



FCPF - REDD+
VIETNAM



INTERNATIONAL CONFERENCE PROCEEDING

LINKAGE OF HIGHER EDUCATION, RESEARCH AND INTERNATIONAL INTEGRATION TO SUSTAINABLE FOREST MANAGEMENT AND BIOECONOMY

Hanoi, 12-13 November 2019



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FREFACE

In Vietnam, forests provide the bio-economy sector with its most important, versatile and affordable renewable raw material: wood. In 2018, exported value from wood and forest products reached USD 9.4 billion, finishing 2 years ahead of the target of the National Target Program on Forest Development. The Government strives to reach USD 11 billion by 2019, and USD 20 billion by 2025. Export of forest products accounts for 28% of the total export value of the agricultural and rural development sector, ranking 6th in the export sectors of our country. Vietnam became the leading country in ASEAN, the second in Asia and the fifth in the world of forest product exports, behind only China, Germany, Italy and Poland. A revised model of profitability and sustainability in forestry is needed to support long-term investment in forests and encourage political and societal appreciation for forest ecosystem services. The demands on Vietnam's forests for wood and bioenergy production will increase in the future, eventually depleting resources. Additionally, climate change projections indicate that frequency of extreme weather events like storms, heavy rainfall and droughts will increase, thus putting additional pressure on forest resources.

Vietnam has over 14 million hectares of forests, of which over 10 million hectares are natural forests mainly distributed in five ecological regions with coverage of 41.65% (VNFOREST, 2019). Currently, there are only about 240,000 ha of forest certified FSC generates a big concern on the sustainable high quality wood supply to secure the fast development of the wood industry, especially for exporting its products to US, EU and Japan.

Education develops a country's economy and society; therefore, it is the milestone of a nation's development. Education provides knowledge and skills to the population, as well as shaping the personality of the youth of a nation. Quality education plays a critical role in ensuring that the next generations of foresters are well equipped to face the multitude of challenges that a dynamic society and changing forest landscape will inevitably provide. Over the past 55 years, Vietnam National University of Forestry (VNUF) has many activities seeking to bring together perspectives and knowledge, to encourage international discussions on forest education and capacity building, to identify gaps in current forest education and to improve mobility and forest education opportunities.

The necessity of bioeconomy in Vietnam comes from global environmental issues and current economic development trends. Recently, the Government of Vietnam has issued important policies, which are considered an important legal basis for forest-based bioeconomy development such as National Green Growth Strategy, especially the process of restructuring the forestry sector towards diversifying and increasing the added value of forest products. This opens up many opportunities for cooperation between universities and research institutes in Vietnam and overseas. VNUF is the leading university in the field of forestry such as wood and other forest products processing technology, afforestation and agroforestry, forest and natural resource management, biodiversity conservation and ecotourism, and forestry policy will contribute significantly to the process of developing forest-based bioeconomy in Vietnam. VNUF and other universities in the world as well as the private

sector are very interested in these areas and finding collaboration opportunities among them is essential in the context.

The international conference on “Linkage of Higher Education, Research and International Integration to Sustainable Forest Management and Bioeconomy“ will be held in VNUF is dedicated to the improvement and dissemination of knowledge and understanding on methods, policies and technologies for increasing the sustainable forest resources management and bio-economy development. The lessons and experiences of forestry education from international institutions are also expected to be shared to help VNUF to improve its training programs to meet the society demand and labor market. Another objective is to promote the achievements of VNUF. The conference will also encourage regional and international communication and collaboration in the focus area amongst institutions in Vietnam and over the world.



AGENDA

International Conference

“LINKAGE OF HIGHER EDUCATION, RESEARCH AND INTERNATIONAL INTEGRATION TO SUSTAINABLE FOREST MANAGEMENT AND BIOECONOMY”

Hanoi, 12 - 13 November 2019

Venue: G6 Hall, VNUF

Chaired by:

1. Prof. Tran Van Chu - President of VNUF
2. Mr. Kari Kahiluoto - Ambassador of Finland Embassy in Vietnam
3. Prof. Pham Van Dien - Vice General Director of VNFOREST, MARD
4. Prof. Elena Kudryashova - Rector of NarFU, Russia
5. Mr. Vu Xuan Thon - Director General of MBFP

Moderator: Assoc. Prof. Hoang Van Sam - Director of ICD, VNUF

Secretaries: (1) Dr. Cao Thi Thu Hien (2) Dr. Duong Thi Bich Ngoc
(4) Dr. Phung Thi Tuyen (4) Dr. Ha Bich Hong

Date/Time	Contents	Responsibel by
Day 1. November 12th, 2019		
MORNING SESSIONS		
7.30 - 8.30	Registration	Organizing committee
8.30 - 8.35	Welcome and introduction of participants	Assoc. Prof. Dr. Tran Thi Thu Ha
8.35 - 8.40	Welcome speech of VNUF's President	Prof. Dr. Tran Van Chu <i>President of VNUF</i>
8.40 - 8.45	Statement of Embassy of Finland	H.E. Mr. Kari Kahiluoto <i>Ambassador of Finland</i>
8:45 - 8:50	Statement of Rector of NArFU, Russia	Prof. Dr. Elena Kudryashova <i>Rector of NArFU</i>
8.50 - 9.00	Statement of Management Board for Forestry Projects (MBFP)	Mr. Vu Xuan Thon <i>General Director of MBFP</i>
9.00 - 9.10	Keynote speaker: Vietnam Forestry: Present and Future Aspirations	Prof. Dr. Pham Van Dien <i>Deputy Director General, VNFOREST, MARD</i>
9.10 - 9.20	Keynote speaker: Global transformation in forestry: Diagnosis, consequences for research, extension and university teaching	Prof. Dr. Jürgen Pretzsch <i>TU Dresden, Germany</i>
9.20 - 9.30	Keynote speaker: ABS and Biodiversity conservation in Vietnam	Dr. Hoang Thi Thanh Nhan <i>MONRE</i>
9.30 - 9.45	Keynote speaker: How to respond to people's diversified needs for forests - JICA's efforts	Mr. Hiro MIYAZONO <i>SNRM Project - JICA</i>
9.45 - 10.00	Keynote speaker: REDD+ from preparation	Mr. Nguyen Huu Dzung

Date/Time	Contents	Responsibel by
	to Implementation in Vietnam	Ms. Nguyen Thi Thu Thuy Mr. Nguyen Viet Hung <i>FCPF - MBFP</i>
10.00 - 10.15	Keynote speaker: Application of advanced technologies on forest resources management in Vietnam	Assoc. Prof. Dr. Phung Van Khoa Assoc. Prof. Dr. Nguyen Hai Hoa <i>VNUF</i>
10.15 - 10.30	Plenary discussion	All participants
10.30 - 10.50	Group picture and Teabreak. Venue: <i>G6 Hall</i>	All participants
Session 1. Forest-based and Bio-economy Development		
Venue: G6 Hall Chaired by: 1. Assoc. Prof. Dr. Bui The Doi (VNUF) 2. Prof. Dr. Jürgen Pretzsch (TU Dresden) Secretaries: (1) Dr. Cao Thi Thu Hien (2) Dr. Duong Thi Bich Ngoc		
10.50 - 11.05	Forestry education in contemporary time: a call for adoption of result-oriented teaching and learning styles for sustainable development	Dr. Onyema, M. C Dr. Gideon A. N Dr. Okeke, N. C. Igwe <i>Federal University of Technology Owerri, Nigeria</i>
11.05 - 11.15	Agroforestry as a way forward for sustainable forest management in Vietnam?	Dr. Nguyen Quang Tan <i>ICRAF</i>
11.15 - 11.30	Simosol: designing forestry solutions in Finland specifically for Vietnam	Dr. Santiago Velásquez Dr. Jussi Rasinmaki <i>Simosol Oy, Finland</i>
11.30 - 11.45	Mapping timber value chains-A case of <i>Acacia hybrid</i> timber in central Vietnam	Ms. La Thi Tham Prof. Dr. Jürgen Pretzsch <i>PhD - TU Dresden</i>
11.45 - 12.00	Plenary discussion	All participants
Session 2. Sustainable Forest Resource Management		
Venue: Meeting D room, T10 building Chaired by: 1. Assoc. Prof. Dr. Hoang Van Sam (VNUF) 2. Dr. Oliver Wearn (FFI) Secretaries: (1) Dr. Phung Thi Tuyen (2) Dr. Ha Bich Hong		
10.50 - 11.05	20 years of conservation in Vietnam: A case study of challenges and success from Fauna & Flora International	Dr. Josh Kempinski Dr. Oliver Wearn <i>FFI Vietnam</i>
11.05 - 11.15	Forestry in the European North of Russia: The role of higher education in the development of sustainable forest management	Prof. Dr. Sergey Koptev <i>NArFU, Russia</i>
11.15 - 11.30	Conservation Enterprise and Sustainable Livelihood Development: Lessons Learned from the USAID Green Annamites Program	Dr. Daniel Lopez Dr. Do Quang Teo <i>USAID Green Annamite Program</i>
11.30 - 11.45	Biodiversity conservation of forest species of Kazakhstan	Prof. Dr. Svetlana Kabanova Dr. Vitaliy Kirillov

Date/Time	Contents	Responsibel by
		<i>Kazakh Research Institute of Forestry and Agroforestry</i>
11.45 - 12.00	Plenary discussion	All participants
12.00 - 13.30	Lunch	All participants
Venue: First Floor, T10 building		

AFTERNOON SESSIONS

Date/Time	Contents	Responsibel by
Session 1. Forest-based and Bio-economy Development (continues)		
Venue: G6 Hall		
Chaired by:		
<ol style="list-style-type: none"> 1. Assoc. Prof.Dr. Bui The Doi (VNUF) 2. Prof.Dr. Jürgen Pretzsch (TU Dresden) 		
Secretaries:		
<ol style="list-style-type: none"> (1) Dr. Cao Thi Thu Hien (2) Dr. Duong Thi Bich Ngoc 		
13.30 - 13.45	The importance of metallophytes in phytoremediation of mined out areas in Didipio, Nueva Vizcaya, Philippines	Dr. M.H. Ancheta Dr. M.O. Quimado Dr. C.L. Tiburan Prof. E.S. Fernando <i>University of the Philippines</i>
13.45 - 14.00	Scope of technological interventions in improving the productivity and commercialization of multi utility trees to mitigate climate change and rural upliftment	Dr. Vipin Guleria Dr. Amol Vashist Dr. Atul Gupta Dr. Puneet Chaudhary <i>Parmar University of Horticulture and Forestry, India</i>
14.00 - 14.20	Enhancing Impacts of Payment for Environmental Services on Forest Management: Experience of SNRM Project, REDD+ Pilot Implementation in Muong Gion Commune, Son La Province	Dr. Wataru Yamamoto Mr. Pham Van Hung Mr. Vu Van Tuan Mr. Nguyen Huu Tien <i>IDES Inc. Japan</i>
14.20 - 14.35	Adaptive Collaborative Approach in Forested Landscape Governance: Case study from A Luoi, Central Vietnam.	Dr. Trinh Le Nguyen Mr. Nguyen Ngoc Quang <i>Pan Nature</i>
14.35 - 14.50	Estimation of changes in mangrove biomass and carbon stocks from remotely sensed data-based models: Case study in Quang Ninh province	Assoc. Prof.Dr. Nguyen Hai Hoa <i>VNUF</i>
14.50 - 15.20	Plenary discusion	All participants
Session 2: Sustainable Forest Resource Management (continues)		
Venue: Meeting D room, T10 building		
Chaired by:		
<ol style="list-style-type: none"> 1. Assoc. Prof.Dr. Hoang Van Sam (VNUF) 2. Dr. Oliver Wearn (FFI) 		
Secretaries:		
<ol style="list-style-type: none"> (1) Dr. Phung Thi Tuyen (2) Dr. Ha Bich Hong 		
13.45 - 14.00	Enhancing Northeast British Columbia's boreal forest resilience and carbon storage	Dr. Christopher Hawkins Dr. Christopher Maundrell

Date/Time	Contents	Responsibel by
	in a changing climate	<i>Adlard Environmental Limited, Canada</i>
14.00 - 14.15	Outstanding achievements of Vietnam Forestry from 1991 to present; Potentials and advantages, opportunities and challenges for forestry development after 2020	Prof. Dr. Nguyen Ba Ngai <i>VIFORA</i>
14.15 - 14.30	Sustainable Plantation Management and Forest Certification for Small-household's Plantations- Opportunities and Challenges	Dr. Le Thien Duc <i>Center for Nature Conservation and Development</i>
14.30 - 14.45	Measuring sustainability of forestry development in Vietnam	Mr. Tomas Zuklin Ms.Vo Thi Phuong Nhung <i>VNUF</i>
14.45 - 15.00	Forest certification in Vietnam: Status, opportunity and challenge	Assoc. Prof. Do Anh Tuan <i>VNUF</i>
15.00 - 15.20	Plenary discusion	All participants
15.20 - 15.50 Tea break		
Venue: G6 Hall		
Venue: G6 Hall		
Chaired by:		
1. Asso.Prof.Dr.Bui The Doi (VNUF)		
2. Asso.Prof.Dr. Hoang Van Sam (VNUF)		
3. Dr. Jussi Rasinmaki (Simosol)		
Secretaries:		
(1) Dr. Cao Thi Thu Hien		
(2) Dr. Duong Thi Bich Ngoc		
(3) Dr. Phung Thi Tuyen		
(4) Dr.Ha Bich Hong		
15.50 - 16.05	Presentation of 2 paralel sessions	Chairs of Session 1 and Session 2
16.05 - 16.50	General discussion	All participants
16.50 - 17.00	Conclusion and Closing	Assoc. Prof.Dr. Bui The Doi <i>VNUF</i>

Day 2. November 13th, 2019

7.30 - 16.00	Field trip to Ba Vi National Park and Vietnam National Village for Ethnic Culture and Tourism (Ba Vi, Ha Noi)	Organizing commiitee
Day 3. November 14th, 2019		
8.30 - 11.30	Attend the 55th Anniversary of VNUF's foundation	

**LINKAGE OF HIGHER EDUCATION, RESEARCH AND
INTERNATIONAL INTEGRATION TO SUSTAINABLE FOREST
MANAGEMENT AND BIOECONOMY**

INTRODUCTION

Welcome speech of President of Vietnam National University of Forestry

Prof. Dr. Tran Van Chu

President of Vietnam National University of Forestry

Distinguished guests! Ladies and Gentlemen!

First of all, on behalf of the Vietnam National University of Forestry, I would like to welcome you to attend the International Conference on **“Linkage of Higher Education, Research and International Integration to Sustainable Forest Management and Bioeconomy”** on the occasion of the 55th Celebrations of the Vietnam National University of Forestry.



Your presence is a great encouragement for VNUF to further improve training, scientific research, and human resource development for the benefit of the country and its people! I wish you a good health, happiness and success!

Ladies and gentlemen! Vietnam National University of Forestry was established in 1964. Now our University is a leading university, a reputational scientific Center for Agriculture and Rural development, environmental protection, prevention and reduction of natural disasters, forest product processing, forestry economy, and thus contributing to the sustainable socio-economic development of the Country.

Looking back at the history of 55 years of development, the fundamental achievements of VNUF are as follows:

1. Training and education: VNUF has always been at the forefront of innovation of goals, programs, curriculum, teaching methods and scaling up professional development. So far VNUF has trained 40,000 engineers and bachelors, and more than 4,000 MSc and PhD students. Additionally, VNUF has trained more than 400 international students

The generations of academics trained by our University have been working in all parts of the country, representing the high reputation of our University.

2. Scientific and technology development: a great number of forestry scientists in the country are highly qualified, experienced and dedicated to lead both state and international projects.

The scientific research results of scientists are mostly applied and transferred to production. These achievements are highly appreciated by businesses and organizations. From the research results, VNUF scientists have published many articles and scientific publications in prestigious scientific journals. Scientific research and entrepreneurship have flourished among students.

3. International cooperation and integration: VNUF has been actively expanding cooperation relations with 120 international organizations and institutes around the world. VNUF is cooperating internationally in academic education for instance with the Colorado State

University in the English-thought Advanced Program for Natural Resources Management, and with Dresden University and Göttingen University in Germany in the Master's program in Tropical Forestry. Furthermore, the Sustainable Forest Resources Management and the Bioeconomy Program has the participation of 6 universities from Spain, Germany, Finland and Vietnam and is sponsored by the EU Erasmus+ Program. VNUF has received many international experts and volunteers coming to work here. It can be said that VNUF's international cooperation has never been so strong and effective as currently.

4. Effective implementation of training programs contribute to the protection and improvement of the ecological environment.

Proud to say that, there are only few universities having such beautiful and fresh scenery as VNUF in both campus in Hanoi and Dong Nai province.

5. Building organizations, developing human resources:

University has 3 campuses: the main campus in Xuan, Hanoi, and the second campus in Dong Nai Province. The 3rd campus will be established in 2020 in Gia Lai province, Central Highlands

VNUF regularly performs training and development of its staff, particularly lecturers and researchers. We have 900 staff members: There are more than 600 lecturers, among 8 professors, 200 associate professors and PhD. More than 100 staff are studying abroad. *Fully proud and saying that: VNUF has scientists who are very good at high level, specialized and adapt well to international integration.*

Ladies and Gentlemen! During 55 years of development, the University has been focusing on education, scientific research and human resources development. The achievements have been remarkable. However, with facing new challenges and opportunities; VNUF is required to define directions, solutions and actions to cope with the upcoming demands.

To accomplish the previously mentioned missions, it is necessary to pursue a strategy that is leading the university towards international integration. At this point, I would like to summarize the report about the development strategies of VNUF.

Orientation for developing the VNUF:

- VNUF is a reputable center for training, scientific research, cooperation and integration on an equal level with other universities in ASEAN and other countries in the world. Further develop VNUF with the aim to become a center of scientific research and technology having the ability to participate in solving the following challenges: The national strategies for the development and protection of forest resources, biodiversity, biotechnology, environmental ecology and processing and marketing of forest products.

- Engaging in international relations will be the key task of the University. The improvement of the quality and efficiency of international cooperations can lead to a breakthrough for international projects, publications, education programs. Furthermore, student and staff exchanges shall be expanded with universities within the region and the world.

- Strengthening of the interest for human resources development has to be linked with a planning review, training and retraining for the staff.

- By the means of an innovative basic and comprehensive education the university shall move step by step towards autonomous mechanisms. Applying solutions enhances the training quality and seems to be a trademark of VNUF. A key investment is planned to develop training programs in English for high-quality, advanced and associated students with guest lecturers from other countries.

- Develop the infrastructure and advanced technical facilities aiming modernize teaching and training service.

Ladies and gentlemen! With its achievements and objectives VNUF has contributed to the development of the forestry sector in particular and the country in general.

With high expectations regarding the following years, the International Conference on *"Linkage of Higher Education, Research and International Integration to Sustainable Forest Management and Bioeconomy"* is a great opportunity to exchange and share experiences; it gives us the opportunity to cooperate with colleagues and partners in its strategic objectives.

I hope that, there will be many documents, notes of exchanges, and agreements representing the cooperation between the VNUF and your side regarding the issues discussed today.

Once again, thank you for your great valuable contributions for the development of the Vietnam National University of Forestry.

Speech given by the Ambassador of Finland

H.E. Mr. Kari Kahiluoto

Ambassador of Finland

Prof. Tran Van Chu - President of Vietnam National University of Forestry Distinguished Guests

Ladies and Gentlemen!

I am honoured to have been invited here today to participate in the international conference on Linkage of Higher Education, Research and International Integration to Sustainable Forest Resource Management and Bio-economy.

Firstly, please allow me to take you a short journey to visit Finland.



The wealth of Finland derives largely from its forests, particularly from the wood-processing industry. The forestry sector has played the most important role in Finland's industrialization, trade, foreign export and for Finnish people. When you ask a Finn to describe his or her home country, you would receive the answer is that Finland has a lot of forests and lakes. Indeed, Finland has almost 200,000 lakes and forests cover more than 80% of the land area of Finland.

Forestry has provided a livelihood for more Finns than any other industry in the country since our independence in 1917. The forest industry covers around 20 percent of all exports in Finland and it is the third-biggest industry, after electronics and metal.

Besides wood products and paper as traditional segments, biomasses originating in forests are now being used to create textile fibers, medicines, chemicals, functional foods, cosmetics, smart packaging and biofuels, which form significant new segments of the modern forest industry. The high level of modern production technology and information technology used in the forestry sector today in Finland are widely recognized. To the Finns, besides its economic value, forests are also important for recreation, retreat and leisure. Forests hold an emotional and psychological value to us. It is very important that modern forestry combines economic, environmental and recreational considerations.

Because of our very long and close relationship with forests, we have become experts in the forestry, which makes Finland a true leader in bio-economy. We know how to optimize growth and increase productivity, how to manage forests in a sustainable way. We have already made joint efforts to develop knowledge, technologies and solutions that cannot be found anywhere else in the world. We have also developed first-class technologies related to processing of wood and we have come up with forest-based innovations such as xylitol. You know very well that xylitol is a sweetener produced from xylose, which is found in various trees and plants e.g. birch, beech, corn and berries. Xylitol has been approved by European Food Safety Authority to be a health claim and it is globally recommended to use it daily.

We also have the midnight sun in the summer and the aurora borealis in the winter. This is because we are located in the very Northern part of Europe.

Ladies and Gentlemen!

Finland was one of the first western countries to recognize unified Vietnam in 1973 just before the Paris ceasefire agreement and Vietnam has been one of Finland's main development cooperation partner countries for almost 4 decades. Finland is well-known and enjoys a positive image in Vietnam thanks to successful long-term development cooperation and the good results achieved in, for example, water and sanitation with a brand name "Finnish water" is well known to many people, rural development, poverty reduction, innovation and - of course - forestry with FORMIS system.

During the recent years, Vietnam has made a remarkable progress in economic development and has transformed into a lower middle-income country. Finland's grant-based bilateral development cooperation programmes ended in 2018. Since then, Finland has moved forward from aid to trade and beyond. The focus of bilateral relations between Finland and Vietnam is mutual beneficial cooperation.

Although the end of grant-based bilateral development cooperation marks an end of a certain area, I would like to emphasize the opportunities that are yet to be further explored to strengthen collaboration as Finland has knowhow and technology that are highly relevant to various priority areas of Vietnam's future development. I am very glad that there are a considerable amount of start-up in the broad forestry field. The future cooperation should not only limit itself to the private sector, but also scientific and research institutions as well as universities and other educational structures.

Ladies and Gentlemen, colleagues and friends!

Finland and Vietnam have become good and old friends. Our relations are on a solid foundation and there are lots of opportunities for further strengthening them. In this regard, I am very pleased to see the wide range of speakers and presenters coming from different parts in the world to share their experiences, lessons learned and best practices. This is true collaboration and cooperation, beyond aid.

I would like to take this opportunity to sincerely thank the Vietnam National University of Forestry for very good cooperation and wish you all a very good conference.

Thank you!

Speech given by the General Director of Management Board for Forestry Projects (MBFP) Mr. Vu Xuan Thon

Mr. Vu Xuan Thon

Director general of the Management Board for Forestry Projects

Distinguished guests! Ladies and Gentlemen!

