained from wood fibres, it depicts that such fibre is thinner cellwall, and thin wall fibers can easily be crushed on paper production which eventually affects the density of paper produced and tear resistance properties positively. Hence, the use of thin wall fibres is more preferable in the paper industry among which *A.altilis* species can be categorized. Hence, According to (Oluwadare, 1998), these values are of the acceptable range for hardwoods for papermaking.

Table 3: Mean values of Derived Fibre Morphology

SH	RP	Slenderness	Flexibility (%)	Runkel Ratio	Rigidity Coefficient (%)	F-Factor	Muhlsteph Ratio (%)
Base	Corewood	$35.13\pm6.9_{c}$	$69.44\pm9.3_{a}$	$0.46\pm0.2_{c}$	$0.15\pm0.1_{b}$	$240.28\pm55.1_{c}$	$51.11\pm12.5_{c}$
	Innerwood	$47.25\pm8.9_{ab}$	$64.34\pm4.2_{b}$	$0.56\pm0.1_{b}$	$0.18\pm0.2_{ab}$	$264.58\pm37.3_{a}$	$58.41\pm5.5_{b}$
	Outerwood	$51.18\pm10.5_{a}$	$59.96\pm10._{c}$	$0.71\pm0.3_{a}$	$0.20\pm0.1_{a}$	$261.95\pm50.9_{b}$	$63.25\pm12.5_{a}$
Pooled Mean		**44.52± 10.9**	**64.57± 8.6**	**0.58± 0.2**	**0.18± 0.04**	**255.60± 46.59**	**57.60± 11.04**
	Corewood	$37.09\pm7.3_{c}$	$65.73\pm7.4_{a}$	$0.55\pm0.2_{b}$	$0.18\pm0.1_{b}$	$220.73\pm46.20_{c}$	$56.25\pm9.1_{b}$
Middle	Innerwood	$50.86\pm12.3_{a}$	$60.29\pm8.6_{b}$	$0.69\pm0.3_{ab}$	$0.19\pm0.1_{b}$	$262.97\pm76.22_{a}$	$63.09\pm10.2_{ab}$
	Outerwood	$48.30\pm12.8_{b}$	$59.21\pm8.7_{b}$	$0.72\pm0.3_{a}$	$0.22\pm0.1_{a}$	$243.61\pm92.75_{b}$	$64.37\pm10.1_{a}$
Pooled Mean		**45.41± 12.64**	**61.74± 8.2**	**0.65± 0.24**	**0.19± 0.04**	**242.43c 63.96**	**61.23± 9.76**
	Corewood	$37.11\pm6.0_{b}$	$68.67\pm6.3_{a}$	$0.47\pm0.1_{c}$	$0.16\pm0.1_{b}$	$246.84\pm60.7_{b}$	$52.47\pm8.8_{b}$
Top	Innerwood	$47.41\pm9.2_{ab}$	$62.40\pm7.9_{b}$	$0.63\pm0.2_{ab}$	$0.19\pm0.1_{ab}$	$255.76\pm34.2_{b}$	$60.56\pm9.9_{a}$
	Outerwood	$48.76\pm13.6_{a}$	$62.30\pm9.8_{b}$	$0.65\pm0.3_{a}$	$0.19\pm0.0_{a}$	$259.87\pm36.2_{a}$	$60.21\pm12.1_{ab}$
Pooled Mean		**44.43± 11.31**	**64.46± 8.6**	**0.72± 0.24**	**0.18±0.04**	**254.15± 48.8**	**57.74± 11.05**
Mean		**44.79±11.49**	**63.59±8.46**	**0.60±0.23**	**0.18±0.04**	**250.73± 53.25**	**58.86±10.62**

SR: Slenderness ratio, FR: Flexibility ratio, RR: Runkel ratio, CR: Coefficient of rigidity.

Means ± standard error of the mean of 5 replicate samples. Values with the same alphabet in each column are not significantly different at $\alpha = 0.05$ using Duncan multiple range test.

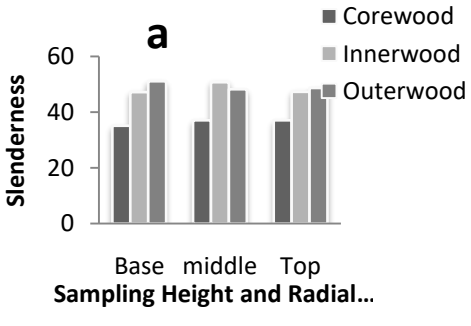

Fig 5a

Variation of derived morphology (Slenderness) values along the SH and RP

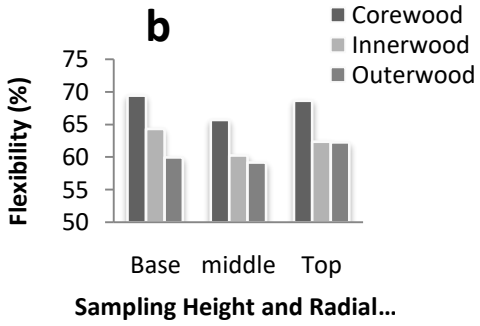

Fig 5b

Variation of derived morphology (Flexibility) values along SH and RP

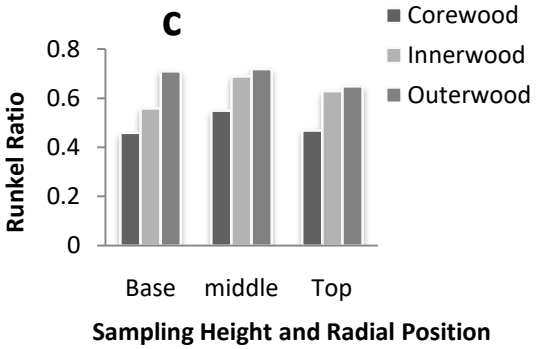

Fig 5c

Variation of derived morphology (RG) Runkel ratio) values along the SH and RP

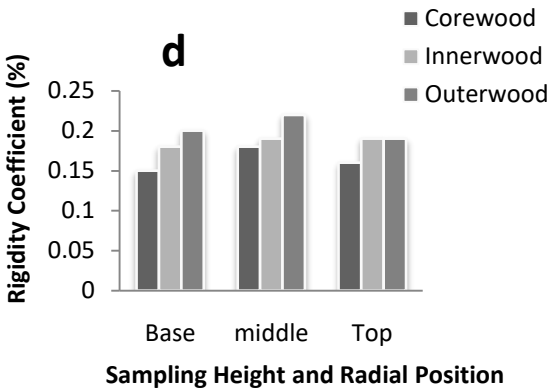

Fig 5d:

Variation of derived morphology values along the SH and RP

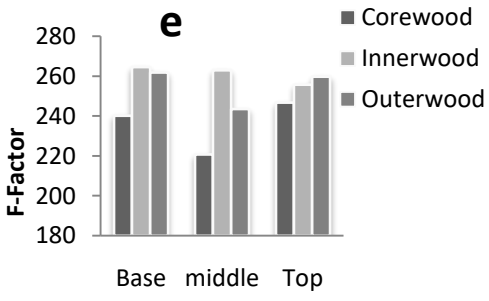

Fig 5e

Variation of derived morphology (F-factor) values along the SH and RP

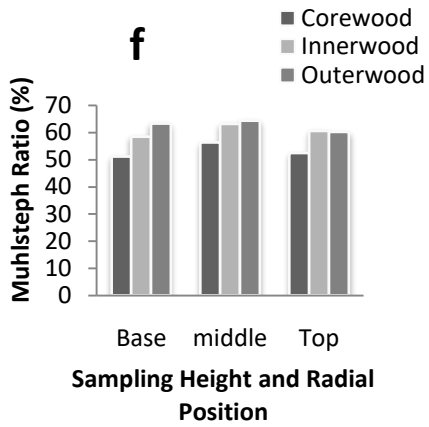

Fig 5f

Variation of derived morphology (Muhlsteph ratio) values along the SH and RP

Conclusion

This investigation presented an effort to make known of *Artocarpus altilis* wood as a lesser known wood species by providing detail information about the basic density and fibre properties along the axial and radial portion. The results revealed that the basic density of the *Artocarpus altilis* varies uniformly along the sampling height across the radial position. This implies that quality wood can be obtained within the region of base and middle of the merchantable height. However, *A. altilis* wood can be regarded as a medium density making it suitable materials for light construction while the fibre dimensions of *Artocarpus altilis* are in the normal range for tropical hardwood timbers and the derived morphology indices are found to be reasonably good. These values are of an acceptable range for hardwoods for papermaking.

References

Adi DS, Risanto L, Damayanti R, Rullyati S, Dewi LM, Susanti R, Dwianto W, Hermiati E, Watanabe T. (2014) Exploration of unutilized fast growing wood species from secondary forest in Central Kalimantan: Study on the fiber characteristic and wood density. ***Procedia Environmental Sciences*** *20: 321-327*

Ajala, O.O and Ogunsanwo, O.Y. (2011) Specific gravity and mechanical properties of *Aningeria robusta* wood from Nigeria; Journal of tropical forest science 23(4): 389–395

Akachuku, C. O. (1997) Status of Forest food plant species and environmental management in study/Action plan, Ibadan, Nigeria. Pg 248

Akinsanmi, F.A and Akindele, S.O. (2002) Timber yield Assessment in the Natural Forest Area of Oluwa Forest Reserve, Nigeria. Nigerian Journal of Forestry, 32(1): pg 16-22

Akgul, M., and A. Tozluoglu, (2009).Some Chemical and Morphological Properties of Juvenile Woods from Beech (*Fagus orientalis* L.) and Pine (*Pinus nigra A.*) plantations Trends in Applied Sciences Research,4: pg 116-125. **DOI:**10.3923/tasr.2009.116.125 https://scialert.net/abstract/?doi=tasr.2009. Pg 116.125

Akpakpan, A. E., Akpabio, U. D. and Obot, I. B (2012) "Evaluation of Physicochemical Properties and Soda Pulping of *Nypa Fruticans* Frond and *Petiode*," Elixir Applied Chemistry 45: 7664-7668.

Anon, (1984) Chemical Analysis of Nigerian Grown timbers. Annual Report of the Forestry Research Institute of Nigeria (FRIN). Jan- Dec pp 108-109.

Anguruwa, T.G (2018) Anatomical, Physico-Chemical and Bioenergy properties of *Ficus exasperata* Vahl. In Ibadan, Nigeria. Ph.D Thesis submitted to the Department of Forest production and products. University of Ibadan.

American Society for Testing and Materials (1991) Standard test methods for specific gravity of wood and wood-based materials D2395-02. Annual Book of ASTM Standards. Section 4. Volume 04.10. West Conshohocken, PA. USA: 844 p.

American Society for Testing and Materials, ASTM D 2395-17 (2017) Standard Test Methods for Density and Specific Gravity (Relative Density) of Wood and Wood-Based Materials, ASTM International, West Conshohocken, PA, 2017.

American Society for Testing and Materials, ASTM D1413-61. (2007) Preparation of Decayed Wood for Microscopical Examination.

Barefoot AC, Hitchings RG, Ellwood EL. (1964) Wood characteristics and kraft paper properties of four selected Loblolly pines: 1 effect of fiber morphology under identical cooking conditions. ***Tappi*** *47: 343-356*

Bektas, I., Tutus, A. and Eroglu, H. (1999) A Study of the Suitability of Calabrian Pine (*Pinus brutiaten*) for Pulp and Paper Manufacture. Turkey Journal of Agriculture, 23: 776-784.

Chudnoff, M. (1980) Tropical Timbers of the World. Agricultural Handbook No. 607. USDA Forest Service, Forest Products Laboratory, Madison.

Dinwoodie, J. M. (1989) Wood: Nature's cellular, polymeric fibre composite. Pub. The Institute of Metal London

Dutt, D. and Tyagi, C. H. (2011) Comparison of Various *Eucalyptus* Species and Their Morphological, Chemical, Pulp and Paper Making Characteristics. Indian Journal of Chemical. Technology, 18:145-151

Food and Agriculture Organisation. (2001) Forest Plantations Thematic Papers: non-forest tree plantations based on the work of W. Killmann. Working Paper Series FP/6.FAO. Rome

Fuwape, J. A. and Fabiyi, J.S (2003). Variations in Strength properties of Plantation grown *Nauclea diderichii* wood. Journal of Tropical Forest Products 9 (1&2): pg 45-53

Fuwape, J. A. (1991) Wood utilization: From Cradle to the Grave. An Inaugural Lecture. Federal University of Technology, Akure. Dec 5, 2000. 33pp

Izekor, D.N. (2010. Physico-Mechanical Characterization and Anatomy of Teak (*Tectona grandis* L.F) Wood Crown in Edo State, Nigeria, Ph.D Thesis Submitted to the Dept. of Forestry and Wood Technology, Federal University of Technology, Akure, Nigeria. pp 225

Istikowati WT, Aiso H, Sunardi, Sutiya B, Ishiguri F, Ohshima J, Iizuka K, Yokota S. (2016) Wood, chemical, and pulp properties of woods from less-utilized fast-growing tree species found in naturally regenerated secondary forest in South Kalimantan, Indonesia. ***Journal of Wood Chemistry and Technology*** *36: 250-258.*

Istikowati WT, Ishiguri F, Aiso H, Hidayati F, Tanabe J, Iizuka K, Sutiya B, Wahyudi I, Yokota S. (2014) Physical and mechanical properties of woods from three native fast-growing species in a secondary forest in South Kalimantan, Indonesia. ***Forest Products Journal*** *64: 48-54*

Itsek, A., (2006) Effect of *Phanerochaete crysososporium* white rot fungus on the chemical composition of Populus tremula L. cellulose Chem Technology, 40(6); pg 475-478

Listya, M. D. and Supartini, (2011) .Anatomical Properties of *Shorea mujongepse* Species of Dipterocarpus from Kalimanta. *Journal of Forestry Research* 8(2): 91-100.

Luce GE. (1970) Transverse collapse of wood pulp fibers: fiber models. In: Page DH (ed) ***The physics and chemistry of wood pulp fibers (Special Technical Association publication, no. 8)****. Technical Association of the Pulp and Paper Industry, New York, 278-281*

Malan FS, Gerischer GFR. (1987) Wood property differences in South African grown ***Eucalyptus grandis*** *trees of different growth stress intensity.* ***Holzforschung*** *41: 331-335*

Malasyia Timber Company (MTC) (2018) MTC Wood Wizard version 1.1.http// www.mtc.com.my/wizards/mtc_tud/print.htm1

Manahil, F. E. and Abdelazim, T. A. (2015) Effect of Growth Rate on Fibre Characteristics of *Eucalyptus camaldulensis* Wood of Coppice Origin Grown in White Nile State, Sudan.*Journal of Natural Resources and Environment*, STU. 3.1(3): 14-23.

Ohshima, J, Yokota S, Yoshizawa N, Ona T. (2005) Examination of within-tree variations and heights representing whole-tree values of derived wood properties for quasi-non-destructive breeding of *Eucalyptus camaldulensis and Eucalyptus globules* as quality pulpwood. Journal of Wood Science 51: 102-111.

Ogbonnaya, C. I., Roay-Macauley, H., Nwalozie, M. C. and Annerose, D. J. M. (1997) Physical and Histochemical Properties of Kenaf (*Hibiscus cannabinaus* L) Grown Under Water Deficit on a Sandy Soil. Industrial Crops Production, 7: 9-18.

Oluwadare, A.O. (2007) Wood properties and selection for rotation length in Carribbean pine *(Pinus caribaea* morelet) grown in Afaka, Nigeria. *American-Eurasian Journal of Agric and Environ, Sci*.2(4); pg 259-363

Oluwadare, A. O. and Sotannde, O. A. (2007) The Relationship between Fibre Characteristics and Pulp-Sheet Properties of *Leucaena leucocephala* (lam.) De Wit. *Middle-East Journal of Science Resources*, 2(2): 63-68.

Oluwadare, A.O., (1998) Evaluation of the Fibre and Chemical Properties of Some Selected Nigerian Wood and Non-Wood Species for pulp production. *Journal. Trop. For. Res.,* 14: 110- 119.

Ogunjobi, K. M., Adetogun, A. C and Shofidiya, S. A. (2014) Investigation of Pulping Potentials of Waste from Conversion of *Anogeissus leiocarpus*. *Journal of Polymer and Textile Engineering*. 1(2): 26-30.

Ogunnika, C.B. and Kayode, J.O (2002) Importance of Nigerian Forest Indigenous Fruits Trees as Household support. Proceeding of the 28th Annual Conference of Forestry Association of Nigeria, pg 300-315.

Ogunnika, C. B (2001) Use of non-timber forest products as food from Nigeria Forest Book of Abstracts of the 35th Annual Conference of Agricultural Society of Nigeria. Abstract of Papers, pp 8-10.

Ogunsanwo, O. Y and Onilude, M. A. (2001) Radial and axial variation in fibre characteristics of plantation grown Obeche in Omo forest reserve. Nigeria Journal of Forestry, Vol 30(1):33-37

Ogunsanwo, O.Y. (2000) Characterization of Wood Properties of Plantation grown Obeche (*Triplochiton sceleroxylon*. K. Schum) in Omo Forest Reserve Ogun State, Nigeria, Ph.D Thesis in the department of forest Resources Management. Univ. of Ibadan pp 253

Ogunwusi, A.A. (1991) Influence of wood quality and pulping variables on pith deposits and properties of paper produced from 15 Nigeria hardwoods. Ph.D Thesis in the Department of Forestry Resources Management, University of Ibadan. Pp 27-59

Okojie, J.A. and Akande, J.A. (1995) Environmental Sustainable Wood Industry Development. Nigerian Journal of Forestry Vol.25 (No. 1&2) 101-103.

Osadare, A.O. (1993) Strategies towards self-sufficiency in long fibre pulp production in Nigeria. Nigeria Journal of Forestry, Vol 24(1) pp16-20. Osadare, A.O. 1993. Strategies towards self-sufficiency in long fibre pulp production in Nigeria. Nigeria Journal of Forestry, Vol 24(1) pp16-20.

Osadare, A.O. (2001) Basic wood properties of Nigerian grown (*Pinus caribeae* Morelet) and their relationship with tree growth indices Ph.D Thesis, University of Ibadan.

Orwa, C, Mutua A, Kindt R, Jamnadass R, Simons A, (2009) *Artocarpus altilis.* Agro forest tree Database: A tree reference and selection guide version 4. http://www.worldagroforestry.org/af/treedb/

Pirralho M, Flores D, Sousa VB, Quilhó T, Knapic S, Pereira H. (2014) Evaluation on paper making potential of nine ***Eucalyptus*** *species based on wood anatomical features.* ***Industrial Crops and Products*** *54:327-334.*

Philips, E.W.J. 1941. The inclination of the fibrilsin the cell wall and its relation to the Paper presented at Irish Timber Growers Association Seminar, 2nd November 1995, UCD Industry Hall, Dublin, Ireland

Plomion, C: Leprovost, G and Stokes, A. (2001) Wood Formation in Trees. Plant Physiology.Vol 127.pg 1513-1523.

Poku, K., Qunglin Wu and Richard Viosky. (2001) Wood Properties and their variations with the tree stem of lesser-used species of Tropical hardwood from Ghana. Wood and Fibre Science. Journal of the society of wood science and Technology. Vol.33, No22; 284-291

Ragone, D, (2011) *Artocarpus altilis* (revised). Farm and Forestry Production and Marketing for Breadfruit. Species profiles for Pacific island agroforestry. Permanent Agriculture Resources(PAR),Holualoa, Hawaii (ed.by Elevitch,C.R) http://www.agroforestry.net/scps/Breadfruit_specialty_crop.pdf.

Richter, H.. G., and Dallwitz, M.J. (2000) Commercial timbers: descriptions, illustrations, identification, and information retrieval. In English, French, German, Portuguese, and Spanish. Version: 17th February2019. http://delta-intkey.com

Rincon, A.M. and Padilla, F.C. (2004) Physico-chemical properties of breadfruit (*Artocarpus Altilis)* starch from Margarita Island, Venezuela. Arch Latinoam 54(4):449-456

Roger, M. R., Mario. T. F. and Edwin C. A. (2007) Fibre Morphology in Fast Growth *Gmelina arborea* Plantations. Madera Bosques, 13(2):3-13.

Runkel von ROH. (1949) Über die Herstellung von Zellstoff aus Holz der Gattung ***Eucalyptus*** *und Versuche mit zweiunterschiedlichen Eucalyptusarten (On the production of pulp from wood of the genus* ***Eucalyptus*** *and experiments with two different* ***Eucalyptus*** *types).* ***Das Papier*** *3: 476-490*

Saika, S. N., Goswami, T. and Ali, F. (1997) Evaluation of Pulp and Paper Making Characteristics of Certain Fast Growing Plants. Wood Science and Technology, 31: pg 467-475.

Shakhes, J., Marandi, M. A. B., Zeinaly, F., Saraian, A. and Saghafi, T. (2011) Tobacco Residuals as Promising Lignocellulosic Materials For Pulp And Paper Industry. BioResources 6(4): 4481-4493

Sharma, M., Sharma, C. L. and Kumar, Y. B. (2013) "Evaluation of Fibre Characterizations in Some Weed of Arunachal Pradesh, India for Pulp and Paper Making," Research *Journal of Agriculture and Forestry Science,* 1(3): 15-21.

