

Teaknet Bulletin

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TEAKNET wishes a very Happy & Prosperous
New Year 2023 to all our Readers !



Editorial

Greetings for the Year 2023!!

TEAKNET ushers in 2023 with new hopes and aspirations. Through the past 27 years, TEAKNET has successfully established a global network of teak cultivators, traders, private enterprises, plantation managers, researchers, students and other stakeholders. TEAKNET has been successful in disseminating relevant information on teak and providing custom made solutions to different stakeholders. The success of this network is the result of each of your valuable contributions and we seek your continued support in all our future endeavours.

In this issue, we bring you an article on 'Teak Genomics for Conservation and Timber Verification'. The article points out genome-wide SSR markers as an ideal tool for teak timber verification that can be used to trace illegal teak logging with high accuracy. This Bulletin also provides glimpses of the forthcoming IUFRO Division 5 Conference during 4-8 June 2023 at Cairns, Australia. The IUFRO Division 5 Conference would comprehensively discuss forest products research in 24 sessions, details of which are hosted on the conference website. In addition, market price of plantation teak imported to India and our regular column on teak prices are provided for the benefit of our readers.

We invite your feedback on issues related to teak and to enrich us with articles, news, research papers etc. of non-technical nature for inclusion in the Bulletin.

S. Sandeep
TEAKNET Coordinator

Teak Genomics for Conservation and Timber Verification

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Introduction

Teak (*Tectona grandis*) is an obligate outbreeder with natural distribution zone limited to South and Asian countries such as India, Myanmar, Thailand, and Laos. Owing to its excellent wood quality and economic value, teak is maintained as plantations in more than 70 countries all over the world (Kollert and Kleine et al. 2017). Teak being a slow growing species, its cultivation is a long-term investment with productivity of the species mostly controlled by genetic and environmental factors (Keiding et al. 1986; Wellendorf and Kaosa-ard 1988; Kaosa-ard 1993). Therefore, good planting material, appropriate site, and proper silvicultural practices are important for successful establishment and maintenance of the plantations (Arias 2013). India is considered as the genetic diversity center of teak (Verhaegen et al. 2005; Hansen et al. 2015) and is the seed source of major plantations raised outside the natural distribution range (Verhaegen et al. 2010; Hansen et al. 2017). Meanwhile, most planted teak forests in India are developed from selected germplasm of narrow genetic base. The consequent decline in the genetic diversity of teak plantation forests may not support long-term evolution and survival in the projected climate change scenario with reported 30% of teak grids in India being vulnerable to climate change (Gopalakrishnan et al. 2011). Hence, it is vital to plan, organize and implement a program for the sustainable management and conservation of major teak genetic resources in the country.

Integrating population genomics and conservation biology would be an ideal approach to formulate appropriate strategies for sustainably managing the natural and planted teak genetic resources. Teak draft genome constructed using NGS approach (Yasodha et al. 2018) has provided major insights into the genetic architecture (structural and functional aspects) of teak enabling identification of genome-wide SSR markers and major genes involved in wood formation. In our study, a total of 25 highly polymorphic SSR markers identified from the teak genome were used for genotyping 425 individuals sampled from 18 natural teak populations across different regions of peninsular India (Fig 1). The genotyping data could recognize Kerala populations as genetic diversity hotspots with maximum genetic diversity and admixture patterns. We also identified populations with higher number of private alleles (Nilambur) which characterize genetic distinctiveness. A drastic decline in the allelic richness and genetic diversity of the populations in northern Western Ghats owing to habitat loss and fragmentation was also observed. Further, three gene-ecological

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zones were recognized (Fig 2) which would help in effective conservation. We could also explain the structure of teak genetic resources in India through eastward migration and dispersal route from the state of Kerala to Tamil Nadu and Karnataka states and towards central India. This eastward movement of teak natural resource is in agreement with earlier studies wherein a global picture was also drawn considering all the natural distribution zones (Hansen et al. 2015). Further, our study also indicated that the genetic variation of natural teak populations in India is attributed to historical climatic variation along with anthropogenic activities. The populations identified in the study with higher allelic richness, rare alleles and genetic diversity can be used as seed sources for future management of the resources. Furthermore, these populations with private alleles can be assessed for adaptive potential (abiotic stress, drought resistance) via landscape genomics for effective restoration, considering the shifts in the distribution pattern of *T. grandis* populations in the context of climate change.