First of all, on behalf of the Management Board for Forestry Projects (MBFP), I would like to send my best wishes to all participants of this international conference.

Ladies and gentlemen!

Vietnam has over 14 million hectares of forests, of which over 10 million hectares are natural forests mainly distributed in five ecological regions with coverage of 41.65% (VNFOREST, 2019). In recent years, forestry is gradually becoming an important economic industry contributing to the total income of the agricultural sector. In 2018, exported value from wood and forest products reached USD 9.4 billion. The Government strives to reach USD 11 billion by 2019. Export value of forest products accounts for 28% of the total export value of the agricultural and rural development sector, ranking 6th in the export sectors of our country. Obtaining such important achievements, there is an important contribution of the higher education.



Education develops a country's economy and society; therefore, it is the milestone of a nation's development. Education provides knowledge and skills to the population, as well as shaping the personality of the youth of a nation. Quality education plays a critical role in ensuring that the next generations of foresters are well equipped to face the multitude of challenges that a dynamic society and changing forest landscape will inevitably provide.

In the context of general international integration, Vietnam's forestry industry is also actively transforming to meet practical needs. Recently, the Government of Vietnam has issued important policies, which are considered as an important legal basis for developing forest-based bioeconomy such as the National Green Growth Strategy, especially the restructure process of the forestry sector, improve the policy of forestry seedlings, improve the processing and trade of forest products, protect the watershed areas... develop the forestry sector of Vietnam sustainably in terms of economic, society and environment, gradually transforming the growth model towards improving quality, efficiency and competitiveness.

Therefore, the close Linkage between higher education, enterprises, governmental authority and forest owners is naturally and importantly needed to implement these national targets above. This linkage will help the higher education orienting the students with existing practical problems, help students to quickly understand the practice and get familiar with the job demand after graduation. Besides, it also helps employers to access high intellectual staffs, with advanced scientific and technical foundation to improve the quality of work and its performance efficiency.

Ladies and gentlemen!

MBFP is an organization under the Ministry of Agriculture and Rural Development. The management board has the function of preparing, receiving and implementing projects and programs using ODA funds, counterpart funds and other fund sources in the field of forestry and rural development which are supported by the Ministry of Agriculture and Rural Development. At present, MBFP are implementing 12 projects from donors such as JICA; WB, KfW, ADB, USAID....

During the past few years, MBFP and Vietnam National University of Forestry (VNUF) have close links such as: MBFP and VNUF have signed MOU on collaborating in research, training and development; Collaborate with VNUF in implementing some research projects relating to forestry; Collaborate in organizing many forestry related workshops at both international level and national level; Develop 2 curriculums for forestry students with supports from VFD experts, VNUF professors and experts from US Forest Service. These curriculums have been approved by VNUF to officially integrate into training programs for 4 faculties/ colleges in VNUF.

MBFP is also an organization with many technical staffs/ officials have been trained at VNUF or with forestry major. Therefore, MBFP really want to cooperate with higher educations and receive more excellent students who are able to catch up with the international development.

Ladies and gentlemen!

By joining this international conference, we want to hear more opinions from participants and wish to strengthen the linkage in future between MBFP and other universities, governmental authorities, donors and to improve the quality of higher education and successfully implement the national strategy on forestry.

On behalf of the MBFP leadership, we would like to wish you good health, wish to all of us fruitful discussions and a successful conference.

Thank you!

Speech given by the Rector of the Northern Federal University of Lomonosov, Russia

Prof. Dr. Elena Kudryashova

Rector of the Northern Federal University of Lomonosov, Russia

Dear Mr. Rector, Prof. Dr. Tran Van Chu

Dear colleagues,

We consider it a special honour to be here, in Vietnam National University of Forestry. On behalf of Northern Arctic Federal University, we would like to congratulate You on the opening of the International Conference, dedicated to such an important topic for the global society as “Linkage of higher Education, Research and International Integration to Sustainable Forest Management and Bioeconomy”.

First of all, I would like express our deep gratitude to Mr. President of Vietnam National University of Forestry Professor Tran Van Chu for his recent visit to our university, outstanding presentation given to our faculty and his kind invitation to take part in the Conference. We immensely appreciate the opportunity to meet outstanding international experts in various aspects of forestry.

Historically, the Arkhangelsk region has been the center of wood processing and pulp and paper industry. Established on the basis of Arkhangelsk State Technical University, whose primary focus was forest engineering, NArFU strives to maintain its traditions of excellence in this field and remains the key center of staffing for the regional forestry enterprises.

Today we are eager to embrace this wonderful chance to participate in the conference in order not only to learn from highly experienced experts in the field, which will be undoubtedly useful to us, but also introduce our colleagues to our perspective on forestry in the European North of Russia and the role of higher education in the development of sustainable forest management.

I would also like to emphasize that we especially appreciate the opportunity to congratulate Vietnam National University of Forestry on the 55th anniversary of its foundation ceremony, which will be celebrated on 14 November. Indeed, there is no better way to celebrate the jubilee of a higher education institution with strong academic traditions than by organizing a meeting of inspired scholars and highly skilled professionals. We sincerely hope that the upcoming Conference will bring us all satisfying outcomes and will become a true celebration of our host university, as well as everything and everybody connected with forests, their potential, present and future.

I thank you for your attention and wish to all of us fruitful discussions, new ideas and inspiration!



**LINKAGE OF HIGHER EDUCATION, RESEARCH AND
INTERNATIONAL INTEGRATION TO SUSTAINABLE FOREST
MANAGEMENT AND BIOECONOMY**


KEYNOTE SPEAKERS

Vietnam Forestry: Present and Future Aspirations

Prof.Dr. Pham Van Dien
Deputy Director General, VNFOREST

VIET NAM FORESTRY
PRESENT AND FUTURE ASPIRATIONS

Prof.Dr. Pham Van Dien
DDG of VnForest


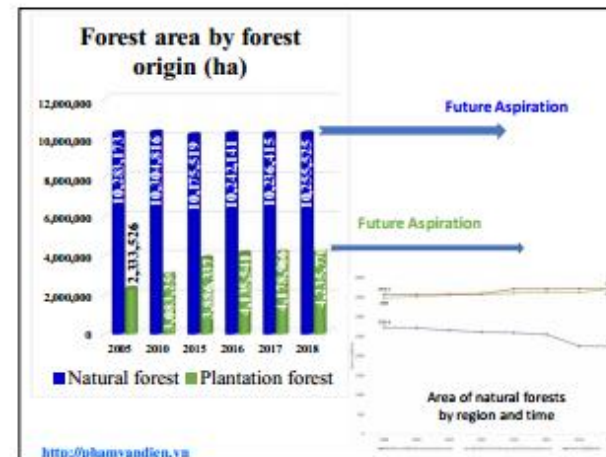
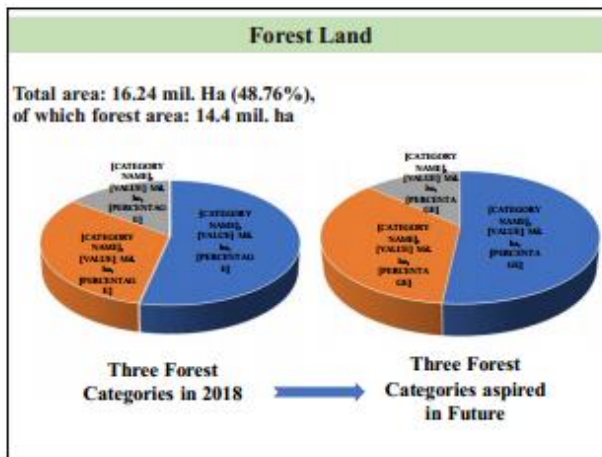


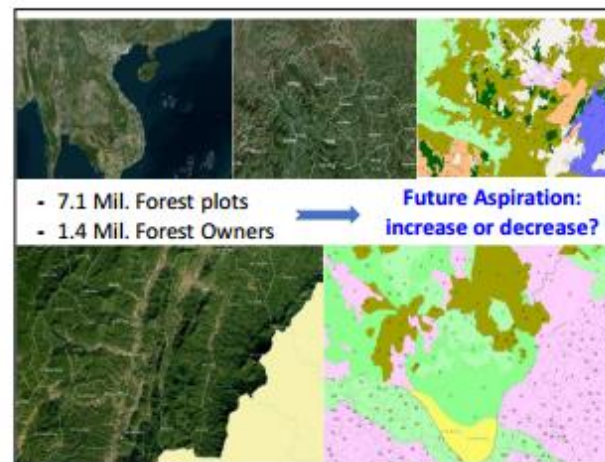
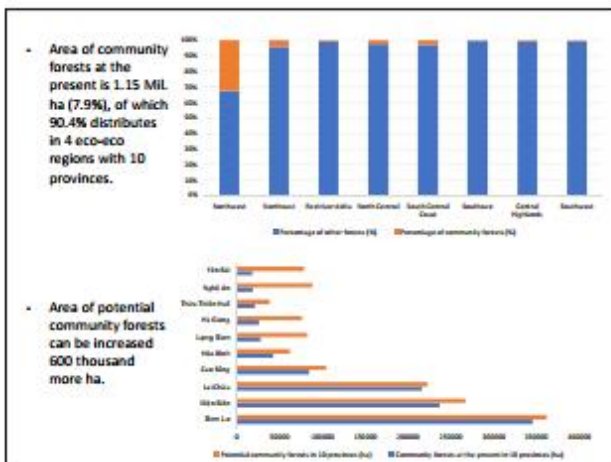
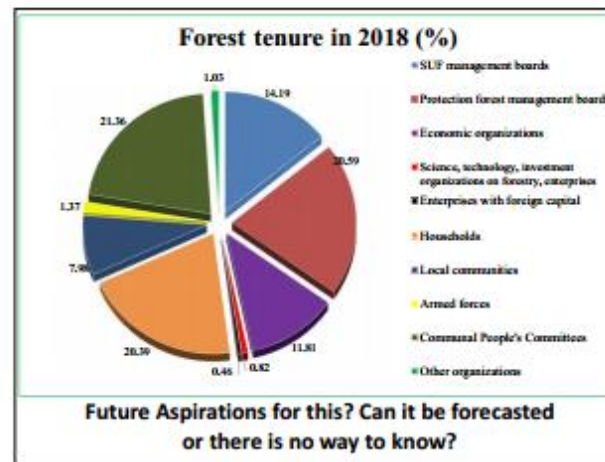
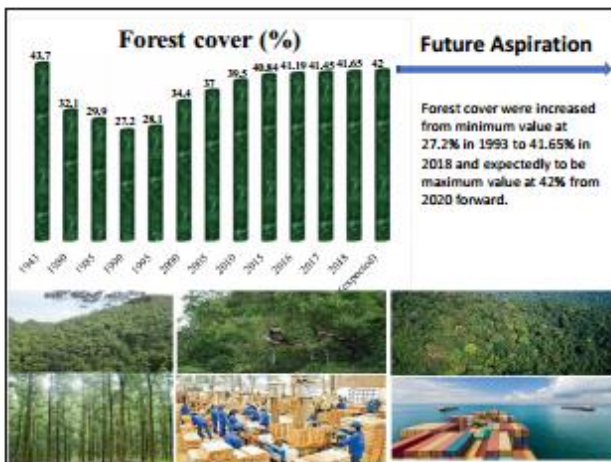
"... Forests are gold, if we know to protect and develop them well, they will be very precious ..."

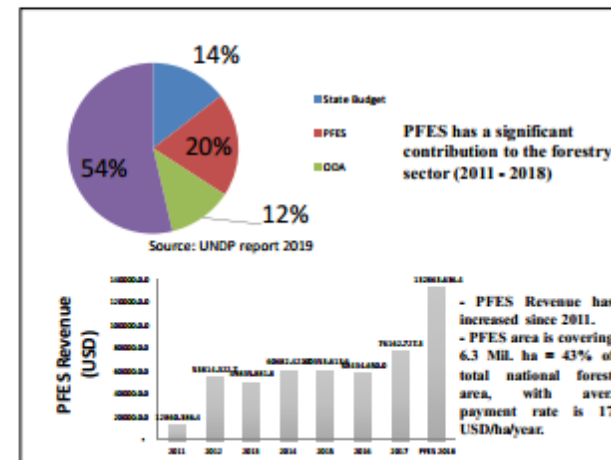
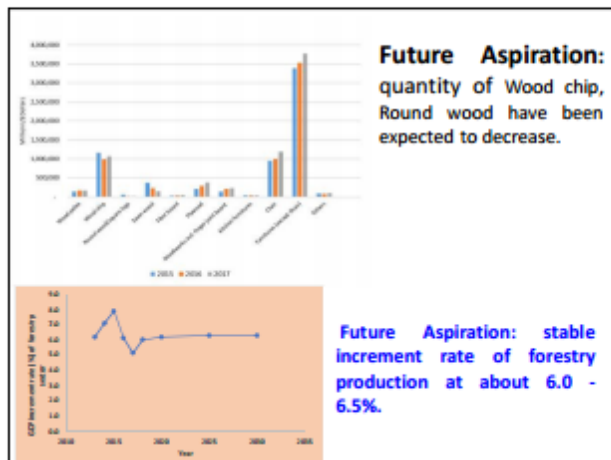
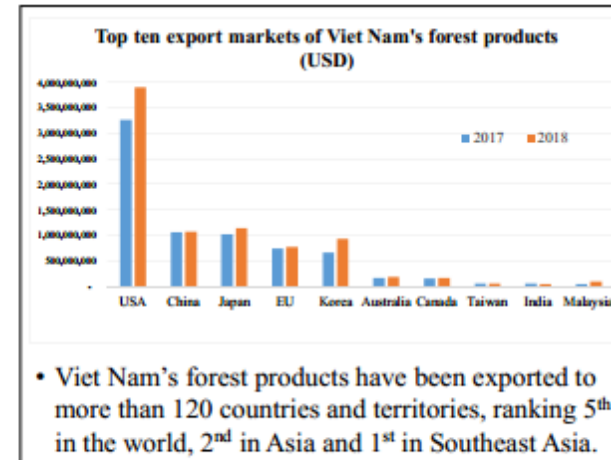
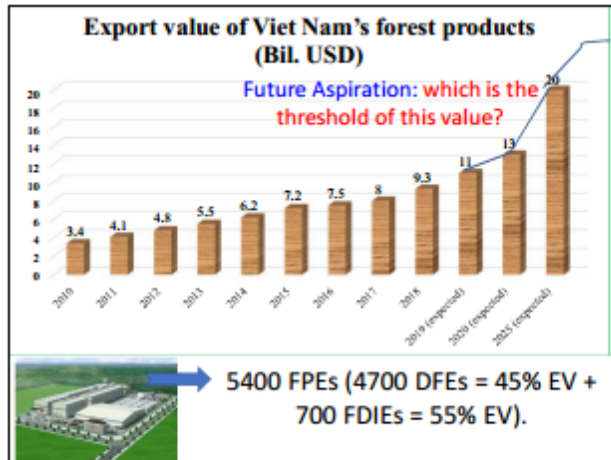
<http://phamvandien.vn> (President Ho Chi Minh, 1963)

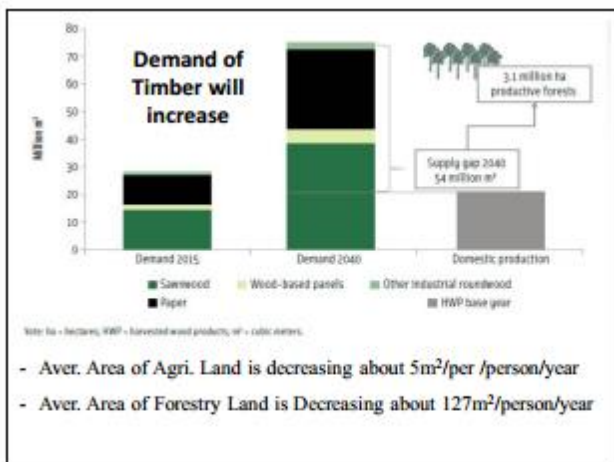
Outline

Some highlighted features of Viet Nam Forestry at the present and of future aspirations will be parallely figured out in the presentation.







Orientation of Forestry Sector Restructuring

- ✓ Strengthening the system of forests.
- ✓ Increasing the added values of the sector, including adoption of a value-chain based production approach throughout stages of supply chain from harvesting to processing and marketing; development and promotion of forest quality; and development of timber processing industry.
- ✓ Reforming economic entities in the forestry sector.

<http://phamvanden.vu>

Objectives of Target Program for SFD for the 2016-2020 period

ECONOMY

- To increase production value up to 5.5-6.0%;
- To improve aver. plantation productivity to 20 m³/ha/year;
- To increase forestry product export turnover to 8.0-8.5 bil. USD.

ENVIRONMENT

- To increase forest cover up to 42%;
- To increase the area of different forest categories to 14.4 mil. ha.

SOCIETY

- To maintain stably 25 mil. jobs
- To increase income and improve livelihoods for forest owners.

Which ways for forestry of natural and plantation forests?

Natural Forests

- Environmental Forestry
- Conservative Forestry with extraction (NWFPs).

Plantation Forests

Economic Forestry linked to Environmental Forestry

Sustainable Forestry

The Green of Mountains and Forests contains the Green of our Aspiration. This will help us to continuously write the beautiful songs about the close relationships among people, forests, and country for prosperity and peace of the world.

General Aspirations for the Future of Viet Nam Forestry

- A sustainably and smartly technical - economic sector; having a high effectiveness and contribution in national economy; is "the pole" for green economy; developing value chains of forest products which bases on markets as *the attraction*, on wood processing as *the dynamic*, and on forestry socialization and integration as *the repulsion*.
- Paying much more attention on the quality, quantity and core values of forests.
- Developing to have a high rank and prestige in the global value chains of forest products.

**Thank you very much
for your attention!**

<http://phanvandien.vn>

Global transformation in forestry: Diagnosis, consequences for research, extension and university teaching

Prof. Dr. Jürgen Pretzsch
 Technische Universität Dresden


TECHNISCHE UNIVERSITÄT DRESDEN
 Faculty of Environmental Sciences, Department of Forest Sciences
 Institute of International Forestry and Forest Products, Chair of Tropical Forestry

DRESDEN CONCEPT

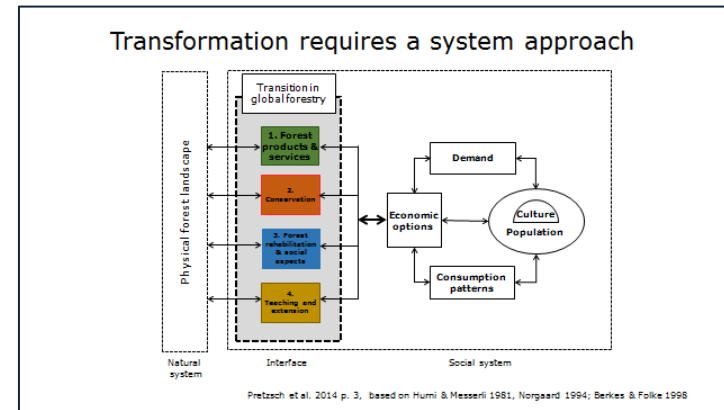
Vietnam National University of Forestry, Xuan Mai, Ha Noi, Vietnam, 12 – 13 November 2019

International Conference: Linkage of higher education, research and international integration to sustainable forest resources management and bioeconomy

Global transformation in forestry: Diagnosis and consequences for research, extension and university teaching

Jürgen Pretzsch


<http://www.forst.tu-dresden.de/Inter>



The implementation gap: Instruments are available, but not implemented in a proper way

Normative dimension: how forestry should be

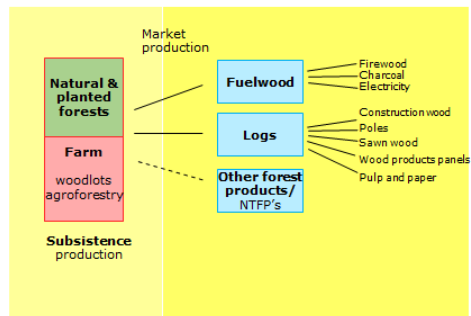
International Conventions, Green economy, SDG's

High complexity, actors are not reached, implementation gaps

Real world: What happens on the ground



1. Elements of the forest-wood cluster



1. Forest sector Vietnam

- Vietnam forest area (2018): 14.4 Mio ha (10.2 natural forest; 4.2 forest plantation)
- Timber production (2018) 27.5 Mio m³ (plantation 18.5 Mio)
- Import 9.7 Mio. m³ raw/round wood material
- Population 97 Mio. (2018)
- Export value of wood products around 9.3 Bio US\$

(MOARD, 2019)

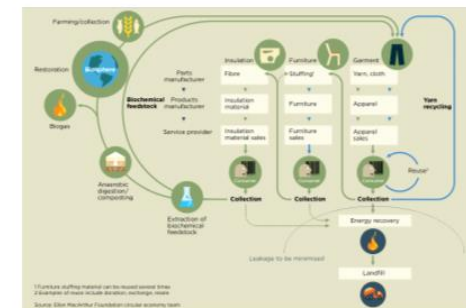
The Vietnamese Woodcluster is a very strong sector. Statistics are not complete.