Shupe, T.F; Choog, E.T. and Gibson, M.D. (1995). Differences in moisture content and shrinkage between outer wood, middle wood and core wood of two yellow Poplar trees. Forest Products Journal 45 (9): 85 – 90

Singh, S., Dutt, D. and Tyagi, C. H. (2011) Complete characterization of Wheat Straw (*Triticum aestivum* PBW-343 L. Emend. Fiori and Paol) A renewable Source of Fibre For Pulp And Paper Making. BioResources, 6 (1): 154-177

Smith, D. N. (1954) Maximum moisture content method for determining specific gravity of small wood samples. Rep. U.S. Forest Product Laboratory, Madison No.2014, http://agris.fao.org/agris-search/search.do?recordID=US201300084853

Smook, G.A., (2003) Handbook for Pulp and Paper Technologists. 3rd Ed, Angus Wilde Publications, Vancouver, B.C., ISBN-13: 978-0969462859.

Tsoumis, G. (1991) Science and Technology of wood; structure, properties, utilisation. New York: Van Nostrand Reinhold: London; Chapman and Hall, pg 494

Tutus, A., Comlekcioglu, N., Karaman, S. and Alma, M. H. (2010) Chemical Composition and Fibre Properties of Crambe orientalis and C. Tataria. International Journal of Agriculture and Biology, 12(12): 1814-9596.

Yahaya, R., Sugiyama, J., Silsia, D. and Gril, J. (2010) Some Anatomical Features of an Acacia Hybrid, *A. mangium* and *A. auriculiformis* Grown in Indonesia with Regard to Pulp Yield and Paper Strength. Journal of tropical Forest Science 22(3): 343-355.

Ververis, C., Georghiou, K., Christodoulakis, N. and Santas, R. (2003) Fibre Dimensions, Lignin and Cellulose Content of Various Plant Materials And Their Suitability For Paper Production. Industrial Crops and Products 19:245-254. DOI:10.1016/J. IND CROP. 2003.10. 006.

Conservation of the endangered endemic Boswellia trees on Socotra Island

The goal of the project:

The goal of the project is to conserve the endemic Boswellia species occurring on Socotra Island. Eight endemic Boswellia tree taxa are threatened on Socotra Island and current threats to the terrestrial environment call for urgent aimed conservation measures. The goal will be reached by proper conservation status evaluation, cultivation in home-gardens, re-plantation from wild source populations, establishment of nurseries capacity building of local stakeholders, with emphasis on local communities and conservation agencies.

Current situation:

The biodiversity on Socotra is increasingly affected by human-induced and climatic impacts. Recent changes in land management practices by local people cause overgrazing, resulting in the lack of tree regeneration and ultimately leading to decline, even extinction of local populations. Moreover, locally intensified cyclones and prolonged droughts caused by global climate change, have recently destroyed mature frankincense trees across the island.

Expected outcomes:

1. Knowledge on distribution and abundance of Boswellia species populations gained and their conservation status re-evaluated
2. Boswellia conservation measures fully implemented
    - At least 5 forest nurseries, at least 2,000 newly produced Boswellia seedlings
    - 1,500 replanted trees, at least 50 home-gardens
3. Conservation measures applied by local communities and agencies
    - 5 local communities and 500 individuals successfully involved
    - Capacity building activities on at least 15 trainings, at least 500 participant
4. Results published and awareness raised:
    - At least 2 scientific papers, 4 conference presentations

Timeframe:

1.1.2020 – 31.12.2022 (36 months)

Project lead :Mendel University in Brno, Czechia

Project lead contact: Prof. DrIng. Petr Maděra, Mendel University in Brno, Faculty of Forestry and Wood Technology, petrmad@mendelu.cz

Partners:

Environmental Protection Authority Socotra (EPA)

Sapienza University and Botanic Garden in Rome

Royal Botanic Garden Edinburgh,

Centre for Middle Eastern Plants

Conservation based Ecotourism Through Community Participation - A case from Tripura India

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A project entitled “Conservation of Biodiversity and livelihood enhancement through Community based Forest Management and Ecotourism in and around submergence of Small Hydropower project” is being implemented by the Tripura University, Agartala in partnership with Jana UnnayanSamiti Tripura a Social development wing of the Diocese of Agartala and funded by National Mission on Himalayan Studies, implemented by Ministry of Environment, Forest and Climate Change, Nodal and Serving hub with G.B. Pant "National Institute of Himalayan Environment"Kosi-Katarmal, Almora, Uttarakhand. Under this efforts were initiated by the principal author who is the Principal Investigator of the project around Dumburreservoir, Tripura to promote Conservation based Ecotourism through Community participation so that the Livelihood of the people living around this area can be enhanced.

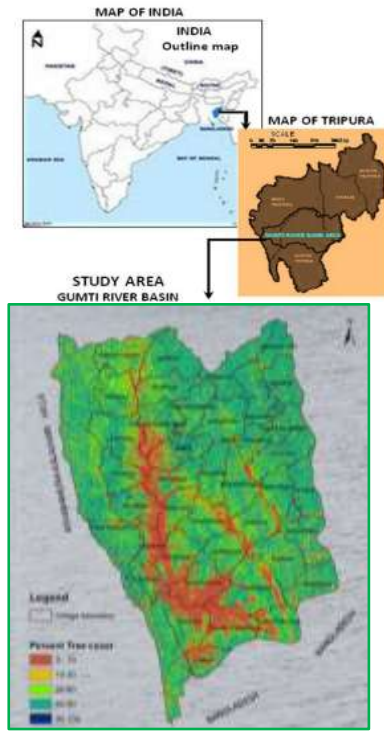

Fig 1:Map of Study area (Gumti basin)

The creation of Dumbur Hydro Electric Project (15 MW) on the river Gomati at Dumboor falls, Tripura, has submerged about 40 Sq. Km. of land in the year 1976 displacing about 27,000 indigenous farmers. This submerged area in due course of time has become a biodiversity rich wetland.But the displaced farmershad to move towards the nearby hills and settled there giving pressure to the forest and forest resources. Due to the lack of other livelihood options they are now overexploiting the existing resources with no control. Some of them even practise slash and burn agriculture on a large scale which is devastating the large stretches of forest (Fig. 3). Part of the study area which falls under the Gumti Wildlife Sanctuary is also facing threat. It is where the concept of Ecotourism originated through community participation so that the indigenous communities living around the reservoir find new way for livelihood option due to the potentiality of this region (Fig. 2).

Fig 3: Practice of Shifting cultivation at surrounding hills

Fig 2: A beautiful lake Island at Dumbur reservoir

The study area falls in two Districts of Tripura state, India namely, Dhalai and Gumti which covers two Sub-Divisions and three Rural Development Blocks. Communities living in this area are Reang, Tripura, Jamatia, Molsom, Chakma, Mog and Bengali. Each community is rich in Indigenous Traditional Knowledge (ITK) with ethnocultural knowledge. These communities have diverse traditional ethnic foods specific to each community. These communities make many traditional instruments, handicrafts, clothing, housing etc which are specific to particular ethnicity. Apart from this, it is also rich in folklore and traditional dances with some important fairs and festivals exclusively in this region.

Fig 4 Sensitization programme A: Tarini village B: Gandachara Rural School

The handicraft items crafted by them are remarkable. Twi langa, Twiseng, Ura, Takhuk, Chakhuikhok, Leshu, Bailing, Rusham, Khuri, Rignai, Risha, Ritrak etc. are some of the handicraft items found in the area. The indigenous food items are also unique in every community. Chakhui, Gudok (Pengmo), Awandru, Chakhutwi, Alum (Rugmo), Lausi, Awan, Awan bwthai , Awan pong, Muituru, Sidolgabi, Paganabigun etc. are some of the indigenous food items cooks in every households of the area.

Fig 5.Construction of Eco-hut by the local community at Tarini para, Gandacherra for conservation based ecotourism

We are working in this project from last two years. Several visits and sampling were made by Principal Investigator (PI), Co-PI and the Project Teamto understand the local scenario, the socio-economic status, the perception of the people and the willingness to take up any initiative etc. To make aware about the importance of

conservation of different resources,sensitization programme were also carried out in the villages, schoolsetc so that people realize about the responsibility towards the conservation.

Though the sensitization programme was done in number places and the place for starting ecotourism were also selected in various location, Tarini para of Pancharatan VC was the first one to take up this initiative in their village. Tarini para is dominated by Reang community. Through this project we are trying to empower people by giving them technical support for building a proper channel for ecotourism activities so that they can take up the actual work easily for their own benefit to showcase linking the traditional culture and value based products to promote livelihood.

Building a traditional cottage by the Reang community for the tourist was encouraging not only to us but also to the other communities living in the area. We believe that there will be successful story of their work and many more will be encouraged to take up such initiative for livelihood enhancement through conservation based ecotourism.

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Análisis de las bases técnicas y científicas para atender los temas de salud y sanidad forestal en México y Centroamérica

Jorge E Macías Sámano
Forest Health and Semiochemicals Consulting

Introducción

La realidad actual de la región formada por México y Centroaméricafavorece una perspectiva económicapara atender los problemas de plagas y enfermedades forestales y sobre todo porque la región cuenta con recursos financieros finitos (muchos provenientes de agencias internacionales) para manejarsus recursos forestales y con necesidades inmediatas sociales y de desarrollo. Sin embargo, en una búsqueda del desarrollo sustentable, los recursos naturales demandan del manejadorel compromiso entre una perspectivaeconómica y una ecológica. Es decir, la demanda inmediata de recursos directos (madera, semillas, alimentos, etc.) generados por los árboles y el bosque es indiscutible y necesaria, pero paralelamente, es impostergable definir parámetros que permitan evaluar el efecto de las plagas y enfermedades en términos de los servicios ambientales que prestan los recursos forestales.

Ya sea con perspectivas económicas o ecológicas, los procesosde prevención, diagnóstico, evaluación y manejo, usados para la atención de plagas y enfermedades forestales, deben de estar fundamentados en el conocimiento profundo de los recursos forestales de la región, el de sus principales agentes naturales de daño, y más importante aún, enel de las interacciones entre ambos organismos en tiempo y espacio.Conocimientos que teóricamente deben de ser enseñados y/o generados en instituciones académicasde la región. Estos conocimientos constituyen la línea base de información crítica no solo para el manejo de plagas, si no para poder medir o evaluar actualmente los efectos que el calentamiento

global tiene sobre las plagas y el bosque mismo. La necesidad de un mejor conocimiento y el desarrollo de investigación en las disciplinas de sanidad y salud forestal es un punto clave establecido enla Estrategia Regional de Salud y Sanidad Forestal para Centroamérica y República Dominicana propuesta ante la Comisión Centroamericana del Ambiente y Desarrollo (Macías Sámano 2016 y 2018, CCAD 2017).

En un análisis reciente Schweizery colaboradores (2018) discuten las oportunidades y desafíos que enfrenta América Latina para la gobernanza de la restauración de paisajes forestales y destacan varios comentarios de los académicos entrevistados. Por una parte, ellos muestran preocupación por las cuestiones conceptuales y metodológicas de los marcos legales y que tanto estos se adaptan a los contextos ecológicos. Por otra parte, ellos indican claramente la insuficiencia de conocimiento para realizar protección de bosques y actividades forestales restaurativas. Y de igual manera es su preocupación el reemplazo de especies nativas con exóticas, fenómeno que lo aducen a la falta de conocimiento y producción de especies nativas y que es diametralmente opuesto a lo que se conoce y produce de especies exóticas. Aún más, CONABIO (2010) en México menciona que la falta de congruencia entre políticas ambientales y productivas,aunada al hecho de que no se valora la pérdida de la biodiversidad y no seha invertido en generar paquetes tecnológicos con especies nativas, lo que ha promovidoel uso de especies exóticas. Las políticas públicas que en el largoplazo propician el uso de especies exóticas potencialmente invasoras debenconsiderar los impactos de estas en todos los entornos: ambientales,sociales y económicos. La producción de alimentos debe armonizarse con laconservación de la base natural de producción, es decir, mantener el balancecon los ecosistemas y por ende con los servicios ambientales que brindan.

A manera de hilos conductores, el presente análisis emplea a dos insectos considerados plagas importantes (los descortezadores de pino y el barrenador de las Meliáceas) en la región de México y Centroamérica y los impactos que causanestos insectos. El análisis busca desarrollar un marco conceptual de sanidad y salud forestal en donde se fundamenten los procesos para la atención de plagas y enfermedades forestales; el conocer los programas de estudio de algunas instituciones regionales claves y que generan profesionales dedicados a la actividad de sanidad forestal y, por último, hacer un análisis de la investigación generada en la región y que ha contribuido al desarrollo de la disciplina.

Los Conceptos Sanidad Y Salud Forestal

En los países desarrollados, el término “forestpestmanagement” ha sido reemplazado por el de “foresthealth” que es más amplio. Sin embargo, si bien en el idioma español estos términos se pueden traducir a “manejo forestal de plagas” y “salud forestal”, respectivamente, el primero es usado más ampliamente como “sanidad forestal” por agencias gubernamentales y programas oficiales (CONAFOR, México; INAB, Guatemala; ICF, Honduras). En varias ocasiones, el término salud forestal, se ha convertido*de facto* en un reemplazo del término de sanidad forestal; esto pudiera ser correcto siempre y cuando se entendiera la dimensión del nuevo termino. Sin embargo, al menos en México y Centroamérica, el termino salud forestal sigue siendo empleado, legislado y operado como sanidad forestal o manejo de plagas forestales (lo que incluye enfermedades y plantas parásitas). Adicionalmente, como lo veremos más adelante, los profesionales encargados de esta actividad son así formados por las instituciones académicas (Macías-Sámano 2018, Cibrián-Tovar y Macías-Sámano 2020).

El uso del concepto de salud forestal es relevante dentro del manejo de recursos naturales. Sin embargo, su definición depende en mucho de la perspectiva humana (Teal y Castello 2011). Desde un punto de vista utilitario, la salud forestal se ha definido como la producción de las condiciones forestales que directamente satisfagan las necesidades humanas. Desde un punto de vista de ecosistemas, el concepto es definido por la resilencia, la recurrencia, la persistencia y por los procesos biofísicos que llevan a las condiciones de sustentabilidad ecológica (Trumbore*et al.* 2015). La definición y el entendimiento de la salud forestal son también dependientes de la escala espacial, lo que lleva a una ambigüedad asociada con el incremento de las superficies y el número de árboles involucrados (Kolb *et al.* 1995, Sugden*et al.* 2015).Manion y Grifith (en Teal yCostello 2011) definen un ecosistema forestal como saludable, sustentable y maduro cuando este mantiene una estabilidad de la relación entre estructura y tamaño, por medio del balance entre su crecimiento y su mortalidad. A partir de este concepto, Teal y Castello (2011) desarrollan el concepto de mortalidad basal que provee con un método ecológicamente fundamentado para evaluar la sustentabilidad de cualquier bosque al determinar si la mortalidad causada por algún agente de disturbio causa inestabilidad en el sistema. Los autores sostienen que cualquier bosque presenta varios grados de mortalidad y que el que esta ocurra no implica que sea un sistema no saludable.

Para la región y dado el desarrollo del manejo de recursos forestal existente, pareciera más claro hablar de los términos salud y sanidad forestal por separado, y ponerlos en un contexto económico y ecológico, respectivamente. Sobre todo, en esta región en donde los aspectos sociales y económico definen *de facto*el uso de los recursos forestales y de la manera de cómo se utilizan los recursos económicos para su manejo (Macías-Sámano 2018, Cibrián-Tovar y Macías-Sámano 2020).

Desde un punto ecológico, existen muchos agentes bióticosque usan y viven de los recursos forestales, entre ellos los insectos herbívoros, que constantemente inciden en individuos y comunidades de árboles. Sin embargo, muchos de ellos no los afectan en su reproducción o elimpacto es mínimo en la vida de estos. Por otra parte, existen otros que los afectan de manera más profunda, tanto que funciones básicas como la fotosíntesis, la conducción de nutrientes o incluso el sostén mecánico, se ven tan comprometidos que la vida de los individuos se acorta o llega a su final. Muchos de estos factores solo afectan algunos individuos de la población y por ende no afectan la integridad de toda la comunidad, y en consecuencia no ejercen un impacto crucial en la estabilidad y permanencia de los bosques. Por otra parte, existen otros agentes que, por su persistencia e incidencia en funciones básicas de los árboles, causan mortalidades extensas creando un efecto importante que pone en riesgo la integridad de la comunidad de árboles, es decir, afectan el funcionamiento del ecosistema (Macías-Sámano 2018, Cibrián-Tovar y Macías-Sámano 2020).En consecuencia, para determinar y evaluar aspectos de salud forestal (funcionalidad del ecosistema), es indispensable un enfoque integral de conocimientos profundos de fisiología, ecología y ecosistemas (Kolb *et al.* 1995).

Debido a que estos dos conceptos dependen del valor que tiene un determinado recurso forestal, ellos deberían de ser la bases sobre las cuales se defina el estatus de plaga. Y ello, esta intrínsecamente ligado al tipo de escenario forestales en que se encuentren. Estos, los escenarios forestales, se definen antropocéntricamente y tienen objetivos de manejo particulares, así tenemos aquellos que tienen estructuras básicas naturales de ecosistemas completos como son los bosques y selvas, y otros creados como son las plantaciones, reforestaciones, viveros y arbolado urbano. Una clasificación de esta naturaleza es muy útil porque *de facto* nos ubica en escenarios que tienen una inversión para su existencia y funcionamiento y otros que pueden o no tenerla, como serían los bosques y selvas.Estos dos escenarios tienen dinámicas totalmente diferentes y así debiera de ser su manejo. Esta clasificación permite definir aspectos como manejo, administración, inversión, pero, ante

todo, definir los objetivos del manejo que de ellos se pretende y algo básico, el valor que tiene cada uno de los individuos dentro del escenario y en consecuencia cual agente es un factor que afecte su línea base de mortalidad (Macías-Sámano 2018, Cibrián-Tovar y Macías-Sámano 2020).

A continuación, utilizando a los descortezadores de pino y al barrenador de brotes del cedro y la caoba hacemos explícitos los conceptos de sanidad y salud forestal.

Los descortezadores de pino

El papel ecológico de este grupo de insectos es el de "renovar" las masas forestales, removiendo individuos viejos, enfermos y estresados, es decir, en realidad estos insectos tienden a crear nuevas masas forestales jóvenes y vigorosas (Safranyik y Wilson 2006, Guldin 2011). Esto es muy claro de ver, pues, aunque año con año existan mortalidades variables de superficies de bosque de pino en el mundono todos los árboles adultos son muertos y la regeneración se reestablece(Hawkins *et al.* 2013, Amoroso *et al.* 2013), si no existen factores exógenos como incendios o, en la región de México y Centroamérica, cambios antropogénicos de uso suelo. Por el contrario, con una perspectiva de producción maderable de esos bosques, es obvio que los planes de manejos se interrumpen, hay perdidas y se requieren de la espera de varios años para poder volver a obtenervolúmenes de maderadeseados.

El papel renovador de masas forestales por estos insectos en las últimas décadas ya no ha sido tan “normal” y es patente que ello es debido al efecto que tiene el cambio del clima tanto en las poblaciones de estos insectos como en la de sus hospederos, las coníferas(Six*et al*. 2014). Se tienen excelentes evidencias de que ha habido cambios en los ciclos de vida, distribución y poblaciones de especies de descortezadores del norte del continente como son *Dendroctonusponderosae*(Bleiker*et al*. 2011, Bentz*et al*. 2014), *D. rufipenis* (Hart *et al*. 2014, W. Ciesla, Forest Health Management International, pers. com.) e *Ipsconfusus*(Kleinman*et al.* 2012), cambios que se han reflejado en extensas mortalidades de sus hospederos. En México y Centroamérica, quizás reflejando el impacto asimétrico del fenómeno global, se han reportado mortalidades similares, pero no tan extensas, en poblaciones de *Ipspini* sobre *Pinusjeffreyi* en Baja California Norte, México (J. Villa, CONAFOR,pers. com.); de *Ipsconfusus* e *Ipslecontei* en pinos piñoneros en el norte y centro de México (D. Cibrián, UACH, pers. com.) y de *Dendroctonusfrontalis* en Honduras (ICF 2015).

EL barrenador de brotes de las melieaceas

EL insecto*Hypsipylagrandella*, denominado barrenador de las Meliaceas (familia a la que pertenecen los cedros y las caobas)es indiscutiblemente la plaga principal de plantaciones de estas especies en América (Floyd *et al.* 2003). El insecto causa la muerte de los brotes principales y ramificar los fustes de los árboles, causando una disminución en su crecimiento y acortando la longitud de la troza comercial de estas maderas preciosa (Macías-Sámano 2007). El efecto de este insecto es permanente y afecta los productos esperadosde las plantaciones,en donde comparativamente con la densidad natural de un cedro o de una caoba en los bosques naturales, su densidad se incrementa hasta 1000 individuos por hectárea, creando un escenario tan homogéneo como un cultivo agrícola para producir madera. En cambio, una selva tiene a lo mucho un promedio de seis árboles adultos por hectárea (Macías-Sámano 2001), y si bien el insecto está presente de manera permanente e incide en todos ellos, su efecto es quizás más bien benéfico al promover la formación de ramas secundarias e incrementar la superficie fotosintética de sus copas (Macías-Sámano 2007). Sin duda, una plantación de Meliáceas en donde su objetivo es producir madera y de buena calidad, requiere un manejo constante de este insecto, es decir el concepto de sanidad forestal se aplica. En cambio, en la selva, un ecosistema natural, a pesar de estar presente el insecto e incluso también dañando frutos, no se considera como importante para la salud de esta(Floyd *et al.* 2003).