Illegal logging is one of the major issues with a global impact on integrity and economic foundation of the teakwood market (Lowe et al. 2016). Though several initiatives in the form of action plans and policies have been implemented to prevent logging of illegally sourced timber [European Union (EU 2003) forest law enforcement and Governance program (Ezzine De Blas and Pérez 2008), U.S Lacey act (2008), Australian illegal logging prohibition act (2012), Korean act on sustainable use of timbers (2018), and United Kingdom Timber regulation (2021)], the lack of accurate timber forensic tools in place has affected the effectiveness in combating the crime (Dormontt et al. 2015). We screened 10 best SSR markers with good forensic parameters from 25 identified teak genome, for match testing of evidence wood and seized wood in a blind test frame-work. The genetic profiles of these woods showed 100% match, indicating high discriminatory power and efficiency of the selected genome-wide SSR markers to thwart illegal felling and for chain of custody validation. Further, a reference database of 425 Individuals from 18 teak natural populations in India generated using 10 highly polymorphic SSR markers was used to identify the source of unknown individuals via assignment test, using distance based, model based and the most efficient machine learning approaches (>80% accuracy). Accession level assignment was not possible due to high genetic similarity between the populations, yet provenance level assignment was possible. Provenance based assignment identified teak plantations to have almost similar seed sources in different ratios indicating related genetic structure of all the plantations (Fig 3). The study provided an insight into the history of teak plantations and natural populations, which signified the quantum of genetic erosion ensued. The development of a robust reference database from plantations and natural populations in all the teak growing countries (since it is location specific) is recommended for conservation of the teak genetic resources and to trace the integrity of teak timber along the supply chains in global market. Hence, a collective effort is recommended for genetic database creation and information sharing to safeguard and protect the interests of the stakeholders as well as to strengthen and add precision to the legal framework for timber trade and forest management.

