Southern African Institute of Forestry
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The Exciting World of Forest Biotechnology

By Wayne Jones

Biotic and abiotic threats to the forest industry, brought on by rapid climate change, are challenging the viability of responding to these threats using traditional breeding strategies. DNA-based biotechnology tools provide exciting new avenues for the sustainable development of agriculture, fisheries and forestry, and can be of significant help in meeting the challenges of the future. In forestry, such biotechnology tools can help predict tree breeding values long before the tree reaches reproductive age. This can be used to complement conventional breeding and accelerate plant improvement by shortening breeding cycles and simultaneously increasing selection intensities. Under the pressure of changing environments, we also need to more rapidly select adaptable genotypes and be more efficient at matching them to the appropriate sites.

Genomics is an interdisciplinary field based on our ability to study all the genes and genetic variation in a tree. It has a key role to play in tree improvement based on greater understanding of the complex genetics of tree growth, wood formation and environmental interactions and the levels of genetic variation available for selective breeding of these traits. Forest breeders are gradually beginning to have greater access to high-throughput tools developed for the implementation of molecular breeding in animals and crop plants. These include access to the reference genome sequence that became available for *Eucalyptus grandis* in 2014 and recent development of genomic resources for pine trees. These are key resources for understanding species diversity; for gene discovery and for dissecting the genetics of tree adaptation to climate change. Similarly, access to the genomes of pest and disease threats (fungi and bacteria), can help us to understand their interactions with trees.

We also have access to genotyping tools; tools that enable us to quantify the genetic variation in key forest tree species. This variation is typically the result of single nucleotide polymorphism (SNP) changes that naturally accumulate in tree genomes. High-throughput SNP genotyping chips (that assess DNA variation at 10,000s of genomic locations) are already available for the eucalypts and will become available, for the first time, for pine species early in 2020. The significance of these genotyping tools is enhanced DNA fingerprinting, species and hybrid identification, as well as genome-wide analysis of DNA variation in tree populations for gene conservation and genetic resource management.

With these tools in place we can begin to focus on implementing advanced molecular breeding approaches, like genomic selection, that allow us to predict the performance of individuals based on the association of DNA markers with various phenotypic traits of interest. The process involves developing marker-trait models based on a training population and then testing the predictive ability of the model in a related population. The benefit of this process is that if a good marker-trait model exists, performance predictions on related populations can be made at a young age, substantially shortening the breeding cycle and increasing the selection efficiency of the breeding programme.

This rapidly developing, multi-disciplinary science (combining genetics and computer/data science) within the forest sector has been possible through industry and government partnerships supporting the Forest Molecular Genetics (FMG) Programme and the Tree Protection Cooperative Programme (TPCP) in the Forestry and Agricultural Biotechnology Institute (FABI) based at the University of Pretoria. These programmes are crucial to our fundamental understanding of tree, pest and pathogen genomes, finding innovative solutions and developing talented graduates that can implement these technologies.

With thanks for input from my colleagues and collaborators.

Inside This Issue

Coffee, round tables and talking jars: Southern African forestry students apply their minds

By Jos Louw and Tatenda Mapeto

The annual Southern Africa Regional Meeting (SARM) of the International Forestry Students Association (IFSA) was again successfully hosted by forestry students from the Nelson Mandela University during the period 24-28 June 2019. Each year most of IFSA Regions in the world organize a Regional meeting which gathers the members of IFSA in the region during several days. Those meetings are quite important to discuss regional topics and trends and promote the cohesion and provide a developmental platform for forestry students in the region. This year, students from the five South African forestry education institutions as well as those from the eastern and southern countries of Tanzania, Uganda, Kenya and Zimbabwe gathered around the theme "Future multiple land-use and alternative business models for the Southern African forestry industry".