1. Forest products & services

Transformation paths:

- Increase of forest production
- Upgrading of value chains and formation of forest product utilisation clusters (furniture, bamboo etc.)
- Follow a circular economy; create cascade uses
- Rank welfare orientation higher than profit interest (state intervention necessary)
- Integrate local (rural) people & minorities in value chains
- Entrepreneurship

1. Cascading keeps materials in circulation for longer – textile example



MacArthur Foundation 2013

1. Small wood scale industry: undercapitalized



1. Chopstick company, Thanh Hoa province



1. Bamboo furniture company, Thanh Hoa province



1. Agreement for future research cooperation:
Joint MARD/BMBF/Client project on bamboo
value chains



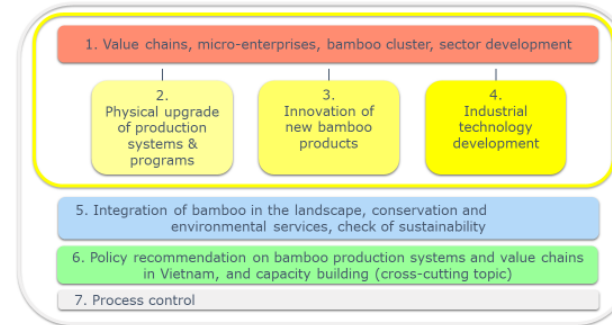
1. Participative Innovation Platform for BambooValue



2. Conservation

- Rapid transformation of the demand of forest products and services
- Development towards post-materialist forestry around urban areas
- Increasing demand of the urban middle class
- Limits of multiple use forest; more segregation is suggested
- More integration of local people in conservation

1. Research Focus: BambooValue



2. Natma Taung National Park Myanmar as a model



2. Mount Victoria (~ 3000m) as a world heritage site



2. Challenge for Biodiversity conservation:
Rhododendron forest on the higher elevations



2. Settlement in and around the park



2. Abundant traditional knowledge of the Chin ethnics





2. Find results in co-management of park resources



2. Use of the Participative Innovation Platform (PIP) as process oriented negotiation instrument



3. Forest rehabilitation & social aspects

- Sustainable use of the land
- Ownership and access rights of local farmers lead to motivation
- Social organisation for empowerment, collective learning and at the same time cost reduction (price/quantity relation)
- Livelihood satisfaction partly based on forestry
- Payment for ES



Elinor Ostrom

Nobel price economic sciences in 2009

Died 2012

Institutional elements of common property resource management

© The Nobel Foundation. Photo: U. Mattan

3. Village in Hoa Binh Province/Vietnam Community vs. Forest user group forest management

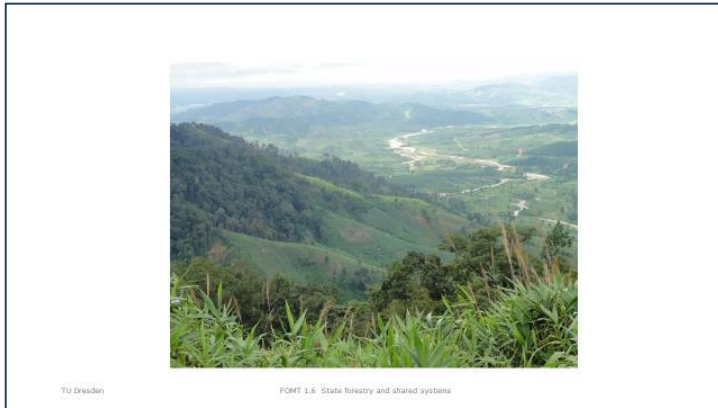


3. Steep slopes require permanent forest cover (Hoa Binh Province)



3. Discussion about organizational structures Binh Province/Vietnam





4. Forestry teaching and extension
- Long history of teaching between VNUF and TU Dresden/Tharandt
 - Transformation of study contents and teaching practices
 - Formal education enriched with more practical examples for job qualification
 - Student projects about land use planning, value chain upgrading, sustainable forest use systems
 - New narratives to convince students to study forestry
 - Dynamics in concepts and innovation by the exchange of international lecturers and students

4. First matriculation of Vietnamese students in 1961



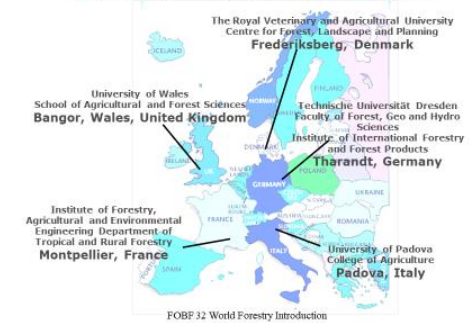
4. Prof. Löschau examining a Vietnamese student in forest inventory in the tropics



4. First batch of the new M.Sc. Tropical Forestry in 1995



4. SUTROFOR Master Programm: Five partner universities in Europe



4. Agreement on the Master Programm



4. VNUF cooperation: Important Focus of international forestry knowledge exchange



4. Innovative knowledge transfer: Socio-economic Field Laboratories (SFL)

Platform for „knowledge exchange“ among local forest users, scientists, students, state authorities, NGOs, and other stakeholders, combining traditional, local and scientific knowledge



4. Structuring results during break down of the bus



4. Innovative study contents and
Engagement of students in the civil society



4. 55 years Tropical Forestry course in Tharandt: Students
have many ideas about the future of this planet



4. They define and require new narratives about
global forestry



Some final conclusions

Long term cooperation and trust building:
Forestry experts from Vietnam and GDR



Invitation to 40 years of Vietnam Forestry
University



Signing follow up cooperation agreement in 2004



Today relations are less formal and conditions for
transformation more flexible ... but forest teaching
institutions need much self initiative for change



Nice cooperation, but urgent and more rapid transformation is essential in the sector and at VNUF

1. Innovation in forest resource use and utilization towards value added and sustainable use systems (Green economy)
2. Adapt conservation to the future needs of the country
3. Further develop forest production systems (community forestry, outgrower schemes, cooperatives)
4. Redefine forest teaching and make forestry more attractive as career; use innovative teaching methods and internationalize more (progress in English was too slow in the last 20 years at VNUF!)



Thank you

Facebook
www.facebook.com/TropicalForestry/

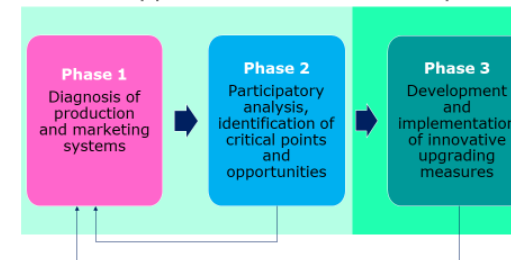
Alumni-Facebook „Tropicana“
<https://www.facebook.com/groups/TropicanaAlumni>

Blog
<https://tropicalforestry.wordpress.com/>

Web:
<https://tu-dresden.de/bu/umwelt/forst/inter/tropen>

Contact:
pretzsch@forst.tu-dresden.de

Initiate transformation: New cooperation instruments like the Participative Innovation Platform (PIP) can be more applied and further developed.




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ABS and Biodiversity conservation in Vietnam

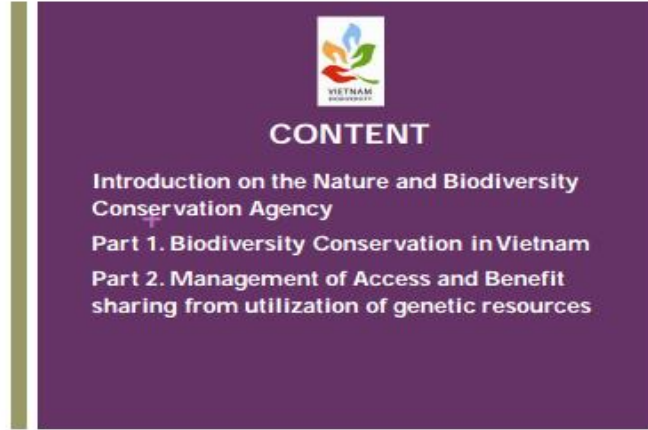
Dr. Hoang Thi Thanh Nhan

Ministry of Natural Resources and Environment



**BIODIVERSITY CONSERVATION AND ACCESS
GENETIC RESOURCES MANAGEMENT IN VIETNAM**

Dr. Hoang Thi Thanh Nhan
Deputy Director
Nature and Biodiversity Conservation Agency (BCA)
Vietnam Environment Administration (VEA)




CONTENT

- Introduction on the Nature and Biodiversity Conservation Agency
- Part 1. Biodiversity Conservation in Vietnam
- Part 2. Management of Access and Benefit sharing from utilization of genetic resources

+ INTRODUCTION TO BCA

- **BCA: Nature and Biodiversity Conservation Agency**
- **Function: support MONRE:**
 - + Focal point of CBD, Ramsar Convention, ABS protocol, Cartagena Protocol
 - + Formulate policies and regulations on BD: Law, Strategy, action plans, secondary regulations (Decrees, circulars...)
 - + Provide guidances and management of BD planning, natural landscapes, protected areas (wetland), endangered species, invasive species, biosafety, ABS...
 - + Monitoring implementation of NBSAP



**PART 1.
BIODIVERSITY CONSERVATION IN
VIETNAM**



BIODIVERSITY

- Locates in Indo-Burma biodiversity hotspot
- S = 331.210 km²
- Ranked 16th on species diversity
- 63 Important bird areas
- 6 of 238 world eco-regions

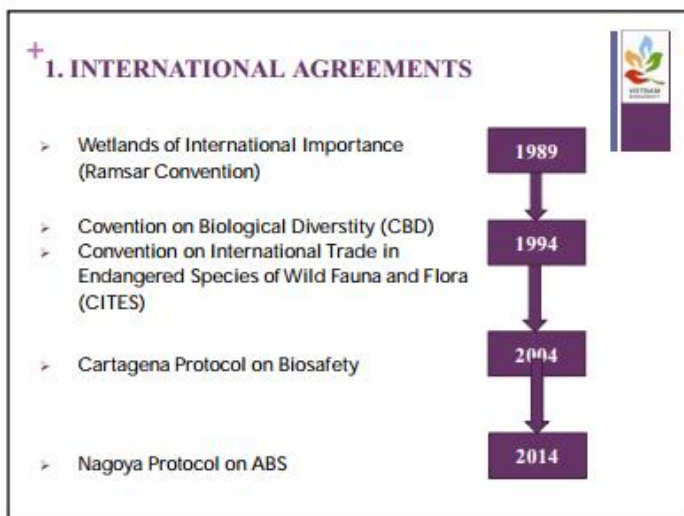
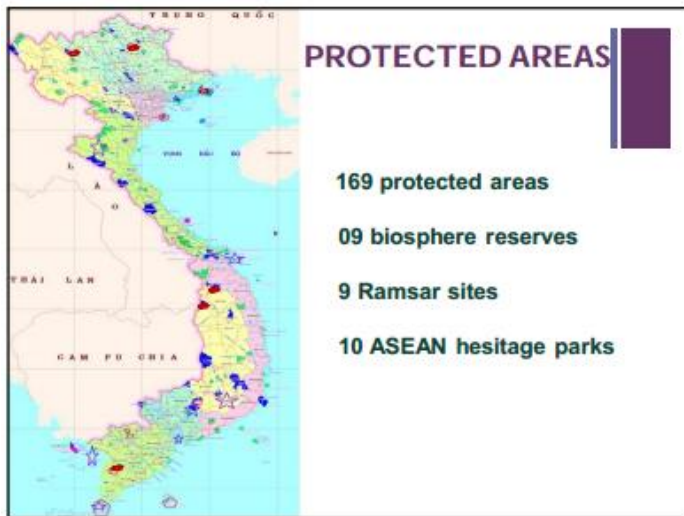
+ DIVERSITY OF ECOSYSTEMS

95 terrestrial ecosystem types;
39 wetland ecosystem types,
20 marine ecosystem types.

+ DIVERSITY OF SPECIES

More than 51.000 identified with high number of endemic species

New species continue being discovered (344 species during 2014-2018)



+ 2. LEGAL FRAME WORK

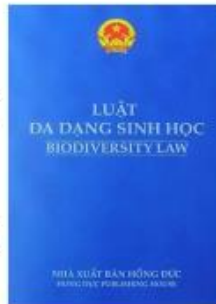
- > The Biodiversity Law, 2008;
- > The Environmental Protection Law, 1993 (amended in 2005, 2014);
- > The Forestry Law, 2017
- > The Fisheries Law (amended in 2017);

+2. LEGAL FRAME WORK



❖Regulates main Issues :

- ✓Biodiversity conservation planning
- ✓Conservation and sustainable development of natural ecosystems, species, genetic resources
- ✓International cooperation on biodiversity
- ✓Mechanisms and resources for biodiversity conservation and sustainable development



+ 3. NATIONAL BIODIVERSITY STRATEGY TO 2020, VISION TO 2030 (NBSAP 2013)



> **On July 31, 2013:** The Prime Minister officially signed the Decision number 1250/QĐ-TTg

> **Target to 2020:** That naturally important ecosystems, endangered, rare, and precious species, and genetic resources are preserved and used sustainably, contribute to the development of the green economy, and actively respond to climate change.

> **Vision to 2030:** 25% of degraded ecosystems of national and international significance will be restored. Biodiversity shall be conserved and used sustainably, bringing major benefits to people and contributing significantly to the country's socio-economic development.



+3. NATIONAL BIODIVERSITY STRATEGY TO 2020, VISION TO 2030 (NBSAP 2013)




MAIN TASKS :

1. Conservation of natural ecosystems
2. Conservation of wildlife and endangered species
3. Sustainable use, fair and equitable access, and sharing of benefits derived from ecosystems and biodiversity
4. Control activities that have negative impacts on biodiversity:
5. Biodiversity conservation in the context of climate change

+ 4. PROMOTE SCIENCE RESEARCH, TECHNOLOGY DEVELOPMENT AND TRANSFER TO IMPLEMENT THE NBSAP



- Research on conservation and sustainable use of biodiversity, including ecosystem conservation and restoration, endangered species rescued and reintroduced to wild environment, conservation of genetic resources, eco-tourism and payment of ecosystem services.
- Develop and transfer new technology for sustainable use of biological resources and biodiversity conservation
- Biodiversity inventory and monitoring
- Bio-prospecting



PART 2. MANAGEMENT OF ACCESS AND BENEFIT SHARING FROM UTILIZATION OF GENETIC RESOURCES

- ### + 1. DECREE 59/2017: SCOPE AND REGULATED ENTITIES
- **Scope:**
 - Applied to all GRs being accessed for utilization purpose, including biochemical compounds and derivatives thereof (Art. 3.11, Decree 59):
 - Definition of "utilization of GRs", "biotechnology", "derivatives":
 - Not covered: GRs for direct usage (eg. purchase of herbal plants for tea bags production, no R&D involved)
 - TK not included.
 - **Regulated entities:** Applies to individuals and organizations engaged in activities related to access to GRs for the purpose of utilization for research or development of commercial products.
- 

- ### + KEY ELEMENTS
- **National Focal Point on the Nagoya Protocol:** MONRE
 - **National Competent Authorities** to grant, renew and withdraw licenses to access GRs: MARD (GRs of plant varieties, livestock breeds, aquatic species and forest seedlings) and MONRE (remaining GRs)
 - **ABS procedures:** i) Contract for access to GRs and benefit-sharing; ii) Appraisal and granting License to access GRs; iii) Content and duration of License to access GRs; iv) Transfer of genetic resources to a third party;
 - **Renewal and withdrawal of license** to access GRs;
 - **Other requirements** for Vietnamese students, or Science and Technology organizations who wish to transfer GRs abroad for study
 - **Mechanism for sharing of benefits** arising from the utilization of GRs;
 - **Reporting mechanism** on ABS

+ Vietnam ABS - Clearing House

<http://vietnamabs.gov.vn>
National focal point's contact: hoangnhan.nbca@gmail.com



How to respond to people's diversified needs for forests - JICA's efforts

Mr. Hiro MIYAZONO

Sustainable Natural Resource Management Project - JICA



How to respond to people's diversified needs for forests
- JICA's efforts in Vietnam -

VNUF International Conference
12 November 2020

Hiro Miyazono
Chief Technical Advisor
SNRM

Contents

- Brief history of JICA's cooperation in Vietnam
- What is SNRM aiming for?
- What's next in Vietnam?

2

Brief history of JICA's cooperation

- JICA's cooperation in Vietnamese forestry sector started in 1992 along with resumption of Japan's ODA to Vietnam.
- Since then, a number of forestry projects have been executed in response to the country's and people's needs through various cooperation schemes, including Technical Cooperation, Grant Aid and ODA Loan.

1990s

2000s

2010s


2020s

- Re-afforestation
- Forest policy formulation and R&D
- Community forestry
- Non-timber forest products
- Coastal area protection
- Watershed management
- Biodiversity conservation
- Climate change mitigation and adaptation

What's next?

3


Geographical distribution of JICA's cooperation



4

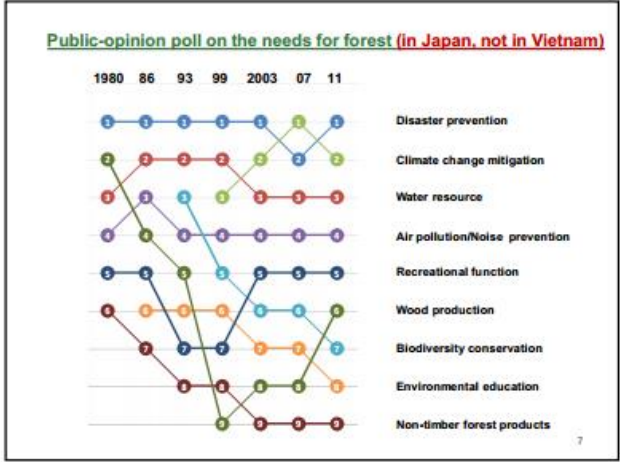
What SNRM is aiming for?

- Objective of SNRM**
 To enhance the national capacity for sustainable natural resource management by focusing on forests, biodiversity and the people who depend on these natural resources for their livelihood.
- Four (4) Components**
 - Policy support
 - Sustainable Forest Management and REDD+
 - Biodiversity conservation
 - Knowledge sharing
- Main counterparts**
 - MARD
 - MONRE
 - 4 Provinces in Northwest (Dien Bien, Son La, Hoa Binh and Lai Chau)
 - Lam Dong Province
- Project period**
 5 years (Aug 2015 – Aug 2020)



SNRM's case on the Public-Private Partnership (PPP)

SNRM (Technical Cooperation Project) in combination with JICA's PPT program (SDGs business support program) is supporting a Japanese private company (Usui Nouchikusan) to establish sustainable supply chain of *May Cha* bamboo.

What's next in Vietnam?

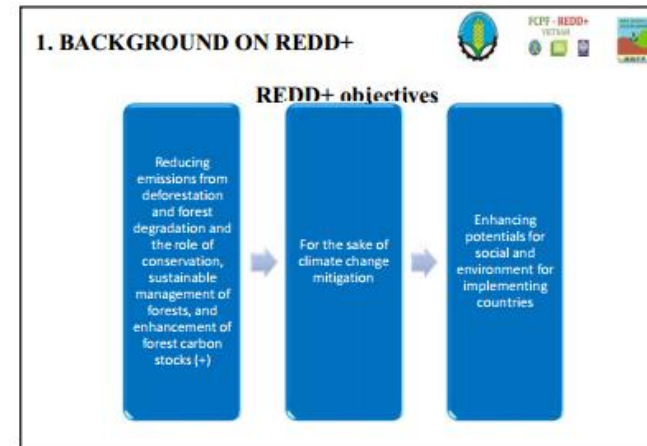
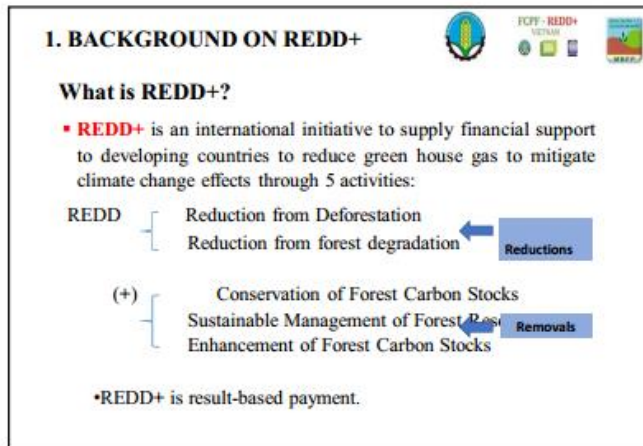
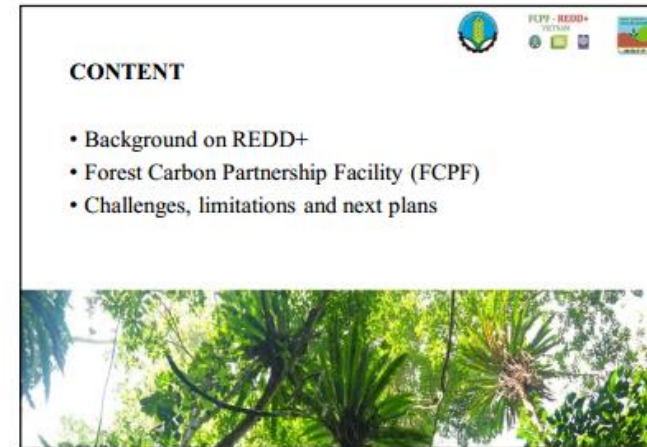
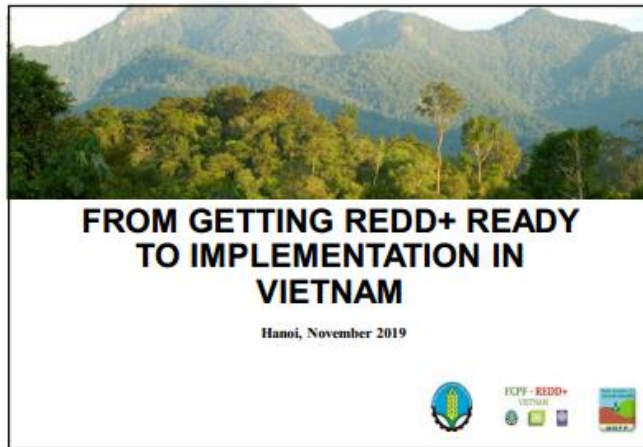


Xin cảm ơn
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REDD+ from preparation to Implementation in Vietnam

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Forest Resource Monitoring System- MBFB



1. BACKGROUND ON REDD+

Decision 1/CP.16 taken during COP16 in Cancun request to implement REDD+ activities in three phases and in the country context.

Phase 1: Readiness
Countries design national strategies and action plans with relevant stakeholders, build capacity for REDD+ implementation, work on policies and measures for REDD+ implementation and design demonstration activities.

Phase 2: Implementation
National strategies, policies and action plans approved in Phase 1 are implemented and activities. This phase may include results-based demonstration activities and involve additional training, building, technology development and transfer.

Phase 3: Results-based actions
Results based REDD+ actions are supported/implemented at the national level and results are fully measured, reported and verified.

VIET NAM

1. BACKGROUND ON REDD+

Results of 4 pillars under Warsaw Framework

- NRAP (Decision 799/TTg in June 2012)
- Replaced NRAP (Decision 419/TTg in April/2017)
- 20 PRAP
- 12 REDD+ Provincial Steering Committees
- SIS phase 1 was operated. The first SOI was approved by MARD at 4788/QĐ-BNN-TCLN dated 5 Dec. 2018 and submitted to UNFCCC in Jan. 2019

- NFMS and MRV are being developed and improved
- FREL/REL was developed and submitted to UNFCCC in Jan. 2016 and completed technical assessment in Apr. 2017

1. BACKGROUND ON REDD+

- ❖ **4 pillars under Warsaw Framework for REDD+:**
- Vietnam is the first country in Asia to have completed the Warsaw framework for REDD+, meeting the UNFCCC requirements.
- Vietnam have enough conditions to receive REDD+ results payment.
- ❖ **Project on Support for the REDD+ readiness preparation**
Vietnam's R-PP was approved by FCPF in Nov. 2011 and Project FCPF phase 1 started with \$3,8 mil. in 2013.
- ❖ **Emission Reduction Program (ER-P)**
- Project FCPF-2 supported to develop and submit ER-P to Carbon Fund to enter the pipeline for result payment. ER-P was approved by Carbon Fund at Resolution CFM/17/2018/2.
- FCPF committed to buy 10,3 mil. tons of CO₂ (estimated 5 USD/ton of CO₂)

1. BACKGROUND ON REDD+


Vietnam REDD+ Vision

- Contribute to reducing greenhouse gas emissions through REDD+ activities; expand the forest cover to 42% and reach 14.4 million hectares of forest by 2020;
- Meet the requirements of REDD+ readiness, ensuring there is capacity to access financial resources for results-based payments as per international requirements;
- Contribute to improve forest governance, create jobs, improve the living conditions of the people associated with the New Rural Programme and ensure security and national defense;
- Improve the quality of natural forests and planted forests to increase carbon stock and environmental forest services; replicate effective models of forest plantation; sustainable management, protection and conservation of natural forests.