Programas Educativos A Nivel Profesional

Los profesionales existentes en la región y que son los encargados de hacer el manejo de recursos naturales y por ende de la sanidad y salud de estos, son egresados preponderantemente de las disciplinas de ingeniería forestal, aunque también existen ingenieros agrónomos y biólogos (CCAD 2017). Una revisión de los planes de estudios de estas carreras en algunas Universidades importantes de la región (ver accesos electrónicos en las referencias de los programas de la Universidad Autónoma Chapingo, México; la Universidad de San Carlos de Guatemala;la Universidad Autónoma de Honduras y la Universidad Nacional de Ciencias Forestales de Honduras, y la Universidad Tecnológica de Panamá) indican que todas ellas ofrecen cursos de entomología, fitopatología, ecología forestaly manejo de recursos naturales o equivalentes, que sin duda ofrecen elementos básicos para comprender la sanidad forestal. Sin embargo, en sus planes de estudio es muy aparente la falta de cursos (o énfasis) que instruyan en aspectos cruciales para

comprenderambos conceptos, el de sanidad y el de salud forestal, como serían las interacciones insecto-planta, la ecología de comunidades, los organismos exóticos, la ecofisiología, etc., mismos que promueven un entendimiento integral de las interacciones dinámicas entre los herbívoros y el bosque. En consecuencia, el concepto de salud forestal no es conocido y los profesionistas egresan denominando*de facto*como plagas,a los insectos,sin realizar evaluación formal de su impacto y únicamente basándose en el hecho que esos insectos se alimentan de árboles y que potencialmentelos pueden matar.

Paralelamente, al no considerar las dinámicas que interactúan entre herbívoros y árboles, por ejemplo, los descortezadores y el bosque de pino y conocer los mecanismos que promueven y determinan la formación de infestación, los métodos utilizados por los profesionistas son exclusivamente de control y son los mismos, año con año. Profesionistas que cuentan con bases de manejo forestal con un enfoque netamente de producción, pero saben que un manejo adecuado promueve la formación de bosques vigorosos, y sin embargono aplican o entienden los principios ecológicos de la dinámica del ecosistema y continúan únicamente controlando plagas sin desarrollar programas preventivosy mucho menos buscando la sustentabilidad(CCAD 2017, Macías-Sámano 2018, Cibrián-Tovar y Macías-Sámano 2020).

En los agroecosistemas el Manejo Integrado de Plagas (MIP) ha sido estudiado y desarrollado a nivel internacional desde hace varias décadas y es el resultado de un largo proceso que va ligado con el avance de la agricultura. El MIP está centrado en el concepto de plaga y es importante resaltar que este concepto es antropocéntrico y carece de bases ecológicas, pero se ciñe bien a las necesidades de los sistemas agronómicos (Cibrián-Tovar y Macías-Sámano 2020).Aunque el MIP ha tenido una enorme utilidad en el manejo de plagas forestales en varios escenarios forestales (plantaciones, viveros, arbolado urbano, entre otros), la complejidad y gran escala espacial de los ecosistemas forestales son un enorme reto para el desarrollo y la implementación de un MIP, el cual no solo queda corto, sino que en muchos casos es negativo para el ecosistema mismo (Cibrián-Tovar y Macías-Sámano 2020). Aunado a ello nuevos conceptos han salido a la luz, como el concepto de salud forestal, el manejo forestal sustentable y el manejo de ecosistemas (Mery et al. 2005) y esto ha llevado a una revisión de los principios del MIP forestal, el cual se centra eminentemente en plagas y no considera el sistema forestal como un todo (Alfaro y Langor 2016).

Un ejemplo bastante indicativo de esta forma de operar la sanidad forestal es la Norma-019-2006 de México que establece los lineamientos técnicos de los métodos para el combate y control de insectos descortezadores (SEMARNAT 2018) y en donde se determina *a priori* especies de insectos descortezadores nativos como plagas e incluso presenta una lista de estas en donde aparecen desde insectos que realmente son un problema potencial hasta insectos que solo están asociados al bosque. Como si esto fuera poco, la norma presenta una serie de métodos de control -- sin precisar una evaluación previa que defina la necesidad de estosy donde los aspectos de prevención son exclusivamente de índole administrativa o basados exclusivamente en un monitoreo que indica "que tan grande" es el problema con base en la extensión de la superficie afectada.

Por otra parte, una formación profesionista fuerte, tanto conceptual comopráctica, sobre la interacción de los factores bióticos y la dinámica de los bosques permitiría que la transferencia de tecnologías generadas en otros países pueda ser adaptada de manera óptima y además normada oficialmente de manera adecuada (CCAD 2017,Macías-Sámano 2018). A manera de ejemplo discutiré brevemente el uso del método de cortar y dejar, una táctica desarrolladapor el Servicio Forestal de Texas (Billings *et al*. 1996) para controlar de manera efectiva infestaciones (brotes activos) específicamente deldescortezador*D. frontalis* en los Estados Unidos. El método fue introducido en 1982 y desarrollado para Honduras y otros países de la región por Ronald Billings (Servicio Forestal de Texas) y Vicente Espino (Corporación Hondureña de Desarrollo Forestal) (Billings *et al.* 1996, Billings y Espino 2005). A pesar de más de 20 años de su utilización en la región con cierta eficiencia, en México y otros países los únicos métodos de control a seguir son los directos, físicos y químicos, mismos que son enseñados en las Universidades (Núñez Hernández 2001, Billings y Espino 2005, Cibrián *et al.* 2013).Recientemente se ha elaborado un manual para la operación del método de cortar y dejar(Macías Sámano *et al.* 2016) y en el cual, además de los pasos a seguir para su implementación, se describe con mucho detalle los principios biológicos y ecológicos que fundamentan ese método de control y que en realidad son estrictamente las interacciones dinámicas mediadas por mensajes químicos de los organismos involucrados, principios que deben de ser enseñados y discutidos ampliamente en los programas de formación profesional.

Investigación

Debido a que la sanidad y la salud son disciplinas eminentemente aplicadas, para efectos de análisis de la investigación realizada en esos temas, utilizaré los procesos de detección, monitoreo, evaluación y control de plagas y enfermedades, para discutir la información que se ha generado regionalmente y que ha llevado a apoyar esos procesos y la que es necesaria para que estos sean eficientes.

Los aspectos más desarrollados en la región son los de diagnóstico de plagas y enfermedades de árboles, y ello bajo un enfoque *a priori*que describe a los insectos y microorganismos asociados con las principales especies de árboles de la región,como plagas, sin establecer un requisito de evaluaciones previas o conteos, o mediciones de parámetros de impacto. Se parte de la premisa tipo "agrícola" de que son herbívoros y como se alimentan de los árboles son o se convertirán en un problema. Por ende, lainformación existente a plagas y enfermedades forestales se desarrolla bajo un esquema agronómico que cubre el nombre, la descripción del insecto, sus hospederos, ciclo de vida, daño que produce y en algunas ocasiones se incluye el control de los mismos; no hay información de las interacciones o de las funciones ecológicas que los organismos puedan tener(Castañeda 1980; Hochmut y Milán 1982, Hiljee*t al.* 1991a, b; CONAFOR 2007; Maes 1992; Billings *et al.* 1996, 2005; Arguedas 1997 y 2007; Landaverde Toruño 2001; Núñez Hernández 2001; Geils*et al.* 2002; Cano Alvarado 2003; ESNACIFOR / PROECEN 2003;Fonseca González 2004;Jiménez-Martínez 2008, Cibrián-Tovar 2017, Núñez Zuffo y Dávila Arce 2004;Cibrián *et al*. 1995, 2007, 2013; FAO 2008;Chavarriaga 2011;Cibrián-Tovar *et al.* 2013, Pavón Tijerino *et al*. 2014; ICF 2015). Si bien parte de la información vertida en todas estas publicaciones se refiere a insectos y microorganismos que efectivamente son plagas y enfermedades, en muchos casos la mayoría de los organismos descritos son tan solo organismos herbívoros asociados a los bosques o a las especies de árboles ahí tratadas. La información que fundamenta esos documentos proviene principalmente de trabajos de tesis de universidades regionales o de alguna institución pública de investigación del gobierno. De manera excepcional y principalmente en forma de tesis profesionales, existen trabajos más específicos sobre biología, ecología de algunos organismos y otros sobre control, la mayoría no publicados de manera formal(Guerra 2004; López Zeledón y Toledo Marín 2005; Rivera Rojas *et al*. 2010; Salinas *et al*. 2010, Espino Mendoza 2012; Jaén Lara 2013 entre otros).Al margen de lo indicado anteriormente, la investigación realizada por México cubre varios temas, sin embargo, está centrada predominantemente en los descortezadores de pino y en

aspectos taxonómicos y bionómicosde insectos y enfermedades de importancia forestal (Cibrián et al. 1995 y 2007; Cibrián-Tovar et al. 2013, Macías Sámano y Zúñiga 2016; y referencias citadas en esos trabajos).

A pesar de contar con estos elementos de diagnóstico, nuevamente con excepción de México, la formación y mantenimiento de colecciones entomológicas científicas y formales de insectos forestales en región es prácticamente nula, aunque en el pasado en países como Honduras la UNACIFOR contaba con una colección reconocida (O'Brien y Ward 1987, Dagoberto Núñez, com. pers.). Colecciones científicas de esta naturaleza son fundamentales para cualquier trabajo relativo a los temas de salud y sanidad forestal, o incluso de ciencia básica. Con contadas excepciones (González-Gaona 2016, Armendáriz-Toledano et al. 2018) no existe material bibliográfico de corte taxonómico escrito en español que permita identificar grupos de insectos y enfermedades forestales de importancia para la región.

Los aspectos de detección y monitoreo de plagas siguen la misma tendencia, es decir, centrándose únicamente en descortezadores, sin el desarrollo deinvestigación original y únicamentebuscandodiagnosticar mediante la identificación de signos y síntomas e implementado y acondicionandotécnicas desarrolladas en otros países, como son la detección área (CONAFOR S/F, CONAFOR 2010) y el uso de trampas cebadas con atrayentes para detectar y monitorear descortezadores de pino (Macías Sámano et al. 2004, Macías Sámano y Niño Domínguez 2016). Esta última metodología se viene realizando en el sureste de Estados Unidos desde 1986(Billings y Upton 2010) y predice de manera específica y confiable las tendencias y niveles de infestaciones por el descortezador *D.frontalis*. El procedimiento se basa en el uso de información histórica generada por el uso periódico de cebos dispuestos en trampas y que atraen a ese descortezador y sus depredadores (usando una proporción numérica de ambos),esta información se integra al conocimiento extenso de la biología y ecología de esa especie de descortezador y se torna factiblepronosticar sus tendencias poblacionales y por ende los eventos de infestaciones en ese país. Esta metodología ha sido la base por más de 20 años del monitoreo de *D. frontalis* en todo el sureste de Estados Unidos (Billings y Upton 2010). Sin embargo, si bien el establecer este monitoreo es factible y se ha hecho parcialmente en México, Guatemala y Honduras, la relación presa-depredador obtenida por los trampeos no es de total utilidad en esos países por dos razones. La primera,porque se desconoce la dinámica de las poblaciones de *D. frontalis* y como es afectada por sus depredadores y la segunda, es que derivado de los pocos estudios formales realizados en la región, los depredadores clave equivalentes a los del sureste de Estados Unidos no son

atraídos a la feromona comercial de *D. frontalis* (Moreno *et al.* 2008, Macías *et al.* 2013, Niño *et al.* 2015), por lo tanto, aunque se implementen los trampeos en la región, los datos relativos a los depredadores clave no se pueden colectar y por ende no se puede usar esa parte de la tecnología. Por el momento únicamente son útiles para comenzar a conocer las variaciones numéricas de las poblaciones bajo las condiciones silvícolas en que es colocado el trampeo. Consecuentemente, para lograr una trasferencia de tecnología óptima es necesaria la realización de investigación regional permanente y formal. En la actualidad si bien se tiene una Manual que guía para la implementación adecuada de esta tecnología en México y Centroamérica (Macías Sámano y Niño Domínguez 2016), en el mismo se indica perfectamente las limitaciones existentes, y en él se invita a que, con el uso de la tecnología puesta en un contexto de investigación científica, se avance en el conocimiento de las especies y la importancia de conocer las interacciones entre los descortezadores, sus insectos asociados y los árboles. Como se indicó anteriormente, con excepción de México, en Centroamérica no existe información taxonómica formal y completa de las especies presentes de *Dendroctonus* y de sus insectos asociados, de especialista taxónomos en esos grupos y tampoco de colecciones científicas de los mismos, por lo que es imposible de una manera operativa y expedita, la identificación de los individuos que sean colectados en trampas

El proceso de evaluación del daño o del impacto son aspectos realmente básicos para decidir si existe una plaga o enfermedad, o simplemente es un organismo asociado del bosque. Como ya se explicó al principio de este documento, esto se logra definiendo uno o varios parámetros y midiendo su efecto en los objetivos de manejo de un determinado escenario forestal. Esta evaluación no se realiza para ninguna plaga o enfermedad en escenarios naturales de México o Centroamérica. Para el caso de los descortezadores y algunos defoliadores de coníferas, lo que se hace en la región es únicamente medir las superficies forestales en donde se presentan las mortalidades y determinando el número de m^3 que son afectados y en algunos casos el grado de avance anual de esas áreas infestadas (CONAFOR 2010, Macías Sámano 2016, CCAD 2017). Algo similar se realiza con muérdagos en donde se aplican escalas de infestación y se determinan superficies afectadas, evaluando de forma muy similar muérdagos enanos y muérdagos verdaderos (CONAFOR 2010) a pesar de que la forma de dispersión e infección de estos dos grupos es totalmente diferente (auto dispersión y vía aves, respectivamente) (Hawksworth y Wiens 1996, Bello González 1984).Definitivamente en México, Centroamérica y el Caribe, no existen evaluaciones de los impactos que los daños por insectos ejercen en los árboles y los bosques.

Terminare con este análisis discutiendo lo relativo al conocimiento y las investigaciones hechas en cuanto a los procesos de control. Esta área ha sido desarrollada únicamente en México y ha seguido la tradición agronómica del uso de insecticidas y herbicidas. Centroamérica y el Caribe siguen procesos similares para el control. En México se usan varios métodos en contra de descortezadores, barrenadores, plantas parasitas y otras plagas, la mayoría derivados del uso directo agrícola y otros validados vía de tesis profesionales o simples experiencias empíricas, siendo estos los químicos (líquidos y fumigantes), los biológicos (hongos y bacterias entomopatógenas) y hasta los comportamentales (feromonas de agregación y antiagregantes), seguidos por los controles mecánicos (descortezado, troceo y uso de maquinaria con esos fines) o los físicos (remoción, uso de fuego), todos ellos oficialmente regulados por la SEMARNAT (2003) y la CONAFOR (Núñez-Hernández 2001, CONAFOR 2010, Cibrián y Quiñones 2014). A lo largo de la experiencia del autor, resulta interesante comentar que, tanto en México como en Centroamérica y el Caribe, han existido experiencias y estudios realizados con la finalidad de usar hongos entomopatógenos (Gijón Hernández *et al.* 2015 y literatura ahí citada) y de insecticidas sistémicos (Gochez López *et al.* 2015 y literatura citada) para el control de insectos descortezadores y barrenadores. Para el caso de los entomopatógenos resalta el hecho que prácticamente todos son efectivos cuando son aplicadosen laboratorio ydirectamente a los insectos objetivo, sin embargo, tales estudios pierden totalmente de vista que esos insectos están perfectamente protegidos bajo la corteza o aún más adentro de la madera, resultando prácticamente imposible que se pongan en contacto con los agentes entomopatógenos y sean infectados, haciendo totalmente inútil e impráctico – al menos en escenarios de bosques -- el uso de estos bio-insecticidas para control. Para el caso de los insecticidas sistémicos, aunque su utilidad es buena para protegerde esos insectos aárboles sanos individualesde alto valor (nuevamente esto resultaría inoperante y de alto impacto a nivel bosque), es impractico para “curarlos” o para “controlar” este tipo de insectos en individuos afectados,pues el funcionamiento del sistema conductor del árbol esta dañados o fuertemente comprometido y por ende no hay forma para que el insecticida se distribuya y actúe. Ambos ejemplos indican la falta de una visión ecológica y fisiológica de cómo funcionan e interactúan los insectos y sus hospederos.

El tema de los organismos exóticos es una prioridad para muchos países desarrollados, ya que forma parte de su seguridad alimentaria, comercio y bienestar de sus recursos naturales. Y este tema es literalmente desconocido en el ámbito Centroamericano y

de reciente inclusión en México. Una forma importante de control son los controles legales que regulan y prohíben la entrada,por medio del comercio internacional,de insectos y enfermedades exóticos provenientes de otras regiones. En México y Centroamérica, estos controles cuarentenarios son regulados y reforzados mediante programas específicos en las áreas de Sanidad Vegetal, no forestal, por medio del Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA) que engloba México, Centroaméricay República Dominicana (Macias-Sámano 2017 y 2018). Hasta muy recientemente esta organización está incursionando en aspectos forestales en México y en Guatemala (Paulo Ortíz, INAB Guatemala, com, pers.). Sin embargo, para OIRSA las fronteras y puertos de entrada son prioritarios y se entiende pues son la entrada de esos organismos a los países, sin embargo,es imperante también monitorear bosques, plantaciones forestales y arbolado urbano que son escenarios no tradicionales para la instituciones de índole de sanidad vegetal. Y esta atención no solo es prioritaria por aspectos de sanidad, sino por cuestiones de biodiversidad y protección a la salud de los ecosistemas naturales y que son afectados fuertemente por la introducción de estos organismos invasores tal y como se ha constatado en Estados Unidos, Canadá y Europa (Hu*et al.* 2009, Kovacs *et al.* 2009, Rassati*et al.* 2015).Recientemente en la región, la falta de conocimiento en aspectos cuarentenarios fue patente cuando Honduras, tratando de comercializar la madera derivada de los saneamientos por la mortalidad causada por *D. frontalis*,quiso venderla y a Guatemala y El Salvador. Entrando en varios problemas de índole legal y sanitaria.

Conclusiones

Es aparente que después de una experiencia técnica en sanidad forestal de más de 40 años en la región, todos los países incluido México, han centrado sus esfuerzos primordialmente en el control de los gorgojos descortezadores de pino, sin promover o desarrollar medidas preventivas en contra del insecto, mientras que la tecnología moderna para su detección y monitoreo a penas se comienza a conocer y establecer en la región.

Esta desventaja profesional de la región es quizás el reflejo de la muy aparente fata de actualización en los programas de formación profesional y la inexistencia de investigación científica formal. Ambos aspectos crearíanconocimiento regional y este a su vezfundamentaría tecnología propia. Consecuentemente, por esa carencia, la región se apoya en el uso de tecnología extranjera, pero que, por el poco desarrollo de conocimiento local, esa transferencia no llega a ser la adecuada.

Una desventaja mayúscula que tienen muchos profesionistas en la región es la imposibilidad de leer publicaciones que están en otros idiomas que no sean el español. Situación que los limita fuertementeen la actualización de conocimientos, pues el desarrollo de la ciencia es eminentemente en el idioma inglés. Ojalá fuera posible que organizaciones internacionales pudieran enfocar algunos esfuerzos a la traducción de trabajos claves en el área para contribuir a solventar este problema (Macías-Sámano 2017).

Si Latinoamérica quiere enfrentar exitosamente el problema de descortezadores y sus efectos deletéreos en el recurso forestal, debe de comenzar con formar profesionales con fuertes fundamentos ecológicos de los sistemas que maneja y no solo en aspectos de producción forestal o utilitarios.Paralelamente, el desarrollo de una investigación interdisciplinaria (e.g. biólogos e ingenieros forestales) generaría conocimientos que permitan entender, por ejemplo, las relaciones de las estructuras forestales y la promoción de poblaciones altas de los gorgojos. De esta manera la región podría ocuparse de diseñar aspectos preventivos fundamentados en el conocimiento de las características locales y ya no en información extranjera generada bajo otras circunstancias no solo ecológicas, si no políticas y sociales.

Es patente la urgencia de realizar lo propio con otros agentes bióticos de deterioro y en la conceptualización regional del término salud forestal, buscando no solo dar elementos derivados de la ciencia, si no ubicarlo adecuadamente dentro del manejo de los recursos forestales y de la normatividad correspondiente. Escenarios forestales como las plantaciones y el arbolado urbano a nivel mundial han probado ser el objetivo del impacto de varios insectos exóticos barrenadores de madera y que han requerido millonarias inversiones para aminorar sus impactos y reestablecer la inversión efectuada para su establecimiento, sin embargo, estos aspectos son todavía invisibles para la región y debieran ser de mucha preocupación para los países debido a las grandes superficies de árboles plantadas con distintos objetivos, muchos de ellos exóticos y cuyos mercados visualizan países que cuentan con fuertes medidas cuarentenarias para productos forestales (Macías-Sámano 2017).