The program was designed to keep the students engaged through a series of high level industry and academic talks and presentations, field tours and café dialogues, the latter which I had the privilege of facilitating. As an entry level lecturer, I must emphasise the beauty that it is to facilitate conversations with a room full of students from diverse backgrounds who have coffee and cookies on tap. It is one way to get even the most reserved person talking while cultivating listening and reflecting skills, especially more so for the verbally gifted. The point, however, was not to give students coffee, but to create an environment that allows free and uninhibited conversation on a personal level, free from the interruptions of daily routine, social media and other commitments on campus. The organising team applied their minds to the formulation of conversation prompts and questions related to the conference theme. The rapidly changing local forestry industry, in terms of technology, patterns of land ownership and environmental related challenges formed the ideal background for a critical analysis and discussion of this nature. The main thoughts and visions of the delegates are briefly discussed below. In addition to these insights, the personal feedback of student experiences of the sessions was quite humbling. One of the students' feedback note said, "I really had a good experience, because I learnt new things, how to share in the different minds of other young people, learning how people think and learning what they would do to change the world. I have also learnt a lot about forestry, that I would not have necessarily known from just being in class, and, I was also reminded of why I started studying Forestry after being lost and confused for a while". There are many of such hopeful personal notes, but for now, I will report on the dialogue insights.

Two café dialogues were facilitated, the first one had questions that prompted conversations on the students' reflections on the current forestry value chain in terms of sustainability and multiple land use, their insights on the opportunities and challenges in the forestry industry and their suggestions for addressing these challenges. The second dialogue prompted the students to envision an ideal South African forestry business model in terms of size, structure, technologies and management principles. Also, this dialogue prompted the students to reflect on their educational preparedness for the current and future forestry industry as well as their opinion on actionable recommendations for improving forest education in our region.

On the status quo of the current industry, the variable sizes of forest business entities were a general consensus point. It was noted that although there are large, medium and small-scale plantation forestry entities, in technical terms they all have a similar production system, i.e. medium to long term intensively managed monoculture plantations of key species. The notion that came through was that forestry is forestry, the same species that is grown by a big corporate entity is the same one that is grown by a small grower and as such there are limitations to ways in which forestry can be practiced. According to the students this had two key implications to the sustainability of the industry. Firstly, risks to plantation forestry such as pests, diseases, fire and soil fertility losses are realities that apply to all forestry entities regardless of their size. The students then brought up the notion of resilience as an important sustainability indicator, as they questioned the ability of the smaller and medium entities to bounce back in the event of a challenge such as a pest infestation. Furthermore, it was questioned who defines sustainability, the small-scale farmer, the big corporate or the medium scale plantation owner? A general response was that sustainability has different expressions for the different scales at which forestry is practiced, yet the dilemma is that in the biophysical sense forestry is forestry. Conversations around this conceptual understanding of sustainability led to the group noting that it very much depends on what form of environmental ethic will dominate thoughts? Also, stakeholders' understanding of the inter-relatedness of the social, economic and biophysical components of the environment will determine how they approach sustainable forest management. An example would be that, depending on size, design and leadership style, some entities would follow a stronger econo-centric approach to sustainability, while others would pursue a more bio-centric or human-centred approach. The group agreed that sustainability cannot be a one size fits all concept. It should always be considered from the ecological context, the management intensity, economic expectations and lastly the broader ecosystem values present in the landscapes where forestry is being practised.

As far as challenges and opportunities related to the forestry industry are concerned, education and research programs for small scale/independent growers came at the top of the group's priorities. An increased focus on community-based forestry was viewed as an opportunity to invest in communities to stimulate growth in the forestry sector. This will not only create a sense of ownership of forestry landscapes and assets but will also provide big corporations with a secure resource base. A quote from one the students reads as follows: "Educate the communities to know why conservation is important, why certain landscapes must be protected and why others are suited for production purposes, and why they must better understand their functioning and value". Against this background, society needs an improved understanding of our biophysical resource, its inherent potential for forestry, and how it will affect the many aspects of modern forestry production systems, especially against looming uncertainties associated with global climate change and societal demands. Strategies for better adaptation must be developed, such as multiple resource use, product diversification, improved value addition, breeding of superior planting material and precision forestry in general. *(cont pg 5)*