Period 2017-2020

1. BACKGROUND ON REDD+


Vietnam REDD+ Vision



Stabilize the natural forest area by 2030 at, at least, the same level as 2020, and increase forest cover up to 45% of national territory, contributing to realize the national target of reducing total greenhouse gas emissions by 8% by 2030 compared with business as usual (BAU) scenario as committed in the Paris Agreement on climate change. This contribution may increase to 25% if receiving international support;

Period 2021 - 2030

- Replicate highly effective models on REDD+ and sustainable forest management, integrate fully REDD+ into sustainable forestry development programmes;
- Complete policies, laws and action framework of the REDD+ programme and access financial resources for results-based payments in accordance with international requirements.



2. FOREST CARBON PARTNERSHIP FACILITY (FCPF)

2.1. Forest Carbon Partnership Facility


- FCPF was established in 2008.
- is a global partnership of governments, businesses, civil society, and Indigenous Peoples
- focused on reducing emissions from deforestation and forest degradation, forest carbon stock conservation, the sustainable management of forests, and the enhancement of forest carbon stocks
- World Bank acts as the trustee.
- Works with 47 developing countries (Africa: 18; Latin America: 18 và Asia: 11), along with 17 donors that have made contributions and commitments totaling \$1.3 billion.
- The FCPF supports REDD+ efforts through its Readiness and Carbon Funds





2. FOREST CARBON PARTNERSHIP FACILITY (FCPF)

2.1. Forest Carbon Partnership Facility



Project on Support for the REDD+ readiness preparation (2013-2016) and (2016-2019)


R-Package approved by FCPF in May, 2016

Emission Reduction Program (ER-P) approved in Feb. 2018

ERPA negotiation in 2019

EP-P implementation in 2018-2025

Result payment



2. FOREST CARBON PARTNERSHIP FACILITY (FCPF)

2.2. Project on Support for the REDD+ readiness preparation

- Name:** Project on Support for the REDD+ readiness preparation
- Donor:** FCPF/WB
- Phase 1:** 2013 - 2016 (US\$ 3,8 mil) in Quang Binh, Quang Tri, Dak Nong
- Phase 2:** 2016 - 2019 (US\$5,7 mil) in Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue.
- Project owner:** Management Boards of forestry projects
- Objectives:** Support Vietnam to develop an effective REDD+ management and implementation system, contributing to sustainable forest management, biodiversity conservation, low-carbon economy development, poverty reduction and protection of the earth's climate system; Support to improve organizational and technical capacity for relevant central agencies and 06 provinces under the Emission Reduction Program to prepare for REDD+ implementation in Vietnam.





2. FOREST CARBON PARTNERSHIP FACILITY (FCPF)


2.2. Project on Support for the REDD+ readiness preparation

- Vietnam submitted its Emission Reduction Program Idea Note (ER-PIN) to CF and got approval in Resolution CFM/10/2014/3 dated June 19, 2014. Then The Carbon Fund (CF) approved US\$ 650,000 for Vietnam to prepare ER-PD.
- In Jan. 2015, MARD and WB signed Letter of Intent in which WB committed to buy 10,3 mil tons of CO₂ generated from ER-P implementation.
- In 2016, CF approved Vietnam R-Package in Resolution PC/22/2016/5 (Ghana) which shows that Vietnam is ready for REDD+ implementation and receives results payment.
- In Feb. 2018, ERPD was approved at CF17 in Resolution CFM/17/2018/2.

2. FOREST CARBON PARTNERSHIP FACILITY (FCPF)

2.3. Emission Reduction Program

- Name: The Emissions Reduction Program in North Central Coast 2018-2025
- Donor: FCPF/WB
- Area: Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue (high biodiversity and most vulnerable to climate change)
- Purpose: Address drivers for deforestation and forest degradation, promote forest restoration and sustainable management, Contribute to Vietnam's commitments on emission reduction targets
- Objectives:
 - Strengthening enabling conditions for emission reduction
 - Reduce 26 mil. tons of CO₂ in the period 2018-2025
 - promoting forest sustainable management and carbon stock management
 - Promotion of climate smart agriculture and sustainable livelihoods.







2. FOREST CARBON PARTNERSHIP FACILITY (FCPF)

2.3. Emission Reduction Program

ERPA negotiation




- MARD reports to the Prime Minister to lead and sign ERPA and ER-P implementation.
- MARD submits to the Prime Minister the draft of Decision on carbon title transfer and Benefit Sharing Plan within ER-P.
- MARD approves technical documents along with ER-P (safeguards, Reversal mechanism, guidelines on carbon title transfer...)
- Results from ER-P implementation are expected to be reported in 3 times:
 - ✓ First report in 2020 for results of period January 2018 to 2019: 3 million tons of CO₂
 - ✓ Second report in 2023: 4 million tons of CO₂
 - ✓ Third time in 2025: 3.3 million tons of CO₂








3. CHALLENGES, LIMITATIONS AND NEXT STEPS

3.1. Challenges

- ▶ REDD+ is technical with many new terms and jargons.
- ▶ More requirements/ barriers imposed before accessing to results based payment. Consultation process took more time than estimated.
- ▶ Most of the REDD+ projects are small and sustainability beyond the project life is an issues.
- ▶ Limited cross-sectoral coordination.
- ▶ How to use available source of information to provide for safeguards.
- ▶ Role of CSOs/NGOs in the context of REDD+, especially at local level in REDD+ implementation.







3. CHALLENGES, LIMITATIONS AND NEXT STEPS

3.2. Limitations

- Government's commitments to REDD+ and its sustainability.
- Continuous communications and continue to build capacity for in and out of forestry.
- Mechanism for information sharing among information systems.
- Develop national and provincial reporting and monitoring system to provide information for SIS.






3. CHALLENGES, LIMITATIONS AND NEXT STEPS

3.3. Next Steps

- ▶ Improve core REDD+ elements according to the roadmap and comply with UNFCCC provisions.
- ▶ Review and finalize the legal framework related to REDD+
- ▶ Implement and integrate the Plans with the Sustainable Forestry Development Target Program for the period 2016-2020 and the period 2021-2030, connecting with other related programs and projects.
- ▶ Strengthen international cooperation to diversify financial resources for REDD+.
- ▶ Carry out procedures to report results of emission reductions, to receive payments and implement benefit-sharing plan in accordance with the negotiation roadmap.







Application of advanced technologies on forest resources management in Vietnam

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APPLICATION OF ADVANCED TECHNOLOGY IN FOREST RESOURCES MANAGEMENT IN VIETNAM: A PILOT PROJECT IN DIEN BIEN PROVINCE

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National Forest Stats in 2018

(DECISION No. 911/QĐ-BNN-TCLN, dated on March 19, 2019)

- **Total forest areas: 14,491,295 ha**

Diverse forest type:

- Natural forest: 10,255,525 ha
- Planted forest: 4,235,770 ha
- Forest Coverage: 41.65%

Diverse forest classification:

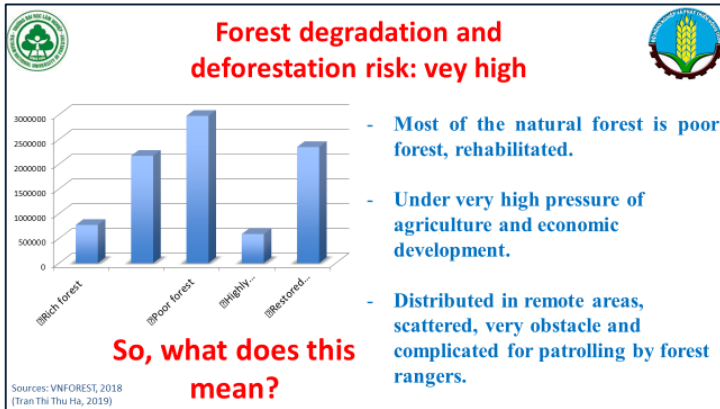
- Special use forest: 2,155,178 ha
- Protection forest: 4,588,059 ha
- Production forest: 7,748,058 ha



National Forest Stats in 2018

- **Diverse forest stewardship entities:**
- Special use forest management board: 2,056,504 ha
- Protection forest management board: 2,984,158 ha
- Economical organizations: 1,711,594 ha
- Community: 1,156,714 ha
- Household: 2,955,134 ha
- Commune government (CPC): 3,094,893 ha
- Armed forces: 198,825 ha
- FDI enterprises: 66,159 ha
- Science and technology, training: 118,521 ha
- Others: 148,793 ha



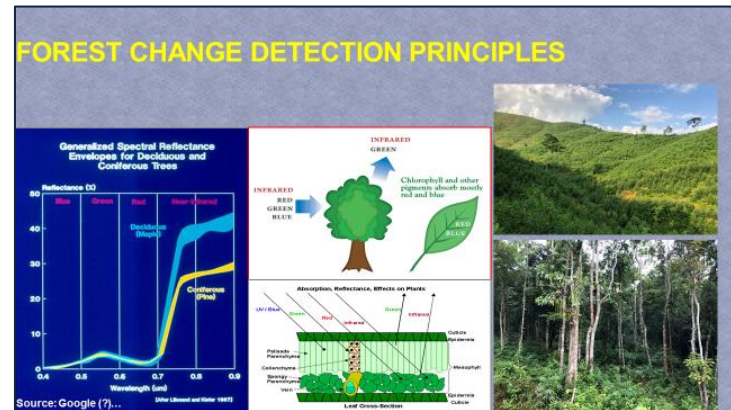


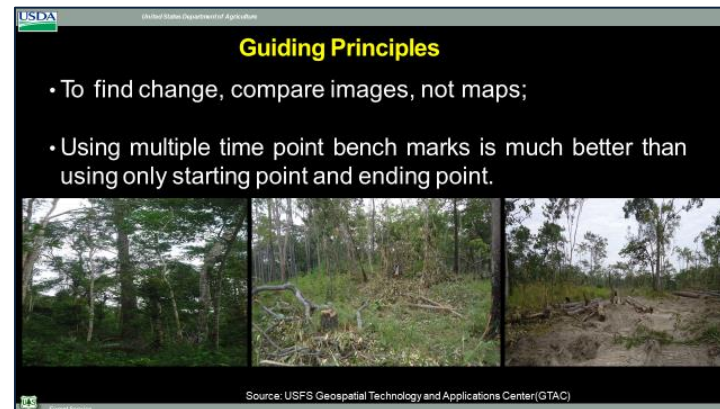
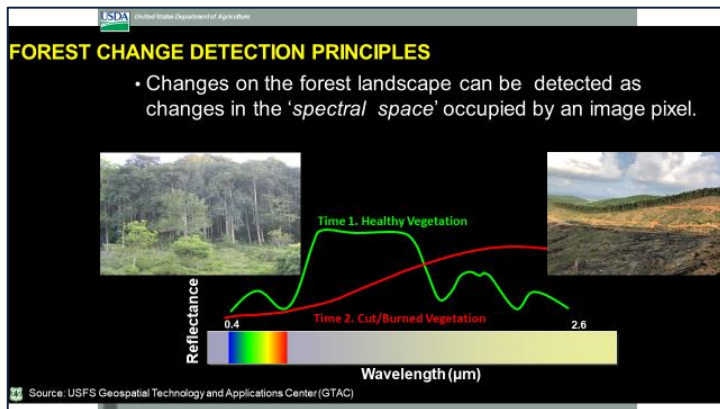
1 AUTOMATED FOREST CHANGE DETECTION

2 AUTOMATED FOREST FIRE WARNING SYSTEM

3 AUTOMATED FOREST PATROLLING SUPPORT SYSTEM

4 GOOGLE EARTH ENGINE TO MONITOR FOREST CHANGE & FOREST FIRES





3 MAIN METHODS FOR DETECTING FOREST CHANGE

Method 1: Point sampling: Total points detected/total points investigated.

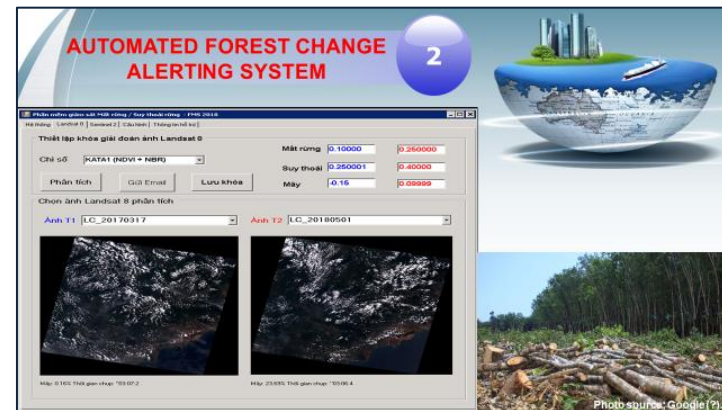
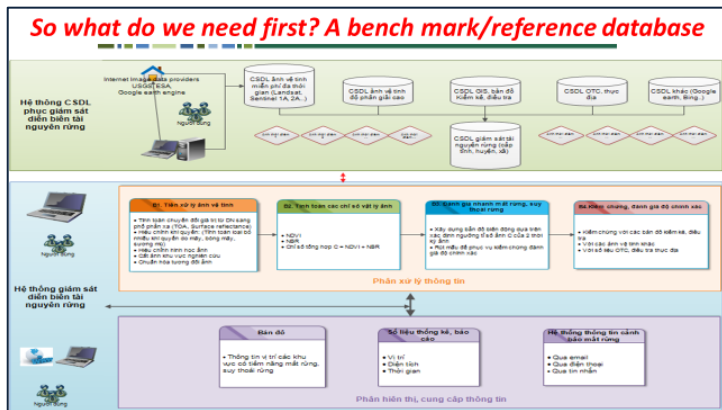
Method 2: Mapping forest cover @ time 1 vs @ time 2.

Method 3: Analyzing change of the region/pixels of interest using remote sensing indices and or indicators (pixel based time series).

- Our own principle for forest change detection: Using relative indices is better than using absolute ones

$$KB = 100 \cdot (\text{Index @ Time}(i) - \text{Index @ Time}(i+1)) / \text{Index @ Time}(i)$$

Index @ Time (i), e.g. NDVI, NBR, MSAVI, EVI, etc



Automatically sending deforestation and forest degradation alerts to specified emails

- 1) Date: 20/5/2018 12:00:00 AM - Landsat 8 [Forest loss]; Plot-Compartment-Block:10-21-133; Area: 0.63(ha); Forest Owner: the People's Committee; Forest type: TXP; Address: Nam Vi commune; District: Mường Nhé; Province: Điện Biên.
- 2) Date: 6/7/2018 12:00:00 AM - Landsat 8 [Deforestation]; Plot-Compartment-Block:141-1-9613; Area: 0.54(ha); Forest Owner: Nguyen Luu Thuy; Forest type: bareland; Address: Son Dong commune; District: Sơn Tây; Province: Hanoi.
- 3) Date: 11/9/2018 12:00:00 AM - Sentinel 2 [Deforestation]; Plot-Compartment-Block:18-7-165A; Area: 0.75(ha); Forest Owner: the People's Committee; Forest type: forest plantation; Address: Trám Hạnh commune; District: Đa Lạt; Province: Lâm Đồng.

Deforestation, forest degradation and forest fire on WEBGIS

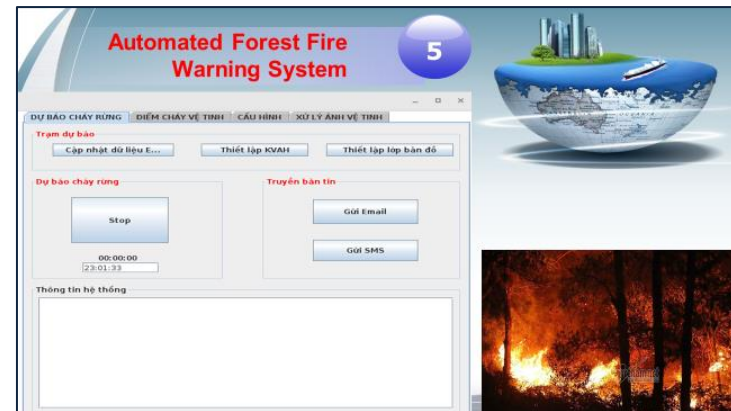
<https://muongne.dbcrc.info/> <https://hanoi.dbcrc.info/>

https://langbiang.dbcrc.info/ and <https://kbtinn.dbcrc.info/>. To the right, there is a photo of a forest with a large tree stump."/>



Automated Forest Fire Warning System

1. **Demarcating fire-prone areas** using input data: forest vegetation type, slope & aspect, wetness index, soil depth, historical fire events, distance to shifting cultivation areas
2. **Creating forest fire risk level surface** (pixel based)
3. **Calculating the Nesterov Fire-risk Rating Index** for every day, every forest plot (using the national and local weather stations)
4. **Modifying Nesterov Fire-risk Rating Index** using the fire risk level surface created in step 3
5. **Saving the result** in a temporary database
6. **Sending fire alerts/warnings** to people, authorities in charge about the forest fire risk at each forest plot for every day.



Automated Forest Fire Warning System 6

The screenshot displays a map of Vietnam and its neighbors, Laos and Cambodia. Red dots on the map indicate forest fire warning locations. A globe icon is positioned in the top right corner. The URL <http://vietnamnet.vn> is visible at the bottom right.

Automated Forest Fire Warning System Database 7

The screenshot shows a database interface with a table titled "Thông tin chi tiết điểm cháy" (Detailed information of fire points). The table lists various fire points with columns for location, area, and other details. A globe icon is visible in the top right corner. The source [Source: https://news.zing.vn](https://news.zing.vn) is noted at the bottom right.

Điểm cháy	Diện tích	Loại rừng	Loại đất
Điểm cháy 1	100.00	Loại rừng 1	Loại đất 1
Điểm cháy 2	100.00	Loại rừng 2	Loại đất 2
Điểm cháy 3	100.00	Loại rừng 3	Loại đất 3
Điểm cháy 4	100.00	Loại rừng 4	Loại đất 4
Điểm cháy 5	100.00	Loại rừng 5	Loại đất 5
Điểm cháy 6	100.00	Loại rừng 6	Loại đất 6
Điểm cháy 7	100.00	Loại rừng 7	Loại đất 7
Điểm cháy 8	100.00	Loại rừng 8	Loại đất 8
Điểm cháy 9	100.00	Loại rừng 9	Loại đất 9
Điểm cháy 10	100.00	Loại rừng 10	Loại đất 10
Điểm cháy 11	100.00	Loại rừng 11	Loại đất 11
Điểm cháy 12	100.00	Loại rừng 12	Loại đất 12
Điểm cháy 13	100.00	Loại rừng 13	Loại đất 13
Điểm cháy 14	100.00	Loại rừng 14	Loại đất 14
Điểm cháy 15	100.00	Loại rừng 15	Loại đất 15
Điểm cháy 16	100.00	Loại rừng 16	Loại đất 16
Điểm cháy 17	100.00	Loại rừng 17	Loại đất 17
Điểm cháy 18	100.00	Loại rừng 18	Loại đất 18
Điểm cháy 19	100.00	Loại rừng 19	Loại đất 19
Điểm cháy 20	100.00	Loại rừng 20	Loại đất 20

Automated Forest Fire Warning System Database 8

The screenshot displays a bar chart titled "Diễn biến điểm cháy: Toàn quốc từ năm 2008 đến năm 2018" (Forest fire point trends: Nationwide from 2008 to 2018). The chart shows the number of fire points per year, with a significant increase in 2018. A globe icon is visible in the top right corner.

Năm	Số điểm cháy
2008	14
2009	16
2010	202
2011	203
2012	202
2013	199
2014	179
2015	201
2016	204
2017	202
2018	202

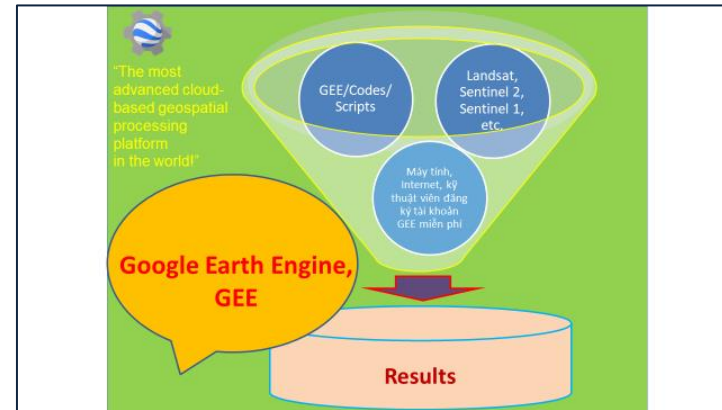
Automated Forest Patrolling Management System 9

The screenshot shows a mobile application interface for forest patrolling management. It features a map view with a location marker and a list of patrol routes. A globe icon is visible in the top right corner.

Automated Forest Patrolling Management System 10

AUTOMATICALLY STORING IN A DATABASE AND SENDING TO RELEVANT AUTHORITIES:

- PATROLLING TRACKS;
- EVIDENT PHOTOS AND ASSOCIATED COORDINATES;
- COMMUNICATION RECORDING



Code Editor Interface of Google Earth Engine

Using Google Earth Engine for detecting forest change and forest fire, using Landsat 8 and Sentinel 2

CONCLUSIONS:

OUR AUTOMATED SOFTWARE SYSTEM, INCLUDING:

- EARLY FOREST CHANGE DETECTION
- FOREST FIRE WARNING SYSTEM
- FOREST PATROLLING SUPPORT SYSTEM

HAS BEEN APPROVED TO BE APPLICABLE AT THE DISTRICT LEVEL, HIGHLY RECOMMENDED TO EXPAND OUR SYSTEM TO THE PROVINCE SCALE AND THEN, TO THE NATIONAL SCALE.




55 Thanks a lot for your attention!

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**LINKAGE OF HIGHER EDUCATION, RESEARCH AND
INTERNATIONAL INTEGRATION TO SUSTAINABLE FOREST
MANAGEMENT AND BIOECONOMY**

**SESSION 1: FOREST-BASED AND
BIO-ECONOMY DEVELOPMENT**

Forestry education in Africa: a call for adoption of result-oriented teaching and learning styles for sustainable forest management

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ABSTRACT

Forestry profession in the twenty-first century will not be immune to complex challenges that currently stare several sectors if it does not swiftly adapt to the changing globalized trend. Professional milieu in the subsector could be requiring a lifelong learning, greatly developed critical thinking ability with well-honed communication skills to break even: attributes already considered by employers to be deficient in prospective forestry employees. As an attempt towards envisioning into a robust and composite education for upcoming forestry professionals, we reviewed training modules that promote learner-based mastery, retention of content knowledge and the development of higher order process skills to meet likely anticipated goals. We investigated and applied the above in the course: Forestry Extension, Education and Development offered at Federal University of Technology Owerri, Nigeria. These modules include active learning strategies with broadened spectrum of content-specific synopsis which engaged trainees with case studies, demonstrable online-based access/links and brainstorming on evolving controversies in handling forestry and wildlife resources-based challenges and emergences to demonstrate how concepts and sustainable management principles can be applied to solve complex problems with multiple stakeholders. By offering trainees links to needed information, periodic evaluations and hands-on scenarios to trainees in relevant contexts, we observed (also as evidenced from cognitive psychology) that learner-based interactive education, hands-on tips and access to needed platforms for self enquiry facilitated trainee innovative discoveries and aptitude in various need-based areas of forestry management. We recommend a build-in of appropriate motivationally cognate hands-on themes into forestry curriculum and adoption of innovative learner-based pedagogies in forestry education to better prepare prospective foresters for cutting-edge learning which foster partnerships among wide spectrum of need-based stakeholders in and across sectoral leanings.