Referencias

Alfaro R y Langor D. 2016. Changing paradigms in the management of forest insect disturbances. Can. Entomol. 148: S7-S18.

Amoroso M.M., Coates K.D.,y Astrup R. 2013. Stand recovery and self-organization following large-scale mountain pine beetle induced canopy mortality in northern forests. For. Ecol. Manag. 310, 300–311.

Arguedas M. 1997. Plagas de semillas forestales en América Central. Manual Técnico No. 25, CATIE. Turrialba, Costa Rica. 120 pp.

Arguedas M. 2007. Plagas y enfermedades forestales en Costa Rica. Kurú: Revista Forestal (Costa Rica) 4(11 y 12 especial). http://www.edeca.una.ac.cr/files/Plagas%20y%20Enfermedades%20Forestales/plagas_KURU_2007.pdf

Armendáriz-Toledano F., G. Zúñiga G., García-Román L.J., Valerio-Mendoza O. y García-Navarrete P.G. 2017. Guía ilustrada para identificar a las especies del género *Dendroctonus* presentes en México y Centroamérica. Instituto Politécnico Nacional. CDMX, México.

Bello González M. A. 1984. Estudio de muérdagos (Loranthaceae) en la región Tarasca, Michoacán. Bol. Tec. 102. INIFAP-SARH. México, D.F.

Bentz B., Vandygriff J., Jensen C., Coleman T., Maloney P., Smith, S. Grady A., y Greta Schen-LangenheimetG. 2014.Mountain pine beetle voltinism and life history characteristics across latitudinal and elevational gradients in the western United States. Forest Science, 60, 434–449.

Billings R. y Espino Mendoza V. 2005. El gorgojo descortezador del pino (*Dendroctonusfrontalis*) en Centroamérica. Como reconocer, prevenir y controlar plagas. Servicio Forestal de Texas y Corporación Hondureña de Desarrollo Forestal. http://www.barkbeetles.org/centralamerica/centralamerica.pdf

Billings R.F. y Upton W.W. 2010. A Methodology for Assessing Annual Risk of Southern Pine Beetle Outbreaks Across the Southern Region Using Pheromone Traps. 73-85 p, En: Pye et al. (eds.) Advances in Threat Assessment and Their Application to Forest and Rangeland Management. Gen. Tech. Rep. PNW-GTR-802. Portland, OR: US. Department of Agriculture, Forest Service, Pacific Northwest and Southern Research Stations. Vol.1.

Billings R.F., Flores J.E. y Cameron R.S. 1996. Los escarabajos descortezadores del pino, con énfasis en *Dendroctonusfrontalis*: Guía para la detección aérea. Texas Forest Service Publ. 149. 27 p.

Bleiker K.P., Carroll A.L.,y Smith, G.D. 2011. Mountain pine beetle range expansion: Assessing the threat to Canada's boreal forest by evaluating the endemic niche Final Report Ver. 1.1. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC. Mountain Pine Beetle Working Paper 2010-02. 17 p.

Cano Alvarado M.F. 2003. El gorgojo del pino: efecto del cambio climático en los años recientes. http://www.iicasaninet.net/pub/sanveg/pdf/gorgojo_pino.pdf 7.

Castañeda C. 1980. El gorgojo del pino en Guatemala. Universidad de San Carlos de Guatemala. Editorial Universitaria. Dirección General de Extensión. Serie Separatas Anuario Vol. 38. 30 p. 8. Global Forest Nursery Development Inc. 2002. Mountain Pine Ridge carbon sequestration project, Belize C.A. Progress Report #1. 15 p.

CCAD 2017. Estrategia Regional de Salud y Sanidad Forestal para Centroamérica y República Dominicana. USFS-ID, FAO, GIZ, Comisión Centroamericana de Ambiente y Desarrollo, CCAD, San Salvador, EL Salvador.

Chavarriaga D.M. ed. 2011. Protección Fitosanitaria Forestal. Instituto Colombiano Agropecuario ICA, Colombia. 229 p. http://www.slideshare.net/diegochava/proteccion-fitosanitaria-forestal-en-col

Cibrián Tovar D. 2013. Manual para la identificación y manejo de plagas en plantaciones forestales comerciales. Universidad Autónoma de Chapingo, México. 229 p.

Cibrián Tovar D. Editor. 2017. Fundamentos de Entomología Forestal. Universidad Autónoma Chapingo. 410 pp.

Cibrián Tovar, D., Méndez Montiel J.T., Campos Bolaños R., Yates III H.O. y Flores Lara J. 1995. Insectos forestales de México / Forest InsectsofMexico. Univ. Auto. Chapingo, SARH, USDA-FS, Com. Forestal. Amer. Norte, FAO. Pub. No. 6. 453 p.

Cibrián Tovar, D., Quiñonez Barraza S., Aguilar Vitela JL, Cassian Santos JM., Soto Rodríguez J., Santillán Soto JL., Olivo Martínez JA., Villa Castillo J., Robles Uribe S. y Hernández Villa G. 2013. Guía práctica para el control de infestaciones por insectos descortezadores de coníferas. Universidad Autónoma Chapingo, CONAFOR, SEMARNAT, Secretaria de Recursos Naturales y Medio Ambiente de Durango. México. 25 p.

Cibrián Tovar D., Alvarado Rosales D. y García Díaz S.E. 2007. Enfermedades forestales de México / Forest DiseasesofMexico. Universidad Autónoma Chapingo, México; CONAFOR,

México; USDA-FS, Estados Unidos de Norteamérica Canadian Forest Service, Canadá; Comisión Forestal de América del Norte COFAN, FAO. 587 p.

Cibrián-Tovar, D. y Macías-Sámano, J. E. 2020. Marco conceptual y desarrollo del manejo integrado de plagas MIPF. En: Fundamentos para el Manejo de Plagas Forestales MIPF, Cibrián-Tovar D. (ed.), Universidad Autónoma Chapingo, México. En desarrollo.

Cibrián-Tovar, D., Sánchez-Martínez, G., Macías-Sámano, J.E., y Cibrián-Tovar, J. 2020. Historia de la entomología forestal. En: Fundamentos para el Manejo de Plagas Forestales MIPF, Cibrián-Tovar D. (ed.), Universidad Autónoma Chapingo, México. En desarrollo.

CONAFOR. Sin Fecha. Manual técnico: Sanidad Forestal: Principales plagas y enfermedades forestales. CONAFOR, México. P. http://www.conafor.gob.mx/biblioteca/sanidad-forestal.pdf

CONAFOR. 2007. Manual de Sanidad Forestal. CONAFOR, México. 76 p. http://www.conafor.gob.mx:8080/documentos/docs/15/810Manual%20de%20sanidad%20forestal.pdf

ESNACIFOR/PROECEN. 2003. Guías silviculturales de 23 especies forestales del bosque húmedo de Honduras. ESNACIFOR, Organización Internacional de las Maderas Tropicales OIMT. Comayagua, Honduras. 271 pp.

Espino Mendoza V. 2012. Determinación de la efectividad de los químicos: aguarrás, etanol y frontalina, como atrayentes del *Dendroctonusfrontalis*. Escuela Nacional de Ciencias Forestales ESNACIFOR, Comayagua, Honduras. 93 pp.

FAO. 2009. Global review of forest pest and diseases: A thematic study prepared in the framework of the global forest resources assessment 2005. FAO Forestry Paper N0. 156. Food and Agriculture Organization of the United Nations, Roma. 222 pp.

FAO. 2008. Manual de Plagas y Enfermedades del Bosque Nativo en Chile. Chile. 224 p. http://www.fao.org/3/a-i0217s.pdf

FAO. 2012. Guía para la aplicación de normas fitosanitarias en el sector forestal. Estudio FAO: Montes. http://www.fao.org/docrep/015/i2080s/i2080s.pdf

Floyd RV, Hauxwell C, Griffiths M, Horak PA, Sands PA, y Speight MR. 2003. Taxonomy, ecology, and control of *Hypsipyla* shoot borers of Meliaceae. En: Lugo AE, JC Figueroa y M. Alayón (eds.), Big-leaf mahogany: genetics, ecology and management. Springer. Pp 381-394.

Fonseca González W. 2004. Manual para productores de teca (*Tectonagrandis* L.F.) en Costa Rica. Heredia, Costa Rica. 121 pp.

Geils B.W.,Cibrián Tovar J., Moody B., tech. coords. 2002. Mistletoes of North American Conifers. Gen. Tech. Rep. RMRS–GTR–98. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 123 p. http://www.fs.fed.us/rm/pubs/rmrs_gtr098.pdf

Gijón-Hernández A.R., Trejo-Sandoval Z., López- Guzmán C.M., Ramírez-Huerta L., Arriola- Padilla V.J.,yPérez-Gálvez I.M. 2014. Caracterización y efectividad de *Trichoderma*spp sobre insectos descortezadores de pino. Entomología Mexicana 2: 293-299.

Gochez López E., Arriola Padilla V.J., Perea Alcala, Reséndiz Martínez J.F. y Camacho A.D. 2015. Insecticidas sistémicos para el control de *Dendroctonusadjunctus*Blandford, 1897 en el Nevado de Toluca. Rev. Mexicana Ciencias Forestales 6(27): 50-63.

González Gaona E., Bonilla Torres F., Quiñones Barraza S., Sánchez Martínez G., Tafoya Rangel F., España Luna M. P., y Robles Uribe S. 2014. Guía para la identificación de moscas sierra de la familia Diprionidae presentes en el Centro Norte de México. SAGARPA INIFAP Publicación Especial Num. 41. 48 pp.

Guerra L. 2004. Caracterización de la comunidad de Scolytidae colectadas con diferentes tipos de trampas ubicadas en cinco sitios con predominio de pino en la República de Panamá. Tesis Maestría, Universidad de Panamá, Panamá. 117 p.

Guldin J.M. 2012. Silvicultural considerations in managing southern pines stands in the context of southern pine beetle. P.317- 352, En: Southern Pine Beetle II, eds. Coulson RN and. Klepzig KD, pp. 75-89, Gen. Tech. Rep. SRS-140, U.S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, NC.

Hawkins C.D.B., Dhar A. yBalliet N. 2013. Radial growth of residual overstory trees and understory saplings after mountain pine beetle attack in central British Columbia. For. Ecol. Manag. 310, 348–356.

Hawksworth F.G. y Wiens D. 1996. Dwarf mistletoes: Biology, pathology, and systematics. Agriculture Handbook 709, USDA_FS. Washington, D.C. 426p.

Hart S. J., Veblen T. T., Eisenhart K. S., Jarvis D. yKulakowski D. 2014. Drought induces spruce beetle (*Dendroctonusrufipennis*) outbreaks across northwestern Colorado. Ecology, 95: 930–939. doi:10.1890/13-0230.1

Hilje L, Araya C, y Scorza F. 1991a. Plagas y enfermedades forestales en América Central, Manual de Consulta. CATIE-ROCAP 596-0117. Manual Técnico N0. 3. Turrialba, Costa Rica. 193 pp.

Hilje L, Araya C, y Scorza F. 1991b. Plagas y enfermedades forestales en América Central, Guía de Campo. CATIE-ROCAP 596-0117. Manual Técnico N0. 4. Turrialba, Costa Rica. 251 pp. http://orton.catie.ac.cr/repdoc/A0603e/A0603e.pdf

Hochmut R. y Milán Manso D. 1984. Protección forestal contra las plagas forestales en Cuba. Editorial Científico-Técnica, La Habana. 290 p.

Hu J, Angelis S, Schuetz S, Luo y Hajek A. 2009. Ecology and management of exotic and endemic Asian longhorn beetle *Anoplophoraglabripennis*. Agric. Forest. 11: 359-375.

ICF 2015. Plan de acción para el control de la plaga del gorgojo de pino. Instituto Nacional de Conservación y Desarrollo Forestal, Áreas Protegidas y Vida Silvestre. Gobierno de la República de Honduras. 35 pp.

Jaén Lara B.A. 2013. Monitoreo de la dispersión de la población de *Ipscalligraphus* en las plantaciones de *Pinuscaribaea*var*hondurensis* en el proyecto bosque siglo XXI, en río Hato, provincia de Coclé, Republica de Panamá. Scientia (Panamá), 23(1): 87-102.

Jiménez Martínez E. 2008. Guía de identificación de los principales insectos coleópteros asociados a los pinares de Nicaragua. 32 p.

Kleinman S.J., DeGomez T.E., Snider G.B., y Williams K.E. 2012. Large-scale pinyon ips (*Ips confusus*) outbreak in southwestern United States tied with elevation and land cover. Journal of Forestry 110: 194–200

Kolb T.E., Wagner M.R. y Covington W.W. 1995. Forest health from different perspectives. In: L. G. Eskew, comp. Forest health through silviculture: proceedings of the 1995 National Silviculture Workshop, Mescalero, New Mexico, May 8-11, 1995. Gen. Tech. Rep. RM-GTR-267. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 5-13

Kovacs K.F., Haight R.C., McCullough D.G., Mercader R.J., Siegert N.W. y Liebhold M. 2009. Cost of potential emerald ash borer damage in U.S. communities. EcologicalEconomics 2009–2019. doi:10.1016/j.ecolecon.2009.09.004

Landaverde ToruñoR.A.L. 2001. Los escarabajos descortezadores del género *Dendroctonus* Erickson plaga de las pináceas en Centro América. Organismo Internacional Regional de Sanidad Agropecuaria, Dirección Técnica de Sanidad Vegetal. San Salvador, El Salvador. 31 p.

López Zeledón L.B. y Toledo Marín L.I. 2005. Dinámica poblacional de descortezadores de pino en dos Municipios del Departamento de Nueva Segovia. Tesis Licenciatura, Universidad Nacional Agraria, Managua, Nicaragua. http://repositorio.una.edu.ni/1960/1/tnh10l864d.pdf

Núñez Hernández D. 2001. Manejo integrado del gorgojo del pino *Dendroctonusfrontalis*. Programa Regional Forestal para Centro América (PROCAFOR-FINNIDA) y Manejo y Utilización Sostenida de los Bosques de Coníferas en Honduras (MAFOR). 30 p.

Núñez Zuffo C. y Dávila Arce M.L. 2004. Guía para la identificación de gorgojos descortezadores del pino e insectos asociados. Universidad Católica Agropecuaria del Trópico Seco, Centro de Investigación en Protección Vegetal. 45 p. http://lacalera2.una.edu.ni/dowload_pdf/Guia_Num-11_Ano-2008.pdf

Macías-Sámano J.E. 2001. Interacciones químicas entre *Hypsipylagrandella* y sus plantas hospedantes. CATIE, Costa Rica. Rev. Manejo Integrado de Plagas 60: 15-21.

Macías-Sámano J.E., Niño-Domínguez, Altuzar-Mérida R. y Maldonado O. 2004. Monitoreo de descortezadores y sus depredadores mediante el uso de semioquímicos. Manual Operativo. Segunda Edición. El Colegio de la Frontera Sur. Tapachula, Chiapas, México. 27 pp.

Macías-Sámano J.E. 2007. Manual de podas para árboles: Con énfasis en el uso de podas para el control del barrenador *Hypsipylagrandella*, plaga del Cedro y la Caoba. El Colegio de la Frontera Sur. Tapachula, Chis. 28 pp.

Macías Sámano J.E. 2016. Estrategia Regional de Sanidad y Salud Forestal para Centroamérica y República Dominicana. Reporte y Documento de la Estrategia presentado ante el USFS-IP para la Comisión Centroamericana de Ambiente y Desarrollo CCAD, Consejo Agropecuario Centroamericano, Centroamérica. 80 Pp.

Macías-Sámano J.E. 2017. Sanidad Vegetal (Forestal y Agrícola) y Sanidad Animal (Pecuaria, Pesquera y Acuícola) y Movilización de Recursos Cooperación Sur-Sur, Región Latinoamericana y Caribe – COMPONENTE FORESTAL -, FAO, agosto 30. 73 pp.

Macías-Sámano J.E. 2018. Forest pests or forest insects: A matter of perspective. International Foresters Working Group Newsletter, Society of American Foresters, September, 13-19p.

Macías-Sámano J.E. y Zúñiga G. 2015. Estado actual del conocimiento en México sobre el uso de semioquímicos que median las interacciones entre insectos descortezadores y las coníferas. En Ecología Química y Alelopatía: avances y aplicaciones, Anaya Lang A.L., F.J. Espinosa, F. Macías and M.Reigosa (eds), UNAM, Mexico. En imprenta.

Macías-Sámano J.E. y Niño A. 2016. Protocolo para monitoreo de descortezadores de coníferas mediante el uso de semioquímicos, México y Centroamérica. USDA-FS-IP and ECOSUR. En imprenta. 39p.

Macías-Sámano J.E., Alegría D. Huerta G., Holguín F., Colomo I. y Moreno-Castillo B. 2005. Manual de manejo de plantaciones de árboles de Primavera (*Tabebuiadonnell-smithii*). El Colegio de la Frontera Sur, Tapachula, Chiapas, México. 36 pp.

Macías-Sámano J.E., Rivera-Granados M.L, Jones R. and Ibarra, G. 2013. Respuesta de insectos descortezadores de pino y de sus depredadores a semioquímicos en el sureste de México. Rev. Maderas y Bosques INECOL, 20(3): 41-47.

Macías Sámano J.E., Billings R.F., Espino Mendoza V. 2016. Guía para implementar el método de cortar y dejar y la franja de contención como medios de control del gorgojo descortezador del pino, *Dendroctonusfrontalis*, en Centroamérica y México. USFS-IP, ICF, Tegucigalpa, Honduras. 51 Pp.

Maes, J-M. 1992. Plagas insectiles de Nicaragua 1. Coleópteros asociados con *Pinusoocarpa*Schiede. Manejo Integrado de Plagas 23: 13-16.

Mery G., Alfaro R.I., Kanninen M. yLobovikov M. 2005. Forests in the global balance: changing paradigms. World Series Volume 17. International Union of Forest Research Organizations, Vienna, Austria.

Moreno B., Macías J. Sullivan B. y Clarke S.R. 2008. Field Response of *Dendroctonus frontalis* (Coleoptera: Scolytinae) to Synthetic Semiochemicals in Chiapas, Mexico. J. Eco. Entomol 101(6): 1821-1825.

Niño-Domínguez A., Sullivan B., Urbina-Lopez, J.H. y Macías-Sámano J.E. 2015 Pheromone-mediated mate location and discrimination by two syntopic sibling species of

Dendroctonus bark beetles in Chiapas, Mexico. J. Chem. Ecol. DOI 10.1007/s10886-015-0608-4

Núñez Hernández D. 2001. Manejo integrado del gorgojo del pino *Dendroctonusfrontalis*. Programa Regional Forestal para Centro América (PROCAFOR-FINNIDA) and Manejo y Utilización Sostenida de los Bosques de Coníferas en Honduras (MAFOR). 30 p

O'Brien C.W. y Ward C.R. 1987. Current state of insect collections in Honduras. Fol. Entomol. Mexicana 71: 87-101.

Pavón Tijerino J., Sequeira A., y Gutiérrez C. 2004. Plantaciones forestales de Nicaragua. Guía N0. 26, Instituto Nicaragüense de Tecnología Agropecuaria INTA. Nicaragua. 49 pp. ww.inta.gob.ni/biblioteca/images/pdf/guias/manejoforestal%202014.pdf.

Rassati D., Faccoli M., Toffolo E.P., Battisti A., y Marini L. 2015. Improving the early detection of alien wood-boring beetles in ports and surrounding forests. J. App. Ecol. 52: 50–58

Rivera Rojas M., Localtelli B. y Billings R. 2010. Cambio climático y eventos epidémicos del gorgojo descortezador del pino *Dendroctonusfrontalis* en Honduras. Forest Systems 19(1): 70-76.

Safranyik L. y Wilson W.R., editors. 2006. The mountain pine beetle: a synthesis of biology, management, and impacts on lodgepole pine. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia. 304 p.

Salinas-Moreno Y., Ager A., Vargas C.F., Hayes J.L., y Zúñiga G. 2010. Determining the vulnerability of Mexican pine forests to bark beetle of the genus *Dendroctonus*Erichson (Coleoptera: Curculionidae: Scolytinae). For. Ecol. Manag. 260: 52-61.

SEMARNAT 2018. NORMA oficial Mexicana NOM-019-SEMARNAT-2017. Diario Oficial de la Nación, jueves 22 de Marzo. Secretaria de Medio Ambiente y Recursos Naturales, México.

Schweizer D., Mell P., Brancalion P.H.S. y Guariguata M.R. 2018. Oportunidades y desafíos para la gobernanza de la restauración del paisaje forestal en America Latina. Documentos Ocasionales 182. Bogor, Indonesia: CIFOR.