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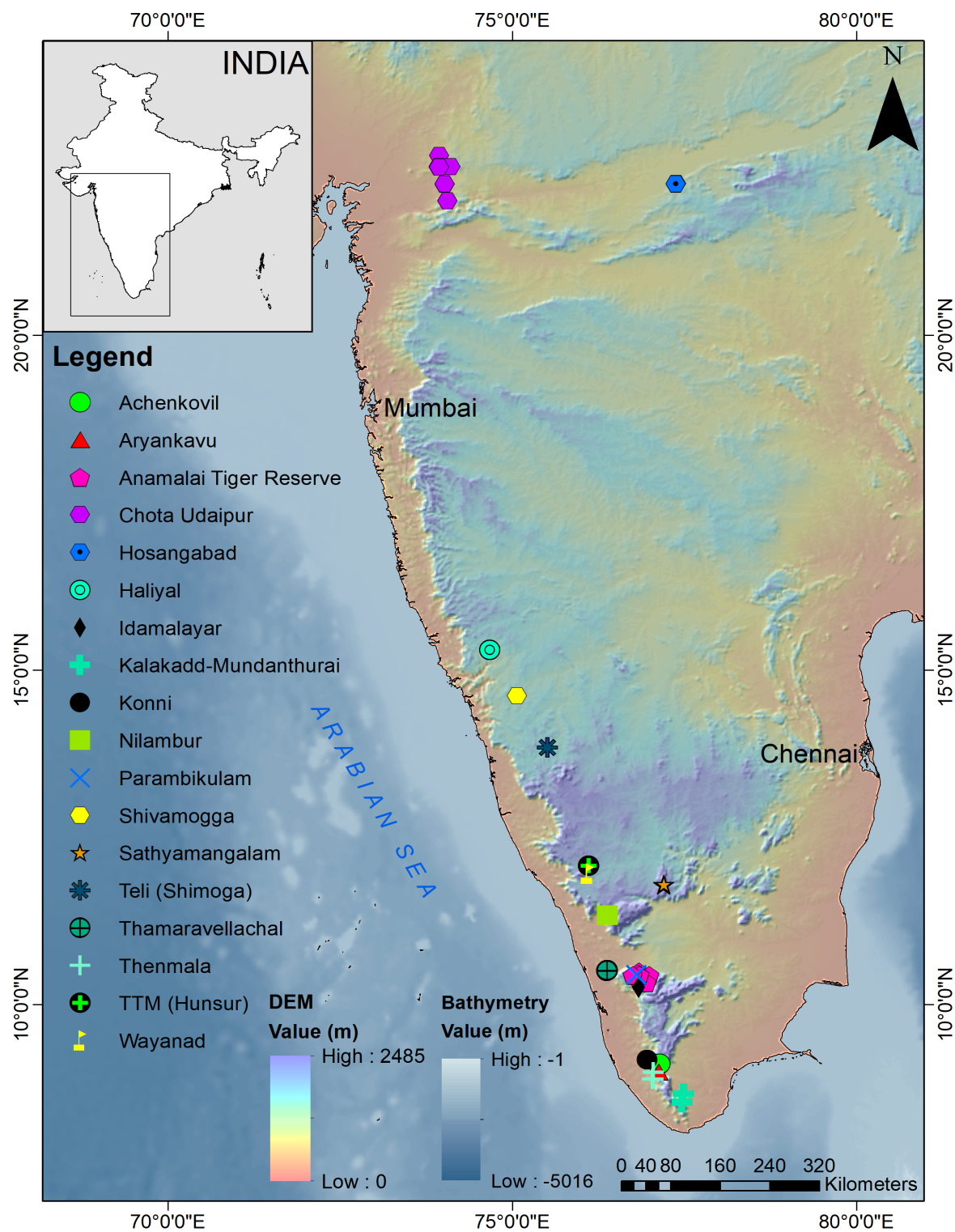


Fig 1. Distribution map of natural teak populations sampled in India. DEM indicates Digital elevation model

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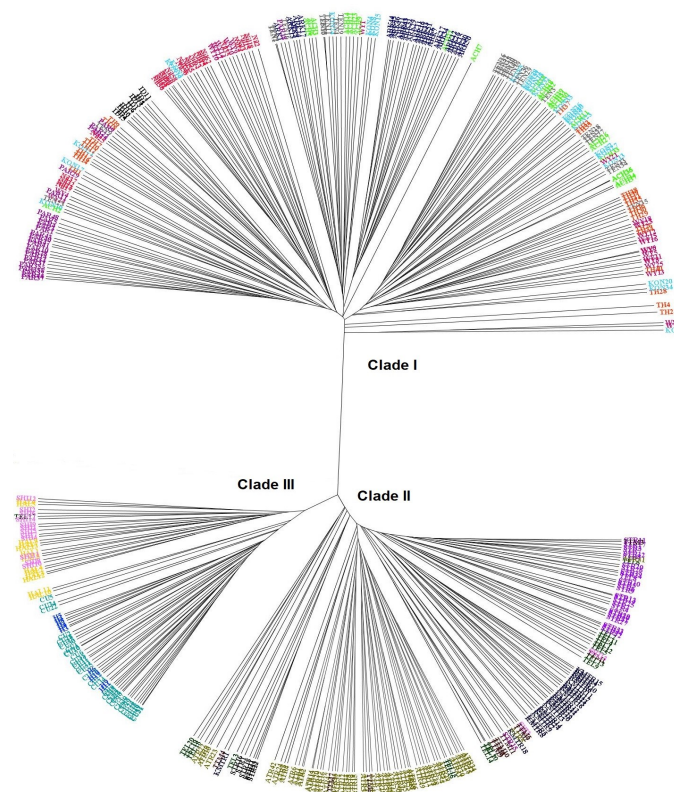


Fig 2. UPGMA dendrogram of 425 individuals per population clustering pattern showing gene-ecological zonation. Clade I, All Kerala populations; Clade II, Tamil Nadu/ Karnataka populations; Clade III, Karnataka/ Gujrat/ Madhya Pradesh populations. Each population is indicated in different colours.