Keywords: Content-specific; Case-studies; Envisioning; Interactive; Stakeholders

Introduction

The boundaries that define forestry are expanding rapidly given the complexity of resources that need sustainable management and more especially the entrance into the profession of persons from sister disciplines (FAO, 1994; Innes, 2010). Again, conventional sustained-yield

approaches that focus on commodity production are gradually giving way to comprehensive and integrated approaches that emphasize sustainability considerations, robust experiences among practitioners and partnerships. These altogether make planners and managers of forestry discipline and profession to engage in almost ceaseless reviews of forestry curriculum in the light of these challenging experiences.

Given these disturbing scenarios, in a bid to catch up with development trends especially having to favourably compete with other disciplines and sub-sectors, forestry graduates must be broadly educated to possess requisite skills and expertise in breadth and in depth (Temu and Kasolo, 2001; Kostilainen, 2005). More so, in response to the proposed comprehensive and integrated approaches to natural resources management, there is needful call to find the means by which focused education, interdisciplinary systems thinking, and communication skills can be developed and applied in and by forestry professionals. In other words, in attaining these clarion calls in which sustainable forest management SFM is a single aspect, formal education in forestry cannot be an outlier. Hence, such a lofty goal and dream can largely be derived from planned educational processes (Paava and Schuck, 2006).

Historical and Experiential Framing

Many forestry courses across different educational institutions worldwide have not changed greatly in decades and some still resemble an Oxford syllabus of which Sisam then gauged to be over a century old (Sisam, 1964). In the submission of Howe (2004), the course consists of the following: the formation and properties of soil; elements of physics, chemistry and biology; systematic botany with special reference to trees and shrubs; the economics of forestry and forest policy; silviculture; forest protection; utilization; mensuration; forest management; forest valuation and finance (Howe, 2004). Preparing a forester to manage situations involving landscape-scale, long-term, multiple resource use, common-property issues with multiple stakeholders is no easy task with current realities. Abridged from Westoby (1971), forestry education should:

- help the student to discern what knowledge is relevant, where to find it, and how to use it;
- bring the student to an understanding of the interrelatedness of phenomena, and the interpenetration of the various disciplines and;
- cultivate in the student a sense of responsibility - for his own actions, and for the welfare of others.

In line with the philosophy of the Department of Forestry and Wildlife Technology of the Federal University of Technology Owerri, Nigeria which lays emphasis on *do-it-yourself* backed with sufficient training, has broadened and consistently revised her curriculum (two times in seven years 2010-2017) to include courses and expand synopsis in Resource Inventory, Natural Ecosystem, Urban Forestry, Agroforestry Technology, Land Use Systems/Planning among others which courses have minimum of two (2) weekly contact/credit hours with stress on guided as well as independent practical components (Department of Forestry and Wildlife Technology, 2017). These aspects of forestry did in time influence idea-focus and experiences of tropical forestry in the trainees and students. The above philosophy seems to be in no sharp disagreement with the proposition of

Bourgeois (2001), who representing corporate employers, proposed the provision of understanding of strategic planning for idealized objectives in students as well as ability to work as a team member capable of building relationships.

Nonetheless, our perceived failure in forestry education across continents might not be so much on our inability to conduct interdisciplinary research but the inability to integrate and synthesize the results of our research (Temu and Kiyiapi, 2008; Koutsoukos et al. 2008). In other words, it is more of a thinking problem than a doing problem. The ability to pool and integrate the large volumes of information from forestry and corollary disciplines has not been adequately synthesized and honed in formal forestry education at any training category. Much energy and attention have been paid in the collection of data in forest science while too little effort has been invested in teaching frameworks that are commonly applied to resource management. A challenge is to design opportunities and platforms for digging deep as well as breath-building into forestry students and upcoming forestry professionals (ICRAF, 2008). This would expectedly make them both generalists as well as specialists. Since the way a subject is taught has a significant impact on its effectiveness and realization of its defined objectives, contemporary approaches must focus on the use of experiential and learner-centered teaching techniques (Wurdinger and Carlson, 2010).

Experience also shows that learner-centered techniques such as discussion, work groups, brain-storming, case study, role play and demonstration supported by outdoor education outside the narrow limits of the conventional classroom, such as field trips and fieldwork increase participation in learning process and encourage the development of critical thinking and communication skills.

Research Style

This study adopted review process and also tried a combination of some perceived teaching styles that seemingly reinforce trainee self enquiry and aptitude in selected need-based issues in forest management. Reviews involved evaluations and assessment of cognate global trends topical to forestry education discourse. Trials of some teaching styles focused a small sample of 63 forestry trainees in Federal University of Technology Owerri Nigeria. This is not a statistical sample of all forestry trainees in the above university but undergraduate students in their terminal degree pursuit who enrolled into the course - Forestry Extension, Education and Development who are presumed to be the hope of forestry in the future. In line with conventional educational practice, predetermined learning outcomes were in terms of criteria reference and expanded opportunity to learn (New Guinea Department of Education, 2008).

Following exposure to a combination of teaching styles and techniques (brainstorming, e-learning, case studies etc), keller plan of a maximum of two weeks for trainees progress evaluation beared on innovative and workable initiatives generated by each trainee and evaluated by three (3) independent assessors including professionals outside the university environment. Similar creative approaches in teaching forestry has been tested and evaluated at University of Vermont (Vermont Forestry Action Plan, 2017). Analysis of results was descriptive and the presentations were in tabular forms with key measures of central tendency.

Evaluation and Assessment of Findings

Cognate Paradigms in Higher Forestry Education and Sustainable Forest Management

A guiding proposal and framework for redefining and redirecting forestry which can serve as a guide for 21st century forestry practitioners.

Table 1: Rebugio’s proposal for new conceptualization of Forestry Profession and Practice

Conceptual Categories	Assumptions	
	Old Paradigm	New Paradigm
Forests	Specialized shops producing one (timber) or few products	Emporium of multiple products and diverse services
Foresters	The technical experts and forestry authority who manage forests themselves	Technical experts and competent social practitioners as well as leaders in forest resources management who manage forests in partnership with others
Forestry Discipline	A biological and physical science	Bio-physical and social science

Adapted from Rebugio (1998, 2000), Rebugio and Camacho (2003)

By this foundational thesis, forestry education if well adopted and implemented should be able to incite and prowl the needed change(s) in terms of knowledge, attitudes, values and skills both in foresters and non-foresters who are not mutually exclusive in the utility of the products and services from such a nature resource as forest. Through formal education, under which pedestal defined anticipated professional goals can be driven, forests, foresters and forestry discipline would in this new paradigm chart, promote and stimulate advocacy, information/knowledge generation and human capacity building if locally and trans-continently adopted and domesticated.

Models for Forestry Education in Africa

Two key models have been applied in forestry education. One model regards forestry as a professional discipline similar to law and medicine; the other model regards forestry as an undergraduate pursuit similar to many other courses of study as those in agriculture and other disciplines. Both models accept a utilitarian view that forests are significant to human life and sustenance. However, obvious differences between these two models arising from the dichotomy of professional thrust will of necessity determine the future of forestry education regionally, continentally and globally. In Nigeria, for instance, as well as in other developing societies, the undergraduate model (requiring 4-5 years) is blended with components of basic liberal arts and meeting university core education requirements (emphasizing breadth). The *sub-professional model* offers relatively less scientific depth but more of liberal breadth unlike the professional model which offers more scientific depth with less liberal breadth.

Again, we see forestry education at the professional level being closely knitted to the trends and needs that brew around the undergraduate forestry curriculum model. Many of the students who enter forestry professional programmes are forestry undergraduate students. Thus, undergraduate education of necessity ought to be as deep as possible to provide some sufficient insights into contemporary forestry needs and challenges.

The inception of forestry education in Africa was largely patterned and shaped following majorly professional models that were already in place in America and Europe around the 1930s (Nwoboshi, 1988). The framework was very vibrant and promising for forestry in Africa although the objective was selective and underemphasized economic, socio-cultural and ecological/environmental issues (Wyatt-Smith, 1970). From the 1970s-1990s, many African countries and their universities de-emphasized the above stated forestry objective and adopted their own teaching style(s) to realize their defined national forestry mandates.

Table 2: Some Higher Institutions in Africa offering Forestry Courses and their Key Teaching Styles

Country	Institution	Style of Teaching
Algeria	Abou Bark Belkaid University	Lecture method
Burkina Faso	University of Quagadougou	Seminar
Cameroon	The National Forestry University of Cameroon	Lecture method
Egypt	Forestry University Alexandria	Workshop method
Ghana	University of Renewable Natural Resources	Lecture method
Kenya	University of Eldoret	Outreach
Nigeria	University of Ibadan	Lecture method
Senegal	Cheikh Anta Diop University of Forestry	Seminar
Uganda	Makerere University of Forestry and Nature Conservation	Lecture method

Adapted from FAO (2008)

The traditional lecture method which characterizes teaching in forestry discipline across Africa seems to have predominated over the years with apparently no wide variations and concrete synergies amongst the forestry milieu especially across geographically and culturally uniform sub-regional groupings. The proposition of the Advisory Committee on Education as earlier reposed (FAO, 1994) for competency-based and culturally oriented harmony among forestry education stakeholders seems to have yielded no good results. Needed thrust should be revived in educational cooperation and this can only be engineered not by African governments, her agencies or politicians but organized national forestry groups especially forestry educators.

Description of Trial Teaching Styles

Results generated on the above included key details of the sample trainees as well as learning outcomes from the styles tried.

Table 3: Some background information of forestry trainees during the study (N=63)

Variables	Categories	Freq.	%
Gender	Male	15	23.8
	Female	48	76.2
Age (years)	18 - <20	20	31.7
	20 - 24	43	68.3
Previous teaching styles trainees have been exposed to	Conventional lecture method	58	92.1
	E-learning	-	-
	Blended learning	12	19.0
	Kellen plan	-	-
	Z - A method	16	25.4
	Case method	-	-
	Brainstorming	-	-
	Project management	29	46.0
	Average cumulative on trainees past performance assessment	High (70% and above)	14
	Medium (40% - <70%)	45	71.4
	Low (<40%)	4	6.3
	Mean Score = 51.3%		
	Standard Deviation = 23.64		
Career specification	In-forestry course of study	58	92.1
	In forestry-related course of study	5	7.9
Proposed area of career interest	Tree taxonomy	21	33.3
	Forest genetics	10	15.9
	Environmental forestry	12	19.0
	Wood science	10	15.9
	Forest management	6	9.5
	Wildlife/Animal Science Management	4	6.3

The correspondingly high enrollment of females into forestry discipline (76%) than males appears to be spectacular as against what obtained some decades past when males dominated forestry learning and profession. More so, the dominance of the age-group (20 years +) who belong to the Z-generation (internet age) could be reflective of even greater prospects for innovative and computer-based learning, enquiries, cooperation and partnerships which abound across the globe.

With exposure to varying teaching styles in the past previous cumulative assessment score of the trainees showed 22% scoring over 70% in their overall forestry courses taken. The majority of the trainees (71%) fell within mid-scores ranges of 40% - <70%. Importantly, the reposed interest in varied areas of forestry with the above small sample of trainees again signals some good trend and optimism that given needed professional and mentoring assistance, the envisioned new paradigm in forestry profession and practice could be taken to the next level at least within short and mid-term range.

Table 4: Evaluation of Performance of Trainees following exposure of New Teaching styles

Variables	Categories	Freq.	%
Average performance by Assessor I (Evaluation of learning outcomes after periodic fortnight: 2 credit hours/week)	High (70% and above)		61
	Medium (40% - <70%)		
	Low (<40%)		
Average performance by Assessor I (Evaluation of learning outcomes after periodic fortnight: 2 credit hours/week)	High	59	59
	Medium		
	Low		
Average performance by Assessor I (Evaluation of learning outcomes after periodic fortnight: 2 credit hours/week)	High (70% and above)	74	74
	Medium (40% - <70%)		
	Low (<40%)		
	Mean Score = 64.7%		
	Standard Deviation = 16.38		

In Table 3, young forestry trainees had in the past been exposed majorly to lecture method (92.1%) which further justifies earlier documented dominant teaching style across African educational institutions. Previous cumulative evaluation of the trainees (average performance of 51.3%) as contained in Table 3 using some of the above teaching styles. Case method/case studies (consisting in presenting trainees with a case and putting them in the role of a decision maker facing a defined problem, keller plan (in which every student makes progress at his/her own pace in which case one should fully understand earlier units before proceeding to later units) and e-learning (or online learning through the internet or institutional intranet) were distant from previous teaching experiences and exposures of the trainees in this study. Hence, they could have been very absent from inclusion in forestry teaching module. However, they form integral part of modern-day teaching methods although reflective of the level of economic and technological advancement. Previous generations of African forestry professional could have been similarly trained using same prevalent teaching styles.

In Table 4, an integrated teaching mode which consists in blended learning (hybrid learning combining online (e-learning) and face-to-face instruction (conventional lecture method), brainstorming (in which trainees bring to their mind preexisting notions freely and spontaneously by expressing key words/terms related to a given forestry concept), creation of periodic interactive platform accompanied with trainee evaluation and key case studies

among others could have necessitated improvements in learning outcomes. There was a comparatively lower deviation 16.38 (Table 4) from 23.64 (Table 3) in trainee assessment report with corresponding average assessment of 64.7% from 51.3%. Importantly, trainees in this trial study could with such needful stimulation and prop make systematic and informed evaluations of a given problem issue of forestry importance with even minimal guidance and supervision from trainers. This trial could be replicated with larger sample of trainees to verify and/or justify or otherwise the veracity and efficacy of these propositions as applicable in tropical forestry education.

These practices and teaching styles which tend to activate the cognitive senses stimulated learning and apprehension among trainees, thus a sharp departure from writing-to-pass to learning-to-know and practice syndrome among African students and learners. The psychological foundations of learning emphasize much on variations in teaching and learning methodologies which consist in and not limited to group work and interactions, outdoor field engagements, self discoveries, periodic interactive with needful backstopping platforms and the likes.

Key Observations and Recommendations

Students entering higher institutions from post-primary school (equivalent of high school) generally belong to generation Z. These are those born between 1996 and the present (<25 years). They have a conscious and almost immediate access to the internet which has the benefit of increasing their knowledge (Mohr, 2017). Many of these traits result in students that learn best with hands-on activities. This trend can give some rays of hope on readiness of future generations to confront even the direst forestry challenges with whatever tool(s) available within their disposal. However, the sting of plagiarism and seemingly the possible bold dints on originality cannot be over-emphasized thus necessitating an integrated and holistic teaching and learning method.

We need to consider developing curricula that include more mix of trainees from various disciplines through the use of multidisciplinary teams in teaching. In the future, teams of scientists from multiple disciplines will carry out much or even more of forest researches, and this requires collaboration, team building and renewed disciplinary commitment and neutrality. This mix will help facilitate forestry trainees and build inter-personal communication skills which is expected to help them explain, in a reduced-jargon environment, what they are doing and why they are doing it. This is healthy disciplinary partnership that builds both scholarship and mutuality.

This envisioned new direction for forestry education should develop joint training to ensure a dose of university as well as out-of-university mentoring expertise in fields where expertise might be dispersed. Regional cooperation is here viewed as a way to strengthen and expand capacity and step up specialization by pooling resources in important areas of need (McDonough and Wheeler, 1998). This will include and not restricted to universities, governments, industries and private groups.

The spate of current North-South collaboration does not call for celebration. The lopsided nature in forestry education between the North (developed world) and the South (developing

and under-developed world) should be a source of worry to forestry educators especially Africans. Governments across the respective continents have not shown significant interests to bridge this divide. To save the profession and to better secure the future of our planet earth (which in the event of any catastrophic scenario has trans-boundary effects), much more collaboration is highly recommended.

Conclusion

Newer or more student centered techniques here includes group activities, active learning or cooperative learning, problem based learning, discovery based learning, experiential learning or nontraditional forms of assessment. Whatever the innovative teaching methodologies and styles are, they should reach the expectations of forestry trainees after completing their training in forestry. This is not at the expense of the expectations of the industries and external world which must also be kept in mind also by forestry education administrators and planners. There has to be a stronger and more concrete agreement in the strategies and implementation modules of the demands in sustainable development on the one hand and among trainers, trainees, students and other prospective entrants into the profession today who will be the ambassadors and hope of forestry in the future.

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Agroforestry as a way forward for sustainable forest management in Viet Nam?

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Abstract

Sustainable forest management addresses the issues of forest degradation and deforestation while increasing direct benefits to people and the environment. In social terms, sustainable forest management contributes to livelihoods improvement, income generation and employment creation. In environmental terms, sustainable forest management contributes to generation of such services such as carbon sequestration and water, soil and biodiversity conservation.

With the potentials to create important ecosystem services while improving the local livelihoods, particularly in the context of climate change, agroforestry is believed to be able to contribute to sustainable forest management. Through review of current literature, this paper argues that the potential contribution of agroforestry has not been fully recognized and agroforestry has not been given proper attention in both legal framework and technical implementation on the ground. For agroforestry to materialize its potentials to address climate change, improve local livelihoods and contribute to sustainable forest management; it is necessary that adequate attention be given to agroforestry both at the policy and practice levels.

Key words: agroforestry, sustainable forest management, local livelihoods, climate change, Viet Nam.

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Simosol. designing forestry solutions in Finland specifically for Vietnam

Dr. Santiago Velásquez
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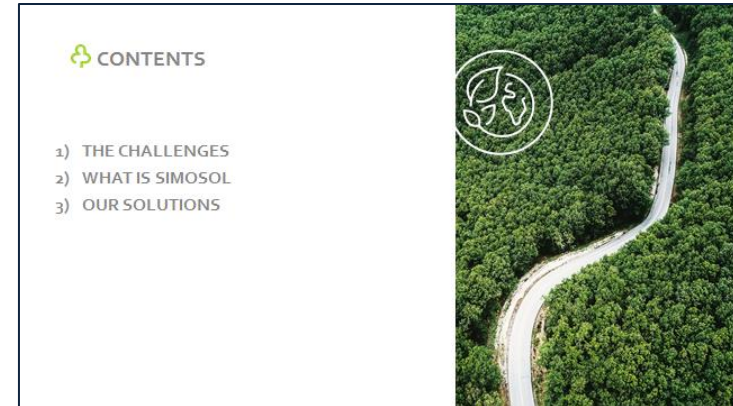


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The slide features the Simosol logo (a green stylized leaf icon) and the text 'simosol' in a bold, sans-serif font. Below this, the text 'FORESTRY SOLUTIONS FOR VIETNAM DESIGNED IN FINLAND' is displayed. To the right, a large green circle contains three white icons: a tree with a person, a tree with a gear, and a tree with a truck. At the bottom left, the date '6 November 2019' and copyright notice '© 2019 Simosol Oy. All rights reserved.' are visible.



CONTENTS

- 1) THE CHALLENGES
- 2) WHAT IS SIMOSOL
- 3) OUR SOLUTIONS

The slide shows the 'CONTENTS' section with a list of three items. The right side of the slide is a photograph of a winding road through a dense green forest. A circular icon with a stylized tree and person is overlaid on the top left of the forest image. At the bottom left, the date '18 December 2019' and copyright notice '© 2019 Simosol Oy. All rights reserved.' are visible.



THE CHALLENGES

- LIMITED AVAILABILITY OF "BIG TIMBER" (LARGE DIAMETER WOOD).
- LIMITED RESOURCE DATA.
- LACK OF ROBUST FEASIBILITY ANALYSES TO ASSESS PROJECTS AND INVESTMENTS.
- OUTDATED TECHNOLOGIES.

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The slide features a green header with a circular icon containing a stylized tree and person. Below the header, the text 'THE CHALLENGES' is displayed. The main content is a list of four bullet points. The right side of the slide is a photograph of a road through a forest. At the bottom left, the date '18 December 2019', copyright notice '© 2019 Simosol Oy. All rights reserved.', and the number '3' are visible.



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This slide is identical to the one on the left, showing the 'THE CHALLENGES' section with the same list of four bullet points and the same forest image on the right. At the bottom left, the date '18 December 2019', copyright notice '© 2019 Simosol Oy. All rights reserved.', and the number '3' are visible.





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KEY CHALLENGES

- Lack of robust feasibility analyses to assess:
 - Optimal sourcing areas and logistic chains to mills.
 - Assess the financial and operational feasibility of investing in new production lines.

Possible consequences:

- Increase of risk of having to exit a market as a result of not delivering high quality.
- Robust feasibility analyses are key for accessing to international credit.

LACK OF ROBUST
FEASIBILITY
ANALYSES TO
ASSESS
INVESTMENTS



KEY CHALLENGES

- Processing companies are facing challenges due to the use old or low-quality machinery.
- Lack of modern software to:
 - Manage forest data
 - Model growth and yield.
 - Create management scenarios
 - Optimise management plans

Possible consequences:

- Decreased efficiency results in loss of competitive advantage.

OUTDATED
TECHNOLOGIES



KEY CHALLENGES

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Possible consequences:

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OUTDATED TECHNOLOGIES

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OUR SOLUTIONS FOR VIETNAM



- Support for large commercial forest owners with forest planning, optimisation and pre-feasibility analyses.
- Support small holders and their management planning interaction with larger clients.

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SUPPORT TO LARGE FOREST OWNERS (THÚY SƠN)


- Introduction of IPTIM software for optimizing management plans and managing forestry data.



esri

SUPPORT TO LARGE FOREST OWNERS (THÚY SƠN)

- Introduction of IPTIM software for optimizing management plans and managing forestry data.