Six D.L.; Biber E.; Long E. 2014. Management for Mountain Pine Beetle Outbreak Suppression: Does Relevant Science Support Current Policy? Forests 5, 103-133.

Sugden A., Fahrenkamp-Uppenbrink J., Malakoff D. y Vignieri S. 2015. Forest health in a changing world. Science, 349 (6250): 802-805.

Teale, S. A. and J. D. Castello. 2011. The Past as Key to the Future: A New Perspective on Forest Health. Pp. 3-16 In Castello, J.D.and S.A. Teale (Eds.). 2011. Forest Health: An Integrated Perspective. Cambridge Univ. Press. 384 pp.

Trumbore S., Brando P. y Hartman H. 2015. Forest health and global change. Science, 349 (6250): 819-822.

UACH (Universidad Autónoma de Chapingo). Accesadojunio 2, 2020. Carrera de Ingeniería Forestal http://dicifo.chapingo.mx/if/

UANH (Universidad Autónoma de Honduras). Accesadojunio 2, 2020. Centro Universitario Regional del Litoral del Atlántico, Carrera de Ingeniería Forestal. https://curla.unah.edu.hn/assets/Planes-de-estudio/Ingenieria-Forestal.pdf

UNACIFOR (Universidad Nacional de Ciencias Forestales de Honduras). Programa de ingeniería Forestal proporcionado en Julio 26, 2016 por el M. en C. Oscar Leverón, profesor de Protección Forestal.

USAC (Universidad San Carlos de Guatemala). Accesadojunio 2, 2020. Universidad de San Carlos de Guatemala, Centro Universitario del Noroccidente, Carrera de Ingeniería Forestal. https://www.usac.edu.gt/catalogo/cunoroc.pdf

UTP (Universidad Tecnológica de Panamá) Accesado junio 2, 2020. Carrera de ingeniería Forestal. http://www.fct.utp.ac.pa/licenciatura-en-ingenieria-forestal

Peat Restoration base on Bioenergy with Community in Dusun Hilir District South Barito, Indonesia

Siti Maimunah and CIFOR

Dusun Hilir District Kab. South Barito, Indonesia is a deep peat area that has experienced land degradation due to logging, peat drainage, forest fires and land clearing for other uses. Areas for these various activities tend to experience a decrease in land quality and are at risk of burning in the dry season.

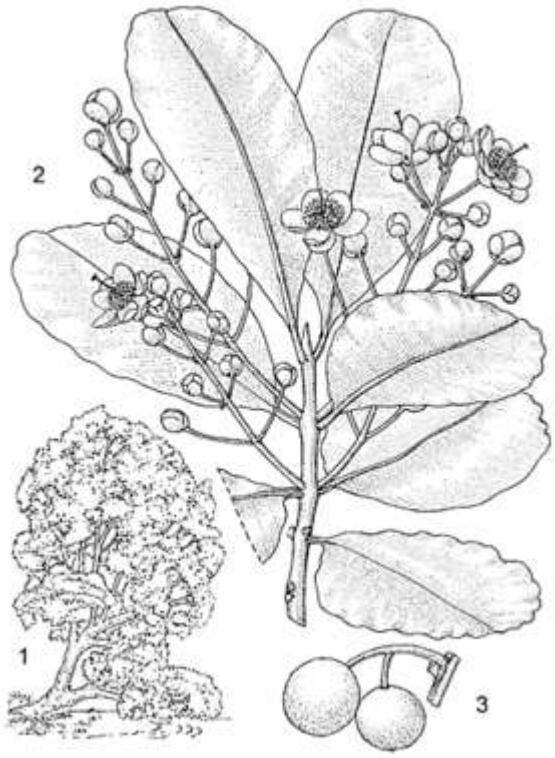
Bioenergy-based peat restoration activities with communities in the region aim to provide solutions and examples for the community to have the willingness and ideas to utilize abandoned land especially peatlands around their villages to be more useful. It is hoped that planting nyamplung will produce the expected results such as forests returning to green and not bare and communities can harvest nyamplung fruit as a biosolar raw material that is needed by the community. Currently the community is highly dependent on the existence of diesel fuel for the needs of electricity generators, water transportation or for sale to provide excess income for the community.

Nyamplung (*Calophyllum inophyllum*) is a type of tree that grows around the rivers when deforestation has not yet occurred known to the local community as panaga kelakai.Usually people use the wood for building materials because the quality is parallel to meranti wood. Nyamplung grows evenly in the village of Damparan which has been cut down only to find the stumps. Hope with Nyamplung planted will provide an alternative for the community for other sustainable livelihoods, perhaps in the past there were not many known benefits other than the wood. In addition to wood and fruit, it turns out that nyamplung flowers also produce medicinal honey.

Bioenergy-based peat restoration by planting nyamplung in Dusun Hilir sub-district is expected to provide ecological, economic and socio-cultural benefits for the communities surrounding peatlands and help restore peat with the community with bioenergy-producing plants for regional energy security. In 2020 this plant is expected to replace sapat *Mitragyna speciosa* leaves as a source of economic community after sapat leaves are prohibited from being traded by the POM.

Nyamplung apart from being a enrichment, reforestation and closing of open land in peat and swamp areas, the fruit is of economic value to make bioenergy as a raw material for making diesel, as well as for medicinal purposes such as raw material for making anti-aging

drugs as it is known in the market is tamanu oil . Nyamplung flowers are favored by honey bees so that under the nyamplung stands honey bees can be nurtured. In the fourth year it bears fruit and throughout the year it has fruit production. Naturally, fruit is also a wild animal feed. Oil-pressed seed remaining oil can be used as animal feed. The fat produced can also be processed into soap.



Restoring peat must use wise methods, including planting plants that do have the ability to grow in peat swamp which are always inundated, and have side benefits such as producing products that can benefit the surrounding community without damaging the forest including harvesting fruit or honey or other vegetative products that are sustainable. When the ecosystem is managed so the peat habitat does not change, the results obtained are maximum and sustainable.

Getting More, Much More, from Tropical Agriculture: from 'Land Failing' to 'Land Maxing'

Roger RB Leakey

Food production capacity lies at the heart of many of the 'Big Issues' facing our planet due to deforestation, land degradation and the challenges agriculture has faced in the tropics and sub-tropics to be an "engine of economic growth" (Leakey, 2018). Despite the successes of the Green Revolution in industrialized countries, this phenomenon manifests itself as declining yield which creates *yield gaps* – the difference between potential yield and the actual yield achieved by farmers – in key crops, such as staple food crops of critical importance to smallholder farmers, especially in Africa. I have described this as the result of a downward spiral of the "cycle of land degradation and social deprivation" (Leakey, 2013) that, in effect, results in *'land failing'*. It is a symptom of the failure of conventional agriculture to recognise the major differences between the physical, ecological, social and economic conditions of agriculture in industrialized and developing economies. These differences affect the appropriateness of conventional approaches to agriculture which lead to the so-called 'inevitable trade-offs' of intensification, such as the loss of biodiversity, greenhouse gas emissions, and ongoing poverty in smallholder households (Leakey, 2018).These differences are especially stark with regard to farm size, soils and natural resources (natural capital),livelihoods (social capital), income, and the availability of and the returns to finance (financial capital). These 'trade-offs' are especially serious in the tropics and sub-tropics, and devastating in Africa.

Issues

The above 'trade-offs' arising from conventional agricultural intensification are unacceptable if we are to heal the environmental, social and economic woes of our divided and dysfunctional world. So, what can we do about them? In recent years, the importance of agroecology to reduce the negative environmental impacts of modern agriculture by promoting ecological functions, such as nutrient cycling and the biocontrol of pests and diseases, has greatly increased. While improving ecological health in this way should increase crop yields, it typically has only limited impacts on the social and economic situationof smallholder households on the edges of the cash economy. This leads to an important question: what can be done to diversify the farming system with perennial species that both initiate an agroecological succession and generate income?

Potential solutions

Agroforestry has long been recognised as a lowcost, simple way to restore soil nitrogen (Sanchez,2002; Sileshi et al, 2008, 2014), create functional agroecosystems (Leakey, 2014a) and produce wood and fodder products (Ong and Huxley, 1996). However, these are only partial solutions to the yield gap problems of crops, especially for staple food crops. Nevertheless, such systems are making substantial progress towards the environmental issues (eg the Great Green Wall of the Sahel) and the 'Ever Greening' of other dry lands through farmer-managed natural regeneration and the planting of 'fertiliser trees'(Garrity et al, 2010). However, there is great potential in agroforestry to use the vegetative propagation of elite individual trees to create superior cultivars producing marketable products. One example is safou (*Dacryodes edulis*), which has large fruits and a superior taste: three fruits sold for 250 CFA in Cameroon in1999, rather than 10 fruits for 100 CFA previously(unpublished data related to the fruit characterization done in 1999 and published in Waruhiu et al, 2004).This has been the focus of research and development(R&D) activities in Cameroon and elsewhere over the last 25–30 years, developing strategies and techniques for the participatory domestication of useful indigenous trees.[1] Many of these culturally important trees produce a wide array of highly nutritious food(fruits, nuts and leaves) and other non-food (medicinal, cosmetic and other marketable) products (Leakey,2014b) that have local and regional markets. The sale of these products can greatly enhance the livelihoods of smallholder farmers trying to support their families on already degraded land. This generates income for multiple uses (farm inputs, local infrastructure, health and education services, etc), while simultaneously enhancing the agroecological environment.

This decentralised, bottom-up approach to tree domestication, led by the World Agroforestry Centre, has been based on the development of rural resource centres in local communities (Tchoundjeu et al,2006; Degrande et al, 2015) in ways that promote integrated rural development.[2] The crops created by this participatory domestication of local specieshave recently been described as "socially-modified organisms [SMOs]" (Leakey, 2017a). By adding to the ecological benefits of trees and meeting the social and economic needs of farmers, the cultivation of these SMOs and the processing and marketing of their products in cottage industries can form a three-step process to reversing the cycle of land degradation and social deprivation. The process consists of: (i) planting nitrogen-fixing 'fertiliser trees' to improve soil fertility;(ii) the selection of elite trees for domestication as cultivars for income generation and improved nutrition; and (iii) processing and value-adding

to extend shelf life and marketability of the fruit. This creates a highly adaptable generic model for closing the yield gaps in failing farming systems (Leakey, 2013, 2018, 2019a). By substantially increasing staple crop yields it is possible to produce more food from a smaller area of farmland, so releasing the rest of the land and other factors of production for the cultivation of new tree crops.

Getting much more

The generic model described above offers theopportunity to make a 'quantum leap' (see Figure 1)in the productivity of tropical agriculture through the healing of decimated agroecosystems by restoring soil fertility using nitrogen fixation and promoting ecological health by system diversification (steps i and ii). Then, through the domestication of new crops (step ii), the marketability and value chain of non-timber forest products (step iii) are greatly enhanced. This in turn creates much greater product uniformity, while processing and value addition enhance the reliability of supply (Leakey & van Damme, 2014).

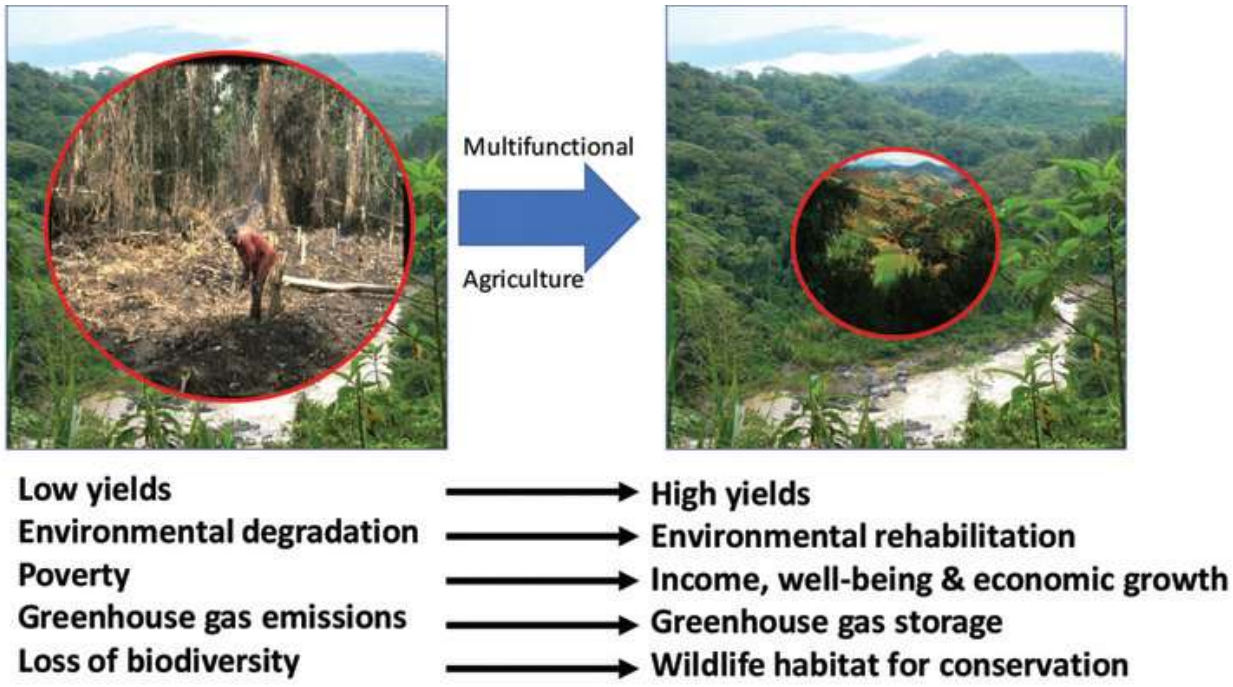


Figure 1. Quantum leap.

When cultivated on farm, these products cease to be common property forest resources and become new crops producing agroforestry tree products (AFTPs)with expanded market potential (Leakey, 2012). This starts through the characterisation of

intraspecific variation and the formulation of an 'ideotype' to direct the selection processes for domestication according to the needs of specific markets and new industries (Leakey & Page, 2006). Opportunities for enhanced income generation then arise: firstly through local processing and packaging in cottage industries to build a wider regional market across seasons, creating new jobs in rural and local urban communities. Secondly, these cottage industries can go on to become more sophisticated as ways are found to harness the so-far seldom- recognised potential of the biochemical characteristics of many of these AFTPs. Ideally, these new industries should be developed in-country to retain these benefits for the national economy and to counter the practice of exporting raw materials for value-adding in industrialised countries.

By building new enterprises and value-adding industries, diversifying the national economy and creating employment, the benefits of cultivating these new nutritious and marketable crops can greatly enhance the livelihoods of all involved along the value chain. This maximises the social, economic and environmental benefit flows from the enriched and more productive farming systems (Leakey, 2018) through greater economic, food and nutritional security, poverty reduction, improved livelihoods and social equity, carbon sequestration, and restored wildlife habitat. This approach to improved sustainability and productivity from tropical and subtropical farming systems has been described as "landmaxing" (Leakey, 2019a). It is based on the concept of eliminating the so-called 'inevitable trade-offs' by adding them to the beneficial outputs – or 'trade-ons' –targeted by more sustainable agricultural policies.

Does all this seem a bit far-fetched? Well, it certainly does demand a different mindset, but the good news is that it has been tried and tested over some 15 years (Leakey, 2018, 2019a) and found to be effective at the level of 10,000 farmers in 500 villages in Cameroon. This case study was found to deliver a cascade of production, environmental, social and economic benefits/outcomes and future impacts (listed in Leakey, 2018) – thereby addressing many of the Sustainable Development Goals (SDGs). For example, evidence from this work shows that members of the participating communities now foresee a better future in their home villages, and they have reported a reduced need to migrate to towns and cities. This could potentially contribute to lower rates of illegal international economic migration.

Vision

When agriculture is said to be the 'engine of economic growth', the USD7 per day median income for all African countries suggests the failure of agriculture alone to deliver this important outcome across the continent (Leakey, 2019b). The approach described above in which tropical and sub-tropical households benefit from growing new crops and processing their products could make a start towards new in-country enterprises and value-adding industries that create a more equitable and inclusive global economy. If implemented on a substantial scale, these 'green' initiatives should contribute to a more sustainable world in which the whole population benefits from environmental, social and economic spin-offs for the planet. These benefits should arise from a new, fairer and a much less damaging approach to tropical and sub-tropical agriculture, which in turn is based on the sustainable cultivation of a wider set of natural resources (Leakey, 2019b). Speculating still further, as much of the social conflict around the world has been reported to be a reaction against hunger, poverty and injustice, this approach could replace pressures fomenting conflict with pressures for more peaceful coexistence.

Looking ahead

All of the above suggests that, at the very least, more work should be initiated to up- and out-scale the generic development model. This will be dependent on multi- and trans-disciplinary practice by networks of stakeholders to implement multifunctional agriculture (see Leakey, 2017b, for examples).

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[1] With funding from Department for International Development and the World Bank.

[2]With funding from Belgian Aid, International Fund for Agricultural Development and United States Department of Agriculture.

References

Degrande A, Tchoundjeu Z, Kwidja A, FongangFouepe G, 2015. Ruralresource centres: a community approach to extension. Note 10. In:*GFRAS Good Practice Notes for Extension and Advisory Services*. Lindau,Switzerland: Global Forum for Rural Advisory Services.

Garrity DP, Akinnifesi FK, Ajayi OC, Sileshi WG, Mowo JG, Kalinganire A,Larwanou M, Bayala J, 2010. Evergreen agriculture: a robust approachto sustainable food security in Africa. *Food Security*, **2**, 197–214.

Leakey RRB, 2012. Non-timber forest products – a misnomer? Guesteditorial. *Journal of Tropical Forest Science*, **24**, 145–146.

Leakey RRB, 2013. Addressing the causes of land degradation, food/nutritional insecurity and poverty: a new approach to agriculturalintensification in the tropics and sub-tropics. In: Hoffman U, ed.*UNCTAD Trade and Environment Review 2012*. Geneva, Switzerland:United Nations Conference on Trade and Development.

Leakey RRB, 2014a. The role of trees in agroecology and sustainableagriculture in the tropics. *Annual Review of Phytopathology*, **52**, 113–133.

Leakey RRB, 2014b. Agroforestry: participatory domesticationof trees. In: Van Alfen N, ed. *Encyclopaedia of agriculture and foodsystems*, Vol. 1. San Diego, CA: Elsevier, 253–269.

Leakey RRB, 2017a. Socially modified organisms in multifunctionalagriculture – addressing the needs of smallholder farmers in Africa.*Scientific Pages of Crop Science*, **1**, 20–29.

Leakey RRB, 2017b. *Multifunctional agriculture: achieving sustainabledevelopment in Africa*. San Diego, CA: Academic Press.

Leakey RRB, 2018. Converting 'trade-offs' to 'trade-ons' for greatlyenhanced food security in Africa: multiple environmental, economic andsocial benefits from 'socially modified crops'. *Food Security*, **10**, 505–524.

Leakey RRB, 2019a. From ethnobotany to mainstream agriculture –socially-modified Cinderella species capturing 'trade-ons' for 'landmaxing'. *Planta*, **250**, 949–970.

Leakey RRB, 2019b. A holistic approach to sustainable agriculture:trees, science and global society. In: Mosquera-Losada MR, Prabhu R,eds. *Agroforestry for sustainable agriculture*. Cambridge, UK: BurleighDodds Science Publishing, 275–299.

Leakey RRB, Page T, 2006. The 'ideotype concept' and its application tothe selection of 'AFTP' cultivars. *Forests, Trees and Livelihoods*, 16, 5–16.

Leakey RRB, van Damme P, 2014. The role of tree domestication invalue chain development. *Forests, Trees and Livelihoods*, 23, 116–126.

Ong CK, Huxley PA, eds, 1996. *Tree-crop interactions, a physiologicalapproach*. Wallingford, UK: CAB International.

Sanchez PA, 2002. Soil fertility and hunger in Africa. *Science*, 192,2019–2020.

Sileshi G, Akinnifesi FK, Ajayi OC, Place F, 2008. Meta-analysis of maizeyield response to planted fallow and green manure legumes in sub-Saharan Africa. *Plant and Soil*, 307, 1–19.

Sileshi GW, Mafongoya P, Akinnifesi FK, Phiri E, Chirwa P, Beedy T,Makumba W, Nyamadzawo G, Njoloma J, Wuta M, Nyamugafata P, JiriO, 2014. Agroforestry: fertilizer trees. In: Van Alfen N, ed. *Encyclopediaof agriculture and food systems, Vol. 1*. San Diego, CA: Elsevier, 222–234.

Tchoundjeu Z, Asaah E, Anegbeh P, Degrande A, Mbile P, Facheux C,Tsobeng A, Atangana AR, Ngo-Mpeck ML, Simons AJ, 2006. Puttingparticipatory domestication into practice in West and Central Africa.*Forests, Trees and Livelihoods*, 16, 53–70.

Waruhiu AN, Kengue J, Atangana AR, Tchoundjeu Z, Leakey RRB, 2004.Domestication of Dacryodes edulis: 2: Phenotypic variation of fruittraits in 200 trees from four populations in the humid lowlands ofCameroon. *Food, Agriculture & Environment*, 2, 340–346.

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My Journey into Forestry

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I never saw myself as one of the herd… When everyone wanted to do one thing, my instinct was always to do something else.