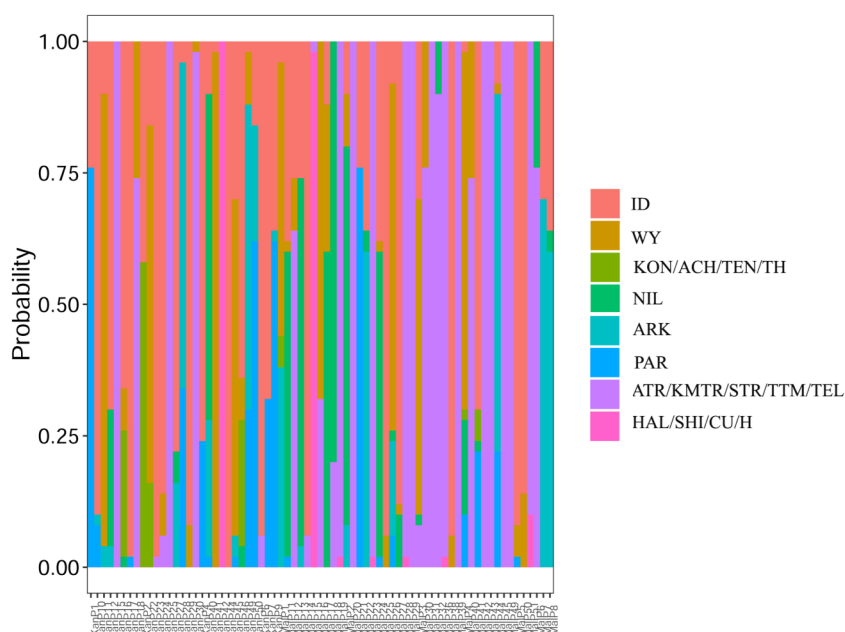


Fig 3. Assignment of unknown individuals to source population using reference database. Kerala-ID/WY/KON/NIL/ARY/PAR/TEN/TH/ACH; Tamil Nadu-ATR/STR/KMTR; Karnataka-HAL/SHI/TTM/TEL; Gujrat-CU; and Madhya Pradesh-H populations

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Summary

The genomic and genetic characterization of teak at the genotype and population level thus provided crucial information required to design and implement a proper conservation strategy for sustainable utilization of teak genetic resources. It also demonstrated the use of genome-wide SSR markers as an efficient timber forensic tool. Furthermore, the teak genome data generated can be used as a foundation for future research in landscape genomics and system biology.

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IUFRO Division 5 Conference

4-8 June 2023
Cairns, Australia

IUFRO Division 5 conference will be held at the Cairns Convention Centre in Cairns, Australia from 4-8 June 2023. This conference focusses on products sourced from both natural and planted forests. Specific topics include: the microscopic and macroscopic structure of wood and its utilization; engineering properties; protection in storage and use; wood physics; drying, conversion, and performance of solid wood and wood composites; production of energy and chemicals from trees. The Local Organizing Committee and the Conference Committee of the International Union of Forest Research Organizations (IUFRO) All Division 5 Conference would like to invite you to Cairns, Australia in June 2023. TEAKNET is a Co-organizer of the Side Event on Teak being convened by IUFRO Teakwood Working Party (Div5.06.02) in association with ITTO, Japan

The early bird registrations close on 20 March 2023.

The key dates and the updated programme is available in the conference website.