Shake or Wipe – Travels in the East African Forestry Industry! – Part 3

by Tim Ross

Tanzania

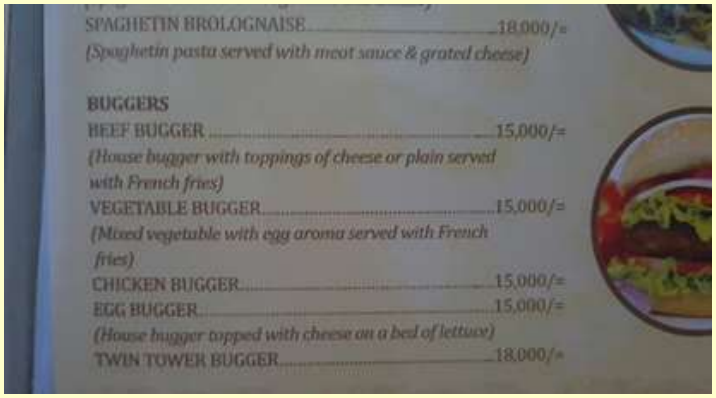
About 40 percent of Tanzania's 88 million hectares of total land area is covered by forests and miombo woodlands as well as soft- and hard-wood plantations, located in the Southern Highlands. About 18 million ha of this total forest area have been gazetted as forest reserves, of which 4.1 million ha are managed under Participatory Forest Management (PFM). Over 17.3 million ha, a third of the total forested land, are on village and general land with no properly defined management regime. Deforestation rates are among the highest globally, and, if they continue or increase, will result in the total loss of all forests in Tanzania within 50-80 years (FAO, 2017).

Tanzania's once thriving plantation forests are not what they once were, mainly due to poor management and over utilisation. Recently, there has been a renewed focus on plantation forestry with several companies, donor organisations and government departments focusing on the industry. The area is reminiscent of the lowveld and escarpment areas of South Africa with species such as *P. pat*, *P. tec* and *E. gra* the most common species planted. Tanzania has a well-developed albeit young, tree improvement programme that is starting to show results. The area under small-grower woodlots is increasing although quality and yields remain low. This is mainly due to the average clearfell age of pine being 6-8 years. *(Photo: E. gra cuttings grown in Jiffy pods).*

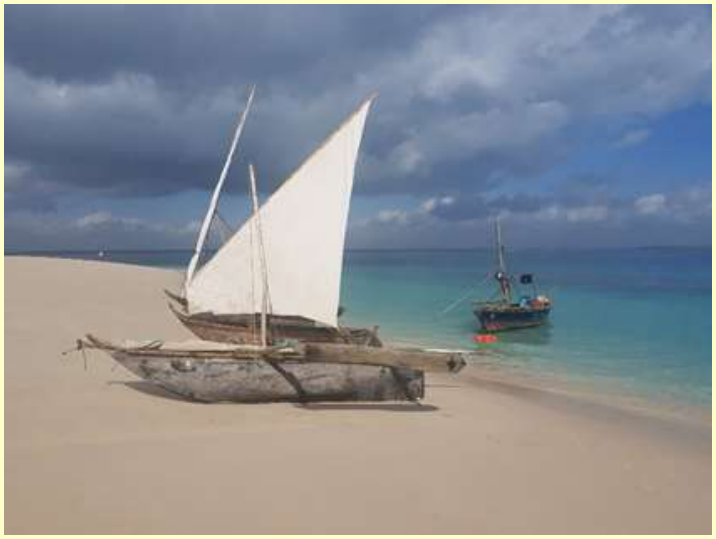
(Photo: P. patula in Tanzania)

East Africa is a beautiful place to visit and exciting and challenging to work in. The forestry industry continues to grow and mature and will continue to be an important industry in East Africa. Government policy and poor infrastructure increase the pressure on running profitable forestry operations. There is much room for improvement and quick wins are possible.