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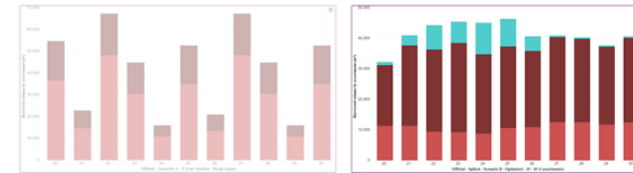
Tia thua Khai thác

SUPPORT TO LARGE FOREST OWNERS (THỦY SƠN)

Mã lô	Năm trồng	Ngày trồng	Loại cây	Ngày thực hiện	Hoạt động	Diện tích	Tuổi	Chi phí khai thác	Thu nhập	Tỷ lệ khai thác	Tỷ lệ khai thác	Khoản lỗ, lỗ đường kính dưới 5cm	Khoản lãi, lãi đường kính từ 5-10cm	Khoản lãi, lãi đường kính trên 10cm
ts_21_5_7	2015	2015-06-01	Keo lai	2020-09-30	Khai thác trồng	12,19	5	-468.095.884	4.570.840.572	4.887	401	1.262	3.554	112
ts_20_4_3	2015	2015-06-01	Keo lai	2020-12-31	Khai thác trồng	11,04	6	-423.935.959	4.733.578.770	4.919	446	1.188	3.450	331
ts_20_6_2	2015	2015-06-01	Keo lai	2020-12-31	Khai thác trồng	9,94	6	-381.699.984	4.358.837.409	4.577	460	1.098	3.254	225
ts_20_4_4	2015	2015-06-01	Keo lai	2020-12-31	Khai thác trồng	11,76	6	-451.564.020	5.042.270.544	5.240	446	1.213	3.675	352
Tổng cộng						44,93	22,07	-1.725.311.975	18.705.547.295	19.424	1.753	4.711	13.892	1.020
ts_20_4_3_2	2015	2015-06-01	Keo lai	2021-06-30	Khai thác trồng	10,73	6	-412.031.982	4.845.379.306	4.877	455	1.012	3.212	634
ts_20_6_2_2	2015	2015-06-01	Keo lai	2021-06-30	Khai thác trồng	10,54	6	-404.735.999	4.759.580.604	4.791	455	1.014	3.155	623
ts_20_3_5_A	2017	2017-06-01	Keo lai	2021-12-31	Khai thác trồng	8,62	5	-331.007.996	2.452.905.535	2.700	313	828	1.865	8
ts_21_7_10	2016	2016-06-01	Keo lai	2021-12-31	Khai thác trồng	17,53	6	-673.152.026	7.794.668.470	8.123	463	1.897	5.719	506
ts_21_5_16	2016	2016-06-01	Keo lai	2021-12-31	Khai thác trồng	17,25	6	-662.490.000	7.670.166.905	7.993	463	1.867	5.628	498
ts_20_2_2_3	2015	2015-06-01	Keo lai	2021-12-31	Khai thác trồng	10,40	7	-399.359.985	5.425.929.176	5.236	503	894	3.287	1.055
Tổng cộng						75,07	34,48	-2.882.487.988	32.948.629.996	33.720	2.652	7.531	22.865	3.323
ts_30_4_6_3	2015	2015-06-01	Keo lai	2022-03-31	Khai thác trồng	11,54	7	-443.133.999	6.864.984.807	6.096	528	1.001	3.517	1.540
ts_30_6_2	2013	2013-06-01	Keo lai	2022-03-31	Khai thác trồng	4,17	9	-160.128.003	3.622.330.879	3.090	743	353	1.168	1.569
ts_20_4_6_2	2015	2015-06-01	Keo lai	2022-06-30	Khai thác trồng	11,61	7	-445.823.987	6.910.893.134	6.428	554	1.018	3.528	1.883
ts_20_4_3_1	2015	2015-06-01	Keo lai	2021-06-30	Khai thác trồng	10,84	7	-416.254.006	6.452.548.210	6.002	561	950	3.294	2.758
ts_20_3_1_A	2017	2017-06-01	Keo lai	2022-09-30	Khai thác trồng	7,76	5	-297.984.009	2.788.188.473	2.950	380	728	2.112	110
ts_21_5_9	2017	2017-06-01	Keo lai	2022-12-31	Khai thác trồng	14,97	6	-574.848.010	5.793.940.097	6.038	403	1.410	4.252	376
ts_30_6_1	2017	2017-06-01	Keo lai	2021-12-31	Khai thác trồng	16,20	6	-621.080.030	6.389.995.479	6.334	403	1.526	4.601	407
ts_19_6_10	2017	2017-06-01	Keo lai	2022-12-31	Khai thác trồng	11,38	6	-436.992.004	4.404.478.143	4.590	403	1.072	3.232	286
ts_21_5_8	2016	2016-06-01	Keo lai	2023-03-31	Khai thác trồng	4,62	7	-177.407.996	2.915.111.253	2.753	596	453	1.595	705
ts_21_5_1_A	2017	2017-06-01	Keo lai	2023-03-31	Khai thác trồng	11,09	6	-425.864.006	4.630.026.753	4.750	438	1.064	3.245	441
ts_20_3_2_A	2017	2017-06-01	Keo lai	2023-06-30	Khai thác trồng	5,93	6	-227.711.993	2.660.666.037	2.681	452	569	1.770	342

SUPPORT TO LARGE FOREST OWNERS (THỦY SƠN)

- Introduction of IPTIM software for optimizing management plans and managing forestry data.

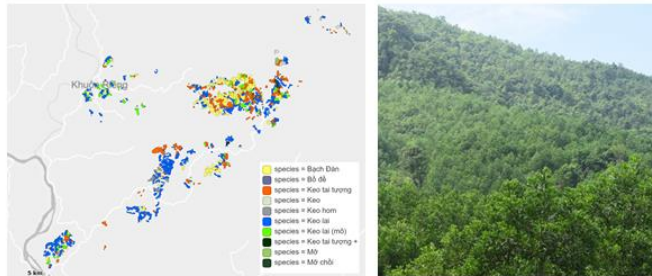


Phương án (Dự trữ chế độ)

Phương án (Tối ưu hóa)

SUPPORT TO LARGE FOREST OWNERS (TUYÊN BÌNH)

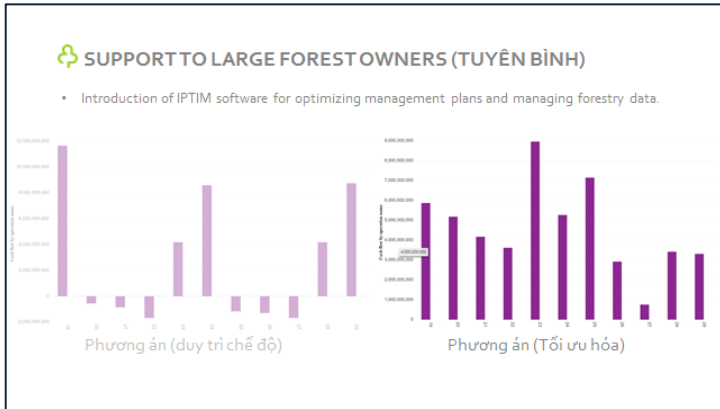
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SUPPORT TO LARGE FOREST OWNERS (TUYÊN BÌNH)

- Introduction of IPTIM software for optimizing management plans and managing forestry data.

TT	Chủ hộ nhận khoán	Khoản h	Lá	Diện tích (ha)	Loại cây	Năm trồng	Viết độ hiện có cây ha	D1,3 (cm)	Hv (m)
174	Vũ Đức Thắng B	349	22x3	1,0	Keo lai	2.014	1000	12	16
175	Phạm Văn Tình	285	27	1,1	Keo lai	2.014	600	11	15
176	Trịnh Văn Tiến	1	15x	2,3	Keo lai	2.014	900	12	16
177	Vũ Đức Hùng	1	31	0,4	Keo lai	2.014	900	12	16
178	Đỗ Văn Hồng	1	20+21+24	1,7	Keo lai	2.014	700	11	15
179	Đỗ Văn Hồng	1	23+26	1,6	Keo lai	2.014	700	11	15
180	Đỗ Văn Hồng	1	29+21	3,1	Keo lai	2.014	700	11	15



SUPPORT TO LARGE FOREST OWNERS (TUYÊN BÌNH)

- Introduction of IPTIM software for optimizing management plans and managing forestry data.

Năm	Trữ lượng khai thác/năm, m³	Thu nhập/năm, VNĐ	Chi phí/năm, VNĐ	Dòng tiền/năm, VNĐ
2019	14.834	13.350.160.609	-7.477.506.680	5.872.653.929
2020	15.401	13.860.653.931	-8.675.589.754	5.185.064.178
2021	14.837	13.352.939.814	-9.180.705.933	4.172.233.881
2022	15.211	13.690.289.124	-10.071.405.152	3.618.883.972
2023	23.482	21.133.791.494	-12.169.890.589	8.963.900.905
2024	19.955	17.959.053.801	-12.691.142.642	5.267.911.159
2025	24.758	22.282.394.663	-15.135.400.039	7.146.994.624
2026	18.769	16.892.237.373	-13.969.121.290	2.923.116.083
2027	15.969	14.372.478.431	-13.614.747.461	757.730.969
2028	19.240	17.315.586.453	-13.897.907.528	3.417.678.925
2029	15.046	13.541.580.471	-10.230.788.891	3.310.791.580



SUPPORT FOR PLANNING FOR MULTIPLE SMALL HOLDERS

Generating automatic management plan

- Our client Stora Enso uses IPTIM Optiops to deliver automatic plans to 15,000 wood suppliers in Finland.
- Each plan delivers multiple options according to the risk that the supplier is willing to take.

iptim Optiops FOREST MANAGEMENT PLANS Page 9 / 15

THE PLANS
Here you have three alternative forest management plans. The goal for all of them is to maximize the value of the forest assets under 0.3% interest rate.
The plans meet the following profiles:
Even income: The harvests have been arranged so that the net income for each successive five year period is as even as possible over the coming 30 years. The silvicultural management activities are based on the management regime for great site classes.
Profitable management: The goal for the plan is the best possible return for the capital tied into the standing stock. However, for each five year period, the regeneration harvests are limited to maximum 10% of the forest area, and thinnings to less than 20% of the area. Harvests are in general avoided on steep slopes.
Stable standing stock volume: For each five year period over the next 30 years, the standing stock volume stays at least at the same level as in the previous period.

The net present value of the future cashflows			
	Even income	Highest profitability	Stable volume
NPV	13,340,888	17,807,807	14,360,918
The difference to the highest net present value	-18%	0%	-18%
in SEK	-2,181,029	0	-3,158,029

Harvested volumes, m³			
	Even income	Highest profitability	Stable volume
Thinning	2,761	2,744	2,663
Regeneration	37,643	42,241	36,186
In total	40,404	44,985	38,849

SUPPORT FOR PLANNING FOR
Generating automatic management plan

- Our client Stora Enso uses IPTIM Options to deliver automatic plans to 15,000 wood suppliers in Finland.
- Each plan delivers multiple options according to the risk that the supplier is willing to take.
- The reports include additional important information for each forest owner, including standing volume, and location of assets to harvest.

TIMBER ASSORTMENT AND PRICES

	Pine log	Pine pulpwood	Spruce log	Spruce pulpwood	Birch log	Birch pulpwood
Forest pricing	€13	15€	€14	22€	-	15€
Quoting	€14	15€	€14	22€	€07	15€
Kilowatt-hour	€13	15€	€14	22€	€01	15€

YEARLY HARVESTS FOR THE NEXT 10 YEARS

OTHER SOLUTIONS

- MAPPING AND MONITORING
- IPTIM SOFTWARE FAMILY
- FOREST VALUATIONS
- CARBON SERVICES

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1. MAPPING AND INVENTORY
From nation-wide assessments to tree level forest inventories

WORLD BANK GROUP

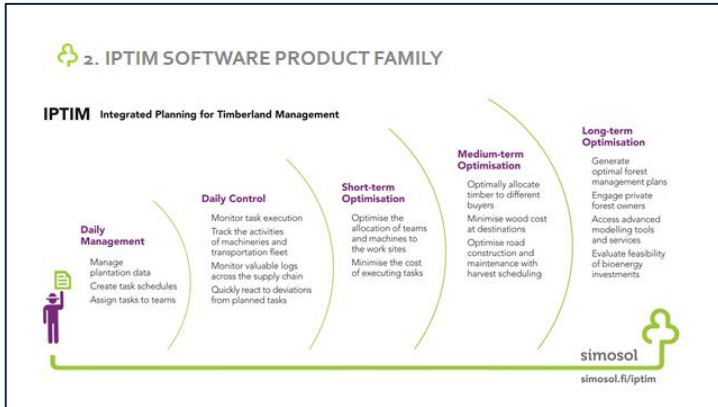
- Satellite image analysis is the most cost efficient way to measure forest/biomass resources.
- We have done this at national levels.
- We locate the best possible sites for bioenergy plants considering productivity and logistics.
- Optimization allows assessing the long term feasibility of the project.

Workflow: Satellite imagery → Land-use & biomass mapping → Field surveys using smartphones → Image analysis → Classification & harvest volume availability → GIS model for green plant site suitability.

1. MAPPING AND INVENTORY
Tree by tree measurement and planning

- Point clouds from drone measurements ⇒ individual tree detection
- Optimized management plans based on tree level data

Visualizations showing point cloud data from drone measurements and the resulting tree-level mapping for management planning.



2. IPTIM ASSETS

Optimized strategic management plans with modern forestry software

- Optimised plans based on your data, models, regimes, products and objectives.
- Projections of key variables for each plan and choose the best for your business.
- Easily modify regimes, assortments and models to see the effects on your business.

DATE	PHASE	STATUS	LOGS	WOOD	WASTE	ROAD	MAINTENANCE	WATER	WATER
24.10.2017	simulation	not completed	1.5	50000	10000	10000	0	0	0
24.10.2017	simulation	not completed	4.5	50000	10000	10000	0	0	0
24.10.2017	simulation	not completed	5.5	50000	10000	10000	0	0	0
24.10.2017	simulation	not completed	6.5	50000	10000	10000	0	0	0
24.10.2017	simulation	not completed	7.5	50000	10000	10000	0	0	0

2. IPTIM OPERATIONS

More detailed optimisation as a consulting service

- We can take a closer look at the projects to consider:
 - Road networks
 - Accessibility to stands
 - Log yard capacity
 - Demand at destinations or clients
 - Available machinery and productivity.
- We deliver feasibility analyses and optimized harvest scenarios.

Legend

- Scenario A
- Road Solution
- Harvest Solution
- Demand at Destinations

0 - 100000
100000 - 200000
200000 - 300000
300000 - 400000
400000 - 500000
500000 - 600000
600000 - 700000
700000 - 800000
800000 - 900000

2. IPTIM OPERATIONS

We can also combine road construction and maintenance with the harvest planning!

- Provides an optimized plan for road construction and maintenance.
- Minimizes the unit cost of wood delivered to destinations.

3. FOREST VALUATIONS

World-class forest valuation services with forest estate modelling

- We have valued assets in Europe, Latin America, Africa and Asia for the largest companies in the world.



Valuation in Kenya

Valuation in Lao

Valuation in Brazil

3. FOREST VALUATIONS

World-class forest valuation services with forest estate modelling

- We have valued assets in Europe, Latin America, Africa and Asia for the largest companies in the world.
- Our valuation reports include:
 - Description of the assets
 - Remote sensing analyses to spot areas of interest
 - Regional market analysis
 - Inventory and growth modelling
 - Land value analysis
 - Valuation results.

4. CARBON SERVICES

Example of carbon analysis



STANDING STOCK CARBON STORAGE
Carbon balance of trees, including branches, leaves and roots.



CARBON STORED IN WOOD-BASED PRODUCTS
Carbon stored in different wood products.



SOIL CARBON STORAGE
Carbon balance of soils.



SUBSTITUTION
Substitution of fossil fuels using wood-based bioenergy. Substitution of other materials with wood-based products.



CARBON EMISSIONS
Carbon released in harvest, silviculture and transport operations.



WHO ARE WE?

- We are a company from Finland.
- Our solutions support more than 100 million hectares of forests and plantations around the world.
- We have active projects in Europe, Latin America, Africa and Asia.

SELECTED REFERENCES

A world map with various logos of forestry and consulting organizations placed over different regions. The logos include: Metsä, A.AHLSTRÖM, UB, OP-Pohjola, OTSO, metsukeskus, TORNATOR, StoraEnso, WORLD BANK GROUP, PRO-ORIENTE, COTOPAXI, adical, Inverlosques, Focys Florestal, KIMAZA, green, and AEDD.

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WE ARE ALREADY IN VIETNAM

A blue header with a tree icon and the text "WE ARE ALREADY IN VIETNAM". Below the header is a map of Vietnam and a background image of palm trees.

- WE HAVE AN OFFICE IN DANANG.
- WE HAVE DELIVERED:
 - STUDY ON THE VIETNAMESE FORESTRY SECTOR TO THE FINNISH EMBASSY
 - DEVELOPED AND DELIVERED THE FIMS SYSTEM.
 - PILOT STUDIES (AS SEEN BEFORE).

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A. FOREST INDUSTRY MONITORING SYSTEM (FIMS)

A screenshot of the FIMS web application interface. The interface shows a map of a forest area with various green shades. On the right side, there are several panels for data management, including "Add healthy forest production report", "Add healthy production report", "Add new factory", "Add factory information", "Production reports", "Factory search and reports", "Factory list", "Industry Type", "Primary Industry", "Factory name", "Factory address", "Factory phone", "Factory email", "Factory website", "Factory status", "Factory type", "Factory size", "Factory capacity", "Factory equipment", "Factory location", "Factory coordinates", "Factory map", "Factory details", "Factory history", "Factory reports", "Factory settings", "Factory user management", "Factory permissions", "Factory roles", "Factory users", "Factory roles", "Factory users", "Factory permissions", "Factory roles", "Factory users", "Factory permissions".

PROJECTS FOR OPTIMISATION AND SOFTWARE

A collage of six photos showing various work sessions and meetings. The photos depict people sitting around tables, discussing documents, and working on laptops. The settings appear to be professional offices or meeting rooms.

Mapping timber value chains - A case of *Acacia hybrid* timber in central Vietnam

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² Institute of International Forestry and Forest Products
Technische Universität Dresden, Germany

1. Introduction

Vietnam wood processing sector shows the significant growth and makes important contribution to national economy, for example in 2015, export turnover of wood and wood products was recorded at 6.4 billion USD and around 7 billion USD in 2016 (Phuc, 2017). In order to sustain the raw material supply for wood-based industry under the context of natural forest loss (Khuc et al., 2018), the Vietnamese government has pursued the target for enlarging industrial timber plantations, especially of fast-growing species. With more than 500,000 ha of plantation area, *Acacia hybrid* becomes the most important plantation specie in Vietnam (Kha et al., 2012). *Acacia hybrid* timber is also known appropriate for woodchips, pulp for paper production as well as furniture and furniture components which have been marketed domestically and internationally (Maraseni et al., 2017).

Since the 1990s, the Vietnamese government has adopted the policy of allocating degraded forest land for afforestation and sustainable management to smallholder households (HHs) (Nambiar et al., 2015; Tham et al., 2018). In Thua Thien Hue province, around 70% and 25% of HHs in high-and lowland area respectively are involved in *Acacia hybrid* timber production. Accounted for more than 70% of total timber quantity provided by plantation forest in this province (Tham et al., 2018), the utilization of *Acacia hybrid* timber contributes significantly for socioeconomic improvement apart from its original environmental benefits. Despite that, a comprehensive analysis of production and commercialization system of this timber so far is lacking. In order to fill this gap, this study took a case study in Thua Thien Hue province to elucidate the configuration of *Acacia hybrid* timber value chains.

2. Material and methods

Several techniques were employed for primary and secondary data collection from various sources along the value chains. The major data collection methods applied were review and analysis secondary data, key informant interviews, household survey, group discussion, in-depth interviews with value chain stakeholders and direct observation.

Normally, the studies focusing on value chain normally started from the production nodes in the study areas as the relevant data were collected along the different stages of the value chains following the products through different transformation stages. In order to understand profoundly the arrangement of *Acacia hybrid* timber value chains, two main production areas named Namdong (district 1) and Phuloc (district 2) in Thua Thien Hue province were selected. While district 1 is highland area characterized by the low quality of infrastructure and limited number of wood processing companies; district 2 is well located in lower-land area which is convenient for transportation and connect with processing companies and seaport for exports. Furthermore, two villages in each district were chosen

mainly based on their abundance of *Acacia hybrid* plantation area. For other participants, such as trader, processing companies the selection was at provincial level as they can source their material from different production areas. Finally, a total of 120 smallholder producers were interviewed between April and July 2018 following stratified random sampling method. The sample represented around 10% of HHs engaged in *Acacia hybrid* production system in each village. In addition, 12 processing companies, eight middlemen were interviewed. Questionnaires were formulated to examine chain stakeholders' socio-economic characteristics, their production and commercialization activities, their interrelationship, support services and policy issues. Typical value chains were mapped and their structured were analyzed mainly based on the concept of the global value chain developed in (Gereffi and Fernandez-Stark, 2016; Kaplinsky and Morris, 2001; Porter, 1985).

3. Results and discussion

3.1. Structure of the *Acacia hybrid* timber value chain

Figure 1 shows a general map of small-scale produced *Acacia hybrid* timber value chains from Thua Thien Hue province demonstrating key stakeholders, markets and relevant value links. Illustrated in the map, *hybrid* timber produced in the study areas moves through chain's marketing actors until it reaches processing and exporting companies, and then to domestic or foreign customers. In the same line with many commercial timber products (Perdana et al., 2012; Putri, 2013; Zachariah, 2008), the typical *Acacia hybrid* timber value chain is relatively long with the involvement of middlemen. This potentially increase the transaction cost as well as the market connection and benefits for smallholder producers.

The structure of current timber value chains, the main participants and market channels have changed over the last decade. Regarding the value chain configuration, at least three major changes can be seen: (i) the establishment of Thua Thien Hue Forest Owner Sustainable Development Association (FOSDA) as an institutional actor facilitating the linkage between HHs and processing companies, (ii) the growing number of middlemen, (iii) the increasing trend of production volume and trade.

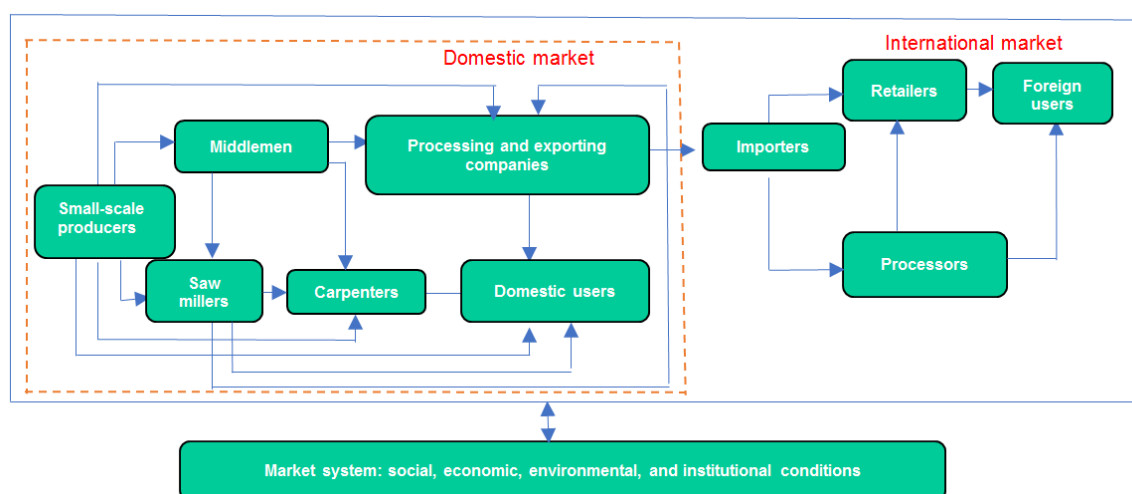


Figure 1: Generalized map of *Acacia hybrid* timber value chains in Thua Thien Hue province, central Vietnam (Source: field survey 2018)

3.2. Major value chain stakeholders and their interaction

3.2.1. Small-scale producers

The interviewed producers differ in terms of socioeconomic and *Acacia hybrid* production system characteristics. The HH heads were mainly male in the middle and upper age classes as the average age was 49 and 59 years in district 1 and 2 respectively. Mean size of HH was around five people in both cases implying the availability of family labor. In general, the producers showed the low level of education, especially in district 1 (five schooling years). Despite that, they have accumulated the traditional knowledge and skill for *Acacia hybrid* production management.