I work in reforestation, I am a tree grower, a forest maker but I did not start the usual way from an academic or previous experience point; oh no my path into where I am has been nothing but typical.

I guess that some may call it luck or destiny but I rather see it as the right combination of the right moment, circumstances, people and a bit of courage that threw me into forestry. With a combination of associates and friends some with vast forestry and business experience and some with nothing at all, mi instinct led me on a very interesting and ground breaking idea which, fortunately, my peers allowed me to materialize.

Today, after a rather hard and long road, my team and I grow and specialize in the silviculture of Dalbergia tree species, better known by their aggregate name: Rosewood or Hongmu in Chinese (The biggest traditional market for the timber).

When I first heard about these species, all the “experts” and “traditional” forestry people said that it was impossible to grow such trees however my friends and associates said “yes” and the more I heard "impossible" the more I wanted to do it. This is very typical of my Israeli mentality.

This was not a leap of faith by no means ... it was a journey of baldness and constant self-criticism that with very hard work and many hard lessons learned, we have proudly accumulated a huge amount of information about these species and have, in practice, wrote the book about how these “difficult” species are supposed to be grown and managed.

After years of persistently trying, we were also able to get a certification for our selected seeds, that guarantees that we have the best genetic material available. In other words, we picked our best trees as seed sources instead of other sources like identified sources in the forest which was the previous only source of planting material.

In very practical terms, our efforts to cultivate these species for commercial purposes has resulted in the development of a great alternative to save and preserve these highly endangered tree species.

On this process of learning, discovering and suffering the lessons learnt about the silviculture of Rosewoods we came up with some interesting findings in regards to available information (technical) on these species.

There is some generic information but not necessarily exact or sometimes consistent and parallel to that we found a significant amount of articles, publications and documentaries in regards to the threats and endangered situation of the Dalbergia genus worldwide.

Every article you find about the specie is concentrating on illegal logging, extinction, business malpractices, corruption and even life threatening situation, etc. They all cry wolf but no one talks about solutions. I guess publications sell better this way. I tried to contact some journalists who specifically wrote about the subject of illegal logging of Rosewood blaming Chinese and other demands.

These journalists wrote articles in national and international publications. I even tried to contact Forestry specific journalists and magazines. To my dismay, no one was interested to hear about solutions. Most did not even bother to respond to my emails or calls to them. I was pretty shocked. It was like there was only interest to say the bad but zero interest to make a change.

We believe that our efforts have been always part of the solution and not part of the problem. Even if one person has a pure economic interest on these high value timber species, their actions will surely subscribe to the need to secure reliable and legal sources of timber and therefore, will be moved towards the silviculture model of forestry plantations.

Plantations of high value timber species represent a particular effort that focuses on specific markets and involves techniques and investments that are significantly different from high yield mid to low value timber species typically oriented to commodity markets.

Smart reforestation economics is the only solution to save all hardwood species with high demand and in danger of extinction. However, to start “creating” something no one has ever done before is more complicated than it sounds even in forestry.

The first thing is to find seeds. This sounds quite simple but when one deals with species which are listed as endangered by CITES, the issue gets very complicated.

Furthermore, in order to get the best results possible, one has to start with the right genetic material. In other words, seeds from the best trees where, at least, one knows that the "mother" has amazing growth characteristic.

Unfortunately, none of that was available with Rosewood species. The best we could find were "identified" sources of seeds or, in other words, seeds from trees which grow in the natural forest and are only identified as being from the specie.

With *Dalbergia retusa* (one of the many Mesoamerican Rosewoods) it was less complicated to find several such sellers but with *Dalbergia nigra* (the Brazilian Rosewood) the issue was extremely difficult and took several years to find seeds with CITES certification but still, "only", from an identified source. We could not know what we were getting as far as quality.

As a forester, who needs to achieve results, report and explain to one's peers, the best approach in such a case is to buy a much larger number of seeds than forecasted and start a rigorous selection from the nursery stage. Another prudent approach, which applies to agricultural in general, is to start little by little.

Plant a certain number of trees, learn the issues, learn the silvicultural management, study the best solutions through trial and error and only then decide whether to expand or not. This is exactly what we did including doing our biggest planting when our own trees produced seeds and we could choose which trees to harvest the seeds from.

Fast forward ten years, after creating 4 plantations in different areas with different soil types, different topography and distinct rain conditions, successfully managing three types of Rosewoods and working with a fourth one, we accumulated a vast amount of information on managing the specie. Few examples of the type of information we have are what illnesses affect the trees at a younger age, which insects love to feast on young or older trees and at which time of year. What type of fungus attacks the tree at different stages, which is the best field management of the specie etc.

We can absolutely say with all the evidence that growing rosewoods requires a lot of work and dedication. The management of rosewood plantations cannot be seen or addressed under a "plant and forget" scheme. Unlike the big commercial mass-market high yield timber species, Rosewood requires individual attention and permanent presence for its first years until an adult tree reaches a size to dominate the site and continue his journey on its own.

The genetics of these species being secondary growing trees in the forest along with the economic need to create efficiencies in extractions translates into a lot of labour invested in each individual tree. Doing just that, along the years we found out the hard way that the species has more misconceptions about it than true facts and that indeed it is not an easy tree to grow.

Looking at the economic side of the equation, the most important fact is that it does not have to take eighty years to cultivate rosewoods from planting to extracting. I write that remembering, when talking about forestry, one can also wait a hundred years with Caribbean Pine trees rather than twelve from bad management of as simple as a bad site however, this is not the economic point of the issue.

The time factor is extremely important to attract investors to the species, most investors, I believe, hope to see a return within their lifetime. This is a dominating factor and the primary "fear" of investors when talking about hardwoods in danger of extinction due to over extraction.

The articles, which I mention above, all talk about illegal logging and exploding demand. Some of that demand started with the Chinese emperors and other when musical instrument manufacturers discovered that the density of Rosewood creates an incredible sound when incorporated into guitars, violins etc.

Due to the fact that, as far as I know, no one has created rosewood plantations, supply became scarce and prices rose accordingly. I feel that we have reached a level of knowledge where it makes sense to confidently use our information to expand and attract investors.

Figure 1. Dalbergia leaves.

Figure 2. Dalbergia bark.

IITF supports crucial tree nursery restoration in Puerto Rico

Yaneris M. Soto Muñiz

The Cambalache Tree Nursery, administered by the Puerto Rico Department of Natural and Environmental Resources (DNER), is the most important tree nursery in Puerto Rico. It produces almost all plant material required to reforest Puerto Rico, especially after Hurricanes Irma and Maria impacted our forests in both urban and rural areas. Cambalache also distributes seedlings to all six (6) DNER regional nurseries. Cambalache is located in the municipality of Arecibo on the Northern coast of the island.

In September 2017, Hurricanes Irma and Maria passed over Puerto Rico, and Cambalache was heavily devastated, reducing its production level to around 20% of its total production capacity. The State and Private Forestry Unit at the International Institute of Tropical Forestry is assisting the DNER in the rehabilitation and restoration of the nursery. State and Private Forestry is investing $371,705.46 to install twelve (12) hoop houses, irrigation system, two (2) shade houses, a specialized equipment including a fridge to storage seeds, and a seed laboratory. Funding comes from the Hurricane Disaster Supplemental approved by Congress.

State and Private Forestry is also assisting the Department of Agriculture in the US Virgin Islands rehabilitating the nurseries in St. Croix, St. John, and St. Thomas. Total costs for the nurseries project is $670,333.95.The 2017 hurricanes caused damages to 90% of the structures in Cambalache, dramatically affecting the production capacity at the nursery. Regular production at Cambalache before hurricanes stroke Puerto Rico was an average of 5,000-6,000 trees per month, with an inventory of 50,000 trees when the hurricanes came. After this, current inventoryfluctuatesbetween 12,000-15,000 trees.

Phase one of the Cambalache nursery officially begun earlier this year in January. As of March 2020, 60% of the scheduled work for phase one has been completed. This includes installing the hoop houses' ceilings, the shade cloth, the ground cover, installation of the shade houses, and the pipelines for the irrigation system. The 8-acre nursery has a production area of 15 hoop houses, germination beds, and a hardening area for young trees.

At the nursery, seeds are brought from different collection sites. DNER staff cleans and dries the seeds. Once they are ready, seeds are taken to the germination room. Each seed is treated and planted based on a germination protocol. The DNER keeps records of the

number of pounds of seeds and the collection dates. Once the seeds germinate, each seedling is transplanted to a container and moved to the hoop houses and grow under controlled shade. Later, each container is moved to the hardening area to allow seedlings to grow with plenty sunlight and be ready to be taken to the field. All plant material is monitored for pests and diseases and treated if necessary. When trees are ready, DNER Forest Technicians distribute the containers trees to the regional nurseries around the island. Those nurseries are located in the municipalities of Aguadilla, Mayaguez, Ponce, Guayama, Humacao, and Arecibo.

Cambalache produces trees for urban forestry projects and for rural forestry initiatives with the participation of private landowners and farmers. An important component of this nursery is the conservation efforts led by on-site production. Cambalache has a vast history producing trees that contributed to reestablish the island's forest cover, especially after the massive deforestation that occurred in Puerto Rico during the agricultural peak. Native and introduced trees are produced in this nursery for several reforestation initiatives that are taking place throughout the island.

Over the years, Cambalache has produced over 100native and introduced tree species. Recent efforts have been concentrated on the production of native species such as Andirainermis (Fabaceae), Hieronimaclusioides (Phyllanthaceae), Cordiaalliodora (Boraginaceae), Manilkarabidentata (Sapotaceae), and many others. DNER also produces important rate and endangered species that are used to implement restoration plans established by the agency.

The Cambalache Nursery Restoration Project in collaboration with the Department of Natural Resources and the support from the International Institute of Tropical Forestry is crucial for the recovery efforts in Puerto Rico to improve the condition of the forests, support local agricultural production, and increase canopy cover in the urban landscape.

Figure 1: Phase one of the Cambalache nursery officially begun earlier this year in January. As of March 2020, 60% of the scheduled work for phase one has been completed. Arecibo, Puerto Rico. USDA Forest Service photo.

Figure 2: Damages caused by Hurricanes Irma and Maria are still visible at the nursery. Arecibo, Puerto Rico. USDA Forest Service photo.

Figure 3: The 2017 hurricanes caused damages to 90% of the structures in Cambalache, dramatically affecting the production capacity at the nursery. Arecibo, Puerto Rico. USDA Forest Service photo.

Figure 4: New buds: Over the years, Cambalache has produced over 100 native and introduced tree species. Recent efforts have been concentrated on the production of native species. Arecibo, Puerto Rico. USDA Forest Service photo.

Figure 5: State and Private Forestry is investing $371,705.46 to install twelve hoop houses, irrigation system, two shade houses, a specialized equipment including a fridge to storage seeds and a seed laboratory in the Cambalache nursery. Arecibo, Puerto Rico. USDA Forest Service photo.

Restoring Forests for Sustainable Development – Policies, Practices and Impacts

Pia Katila, IUFRO-WFSE Coordinator

https://www.iufro.org/science/wfse/

IUFRO‘s Special Project on World Forests, Society and Environment (WFSE) has started the work on a new topic focusing on forest restoration

There is a long history of conservation, reforestation and tree planting for various purposes in different parts of the world. But, due to the continuing alarming rates of deforestation and forest degradation the past decades have seen an unprecedented increase in the acknowledgement of the urgent need to restore forest ecosystems and political commitments towards this aim.

The United Nations has declared 2021-2030 the ‘Decade of Ecosystem Restoration’ and multiple international, nationaland sub-national initiatives now promote the restoration of degraded forest lands. Estimates of the degraded or deforested forest lands (or landscapes) that could potentially be restored range from 0.9 to 2 billion ha. (Bastin et al. 2019; Minnemeyer et al. 2011)

IUFRO-WFSE will provide an overview of the history of forest restoration, current commitments, assessments of restoration potentials and current achievements, and conduct a comprehensive review of and contribute to the knowledge on institutional, social, economic, ecological and technical issues that influence forest restoration and the outcomes and impacts of restoration efforts.

The project will, among other things, discuss the different “forest restoration“ concepts, definitions and datasets, as well as the related perspectives and approaches and how the different understandings are linked to current debates on the ecological, social and environmental aspects of sustainable development.

It will review forest restoration paradigms, discourses and policies and drivers of forest restoration as well as different restoration scenarios and their ecological, economic, cultural and social feasibility. It will also consider the short- and long-term costs and benefits of forest restoration and discuss technological development and advances in sivicultural and ecological management and their implications for forest restoration.

A special focus will be placed on the interrelationship between forest restoration and climate change. Furthermore, the research will review restoration in the context of local development, including governance issues, enabling conditions for restoration, and the distribution of restoration costs and benefits and related impacts on sustainable development and human well-being at the local scale.

The project is coordinated in Natural Resources Institute Finland (Luke) and it brings together scientists and experts from international research and development organizations and universities from different parts of the world, including CIFOR, ICRAF, IIASA, IUCN, WWF, EFI, University of Florida, University of Freiburg, University of Melbourne and Kyoto University, for example. The results of the project will be published as an open access book in early 2023.

Figure : Atlas Mountains, Morocco. Photo credit: IUFRO

San Martin: Integrating geospatial data into land use planning. Zero deforestation conditional land titles

Mateo Salazar,

Vivid Economics (https://www.vivideconomics.com/)

Project background

The UK Space Agency (UKSA), through its International Partnership Programme (IPP), supported Vivid Economics in helping better integrate geospatial data and analysis into land use planning across both the Peruvian National Government and the Regional Government of San Martin. Vivid led and managed the project, with support from Remote Sensing Applications Consultants Ltd (RSAC) and Mecanismos de Desarrollo Alterno (MDA).

The project aimed to reduce deforestation of primary forest in the region of San Martin relative to business as usual projections by July 2019. Deforestation is particularly acute in San Martin with 356,000 ha of tree cover loss over the 2001 – 2014 period, more than any other region in the country.

We used satellite imagery in combination with economic valuation methodologies to develop a series of outputs to help improve land use planning in the San Martin region, Peru. It had three main components:

- **A land-use inventory** demarcating how land is used for a range of different purposes across San Martin and serving as the technical foundation for further analysis in the region;
- **A socio-economic valuation tool**, which is based on the land use inventory. This valuation tool estimates the value to society of land used for different purposes, considering its economic, environmental and social benefits. This helps make informed decisions about land use planning and can also help better identify the drivers of land use change;
- **A small-area (plot-level) mapping tool**, which enables conditional land titling, enforcement of land-use rules, and supports wider policy objectives. It produced high-resolution maps based on user-defined plot boundaries.

This case study focussed on the small-area mapping tool, and its use in issuing conditional land titles (CUSAF contracts), which is discussed in more detail below.

Challenge

Small-scale subsistence farming is responsible for roughly 75% of deforestation in Peru, and 45% of this deforestation takes place on undesignated forest covered land. It is well documented that a lack of clear land tenure arrangements and poor enforcement of property rights is associated with increased deforestation. Deforestation in Peru is mainly driven by migrants with no land titles on illegally settled public lands, moving from one plot to the next as the land is degraded and agricultural productivity falls.

The National Forest Law aims to tackle this by mandating Regional Governments to issue land titles to smallholder farmers under two main conditions: (i) the land is located within Special Treatment Zones, as defined in Forest Zoning laws; and (ii) the farmer does not reduce the forest cover on their land from title issuance. This title (CUSAF contract) provides security, financial stability and access to finance for the farmer, giving them an incentive to neither deforest their own land nor move on to (and deforest) other land. However, until this project took place, little progress was made towards the issuance of these titles as there was no national precedence or guidance on how to issue them.

The National Forestry Service (SERFOR) and the Regional Government of San Martin (GORESAM) faced challenges in developing the geospatial analysis required to meet their mandates:

- **The National Forestry Service (SERFOR):** At the national level, SERFOR has a mandate to explore innovative and effective ways to protect and preserve Peru's standing rainforest and incentivise reforestation. A key element of their approach is through land titling. To date, there has been little work exploring how satellite imagery and spatial data can be used to meet this aim.
- **The Regional Government of San Martin (GORESAM):** As mentioned above, each Regional Government has a mandate to issue conditional land titles to smallholder farmers on eligible plots of land but there exists no policy procedure (only national guidance at a very high level) or precedence to follow.

Approach

The issuance of CUSAF contracts follows three steps. First, landowners must agree on the boundaries of their land and this must be digitally recorded as a shape file. Second, satellite images must be processed to produce a map of current forest cover on each demarcated plot. Third, the regional Government must undertake an administrative process to register the title and, finally, the official contract is issued to the landowner stating the land boundary and forest extent.

We supported SERFOR and GORESAM in devising the process and then implementing it for a set of pilot plots:

1. **Agreeing technical specification and process.** Before any titles can be issued,all relevant stakeholders must agree on the exact technical specification of the maps and the official process to be followed. As part of the project, we led a series of meetings and workshops with GORESAM, SERFOR and other relevant institutions, to reach agreement on basic issues surrounding CUSAF contracts such as definition of agroforestry, segregation of land cover in maps and forest zoning and CUSAF contracts, among others. This ensured clarity and common understanding of the technical outputs that needed to be produced as well as the way in which landowners should be engaged.
2. **Defining plot boundaries.** We accompanied GORESAM technicians to establish the perimeter of the pilot plots. To do so, we had to convene a formal meeting between the landowner, neighbours and representatives of the local authorities. This provided a platform for objections and generated local support and validation for the process.

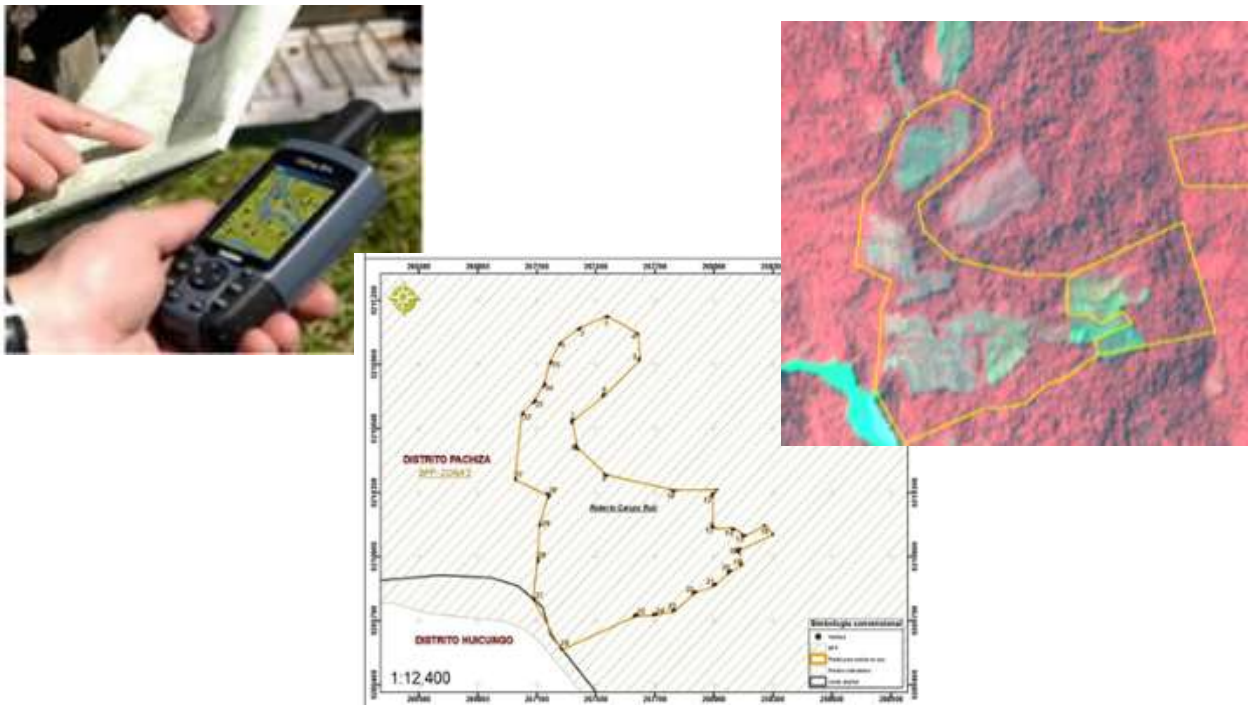


Figure 1. Once plot boundaries wee agreed, shape files were created using GPS receivers.

3. **Producing forest cover maps.** After establishing each perimeter, we produced two maps for each plot. The first map differentiated forest and non-forest while the second also identified two types of agroforestry systems. The accuracy of the second map was roughly 80%, below the standard agreed for the technical specification, due to the limitations of current hardware and processing techniques. As a result, the first map was used to demarcate current forest cover. A small margin of error is particularly important in this context as landowners are liable for breaching their contract based on the boundary of forest on their land.