At the end of a trip, when you've been on the road for a week or two and feel the need for a home cooked meal, there are several wonderful, local restaurants to choose from or places in which to relax. One of my favourites is Agar, not far from the new bridge over the Nile (built by the Japanese) in Jinja, Uganda. The menu offers culinary delights such as the 'Full breastfast' and 'Spaghetti brolognaise' which – after weeks on the road away from home – are both good options. For the hungry, there are a range of 'Buggers' to choose from, although the 'Bugger' is not guaranteed, and you often only end up with the cheese. I've not been brave enough to order the 'Twin Tower Bugger'. *(Photo: Local culinary delights)*



(Photo: Island off Dar Es Salaam, Tanzania)



Understanding that which we don't know

By Rob Thompson

It was a privilege to have been invited, as an industry representative, to attend the University of Stellenbosch, Department of Forestry and Wood Science Advisory Board meeting, held late October 2019.

The experience was insightful on a number of levels, with one of the highlights being the opening address presented by Dr Antoinette Smith-Tolken, retired Director Social impact at the university, who explored the world as it is presenting in the 21st century.

This talk set the scene extremely well and certainly challenged those present, to better understand the current dynamic, adjust, and propel students along an appropriate trajectory.

Change factors such as the fourth industrial revolution which threatens the continuance of "traditional" jobs and the lightening fast growth of the digital economy that still sadly excludes many people, were listed as some of the challenges that tertiary educational institutions have to overcome and master. Dr Smith-Tolken went on to say that very few people and even institutions know what they don't know, meaning that the search for knowledge gaps becomes a tedious affair.

The truth of this statement resonated in me. The more that one thinks about it, the more apparent the implications of the statement becomes. Humankind soldiers on with its inventions and so called technological advancements with seemingly little energy going into consideration of the implications (or that which we don't know). We often end up with a spectrum of unintended consequences ranging from critically serious environmental impacts, such as the volume of plastic now in the oceans exceeding that of the sea life, to the social mayhem created by extreme unemployment in the wake of traditional jobs shed, either due to digital alternatives, or political wrangling's, driven by individuals with delusions of knowledge and insight. How critical it is therefore that educators encourage focus on that which we don't know.

The commendable work-integrated learning approach adopted by the University and the Department appears to be the catalyst towards a more informed and capable forestry practitioner. It does however place more pressure and responsibility on the industry to provide experiential training and support opportunities to students and young graduates. The more that young practitioners have been exposed to real work place issues and circumstances, the more productive and settled that individual asset will be from onset. He or she will have a better understanding of that which they do not know and will fit into the industry so much easier than someone who is inundated with mere theoretical knowledge.

Cori Ham's slide during the proceedings said it all…"It takes an industry to raise a forester / saw-miller".

The Department staff presentations of individual teaching and research fields that followed, highlighted the significant advancements made in the forestry curriculum and certainly gave me confidence that a great deal of energy was being directed towards determining that which we don't yet currently know. Damn! All those years I spent pulling an enumeration chain through bramble infestations and now they come up with concepts such as LiDAR and remote sensing.

The closer integration, to a degree, of the Forest and Wood Science curricula, further provides both sets of practitioners a useful and wider knowledge of what their counterparts are up to. Now the silvics guys will understand just why the saw mill guys are so grumpy when they encounter those knots…and there we were thinking that they were merely decorative! The ever extending product range from the timber being grown extending from structural lumber though to pulp, bio-fuel, dissolved cellulose and more, makes it critical that today's practitioner has a wide knowledge of forestry related processes and disciplines.

The 21st century requires a different type of thinking and a more experiential and interactive teaching approach. As was explained during the proceedings…knowledge has to become more contextual rather than conceptual. I share with you a few of the highlights from the Forestry presentations that illustrated to me that the Department is clearly on the right path.