In general, district 2 has better income compared to district 1 which could be attributed to the better access to the resources, market and market information. *Acacia hybrid* plantation is one of the key natural capital for the HH livelihood in the study area, however they are relatively small and dispersed, especially in district 1. The total land and *Acacia hybrid* area holding of producers in district 2 (7.4 ha and 6.8 ha) were significantly higher than that in district 1 (3.8 ha and 2.9 ha). The average annual income from *Acacia hybrid* timber in district 2 (679.19 USD/ha) was also higher as compared to district 1 (599.14 USD/ha).

Table 1: Characteristics of <i>Acacia hybrid</i> small-scale producers in District 1 and District 2 (Source: Field survey)					
Variables	Unit	District 1 (n=60)		District 2 (n=60)	
		Mean	Sd	Mean	Sd
Smallholder socioeconomic characteristics					
Household head age	Years	49.0	12.7	59.0	7.7
Household size	No.	4.9	1.7	4.7	1.5
Household member in working age	No.	3.0	1.8	3.3	1.5
Household main worker	No.	2.9	1.4	2.5	1.0
Household head	Year	5.1	3.6	8	3.3
Total land holding	Ha	3.8	3.2	6.2	7.4
Total income	USD	381.93	344.48	602.82	503.66
Crop income	USD	423.9	534.9	904	639.7
Livestock income	USD	260.4	314.3	552.4	345.7
<i>Acacia hybrid</i> production characteristics					
<i>Acacia hybrid</i> area holding	Ha	2.9	3.1	5.3	6.8
<i>Acacia hybrid</i> income	USD	173.75	200.32	359.97	471.73
Experience in <i>Acacia hybrid</i> business	Years	12.2	7.7	18	7.0
Distance to plantation forest	Minutes	54.3	54.3	22.3	16.2

Apart from the area of plantation forests, their location from the village demonstrates the notable different between two districts. Following that, the *Acacia hybrid* plantation forests in district 1 were located far away from the village (54 min) than that in district 2 (22 min) which could be an important factor affecting to productivity and benefits from timber production.

3.2.2. Middlemen

There are various groups of middlemen involved in hierarchy of markets along the *Acacia hybrid* timber value chains. They differ, especially in the scale of operation and marketing channel which they are operated in. In general, three main types of middlemen are identified in *hybrid* timber value chains, including: direct traders (traders in short), wholesalers (collection) and commission agents. Of which traders are the main direct buyers of small-scale producers and play the most important role in connecting HHs to markets. Interviewed traders were both male and female, ranging from 40 to 62-year-old. They have quite long experience with *Acacia* timber production and trade (more than 10 years). *Acacia hybrid* is not only the timber species purchased by traders, but it is the most prominent one due to its availability, high demand and relative low investment. In addition, traders normally buy standing tree and pay by cash to smallholders at the harvesting place. They also finance *Acacia hybrid* timber production through informal credit agreement. This activity is also useful for building up the social relationship with producers, and further to maintain their source of timber. For small-scale producers, the advance payment is fundamental to fulfill their cash need and secure their *Acacia hybrid* timber production.

In contrast, wholesalers (collection) do not work directly with smallholders. They only re-collect from traders, normally whom in small-size and in far distance to processing companies. Wholesalers may sign the timber supplying agreement with processing company and receive approximately 0.88 USD/ton of sold timber. Some of them have their own processing factories for sawn wood production. Commission agents facilitate the linkages between smallholders and traders. They do not invest their own, capital but utilize financial resources from traders. They receive the agreed commission based on each timber transaction which they are involved in. Their works are to look for plantation areas which can be harvested; inform and provide information regarding to the species, address, owner, age of plantations; estimate the wood reserves; negotiate the price with smallholders and confirm to traders about final decision of smallholders in terms of price and time for harvesting. They can work for more than one trader, and thus be criticized for their opportunistic behaviors.

3.2.3. Processing and exporting companies

There is a range of companies involved in the processing and exporting activities of *Acacia hybrid* timber products. While large companies are normally specialized in *hybrid* timber processing and exporting, the smaller ones combine *Acacia hybrid* with other timber species. According to their input material and relevant created products, these companies can be classified into two main groups: (i) Wood chip companies and (ii) Furniture companies.

There are seven wood chip processing and exporting companies in Thua Thien Hue province, of which three companies function as pure producers and the remaining act as both producers and exporters. Their capacity varies and ranges from 40,000 to 250,000 ton of dried wood chip annually with the major customers are in China and Japan. While “pure” wood chip producers are located near to the production areas, wood chip exporters are near to the Chan May seaport (about 65km from Thua Thien Hue city) in order to facilitate the transportation and exporting activities. Thus, apart from the taxes and fees such as export tax, income tax which are collected by responsible governmental agencies, these companies normally have to offer “better” price for middlemen to sustain their material demand.

According to Department of Planning and Investment of Thua Thien Hue province, there are currently 132 companies registered as producers of sawn wood or semi-furniture products or producers and exporters of finished furniture products with annual revenue is between 0.1-2.5 million USD. These products further are traded locally, nationally and internationally. The value-added activities are scattered in the province, especially in locations which are near to the production area and convenient for transportation. This indicates the possibility for capturing the associated benefits, such as employment generation in the main production region. The timber demand very differs based on the operation scale of companies and generally ranges from 400-10,000 tons of round wood per year.

3.2.4. Institutional actors

The production and trade of *Acacia hybrid* timber and timber products are embedded in an institutional system at local and national levels. These institutions may function as supporter or regulators assisting and/or constraining the operation of the value chains. The major institutional stakeholders with visible roles in the current *Acacia hybrid* timber value chains are Ministry of Agricultural and Rural Development, Department of Planning and Investment, Department of Custom, Department of Taxation, Forest Protection Department, etc. (Figure 2).

Ministry of Agricultural and Rural Development, established by President in 1995 holds the mandate for the state management of not only *Acacia hybrid* industry but also the general operation of agricultural, fishery, husbandry, forestry, salt production, irrigation sector and rural development in Vietnam. Despite its power emanating from its affiliation to the Presidency, currently it is only dealing strategic issues at macro level and normally activities do not reach to local level.

Regulatory services include license for processing and exporting companies and sometime for middlemen issued by Department of Planning and Investment; collection tax and levies by Department of Taxation; firms' operation check carried out by Forest Protection Department. The custom authority is another regulatory body managing the export of the commodity in the relevant market level. In addition, local authority is in charge to collect environmental fee from producers, issue harvesting license and control resource of plantation together with local Forest Protection Branches.

Financial services are provided by different sources, including both formal and informal. While processing and exporting companies apply to formal loans from banks, producers and traders at local level normally prefer the informal credits such as loans from relatives. There are banks, such as Vietnam Bank for Social Policy provide special financial packets to support small-scale production by offering loans at a lower interest rate (0.55% monthly compared to 0.72% monthly in average as usual). Even though, the banking system is less accessible for small-scale producers and traders as their lack of credibility and collaterals. In addition, interviewed HHs and traders claim on the complicated procedure to get the loans from banks as well as the strictness on payment period.

Forest Protection Department and NGO, such as WWF have played a crucial role in supporting the performance *Acacia hybrid* timber value chains. They provide training, extension services, inputs such as improved seedlings for *Acacia hybrid* timber production. Besides that, they are active in establishing producer groups and develop the "direct"

marketing channel, thereby improve the benefits for producer HHs. In addition, the fundamental role of Hue University of Agriculture and Forestry and forest development projects such as WB3 (funded by World Bank) and ADB (funded by Asian Development Bank) in facilitating resource base and market development is undeniable.

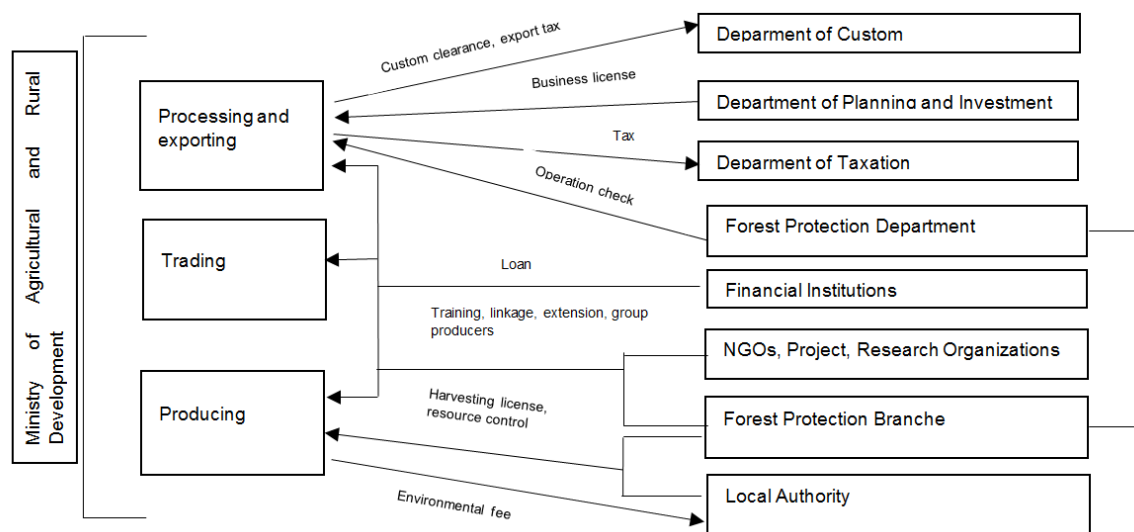


Figure 2: Institution actors in Acacia hybrid timber value chains with relevant support and regulatory function (Source: Field trip 2018)

3.3. Governance and coordination

3.3.1. Horizontal coordination

The horizontal coordination among participants of the *Acacia hybrid* timber value chains generally is rather weak if not absent. In the production node, except in FSC group, there is no formal cooperation among smallholder HHs. In 2016, a Forest Owner Sustainable Development Association (FOSDA) has been established, under the main support of WWF Vietnam and Thua Thien Hue Forest Protection Department, to formalize a managerial structure of FSC certified HHs. The general structure of FOSDA includes a management board, comprised of provincial forest department governors, district, commune and village leaders; and several sub-groups/sub-associations of timber smallholders, organized at the village level. In 2018, the number of members (HHs) in FSC group are 780 distributed in six districts and organized into 29 sub-groups and one sustainable forestry cooperative (established on the April 2018). Participating in this group, small-scale producers have better access to market and market information as well as support services such as credit, training and inputs like improved seedlings. During the interview, some interviewees however mentioned that the function of FOSDA in market management is relatively limited and highly constrained by technical and financial capabilities. Beside the formal organization, most small-scale producers use informal coordination for planting and selling timber together as well as sharing information, technique and labor (locally called “*doi cong*”).

Despite their competition to secure timber supply, there are also informal linkages among traders. They can share market information and transport their collections together to fill a truck load. In some specific cases, traders, especially the big ones, who pay for building up or repairing the road for transportation harvested timber are able to buy the whole area of

plantations in the region. Further down in the chains, the timber wholesalers (collection) operate independently and do not involve in any cooperation.

At the processing and exporting node, despite the existence of several business associations, companies work independently and compete for both acquisitions of timber raw material and market. Such associations are not related to the transformation of timber and marketing activities, but mainly provide supports in terms of administrative procedures, legal regulation explanation and training.

3.3.2. Vertical coordination

The small-scale produced *Acacia hybrid* timber value chain can be characterized as driven by large processing and exporting companies which are in turn in a captive relation with major importers. In the upstream node of the chains, the linkage between small-scale producers and traders normally are market-based in which price is determinant of the interactions and the transaction's complexity is low (Gereffi et al., 2005). However, when producers are linked with traders through informal loans or advance payment, the captive relationship appears. In this case, HHs usually sell their products at lower compared to the market average price. The marketing arrangement through FSC groups and FOSDA is also inclined to captive coordination, as there are several forms of contract with downstream buyers.

Timber wholesaler (collection) and big traders who sign the contract with or receive credits and advance payments from processors are in captive relation with these companies. In contrast, other traders are freely to choose their buyers, normally depending on the distance to processing companies, the offered price and years of doing business together. Processing and exporting companies normally set up the buying price for timber at their gates. Based on that, middlemen determine the price for their own transaction with small-scale producers or lower level of middlemen. Thus, along the value chains, buyers often hold higher bargaining power in all the transactions.

Nevertheless, the dominant form of coordination between exporting companies and importers is captive, partially because of the managing power of these importers with processing technologies and international trade connection. Exporters of wood chips in Thua Thien Hue province are dependent on major importers in China and Japan while US and UK are the main destinations for wood-based furniture. Furthermore, entering into the global economy, the processing and exporting firms are controlled by and have to comply with rules and regulations in relevant foreign markets. For example, wood chips exported to China must apply phytosanitary certificates, demonstrating the compliance of the products to the Chinese government requirement (Clever and Jie, 2015). To some extent, this results in the increasing transaction costs and create the difficulty for exporting companies.

4. Conclusions and Outlooks

This study examines the arrangement of small-scale produced *Acacia hybrid* timber value chains which consists of four core nodes: primary production, processing, distribution and end-consumption. It is undeniable that the current *Acacia hybrid* timber value chains are relatively long with the prevalence of middlemen. Apart from explaining the major direct involved participants, we also interpret the institutional actors, their functions and relevant impacts on the chain's performance.

Participating into the production and commercialization system of *Acacia hybrid* timber potentially benefits the actors, however, the level of achievement depends on their position in the value chains. Vertically, the buyers have upper hand in almost transactions along the chains with the prominence of captive and market-based form of governance. In addition, there is considerable lack of horizontal coordination between stakeholders despite its importance in capturing added value created. This implies the uneven power relation which may lead to the asymmetry benefit distribution in the value chains. Therefore, in order to improve the effectiveness of current *Acacia hybrid* timber value chains, this study suggests that establishment and reinforcement, especially, of producer associations, development infrastructure, and market information system, provision credits, training and extension services are interventions required.

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The importance of metallophytes in phytoremediation of mined out areas in Didipio, Nueva Vizcaya, Philippines

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Abstract:

Metallophytes are group of plants that can thrive on metal rich substrate. These plants have potential in various green technologies. However, it is a must to first identify plants that can absorb heavy metals and tolerate the high concentration in their tissues. This study assessed the ability of plants thriving in a Cu-Au mined areas to uptake copper (Cu), and arsenic (As). The Cu and As content of the dried leaves, root tissues and soils were quantified using Atomic Absorption Spectrophotometer (AAS), and their bioaccumulation coefficient (BAC) were computed. Three species, *Pityrogramma calomelanos*, *Cynodon dactylon* and *Nephrolepis biserrata*, showed metal accumulation in the plant tissues. The three species have accumulation of Cu in the root and the estimated Bioconcentration factor is more than 1.0 which indicates the ability of these species for phytostabilization of the said metal. Noteworthy was the accumulation of As in the shoot of the three species despite of the low soil As (<0.01 ppm). *Nephrolepis biserrata* had the highest arsenic bioaccumulation factor of 30.91 followed by *Cynodon dactylon* (11.01) then *Pityrogramma calomelanos* (8.78) which make them potential species for clean-up of As through phytoextraction. Moreover, this study added *C. dactylon* as a new pseudo metallophytes for phytostabilization of copper and phytoextraction of arsenic in metal contaminated industrial sites.

Keywords: *cuprophytes, phytoextraction, pseudometallophytes, phytostabilization*

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Scope of technological interventions in improving the productivity and commercialization of multi utility trees to mitigate climate change and rural upliftment

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Abstract

Indian part of Himalayas are abode of variety of trees with multiple produce. These not only sequester carbon but also yield many products for the lively hood of the people of rural and urban areas. Species like *Terminalia chebula*, *Terminalia belleric*, *Emblica officinalis*, *Cordia myxa*, *Artocarpus lackoocha*, *Syzygium cuminni*, *Sapindus mukorossi* and *Melia adazirachta*, etc. have great scope in the conservation of forests and lively hood enhancement. The studies were conducted at our institute to standardize the modern techniques to conserve, propagate and multiply the rare and on the verge of extinction germplasm of these species. The techniques have been tried and standardized first time at this station to propagate the superior germplasm of above stated species. Because of this the germplasm which otherwise would have been lost is conserved and transplanted at the farmers field to get early, high value produce and production at shortest possible time. The selections made from the wild are now almost recognized as varieties and fetching good price in the market. The demand for these kind of improved stock is increasing day by day. The efforts are increasing the forest productivity by planting tree outside the forest and the multiple products and increasing the income of the farmers. Apart from this these organically cultivated product beside the wood are being demanded in whole world and their demand is increasing day by day. In present paper we will discuss the methodologies to get early and quality product from these species. Different types of grafting such as side veneer grafting, cuttings and budding techniques such top veneer grafting, air layering wedge grafting modified chip budding, patch budding were employed in were employed on the wild forest species which are being exploited by the rural masses for food fodder and timber viz. *Terminalia chebula* (fruit and timber spp), *Terminalia bellerica*, *Emblica officinalis*, *Artocarpus lackoocha* (fodder and fruit), *Cordia myxa* (fruit and fodder), and *Sapindus mukorossi* (fruit and timber), *Toona ciliate* (timber species), *Syzygium cuminni Madhuca indica* etc. to get improved stock and crop improvement. The top size veneer grafting technique and modified chip budding was found to be most suitable and easy to employ techniques in most of the subtropical wild high value species studied for improvement.

Keywords: *Technology; intervention; productivity; commercialization; multi-utility trees; climate change; rural upliftment*

Introduction

In subtropical and tropical world there exist around two third of the world population and most of it is in the process of development. The forest are integral part of the rural economy

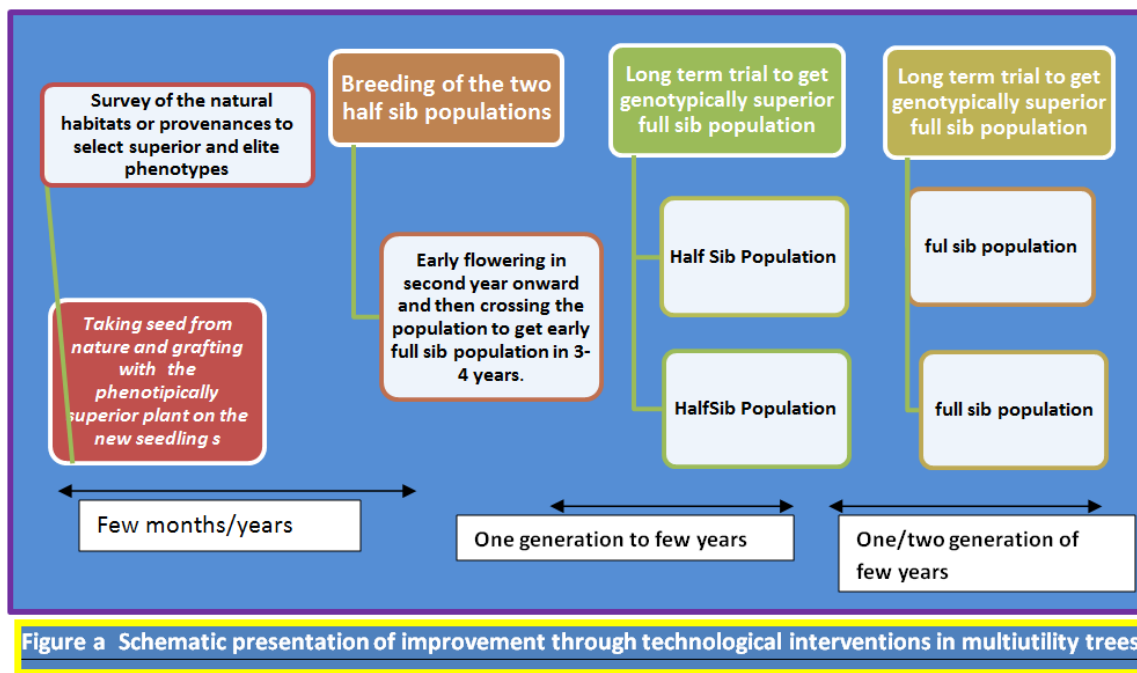
of this region. Many forest produce are being exploited from the forest and used by the local people since time immemorial. But with the advancement of the civilization and need to cultivate for meeting the need of the masses. Improvement in the species with higher yield, saving the good germplasm, shortening the gestation period improving the management practices various methodologies have been tried. In Himalayan region of Indian subcontinent multipurpose and medicinal trees such as *Cinamomum tamala*, *Artocarpus lakoocha*, *Cordia myxa*, and *Sapindus muckrossii* have great potential as crop for the livelihood of local communities and wild fauna in subtropical region of the Indian subcontinent. Selection of elite germplasm, standardization of modern mass multiplication techniques, shortening of time between planting and crop production with proven characters is highly required so that these crops could be cultivated at large scale and over exploitation of these medicinal plants from natural habitat is stopped and become source of income for them. Our previous efforts on some crops have created the great demand among the various agencies, research institution and farmers. There are numerous propagation systems used in crop improvement. The advantages of polythene systems have been known for many years (Loach, 1977) and they have been used to propagate tropical hardwoods with good success, particularly at the Forest Research Institute of Nigeria, Ibadan (Howland, 1975). Clonal propagation and hybrid breeding has become a powerful contribution tool for the improvement of wood quality (Gratapaglia and Kirst 2008) and other adaptation traits. The access to Clonal culture enhances the possibility of reproducing. Stacked layering is a new vegetative propagation method for quaking aspen and other rhizomatous species (Landis et al., 2006). De Souza et al. (2009) reported that seasonal seed availability and short viability are a concern for raising good quality plantations. Minicuttings can a good method of mass scale propagation of *Toona ciliata*. The longer the time interval between the two minicutting production harvests, the greater the speed of minicutting growth was. Ferreira et al. (2012) reported that the increasing demand for raw material for multiple uses of forest products and by-products has attracted the interest for fast growing species, such as the Australian Cedar (*Toona ciliata*), in Brazil which presents high productive and economic potential. Uppal and Singh (2010) reported that *Toona ciliata* root and shoot lengths come under genetic control, whereas germination percentage falls under environmental influence. Besides this, heritability (h^2), genetic advance and genetic gain were again higher for root and shoot lengths, indicating that these characters are under strong genetic control. Clonal propagation and hybrid breeding has become a powerful contribution tool for the improvement of wood quality (Gratapaglia and Kirst, 2008). Stacked layering is a new vegetative propagation method for quaking aspen and other rhizomatous species (Landis and others 2006). Genus like *Cordia* is represents trees or shrubs and about 300 species have been identified worldwide, mostly in warmer regions. The plant parts like fruits, leaves, stem bark, seeds and roots of most species of plants of the genus *Cordia*, especially *Cordia dichotoma*, *C. myxa*, *C. obliqua*, *C. verbenacea*, *C. martinicensis*, *C. salicifolia*, *C. spinescens*, *C. latifolia*, *C. ulmifolia*, among others, has long been used in traditional medicine for cicatrizant, astringent, anti-inflammatory, anthelmintic, ant malarial, diuretic, febrifuge, appetite suppressant, cough suppressant and to treat urinary infections, lung diseases and leprosy and its content varies with geographical distribution (Kumar et al, 200). Fruit and seeds of these species are used in various formulations at national and international levels. Oil extracted from kernels yielded palmitic, stearic, oleic, linoleic, behenic and arachidicacids (Khare, 2004). Quantitative assay for the

presence of plant phytochemical analysis of *Cinaamomum tamala*, and *Sapindus muckrossii*, and *Cordia spp* indicated the presence of restively high levels of glycosides, flavonoids, sterols, saponins, trepenoids, alkaloids, phenolic acids, gums and mucilage (Afzal *etal.*,2004 ;Abdallah *etal.*,2011 ; Malik and Ahmad, 2015). The fruit of *C. myxa* is used for treatment of chest, urinary infection, disease of the lung and spleen and against liver fibrosis when measured level of hepatic enzymes ALT, ALP, AST (Afzal *et al.*, 2009).