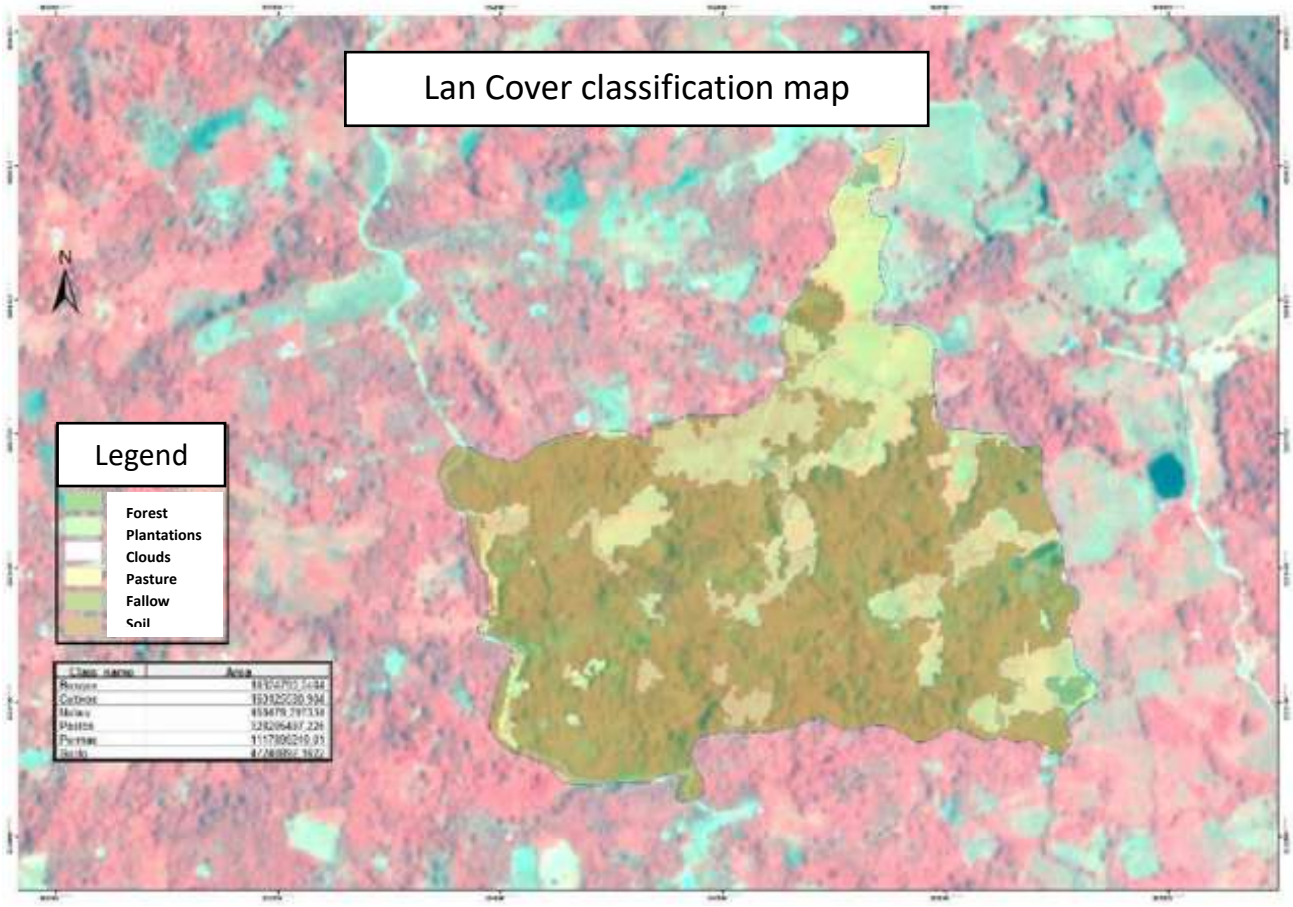


Figure 2. We produced forest/non-forest masks for each pilot plot.

4. **Providing guidance and capacity building.** After finalising the methodology for producing forest cover maps, we produced a technical guide which walked through this in detail. The guide was formally handed over to GORESAM and a technical workshop was held to build regional capacity in map production. The technical guide was accompanied by an operational guide, detailing all the steps followed, who must be present and how agreement must be reached. This guide was developed closely with GORESAM to ensure agreement on the finalised process.

Results

As a direct result of our support, GORESAM issued 14 zero deforestation conditional land titles (CUSAF contracts), becoming the first region in Peru to do so. GORESAM is working hard to issue further titles across the rest of San Martin. There are an estimated 35,000 other plots in San Martin eligible for titles, and 140,000 across the whole of Peru. The project set out a clear process to issue these titles, underpinned by accessible

guidance. Without this support, it is likely that GORESAM (and other regional governments) would have struggled to issue any titles in the short to medium term.

GORESAM is currently formalising the process into regional law, to ensure all future titles must be issued following the specification and guidance produced under the project. To this end, a dedicated working group has been established in San Martin. It has the explicit aim to create a regional law/ordinance on how to issue zero deforestation conditional land titles (CUSAF contracts) in San Martin, as well as who and what land qualifies as eligible. The group has begun drafting a policy document for the regional law/ordinance, which will eventually be proposed as official legislation. In May 2019, the working group and the Environmental Regional Authority of San Martin formally requested the support of SERFOR to finalise the formalisation process.

Podcasts from Open Forests

Open Forests has a new podcast series: https://forest-landscape-stories.simplecast.com/

The latest episode can be found at: https://forest-landscape-stories.simplecast.com/episodes/how-to-grow-your-own-forest

Also from Open Forests, a new article on climate change: https://blog.openforests.com/forest-facts-for-climate/

Innovative "Hungarian" Switchback reduces road construction cost.

Gordon M Gibba [1] and Eric L Kay [2]

1 RFT, Forest Engineering Consultant,vanagrovefc@gmail.com

2 Forest and Industrial Road Consultant,erickay@kayassociates.com

Road design: An non-conventional Switchback (combination of a Reverse Y and a Reversing Loop) cuts road construction cost, enabling harvesting to proceed economically.

A stand of timber, located in the Browns River area of Vancouver Island, British Columbia, Canada was reconnoitered by Gord Gibbs. It contained 73% Hemlock/Balsam, 14% Cypress, 9% Douglas fir, and 1% Western red cedar. The high-value of the Cypress timber content offset the high-volume/low-value Hemlock/Balsam component, making harvesting of the timber economically feasible.

The forest stand location is at Latitude: 49°43'17.24"N Longitude: 125°15'18.82"W. Elevation: 835 metres.

The Biogeoclimatic Ecosystem Classification of the area is CWHmm2 – Moist maritime (montane).

The Karmutsen Volcanic Formation, a Late Triassic volcanic sequence of tholeiitic pillow basalts and breccias forms the bedrock of the region. There are rubbly, colluvial veneers in the local area. A weathered, steep, bluff on a lower bench adjacent to the Browns River presented an excessively high-cost road access concern.

Following standard engineering layout procedure, wherever possible, the road centerline was located on gently sloped benches to minimize construction costs. The side-slopes adjacent the section of road in question, range from 60% to >100%. A switchback was required to access the timber on the lower bench, however, constructing a conventional 30 metre diameter, adverse (loaded logging truck on an uphill pull) switchback would have entailed an excessively costly full-bench, solid-rock cut into a high bluff face on the upper side of the road. (As a note: an engineered fill was not practical in this location due to the large fill volume and high associated costs that would have been required). Both options would have required an extended construction period and a possible delay in the harvesting. Also construction and harvesting at this location were time constrained due to the high mountain elevation and short summer period free of deep snows.

To overcome the challenging road costs and remain within the economic return value of the harvested timber, a non-conventional switchback was engineered by God Gibbs. It consisted of a combination of two elements: a sharp-angled reverse "Y" road junction and a Reversing Loop.

It colloquially became known as the “Hungarian Switchback” from a casual comment made by a logging truck driver during the harvesting phase (see reference to the Szob-Nagybörzsöny forest railway in Hungary).

In practice, this combination allowed empty trucks to drive past the sharp-angled road junction, travel 90 metres to and around the Reversing Loop, return along the same 90 metre section of road and enterthe sharp-angled junction, accessing the lower elevation bench next to the Browns River. Loaded trucks travelling in the opposite direction would adverse haul from the low bench, travel through the sharp-angled road junction, travel the 90 meters to and around the Reversing Loop, pass by the sharp-angled junction and proceed along the main haul road to the tidewater log dump destination.

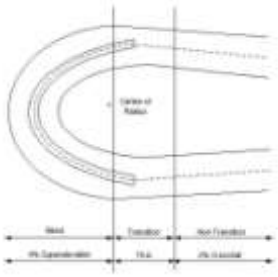
The ingenious engineering solution, provided by the “Hungarian” Switchback, eliminated the need for a large and expensive, solid-rock cut or an engineered fill, which would have been required to install a conventional switchback, thus allowing the stand of timber on the lower bench to be harvested economically.

References:

switchback***noun*** [_C_]**UK** /ˈswɪtʃ.bæk/ **US** /ˈswɪtʃ.bæk/

a path, road, or railway that forms very sharp bends from one direction to almost the opposite direction as it goes up and down steep slopes

Gavriel Jecan/Photodisc/GettyImages



Plan view of transitional cross slope into and out of superelevated corners

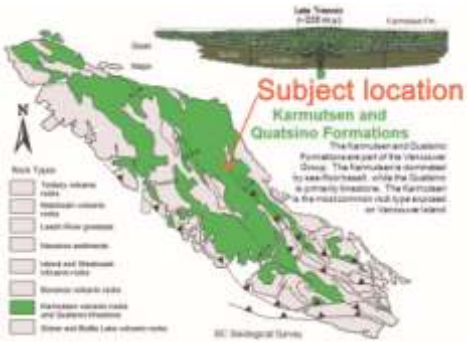
https://dictionary.cambridge.org/dictionary/english/switchback

The “colloquial naming” of the switchback :

The combination of engineering elements was used on a historical Hungarian Forestry Railroad.

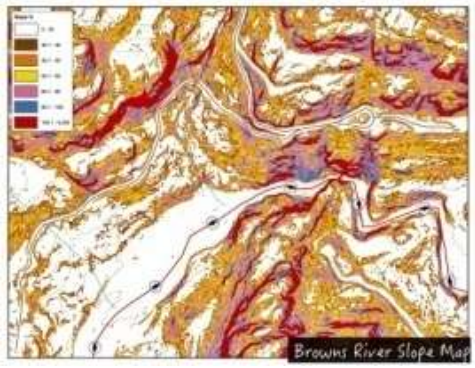
- Zig zag or Switchback (railway): From Wikipedia, the free encyclopedia
- A railway zig zag or switchback, is a method of climbing steep gradients with minimal need for heavy earthworks. For a short distance (corresponding to the middle leg of the letter "Z"), the direction of travel is reversed.

- The Szob-Nagybörzsöny forest railway has a simple zig zag at the middle of the railway line between Kisirtás and Tolmács-hegy stations, with a loop in the middle of the Z shape
- Map: https://upload.wikimedia.org/wikipedia/commons/a/ab/Osm_szob-nagyborzsony.jpg By OpenStreetMap contributors & Antissimo - designed based on OpenStreetMap data, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=50719251



Karmutsen Formation

Browns River Ortho Photo Map.



Browns River Slope Map

Hungarian Switchback base map jun 09 20

Osm_szob-nagyborzsony Forest Railway Map

NOTICE

Jim Ball (9 March 1940 - 20 April 2020)

It is with great sadness that the FAO forestry family announces the passing of Jim Ball on 20 April 2020. Jim had a long and distinguished forestry career, being equally at home in the field in dusty boots planting trees and on a podium orchestrating a large international meeting. Jim worked for FAO from 1974-2001, first as a technical officer and project manager in field projects in Nigeria and the Sudan, followed by ten years at FAO Headquarters in Rome. Jim's first post at FAO HQ was Senior Forestry Officer, Forest Plantations. During this time, among other duties, he actively served as the Secretary of the International Poplar Commission. In his final post with FAO, Jim was Chief of the Forestry Information and Liaison Unit, and in that capacity served as Secretary of the Committee on Forestry and the Regional Forestry Commissions and Chair of the *Unasylva* Editorial Advisory Board. Upon retirement, Jim continued to contribute to global forestry as President of the Commonwealth Forestry Association and to share his knowledge with FAO both as consultant and volunteer. Jim is remembered especially for his consummate professionalism, collegiality, and sense of humour. Jim was a great mentor, respected partner, role model and friend to hundreds of forestry colleagues around the world.

Patrick C. Dugan

The Asia-Pacific forestry community is saddened by the passing of Patrick C. Dugan on 29 March 2020, at 87 years of age. Pat was widely known and respected throughout Asia and the Pacific for his tremendous contributions to forestry and land management over more than six decades of professional work. He was particularly known for his tireless efforts to promote low-impact logging, assisted natural regeneration (ANR) and community forestry. Pat was born in northern Philippines, and worked as a farmer, broadcaster, plantation operator and timber concession manager before shifting his focus to work fulltime on communities and local landscape restoration efforts. Pat worked with numerous development organizations over the years, including USAID, FAO, ITTO, Japanese International Forestry Professionals Organization (JIFPRO). He also helped to train many U.S. Peace Corps Volunteers in forestry, agroforestry and natural resources management. Pat was founder and president of the BagongPagasa Foundation, a grass-roots NGO dedicated to rural development, conservation and sound resource management. In recognition of his outstanding contributions to forestry, Pat was recognized as *"Champion of Asia-Pacific Forests"* at the third Asia-Pacific Forestry Week in 2016. Pat was known far and wide for his friendly, encouraging, easy-going personality, and for his solid practical knowledge of forest and natural resources management. He was a mentor to hundreds of forestry professionals in the Asia-Pacific region and beyond and will be greatly missed.

Dr. Robert Leland Youngs

Dr. Robert L. (Bob) Youngs, age 96, passed away on April 25, 2020, in Blacksburg, Virginia. Bob was born on February 10, 1924, in Pittsfield, Massachusetts, to Frank L. and Florence (Wilcox) Youngs. He was preceded in death by his wife, Esther (Stevenson) Youngs, and his son, Steven Wilcox Youngs. He is survived by his children, Susan Catchpole (Tom), Karen Youngs Hartley, Rebecca Youngs Johnson, and Sarah Reardon (Steve); daughter-in-law Susan Grinna Youngs; his sisters, Lois Dennett, and Myrtle Calkins; brother-in-law John Stevenson (Jean); many nieces and nephews; plus eleven grandchildren and eight great grandchildren.

Bob served in the U S Army during World War II. He earned degrees from Syracuse University, The University of Michigan, and Yale University. During his career he specialized in wood technology and forest resources conservation. Dr. Youngs was recognized as an international expert in paper science, wood products, and tropical hardwoods. He served on numerous professional boards. Bob worked over 35 years for the US Forest Service, leading research programs in Madison, Wi., New Orleans, La., and Washington, DC. He served on the faculty of Virginia Technologic Institute and State University, College of Forestry later in his career, and as online faculty for National Pingtung University of Science & Technology, Taiwan.

Bob was a longtime member of Blacksburg United Methodist Church, active with Rotary International of Montgomery County, and a supporter of the Community Foundation of the New River Valley. Together with his wife Esther, he led the establishment of the International Peace Garden on the Virginia Tech campus. He also participated in the development of the local Huckleberry Trail, supported Appalachian Trail preservation, and was an advocate for land and forest resource conservation programs and for scientific education advancement.

ANNOUNCEMENTS/ EVENTS/MEETINGS/OPPORTUNITIES

A series of free webinars designed to simplify the process of planning your urban forest

Are you involved in the design of your town or city's green infrastructure?
Are you looking for nature-based solutions to urban challenges?
Are you looking for inspiration on how to involve your local communities?

Check out the upcoming webinars below.

June 18 @ 14:00 BST
(9:00am EST)

Tree Planting Strategies: helping you achieve your canopy goals, and more...

How to realise your vision with an evidence-based plan, the difference between tree numbers and canopy cover, where to plant, what to plant, how to plant, tree diversity, and resilience.

>>Register Here

July 16 @ 14:00 BST
(9:00am EST)

i-Tree and the Urban Forest

Evidence-based solutions using i-Tree tools, and the key indicators that fuel urban forest master plans and tree planting strategies.

>>Register Here

August 13 @ 14:00 BST
(9:00am EST)

Trees, People, and Technology

Exploring i-Tree as a catalyst for community engagement. Learn how communities and technology can come together to ensure that trees continue to be the first line of defence against climate change.

>>Register Here

UNESCO Internships

Internship call for applications - Natural Sciences sector, UNESCO.

Deadline: 31 July 2020

https://careers.unesco.org/job/Multiple-Internship-Call-for-Application-Natural-Sciences-Sector-%28Field%29/518766202/

SAF INTERNATIONAL WORKING GROUP NEWS

Join an SAF Working Group

This newsletter goes out to people beyond SAF members, but if you are on the working group list you receive this newsletter.

As a member of the Society of American Foresters you can join SAF working groups by going to the website:

Join a working group here:

If you want to join, or rejoin, this working group, we are B3, the International Forestry Working Group. Please pass this information along to SAF members who might be interested in joining a working group – especially B3, the International Forestry Working Group.

International Society of Tropical Forestry News

1. Tropical Forestry Notes I and II.

Frank Wadsworth has complete Volumes I and II of a compendium of summaries of the salient points of recent abstracts in tropical forestry literature.VolumeI can be downloaded from http://www.orrforest.net/saf/TropicalForestryNotes1to20.pdf and Volume II can be downloaded from http://www.orrforest.net/saf/TropicalForestryNotes21to40.pdf. Frank is one of the founders of the original ISTF when it was established in the 1950s. From 1942 to 2000 Frank was with the International Institute of Tropical Forestry in Puerto Rico, as a researcher, then as director, and then again as a researcher. Tropical silviculture has been his focus, but he also has strong interests in wildlife and conservation, and has worked in many tropical countries. Frank is interested in corresponding with ISTF members on tropical forestry issues. Please send a message to frankhwadsworth@gmail.com or tropicalforesters@gmail.com.

Frank's book *Forest production for tropical America* (*Producciónforestal para América tropical*) is available for download in English at https://www.fs.usda.gov/treesearch/pubs/48916 . It is available in Spanish at https://naldc.nal.usda.gov/download/CAT11107057/PDF .

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2. Africa Forest Forum manuals

The African Forest Forum (https://afforum.org/) has a number of documents to assist with tropical forest management. Recent manuals that have been shared with ISTF can be accessed at this link.

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3. Best practices for management of private forests in Puerto Rico.

Oscar Abelliera has made available a presentation on best practices for management of private forests in Puerto Rico (also applicable to other locations). It can be downloaded at this link. Oscar also has other resources on his website at https://www.uprm.edu/oscarabelleira/inicio/ . Estosrecursos son enespañol/ These resources are in Spanish.

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4. Queen's Commonwealth Canopy (QCC).

The QCC, in collaboration with the Commonwealth Forestry Association (CFA) is committed to raising awareness within the Commonwealth of the value of indigenous forests and to saving them for future generations. It will create a unique network of forest conservation projects that brings collective credibility and integrity to individual Commonwealth initiatives. So far 45 out of 53 Commonwealth countries are participating with 60 projects. For more information on case studies, see https://queenscommonwealthcanopy.org/ The documentary on the project, The Queen's Green Planet, can be viewed at https://www.dailymotion.com/video/x6jtoen .

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5. The Terra Viva Grants Directory

The Terra Viva Grants Directory is an online information service. We develop and manage information about grants for agriculture, energy, environment, and natural resources in the world's developing countries. We post funding news and short profiles of grant makers by subject areas which are available for free on our website.

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6. Pulitzer Center's Rainforest Journalism Fund (RJF)

Pulitzer Center's Rainforest Journalism Fund (RJF) is accepting proposals to report on tropical rainforests in Southeast Asia, Congo Basin, and Amazon regions.The RJF is aimed at developing, promoting, and supporting journalism on issues related to tropical rainforests and climate change. Proposals should address the following subjects: 1) tropical rainforest-climate linkages, including social dimensions; 2) deforestation drivers; 3) solutions to halt deforestation. Learn more here and find out how to apply here (information available in English, French, Spanish, Portuguese, and Bahasa Indonesia). Email nmoragalewy@pulitzercenter.org with questions. Applications are reviewed on a rolling basis until June 2022

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7. The UNDP Equator Prize 2020.

This eleventh cycle of the UNDP Equator Prize focuses on Nature for Life and, will recognize innovative initiatives from local communities and indigenous peoples that demonstrate exceptional achievements in the area of nature-based solutions for local sustainable development. Winning initiatives will be honored for their successes in protecting, restoring and/or sustainably managing biodiversity for positive development outcomes. The winners will join a prestigious network of 245 leading community-based organizations from 81 countries that have been awarded the Equator Prize since 2002. Each Equator Prize winner will receive USD 10,000 and will be supported to participate in a series of policy dialogues and special events during the IUCN

World Conservation Congress in Marseille, France, in June 2020. To access the online nomination system, please visit prize.equatorinitiative.org. For more news about the Equator Prize follow it on Facebook @equatorinitiative, Twitter @equatorinit, or Instagram @equatorinitiative or visit the website here.

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8. Keeling prize for innovation in addressing climate change.

This prize of $25,000 is awarded to 10 projects per year in the areas of Carbon Capture & Utilization, Energy Access, Finance, Transportation, and Social & Cultural Impacts. Application opens 1 November 2019 for the next round. See https://www.kcurveprize.org/ for more information.