Hannél Ham (Forest Ecosystem Ecology and Forest Genetics and Propagation) uses an "Amazing Race" type practical and interactive teaching concept, that explores the interaction between eco-systems, reactions to prescribed burning and a biosphere study. An excellent concept that highlights unintended consequences and opens a window into that which we don't know.

Ben du Toit (Silviculture) has the approach that forests administered by his students should be (amongst others) sustainable, resilient to climate change and water use efficient. The teaching required for students to attain these insights has to be broad and based on problem-solving. Again, top marks for exploring that which we don't know.

Dave Drew (Measuring and Modelling Forest Growth and Yield) oversees the capstone final year management plan. His focus on ensuring that students understand the practical modelling techniques required to determine current and future yields of forests, must stimulate a wide, well-furnished thought process, and culminate in well-equipped foresters producing useful management plans both as students and practitioners. I'm not allowed to say what thought processes went into my management plan years ago…bygones!

Cori Ham (Forest Management) creates students capable of executing valuations (a critical component of forestry business practice), financial analysis and costing along the value chain. The knowledge they gain of Microsoft Excel is also a major asset in their productive journey into the industry. Forecasting and analysis tools in the practitioner's toolbox also contribute towards unlocking that which they do not know.

The forest engineering programme led by Pierre Ackerman (Forest engineering / Forest Operations) presents an integrated approach incorporating the international community, laws, ecosystems, society, policies and the economy. This is responsible engineering practiced beyond the mere confines of the forest. Implications are explored and solutions found. Our practitioners now understand that a road is certainly no longer merely a road. It is an integral part of a much wider system of knowns and unknowns with the practitioner responsible for the ultimate outcome and ramifications. This course provides the tools necessary to ensure positive outcomes.

All told, I found the approach being adopted by the Department refreshing and exciting. The people succeeding today are those that are pushing the boundaries of their understanding and not allowing themselves to become drones mesmerised by media offerings and unchallenged acceptance of the norm.

Flying back home to Durban after the proceedings, a simple occurrence drove home to me the extent that intelligent people have regressed to acceptance of the norm. The plan lands. It taxis to its bay. The seat belt lights go out…and everyone stands up simultaneously to reach for the overhead lockers! Chaos ensues!!

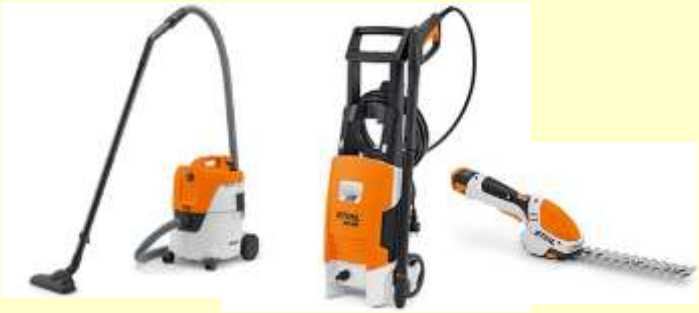
There is a better way but it requires insight, knowledge, thought and leadership. It's good to see that our students at Stellenbosch are being provided with all four.

May they better understand that which they don't know and thrive.

SAIF photo competition 2019

The competition is now closed, and the judging has been completed. Results will be announced soon! Once again, we thank Stihl for the generous prizes:

1. STIHL RE 88 High Pressure Washer
2. STIHL HSA 25 Cordless Shrub Shears
3. STIHL SE 62 Vacuum Cleaner



Southern Forests embracing 2020

By Hannel Ham

The General Assembly of the United Nations declared **2020** as the International Year of Plant Health. This is a unique opportunity to raise global awareness on how protecting plant health (especially forest trees) can help end hunger, reduce poverty, protect the environment and boost economic development. Southern Forests will celebrate the year with a special edition focusing on tree health with Prof Jolanda Roux (Sappi) as guest editor. The focus will be on diseases, pests, Pinus, Eucalyptus and indigenous species. International experts will collaborate and help promote the SAIF through the Southern Forests special edition.