Visit the Conference Website for more updates

www.iufro-div5-2023.com

Planting Materials, Gene Pools among Top Concerns at 4th World Teak Conference

Planting materials, gene pools among top concerns at 4th World Teak Conference

Ghana-hosted gathering discusses key issues for the sustainability of the high-value global teak industry

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A first for Africa: The 4th World Teak Conference was held in Accra, Ghana, on 5-8 September 2022. Photo: P.K. Thulasidas

The central role of plantations in the global teak sector was a key theme at the 4th World Teak Conference, which took place in Ghana on 5-8 September 2022, the first time the gathering has been held in Africa. Quality planting materials and a deep gene pool will also be vital for securing a sustainable future for this valuable hardwood sector, delegates heard at the conference, which drew 270 participants from 28 countries.

The World Teak Conference brings together experts and decision-makers from government institutions, the private sector, universities, research institutes and local communities to share knowledge, experience and ideas on the many economic, social and environmental benefits that teak resources can provide.

The fourth edition of the event was jointly organized by the International Teak Information Network (TEAKNET), the Forestry Commission of Ghana, ITTO, the International Union of Forest Research Organizations, and the Food and Agriculture Organization of the United Nations under the theme "Global teak market: challenges and opportunities for emerging markets and developing economies."

The four-day programme included plenary discussions covering all aspects of teak management: genetics, seedling and trade, community farming and forest landscape restoration; side events organized by ITTO (Box 1), the International Forestry Students Association and the Forestry Research Network of Sub-Saharan Africa; and field trips to natural and plantation forests to get a closer look at the teak industry in Ghana.

Teak in Ghana

In the opening session, Samuel Abu Jinapor, Ghana's Minister of Lands and Natural Resources, commended the selection of his country to host the conference at a time when



A post-pandemic opportunity: Samuel Abu Jinapor, Ghana's Minister of Lands and Natural Resources, said cooperation can power development. Photo: P.K. Thulasidas

the world was recovering from the COVID-19 pandemic. This, he said, was an opportunity for governments and the private sector to work together to conserve natural resources, protect global ecosystems, support people's health and advance sustainable development—including through the utilization of teak.

The minister recounted how teak was introduced to Ghana around 1905, with seeds sourced mainly from India and Burma (now Myanmar). Today, teak covers about 70% of the forest plantations in Ghana, which has prioritized forest landscape restoration and commercial forest plantations. This year, about 5.2 million teak trees were planted under the country's Green Ghana Initiative on an estimated 200,000 hectares of government and privately owned land, Jinapor said.

The latest issue of ITTO Newsletter, Tropical Forest Update Vol 31 (3/4): 2022 carries a small article on the 4th World Teak Conference which was held at Ghana during 05 to 08 September 2022.

For details please see the below link

[Tropical Forest Update Vol. 31 \(3/4\)](#)

Prices of Plantation Teak Imported to India

Prices for recent shipments of plantation teak logs and sawnwood imported to India

Teak Logs	US\$ per cu.m C&F
Brazil	313-600
Colombia	245-615
Costa Rica	263-652
Ecuador	254-495
Gabon	370
Ghana	270-559
Guatemala	277-594
Ivory Coast	263-458
Mexico	322-439
Panama	252-539
PNG	389-595
Tanzania	344-930
Togo	259-532
S. Sudan	367-676
Nigeria	290-630
El Salvador	320-520
Solomon Island	248
Surinam	222

Sawnwood	US\$ per cu.m C&F
Benin	352-712
Brazil	489-777
Cameroon	974
Ghana	485
Ivory Coast	375-752
Mexico	373-585
PNG	492-677
Tanzania	471-1068
S. Sudan	342-633
Nicaragua	328-564
Myanmar	791-980

Price range depends mainly on length and cross-sections

Courtesy: ITTO TTM Report 26: 22; 16-30 Nov 2022

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Teaknet Bulletin is a quarterly electronic newsletter of TEAKNET brought out through its website. It is intended for circulation among the members of TEAKNET and other stakeholders of global teak sector. The views expressed in the newsletter are those of the authors and do not necessarily reflect the views of the organization. The readers are welcome to express their opinions or pass on information of value to teak growers, traders, researchers or others concerned with teak. However, TEAKNET reserves the right to choose the contributions for publishing and also to make necessary editorial modifications in the articles in consultation with the authors.

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