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9. Do you need volunteer (and/or paid) assistance for your international forestry project or research?

The International Society of Tropical Foresters (ISTF), and the International Forestry Working Group of the Society of American Foresters (SAF), are looking for opportunities international forestry for volunteer or paid assistance. Many SAF and ISTF members ranging from students to retirees are looking for such opportunities.

If you know of any international programs that would be open to forestry and natural resource students or professionals please send the information to Bob Sturtevant, Chair of the SAF International Forestry Working Group (robert.sturtevant@colostate.edu). These can include programs that are only offered through your university or agency. They can also include non-profit and religious oriented programs. We are aware of some of the well-known opportunities: Peace Corps, Study Abroad and Semester at Sea; but there must be many more out there. Please share what you know!

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10. Volunteer projects for the ISTF Mission Committee.

The ISTF Mission committee is looking for members who will be interested in completing specific tasks. These would include: 1) Membership engagement: a) Email forestry schools around world about membership; b) Email industry organizations about membership; 2) Mission Analyst: Analysis of survey results in more detail and come up with stats to present to board; 3) Membership Analyst: Analyze membership and come up with statistics to present to board; 4) Assist with developing ISTF website. If you are interested in serving on the Mission Committee and carrying out one of these tasks, please contact the ISTF Board members on the Mission Committee Ruth Metzel (Vice President) ngolela@gmail.comor Paula Sarigumba (Secretary) pausarigumba@gmail.com.

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11. ISTF Senior Resource Pool.

The current ISTF List of senior resource people who are happy to receive questions include:

- **Ron Billings**ronbillings41@gmail.com. Forest pest management, pine bark beetle management in the Caribbean and Central America.
- **Patrick Durst** pdurst.asiaforest@gmail.com**:** Natural resources policy, economics, forest and landscape restoration, assisted natural regeneration, agroforestry, bio-energy, community forestry, forest foods (including edible insects), project development and management.
- **Eberhard F Bruenig**ebruenig@yahoo.de: Integrated Conservation and Management of Forests; 70 years of practice and research in forests of the temperate and tropical zones
- **Carl Mize** carlmize@gmail.com: For help with designed experiments - Experimental design of field and lab experiments.
- **John Schelhas**John.schelhas@usda.gov: Social and cultural aspects of private forests, including landowner decision-making, ways of valuing forests, diverse forestry options, and ethno-forestry.
- **Simon Shomkegh**sshomkegh@uam.edu.ng: Forest resources management, ethnobotany and climate resilience building
- **Frank Wadsworth**frankhwadsworth@gmail.com: Tropical silviculture and tropical forestry in general
- **Jeff Wright**patula.wright@gmail.com: Planted forests, nursery, genetic improvement, silviculture, wood quality, sustainable forest products.

If you are a senior forester and would like to be resource person for others to contact with questions, please send a message to tropicalforesters@gmail.com Please include your name, preferred email address for contact, and a two-line description of your expertise.

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12. ISTF Chapters.

If you are interested in starting an ISTF chapter but have not told us yet, please fill out this survey (https://docs.google.com/forms/d/e/1FAIpQLSehc5LDeycz-91TY6SLZKFaAVs3lePFTSKjmtW_gmArgJIQwg_/viewform) The support documents for developing ISTF chapter proposals can be accessed at this link (https://drive.google.com/open?id=1v37p7yimTQynFLp0yvz8AwS8pfJaoYL_) . If you have any questions, please contact tropicalforesters@gmail.com.

13.News for ISTF Update.

Any short items for the next ISTF update? Please send them to tropicalforesters@gmail.com

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14. Resources for Tropical Forestry.

We need to develop the link library for ISTF, in preparation for the prospective new website. To start, let us focus on "how to" guides for various aspects of tropical forestry. If you have open access publications that explain how to carry out anything relevant to tropical forestry, from clonal propagation to reforestation to…, please send a message to tropicalforesters@gmail.com. Grey literature (government/organization/institution publications) is especially useful for this sort of thing. ISTF can handle publications in English, Spanish, and French. An already-compiled list of resources for tropical forestry and forests and links to those resources is available at this link (https://drive.google.com/open?id=1kyuZX_kBgsCD-tDQTD0p1ONoOQyS7UnC3owivDDIBgI) . The links include websites, elists you can join, and sources of (free) publications. If you have additions to make to this list, please send a message to tropicalforesters@gmail.com.

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15. ISTF Board.

The ISTF officers are: President: Warren K. ("Keith") Moser; Vice-President: Ruth Metzel; Secretary: Maria Paula Sarigumba; Treasurer: Mike Sterner; Tropical Africa Representative: Daniel Kofi Abu; Tropical America Representative: Rene Zamora-Cristales; Tropical Asia-Pacific-Australia Representative: Patrick Durst. Moe information on the Board can be found at this link.

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16. ISTF online resources.

The current online resources for ISTF include:

1) Blair Orr's continuation of the former ISTF newsletter as a newsletter for the Society of American Foresters International Forestry Working Group. (Available at: http://www.orrforest.net/saf/). If you fill out the table, we will add you to the list for receiving this newsletter.
2) The old ISTF web page, still at http://www.istf-bethesda.org/
3) The ISTF Facebook group page at: https://www.facebook.com/groups/2262122534/
4) The ISTF Linked-In page at: https://www.linkedin.com/groups/12150640/
5) The ISTF twitter handle is @tropforester address: https://twitter.com/tropforester

6) Student chapter at Yale University, which sponsors the annual Yale ISTF conference: http://istf.yale.edu/ , https://www.facebook.com/yalefesistf/
7) Student Chapter at North Carolina State University: https://research.cnr.ncsu.edu/sites/istf/ , https://www.facebook.com/NCSUISTF/
8) ISTF Organizing documents can be found at this link

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17. Membership in the Association des Forestiers Tropicaux et d'Afrique du Nord.

ISTF members are invited to join the Association des Forestiers Tropicaux et d'Afrique du Nord (AFT). The AFT embraces those interested in sustainable forestry and conservation for Tropical Africa and North Africa. It produces an annual bulletin, a newsletter 3 times a year, and it publishes books and organizes technical meetings focused on the regions of interest. The annual membership fee for individuals is 40 € for French citizens residing in France, 15 € for non-students outside of France, and 10 € for students. More information on AFT can be found at this link and the membership form can be found at this link. For any questions, please contact the AFT president, Lanly Jean-Paul jean-paul.lanly@orange.fr

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18. Membership in the Commonwealth Forestry Association.

We have been exploring how ISTF might collaborate/cooperate with the Commonwealth Forestry Association (CFA; http://cfa-international.org/). ISTF and CFA are aligned in their objectives, although ISTF is focused on tropical regions. CFA was founded in 1921 and is one of the oldest international forestry organizations. It has 1200 members in 78 Commonwealth and other countries. The CFA "promotes the conservation and sustainable management of the world's forests and the contribution they make to peoples' livelihoods".

*This year the Commonwealth Forestry Association is launching a new free membership category – **Basic Membership** – for those who want to receive the CFA Newsletter in an electronic format, to read on your phone, tablet or PC.* If you would like to join at the **Basic Membership** level please send an email to **cfa@cfa-international.org**.

In addition, CFA is offering ISTF members a discount of 20% on CFA **Professional Membership** fees. That would make the annual cost to ISTF members as follows (in GB£):

Type	Level	Country	Cost
Basic		All	Free
Professional	Standard	Developed	60£
		Developing	20£
	Plus	Developed	72£
		Developing	32£

Basic Membership includes the CFA Newsletter only.

Standard Membership includes the CFA Newsletter (both hard copy and online) and online only access to the International Forestry Review

Plus Membership provides the CFA Newsletter (both hard copy and online) and receipt of the online access and hard copy receipt of the International Forestry Review

If you are interested in becoming a member of CFA, please send a message to tropicalforesters@gmail.com

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19. Membership in the Association for Tropical Biology and Conservation.

ISTF members are invited to join the Association for Tropical Biology and Conservation (ATBC), a scientific professional society. The ATBC is global in scope, membership, and objectives. There are over 900 members from 67 countries. Members include students, researchers, educators, and conservation practitioners concerned with issues of science, conservation, development, and environmental policy in the tropics. The society holds annual meetings around the world, publishes the scientific journal Biotropica, and is increasingly engaged in conservation and capacity building activities internationally. Regional chapters in Asia-Pacific, Neotropics, and Africa also organize events and annual meetings. More information on ATBC and membership can be found at this link.

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20. ISTF membership.

ISTF now stands at ~1450 members. Help us keep growing! If you have any contacts that you would like to invite to join ISTF, you can use the following message:

Dear friends:

We hope you will be interested in joining the International Society of Tropical Foresters (ISTF). With its focus on being a communication network, ISTF can help you connect with others interested in tropical forests and forestry. ISTF was founded in the 1950s and "in response to a worldwide concern for the fate of tropical and subtropical forests, ISTF is committed to the protection, wise management and rational use of the world's tropical forests". So far, over 1270 people from around the world have joined. For now, the organization will be dues-free (although this is under discussion). If you would like to join, please fill out the membership form at GoogleForms .

Questions?

Email tropicalforesters@gmail.com

Sheila Ward, ISTF Coordinator

RECENT PUBLICATION AND RESEARCH NOTES

Agroforestry Systems and Practices in Nepal

Revised Edition

Amatya S.M., Cedamon E., Nuberg I. (2018), AGROFORESTRYSYSTEMS AND PRACTICES IN NEPAL-Revised Edition, Agricultureand Forestry University, Rampur, Nepal, 108pp + xviii. **ISBN: 978-9937-0-4026-6**

The Forward by Tony Bartlett, Forestry Research Program Manager, Agricultural Research, Canberra, Australia:

"Farmers in the hills of Nepal have practiced agroforestry for centuries. For much of this time, farmers grew trees to meet subsistence farming needs, but the nature and extent of these practices depended on the size of their land and the accessibility of fuelwood and fodder from community forests. Over the last decade, much has changed in the rural areas of the Middle Hills. Household livelihood expectations have changed, many families have individuals working in cities or outside Nepal which has increased household income and reduced labour availability. Throughout this period, the role of agroforestry in Nepalese farming system has remained important, but the need for improved agroforestry systems and better knowledge of the various agroforestry options and market possibilities has increased.

"This book written by DrSwoyambhu Man Amatya, Dr Edwin Cedamon and Dr Ian Nuberg makes a timely contribution to the agroforestry knowledge base in Nepal and is a testament to the knowledge of and passion for agroforestry that these three scientists have. It builds on earlier work by DrAmatya and incorporates new knowledge and experienced gained over the past 5 years while they had been collaborating on the Enhancing livelihoods and food security from agroforestry and community forestry in Nepal (EnLiFT) project which was funded by the Australian Centre for International Agriculture Research (ACIAR). One of the objectives of the EnLiFT Project was to improve the capacity of household-based agroforestry systems to enhance livelihoods and food security. A survey of the impacts from the project's agroforestry interventions showed that average farm incomes increased by 57% from NRS 44,817 to NRS 70, 622 which brought an additional 14% of households above poverty line and enables and additional 16% households to achieve food security. Clearly these results demonstrate the great potential that improved agroforestry systems in Nepal.

"The ten chapters in this book make a comprehensive presentation of the current knowledge base for agroforestry, from understanding the local context including local farming systems and sociocultural aspects through to describing benefits, practices, regulatory environment and markets relevant to agroforestry systems. In doing so, it describes what is known, what some of the challenges are and what further research is needed to improve the functioning, profitability and governance of these important farming systems. The book will be a valuable resource for students, academics, forestry and agricultural extension officers and all those people around the world who have interest in agroforestry."

ABSTRACTS AND KEY MESSAGES

Catastrophic tropical drought kills hydraulically vulnerable tree species

Powers, JS, Vargas G., G,Brodribb, TJ, et al.A catastrophic tropical drought kills hydraulically vulnerable tree species. *Glob Change Biol*. 2020;26:3122–3133.

https://doi.org/10.1111/gcb.15037

Abstract

Drought-related tree mortality is now a widespread phenomenon predicted to increase in magnitude with climate change. However, the patterns of which species and trees are most vulnerable to drought, and the underlying mechanisms have remained elusive, in part due to the lack of relevant data and difficulty of predicting the location of catastrophic drought years in advance. We used long-term demographic records and extensive databases of functional traits and distribution patterns to understand the responses of 20–53 species to an extreme drought in a seasonally dry tropical forest in Costa Rica, which occurred during the 2015 El Niño Southern Oscillation event. Overall, species-specific mortality rates during the drought ranged from 0% to 34%, and varied little as a function of tree size. By contrast, hydraulic safety margins correlated well with probability of mortality among species, while morphological or leaf economics spectrum traits did not. This firmly suggests hydraulic traits as targets for future research.

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Integrating DNA Barcoding and Traditional Taxonomy for the Identification of Dipterocarps in Remnant Lowland Forests of Sumatra

Abstract: DNA barcoding has been used as a universal tool for phylogenetic inferences and diversity assessments, especially in poorly studied species and regions. The aim of this study was to contrast morphological taxonomy and DNA barcoding, using the three frequently used markers *matK*, *rbcL*, and *trnL-F*, to assess the efficiency of DNA barcoding in the identification of dipterocarps in Sumatra, Indonesia. The chloroplast gene *matK* was the most polymorphic among these three markers with an average interspecific genetic distance of 0.020. The results of the molecular data were mostly in agreement with the morphological identification for the clades of *Anthoshorea*, *Hopea*, *Richetia*, *Parashorea*, and *Anisoptera*, nonetheless these markers were inefficient to resolve the relationships within the Rubroshorea group. The maximum likelihood and Bayesian inference phylogenies identified *Shorea* as a paraphyletic genus, *Anthoshorea* appeared as sister to *Hopea*, and *Richetia* was sister to *Parashorea*. A better discriminatory power among dipterocarp species provided by *matK* and observed in our study suggests that this marker has a higher evolutionary rate than the other two markers tested. However, a combination of several different barcoding markers is essential for reliable identification of the species at a lower taxonomic level.

Key words: Dipterocarpoideae; tropical tree diversity; genetic distance; reference DNA library.

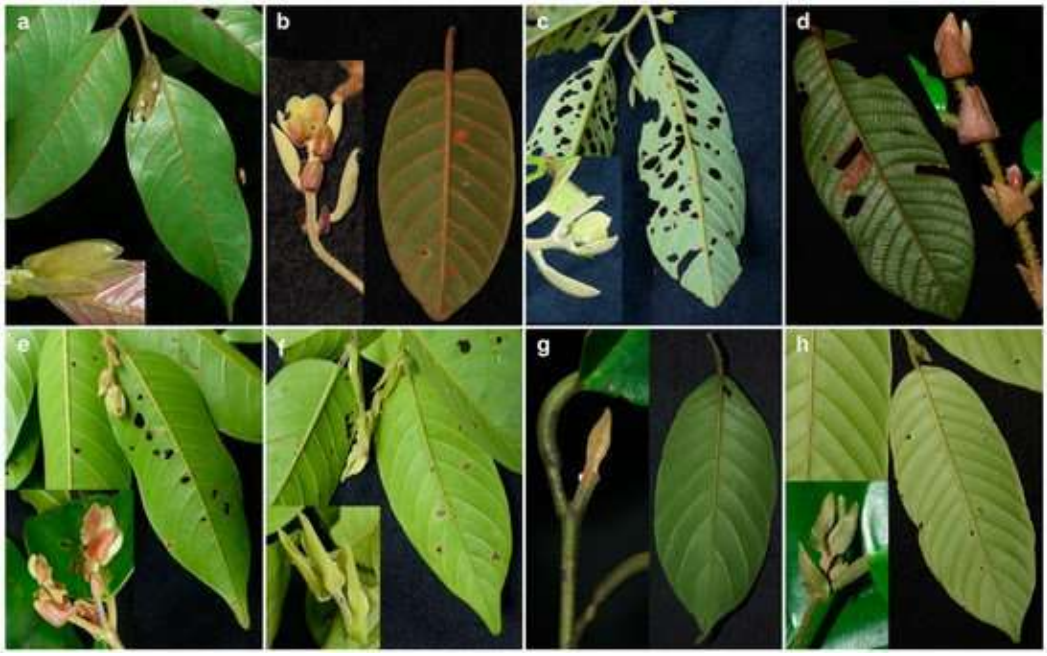

Figure 1. Morphological traits of all Sumatran species and subspecies of red meranti (*Shorea* sect. Rubroshorea) sampled for this study. Shown are branchlets, stipules, and leaves of (a) *Shoreaacuminata* (from specimen Rembold KR0822), (b) *S. dasyphylla* (KR0546), (c) *S. leprosula* (KR5454), (d) *S. ovalis* (KR0891), (e) *S. parvifolia* subsp. *parvifolia* (KR5463), (f) *S. parvifolia* subsp. *velutinata* (KR5509), (g) *S. pauciflora* (KR4807), and (h) *S. singkawang*(KR0842). Not to scale, photographs by K. Rembold.

Citation: Carneiro de Melo Moura, C.; Brambach, F.; Jair Hernandez Bado, K.; Krutovsky, K.V.; Kreft, H.; Tjitrosoedirdjo, S.S.; Siregar, I.Z.; Gailing, O. 2019. Integrating DNA Barcoding and Traditional Taxonomy for the Identification of Dipterocarps in Remnant Lowland Forests of Sumatra. *Plants*, *8*, 461.doi: https://doi.org/10.3390/plants8110461

How to get the article: https://www.mdpi.com/2223-7747/8/11/461

Forestry in Scotland and the UK

As Reported in *Scottish Forestry* (SF) the journal of the Royal Scottish Forestry Society (www.rsfs.org), Carol Crawford, Editor (editor@rsfs.org.uk)

Compiled by Richard Reid, SAF, Clarkston, WA

From the Summer 2020 issue, Vol. 74, No. 1

Research Articles

More on Scotland's wild apples.

Scotland's native wild apple—*Malus sylvestris*ecology and management. Rick Worrell, Markus Ruhsam, James Renny, Will Jessop, and Graeme Findlay. Corresponding author Rick Worrell: rick@thinkingtrees.co.uk.

Summary

Foresters and ecologists appear to have dismissed wild apple (Malussylvetris) as unworthy of professional attention, and as a result we know virtually nothing about the ecology and management of the species. This paper provides a basic account of the characteristics of wild apple based on a surveyof 209 trees across Scotland and northern England. It is widely distributed, except on the most acidlithologies, and occurs infrequently as single trees or mall groups, and never in stands. It grows in ancient woodland. usually near woodland edges, and reaches its highest densities in woodland pastures. It can grow to be a more substantial treethan previously reported; i.e., heights up to 14m and stem diameters up to 1m. The current generation is 60 to 100 years old and natural regeneration is scarce, and there is need to establish a new generation of trees. Cattle, and therefore presumedly formerly auroch, appear to be heavily involved in promoting regeneration. It is a tree with considerable potential as a spectacular landscape tree, as a prolific producer of a 'nonwood forest product' and as an important species for threatened pollinator insects. Outline guidance on conservation and management is provided.

Long-term monitoring of a semi-natural woodland at MAR Lodge Estate NNR.

Andrew Painting and Shaila Rao. Corresponding author apainting@nts.org.uk

Abstract

In 1998 two monitoring transects , totaling 1.8km in lgth and 3.7ha in area, were established in semi-natural Caledonian pine and birch woodland at Mar Lodge Estate National Nature Reserve. These transects were resurveyed in 2008 and 2018. From 1998 to 2008 following a reduction in the resident population of deer there was a modest increase in the number of regenerating tree seedlings above vegetation heights recorded in the survey. From 2008 to 2018 following further substantial reduction in deer numbers, there was a 2,074% increase in the number of seedlings above vegetation height…There were changes in ground flora structure and diversity. Monitoring has shown that from 2008-2018 there has been a shift towards a more diverse woodland with an increase in woodland regeneration, deadwood provisio, and vascular plant diversity.

Travel Opportunities

The Royal Scottish Forestry Society has regularly scheduled field trips to various locations in Scotland, elsewhere in the UK and Europe.This is an opportunity to meet your professional counterparts and forest owners. For details visit the web site www.rsfs.org.

IMPORTANT URLs

Sign up for the ITTO Tropical Timber Market Report

The International Tropical Timber Organization (ITTO) releases the Tropical Timber Market Report two times per month. You can receive a free email subscription by signing up at their website:

http://www.itto.int/market_information_service/

IUFRO Electronic News

The newsletter is also available for download as a PDF or Word file at: http://www.iufro.org/publications/news/electronic-news/.

FAO InFO News

A newsletter from FAO Forestry

The Food and Agriculture Organization's Forestry newsletter is available at this link:

http://www.fao.org/forestry/infonews/en/

Unasylva

http://www.fao.org/forestry/unasylva/en/ - An FAO forestry publication going back to 1947.

Global Forest Information Service (GFIS)

https://www.gfis.net/gfis/en/en/(also available in Spanish and French) Global Forest Information Service contains up-to-date information on news, events, publications and job vacancies (on the homepage) and lists other info resources such asdatabases, as part of the GFIS system.

Cámara Forestal DE BOLIVIA

http://www.cfb.org.bo/noticias