Why is plant health so important?

Although plants make up approximately 80% of the food we eat and produce 98% of our oxygen, pests result in a 40% loss of global food crops and trade losses. Climate change is also having a large impact on plant health by threatening the quality and quantity of plant products (timber, fruit etc.). Rising temperature and water scarcity also contributes to the changing relationship between pests, plants and pathogens. Also, beneficial insects are disappearing at an alarming rate (approximately 80% the past 25 to 30 years) affecting maintenance of soil health, recycling of nutrients, pollination and assisting in managing plant health.

How can SAIF members assist with plant health?

- It is risky and against the law to bypass phytosanitary control measures by transporting plants and plant products across borders. Pests and diseases are not always visible to the naked eye but may spread or cause problems.
- Make trading in plants and plant products safe without setting up unnecessary barriers. Implementing the IPPC, international standards and enforcing existing phytosanitary legislation, help promote trade while keeping it safe.
- Keep plants healthy to protect the environment and biodiversity. Although climate change and human actions have altered ecosystems, pests are one of the main drivers of biodiversity loss.
- Protect, manage and restore terrestrial and marine environments to keep plants healthy. Policy makers need to enable policies to protect, manage and eventually restore natural resources.
- Invest in plant health organisations, phytosanitary efforts, research and development. Industries should come together (government, policy makers, legislators, public and private sector) and work as a united front.
- Healthy plants are crucial for ending hunger and achieving Sustainable Development Goals. This is important for both agriculture and forestry sectors.

For more information: https://www.ippc.int/en/iyph/about/#

Coffee, round tables and talking jars

(Cont. from pg.2). An analysis of the status quo finally gravitated to insights on what an ideal forestry business in South Africa should look like. Semi-mechanised operations were viewed as the most feasible option for a South African forestry business. Technology must be part of the matrix, land use integration should receive priority, and jobs should be re-engineered to make skills development a core of the business. However, as far as technologies for an ideal forestry business are concerned, a strong case for human and environmental wellbeing was emphasized. It was stated that technology should be introduced not only for economic efficiency and profitability, but also for the sake of improving the social and environmental components of sustainability.

It was agreed that a competitive and future forestry industry should have large corporate entities complemented by small and medium scale enterprises so as to facilitate the required consolidation and enable proper planning, timing, optimal production capacities and export market penetration. Such cooperation also matters for an array of other purposes such as training, research and preventing and mitigating risks. However, the potential of small-scale forestry, if properly organised, must not be overlooked. It can certainly become a significant player to support a globally competitive industry through creatively designed cooperative programmes, and the integration of rural communities who to date often feel marginalised.

While these dialogues provide us with windows into the minds of the young generation regarding forestry, it is their transformative nature in getting the students to learn and contribute to the learning of each other that remains an awe. I will end with a quote from one of the students "This dialogue was very educational, it encouraged me to think about advancement in the forestry industry, and solutions to current issues in Forestry. I got to learn that other people's views can be combined with mine to give a way forward".

Special acknowledgements to the student participants of the 2019 Southern Africa Regional Meeting, industry leaders, academics and a huge thank you to the sponsors (FPM & SETA , FSA, SAIF, SAPPI, NCT, MONDI, Nelson Mandela University) and supporters who enabled the success of the meeting

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November 2019 birthdays

03-Nov	SALE G.	15-Nov	WEBB R.J.
04-Nov	BAINBRIDGE W.R.	21-Nov	DOVEY S.B.
04-Nov	LOUBSER C.H.	22-Nov	PREVOST M.J.
05-Nov	JALI S.P.	22-Nov	RAUTENBACH J.J.
08-Nov	VON BENEKE D.	28-Nov	CHIRWA P.W.
12-Nov	GEVERS R.	29-Nov	LANE J.S.
15-Nov	HORRELL I.L.	30-Nov	LINDE B.J.

Newsletter compiled by Andrew McEwan