In the present-day context of fast growth of inhabited areas around the forest and germplasm conservation with superior genes of forest medicinal forest tree species, it is most important to develop fast and economical methods of raising superior stock. Vegetative propagation of forest trees is potentially very useful for not only replicating Clonal material with good genetic base but also to get the quick mass multiplication of stock. Clones offer the advantages of genetic uniformity and the immediate availability of superior individuals for seed orchards and for plantations. Considerable efforts have been made at our institute particularly on medicinal forest tree species and are quite successful. Of various methods of vegetative propagation of forest tree species, the one most likely to succeed on a large scale is the rooting of shoot cuttings, grafting and budding techniques. Cuttings can avoid the problems of seed collection and of ensuring germination and subsequent survival of young seedlings. Stem or shoot portions are generally very good material for rooting purposes, because they usually have undifferentiated tissues which may permit initiation of root primordial, and they also have buds already formed

Materials and Methods

Traditional methods of improvement or breeding if employed in forestry we will give result after sixth generation to stabilise the genetic change which means around 40-50 years. So by the time a technology become usable it may turned out to be obsolete. Apart from this the modern methods such as biotechnological techniques are long costly and also require long duration to trials to stabilise the variation. But if the technological interventions are innovated in combination, we can get not only early products but also shorten the reward period and can conserve the resources with minimum input. First step was to survey the entire niche to find out the variation with in geographical limits and select the superior strains which are needed for further domestication and breeding purpose based on the physical and chemical characters. Second step was to multiply in cost effective manner then to get this early result and output we standardised the vegetative means such as Grafting Technique, budding techniques, air-layering, vegetative propagations by use of hormones and traditional breeding methods were employed in combination with these techniques. Different types of grafting such as side veneer grafting, cuttings and budding techniques, wedge grafting modified chip budding, patch budding were employed in were employed on the wild forest species which were being exploited by the rural masses for food fodder and timber viz. *Terminalia chebula* (fruit and timber spp), *Terminalia bellerica*, *Emblica officinalis*, *Artocarpus lakkoocha* (fodder and fruit), *Cordia myxa* (fruit and fodder), and *Sapindus mukorossi*(fruit and timber), *Toona ciliata*(timber species) *Syzygium cuminni* *Madhuca indica* etc.



To get improved stock and crop improvement. The top side veneer grafting technique was found to be most suitable and easy to employ techniques in most of the subtropical wild high value species studied for improvement. A cut was made in the root stock which penetrated up to the xylem and the piece was removed by giving reverse cut at the lower end of the root stock. The scion wood having epical bud was given slanting cut at its base and a long cut was given on one side deep enough to expose the soft wood and matched with the cut made on the root stock so that the cut fitted that in the root stock. The two parts were joined so that the two cambiums fit (at least at one side) and the scion wood lower base with slanting cut was embedded in the bark of the root stock and matched. A thin slice of bark and wood, about 3.5-4.5cm in length, 3.5-4 mm width(matching with root stock diameter) and 1.2 mm deep was removed by means of a sharp grafting knife from the stem of the stock as well as from the scion branch. Polythene/alkathene strips of about 1.6 cm in width was tied around the union. The top of the root stock was cut off just above the scion after the two parts had united and care was taken so that no new sprout /shoot/leaves came on root stock. It was more successful in *Terminalia chebula*, *Terminalia bellerica*, *Cordia myxa*, Bael (*Aegle marmelos*) and *Sapindus muckrossii*. Modified chip budding Root stock: First cut It was more successful in *Terminalia chebula*, *Terminalia bellerica*, *Artocarpus lakoocha*, *Cordia myxa*, Bael (*Aegle marmelos*) and *Sapindus muckrossii* made at an angle of 45° downwards, ¼ of the diameter. Second cut It was more successful in *Terminalia chebula*, *Terminalia bellerica*, *Artocarpus lakoocha*, *Cordia myxa*, Bael (*Aegle marmelos*) and *Sapindus muckrossii* made ≈ 22 mm above the first, going downwards, to meet the first cut. Bud stick: Cut as for the root stock. It was more successful in *Terminalia chebula*, *Terminalia bellerica*, *Artocarpus lakoocha*, *Cordia myxa*, Bael (*Aegle marmelos*) and *Sapindus muckrossii*. The first cut was made 1-2 cm below the bud. Second cut is made ≈ 1.5cm above the bud going downwards to meet the first cut. The bud with attached wood is removed. The below stated points were kept in mind to assure success in the testing of fast multiplication and transfer of genes from one generation to next by these methods such as Incompatibility of the root stock and scion/bud, Lack of sufficient cambial contact due to in-proper cuts or/and unfit join, Desiccation of the graft union due to

watering ,the plants dry out due to too dry atmosphere, bud timing of the grafting, The scion/bud health before grafting, the root stock sap movement, The plant tissue was damage by knife, damage or loss of the bud/eye. These methods are tied in different seasons too to access their progress. It was more successful in *Terminalia chebula*, *Artocarpus lakoocha*, *Bael (Aegle marmelos)* and *Sapindus muckrossii*. The following steps were taken in order to obtain success in the execution of the softwood grafting /budding methods: a) Cut the scion on both sides like a fork b) a transversal cut was made in the rootstock c) Made a longitudinal cut in the rootstock as long as the two scion cuts and insert it into the longitudinal cut of the rootstock. d) Wrapped and united these two parts (scion and rootstock) with a alkathene plastic starting below this union then going up above it then again coming down below it. Cover the grafted scion with a plastic bag about 25cm long, 4-5 cm wide to promote a kind of CO₂ elevated level and humidity so that fast respiration and foliage growth take place. To maintain grafted plant with acceptable growth and development in the nursery some cultural practices, such as fertilization, irrigation, and weed and disease controls were needed. Regular irrigation based on the season and visual inspection was done on regular basis. The plastic used to tie the graft /bud was removed by giving a slight cut by the end of first season of the grafting. Shade net had been a very vital and useful link in providing mild microclimate to avoid desiccation and drying of the graft and hardening of grafted/ budded plants and often protection. Mist chamber were useful propagating units for the rooting of cuttings, especially those which are difficult-to-root. The successful grafted seedlings were transplanted in to the green house with mist so that the graft union and growth of the scion was attained well within shortest time. A good substrate had both the chemical and physical properties that promote healthy and rapid plant growth since these properties work together. A good substrate with proper nitrogen phosphorus and Potassium was with higher porosity and air movement was also maintained. Then hybridization of the half sib population among them self in isolation was carried out in few years contrary to the traditional waiting time to flower and new strains were developed and tested for their worth.

Results and discussion

Cordia myxa, *Terminalia chebula*, *Terminalia bellerica*, *Artocarpus lakoocha*, *Bael (Aegle marmelos)* and *Sapindus muckrossii* speices niches were selected by surveying the natural habitats of outer Himalayas. However, planted trees were observed in low hill zone to mid hill zone under different agro ecological situations Table 1, 2 and 3).

Table 1: Superior genotype/plus trees of *Cordia myxa* from natural habitats of Himachal Pradesh

Site address	Tree Height (M)	Tree Diameter (cm)	Latitude	Longitude	Altitude (m)	Tree Type
Dehra	11.5	32.75	31°88// N	76° 21// E	607	Irregular
Suliali (Thana)	12.3	25.89	31° 87// N	76° 32// E	560	Straight
Dola-lappiana	11.5	36	32° 17// N	76° 08// E	579	Irregular
Raja Talab	13.4	37.9	32° 19//N	75° 90// E	493	Erect
Gangath	15.6	41	32° 23//N	75° 82// E	434	Forked
Shahpur	18.4	36.9	32° 2//2N	76° 18// E	602	Irregular

Table 2: Details of different collections of *Sapindus mukorossi* collected from different altitudinal ranges of its occurrence in Himalayas.

Name of collection	Altitudinal range	Plant height(cm)	Altitude(m above msl)
Rohi Kadan(Mnadi)	31 ⁰ 78// E 77 ⁰ 00// N	20.00	1125.00
Solan	30 ⁰ 53// E 77 ⁰ 80// N	18.00	1446.00
Jamun KI sair	30 ⁰ 41// E 77 ⁰ 10// N	21.00	1033
Sirmour	30 ⁰ 23// E 77 ⁰ 25// N	19.00	988
Nahan	30 ⁰ 33// E 77 ⁰ 17// N	36.00	867.00
Nauni(Soaln)	31 ⁰ 51// E 77 ⁰ 10// N	23.00	1216.00
Parell (Chamba)	32 ⁰ 36// E 76 ⁰ 05// N	23.00	906.00
Kakira(Chamba)	32 ⁰ 27// E 75 ⁰ 55// N	22.10	1354.00
Shahpur	32 ⁰ 13// E 70 ⁰ 07// N	25.00	736.00
Khundian(Kangra)		22.10	879.00
Dadiala (Dharm sala)	32 ⁰ 12// E 76 ⁰ 15// N	33.00	821.00
Sarol(Chamba)	32 ⁰ 33// E 76 ⁰ 70// N	20.00	900.00
Khajiar	32 ⁰ 55// E 76 ⁰ 05// N	20.00	1890.00
Bhagot	32 ⁰ 34// E 76 ⁰ 71// N	26.00	866.00
Kuhal (Chamba)	32 ⁰ 39// E 76 ⁰ 76// N	26.00	998.00
Dula	32 ⁰ 39// E 76 ⁰ 76// N	17.00	889.00
Cheema	32 ⁰ 36// E 76 ⁰ 50// N	24.00	900.00
Lohal	32 ⁰ 26// E 76 ⁰ 10// N	24.00	1000.00

Table 3: Details of different collections of *Terminalia chebula* collected from different altitudinal ranges of its occurrence in Himalayas

Sr. No.	Altitudinal Range	Avg. Fruit Length (mm)	Avg.Fruit Diameter (mm)	Fruit type
Tamber strain	31° 17// E 70° 15// N	42.50-45.50	25.00-33.15	Oblong "Matka type"
Bhila Bichhowayin	30° 12// E 76° 14// N	44.33-50.17	28.00 - 33.13	Oblong dark colour with short neck
Jammu strain	32° 19// E 76° 14// N	112.26-125.40	23.89-25.98	Pyriform type Fruit
Kalar strain	32° 30// E 76° 717// N	60.29-65.98	25.90-31.12	Pyriform type fruit with Medium neck,
Kothi Strain	32° 05// E 76° 05// N	43.50-52.15	24.50-29.0	Narrowly obovate fruit type without neck
Pragpur strain	30° 34// E 75° 68// N	60.0-71.12	31.0-36.0	Clavate fruit type with prominent neck
Pleuri Strain	31° 39// E 76° 06// N	59.0-70.0	40.0-49.0	Oval, no neck blunt top, neck absent
Common type	32° 49// E 76° 07// N	35.35-47.30	23.00-31.30	Ellipsoid , small sized very common light coloured
Nurpur strain	32 ° 19//N 75 ° 90// E		37.20-40.82	Narrowly obovate medium in size with acute tip

Standardization of technology to preserve the rare and elite germplasm of *Cordia myxa*, *Terminalia chebula*, *Terminalia bellerica*, *Artocarpus lakoocha*, , and *Sapindus muckrossii* was carried out in the plant growth chamber by adopting the vegetative techniques such as budding, grafting air layering to the mass multiplication methods Bud wood bank will created at the research far. The studies on Distinctive Unique and sustainability of the traits of these crops will be done so as to ascertain the superiority of the selections over others. The rare and elite germplasm will be multiplied by the vegetative means standardized earlier for fast and large scale multiplication of the improved stock of these species. Different experiments will laid out to standardize the effect of organic and inorganic fertilizers and plant protection methods and other hormonal treatment to get optimum production per unit area. Demonstrate the new techniques at various location and agroecological situations to test the improved stock under different climatic conditions. Farmer's field will also be selected to test the improved stock. Seed germination is a problem in *Cordia myxa* was that only 1-2% germination exited in nature however, wild type of the species gave germination upto 40-45%. Method of grafting top side veneer grafting maximum success up to 70% in lasura bael (*Aegle marmelos*) Method of Grafting top size veneer Grafting success 60-65% (April) and grafting success 50% (May, July) Grafting success 60-65% (April) *Dheu* (*Artocarpus*

heterophyllus) Method of grafting top size veneer and maximum Success 35-40% Bud wood source Sadwan, Khajjan .Kathal (*Artocarpus lakoocha*) Method of grafting top side veneer but poor Success (0-2%) Bud wood source: Kathal, Rehan and Raja Ka Bagh. *Behra* (*Terminalia belerica*) Method of grafting top size veneer success rate 65-70% Bud wood source Gheta (Gangath) and Rehan *Reetha* (*Sapindus mukrosii*) Method of grafting top size veneer & patch success 70-80% (top size veneer) and 55-60% (patch) Grafting time April to July, best time April.

Terminalia chebula

The locations of sampled natural populations of *T. chebula*, their agro ecological regions and related site information are presented in Table 1 and Fig. 1. Tamber strain recorded the fresh fruit weight varied from 18.59 to 22.25 g per fruit and fruit length varied from 42.50 to 45.50 mm. Average fruit diameter varied from 25.00 to 33.15 mm. The morphological description of Tamber strain of harar was Oblong "Matka/Indian mud pitcher type" and pointed tip (Table 4). Similarly, the perusal of Table 4 shows that the leaf length of the Tamber strain varied from 17.0 to 18.0 cm and leaf width varied 12.00 to 13.5 cm. However, over all the leaf shape was cuspidate with leaf apex is acute in shape. Bhila-bichhowayin strain recorded the fresh fruit weight varied from 26.70 to 32.18 g per fruit and fruit length varied from 44.33 to 50.17 mm. Average fruit diameter varied from 28.00 to 33.13mm. The morphological description of fruit of Bhila-bichhowayin strain was Oblong dark colour with obtuse apex (Table 4). Similarly, the perusal of Table 4 shows that the leaf length of the Bhila-bichhowayin strain varied from 18.78 to 24.00 cm and leaf width varied 10.0-10.5 cm. However, over all the leaf shape was Elliptic Oval shaped with slightly acute leaf apex. Jammu strain recorded the fresh fruit weight varied from 36.40 to 41.10g per fruit and fruit length varied from 112.26 to 125.40 mm. Average fruit diameter varied from 23.89-25.98 mm. The morphological description of fruit type was Pyriform type Fruit with slightly oblique apex (Table 4). Similarly, the perusal of Table 4 shows that the leaf length of the Jammu strain varied from 14.5-18.7 cm and leaf width varied 7.6-7.8 cm. However, over all the leaf shape was Aristate type leaf and small leaf with acuminate leaf apex. Kalar strain recorded the fresh fruit weight varied from 18.99 to 25.80 g per fruit and fruit length varied from 60.29 to 65.98 mm. Average fruit diameter varied from 25.90-31.12 mm. The morphological description of fruit type was Pyriform type fruit with prominent medium neck (Table 4). Similarly, the perusal of Table 4 shows that the leaf length of the Kalar strain varied from 17.9 to 18.90 cm and leaf width varied 12.00-12.67 cm. However, over all the leaf shape was Obtuse type large sized, cuspidatus tip and rotundifolius base. Kothi Strain recorded the fresh fruit weight varied from 15.30 to 18.39 g per fruit and fruit length varied from 43.50 to 52.15 mm. Average fruit diameter varied from 24.50 to 29.0 mm. The morphological description of fruit type was narrowly obovate fruit type without neck (Table 4). Similarly, the perusal of Table 4 shows that the leaf length of the Kothi Strain varied from 17.0-19.0 cm and leaf width varied 8.50-10.08 cm. However, over all the leaf shape was Lanceolate type pointed at both ends. Paragpur strain recorded the fresh fruit weight varied from 29.45-37.87 g per fruit and fruit length varied from 60.0 to 71.12 mm. Average fruit diameter varied from 30 to 36 mm. The morphological description of fruit type was Clavate fruit type (Table 4). Similarly, the perusal of Table 4 shows that the leaf length of the Paragpur varied from 25.00 to 30.00 cm and leaf

width varied 14.00 to 15.50 cm. However, over all the leaf shape was Ovate type big leaf with acuminate leaf tip. Pleuri Strain Selection recorded the fresh fruit weight varied from 60.80 to 73.78 g per fruit and fruit length varied from 59 to 70 mm. Average fruit diameter varied from 40 to 49 mm. The morphological description of fruit type was Oval, no neck blunt top (Table 4). Similarly, the perusal of Table 4 shows that the leaf length of the Pleuri Strain varied from 18.1-19.0 cm and leaf width varied 8.0-11.0 cm. However, over all the leaf shape was Oblong. Nurple harar strain recorded the fresh fruit weight varied from 41.10 - 47.55 g per fruit and fruit length varied from 58.61- 60.32 mm. Average fruit diameter varied from 37.20 - 40.82 mm. The morphological description of fruit type was narrowly obovate medium in size (Table 4). Similarly, the perusal of Table 4 shows that the leaf length of the Nurple harar varied from 14.56 to 17.80 cm and leaf width varied 7.56 to 8.9 cm. However, over all the leaf shape was Ovoid shape leaves, medium in size as compared to other types. Common type is the mostly found type in all the sites with profuse flowering and fruiting low productivity and with unique leaf characters. It recorded the fresh fruit weight varied from 11.40 to 17.84 g per fruit and fruit length varied from 35.35 to 47.30 mm. Average fruit diameter varied from 23.00 to 31.30 mm. The morphological description of fruit type was Ellipsoid, small sized very common light coloured (Table 4). Similarly, the perusal of Table 4 shows that the leaf length of the Common strain varied from 11.40-17.84 cm and leaf width varied 35.35-47.30 cm. However, over all the leaf shape was Oblique leaf type. Fruit shape did not vary within individual Terminalia strain at different location when propagated through vegetative means. This conform to the results of Nasreldin et al. (2014). In general, the variation of measurable characters of fruits and leaves among the sites may be attributed to the different genetic variation because the environmental factors and climatic gradients were minimized.



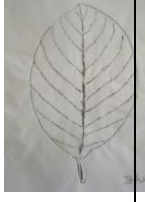














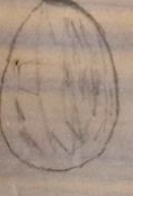

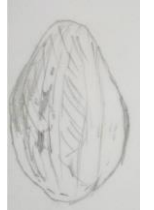
Fig. 1: Different strains of *Terminalia chebula* developed through the technological interventions

To better appreciate the agro-morphological variability in *Terminalia chebula*, a hierarchical clustering (HCA) was performed on the basis of evaluated quantitative traits. In this analysis, 9 variants were put under test to establish the relationship among them. The HCA analysis based on the Euclidean distance computed clustered the strains into four homogenous groups (Figure-2). The cluster 1 was composed of Tamber strain (Bilaspur), Kothi Strain

Bhila Bichhowayin, Kalar strain, Pragpur and Nurpur. The second cluster consisted of Local type strain (most common). The third cluster consisted of Jammu strain and the fourth one was Pleuri strain (Fig. 2). The principal components analysis showed that the first two axes explained 89.24% of the total variation (Table 7). First principal components explained with 67.55 % respectively of the initial variation; while the second accounted for 21.69%. Commonalties among the characters varied from 0.796 to 0.959 when principal components were analyzed (Table 8). Test Kaiser-Meyer-Olkin Measure of Sampling Adequacy showed the value is around 0.649 which is acceptable (Table 9). A greater contribution of fruit characters namely, fruit diameter and the longitudinal section of fruit, to the PC suggests a relationship between clusters and fruit characters (Sanjeewa et al., 2013). Standard deviation of characters varied from 5.46 to 23.77 (Table 5). *Terminalia chebula* is a common tree of subtropical region of sub-Himalayan region with its well-adapted morphology and physiology. Economic importance, nutritional and medicinal value, stress tolerance, and its use tanning industry are underlining the importance of this species for humankind (Chauhan, 1999). In the last two decades, several studies have increased our knowledge on Harar, discussing its potential economical relevance. However, the literature survey is suggesting that so far there were no attempts to study the genetic diversity of the species using morphological tools. Beside this, it is important to obtain basic facts related to the diversity of morphological traits of plants growing in different parts of the sub-Himalayan region.

Table 4: Details of Morphological fruit descriptors *Terminalia chebula* fruit strain developed at RHRTS, Jachh

Sr. No.	Avg. Fruit weight (Fresh) g	Avg. Fruit Length (mm)	Avg. Fruit Diameter (mm)	Shape	Descriptors	Shape	Descriptors
Tamber strain	18.59-22.25	42.50-45.50	25.00-33.15		Cuspitate "blunt end"		Oblong "Matka type"
Bhila Bichhowayin strain	26.70-32.18	44.33-50.17	28.00 - 33.13		Elliptic Oval shaped		Oblong dark colour with short neck
Jammu strain	36.40-41.10	112.26-125.40	23.89-25.98		Aristate type leaf, small leaf		Pyriform type Fruit

Sr. No.	Avg. Fruit weight (Fresh) g	Avg. Fruit Length (mm)	Avg. Fruit Diameter (mm)	Shape	Descriptors	Shape	Descriptors
Kalar strain	18.99-25.80	60.29-65.98	25.90-31.12		Obtuse type large sized, cuspidatus tip and <i>rotundifolius</i> base		Pyriform type fruit with Medium neck
Kothi strain	15.30-18.39	43.50-52.15	24.50-29.0		Lanceolate type pointed at both ends		Narrowly obovate fruit type without neck
Pragpur strain	29.45-37.87	60.0-71.12	31.0-36.0		Ovate type big leaf		Clavate fruit type with prominent neck
Pleuri strain	60.80-73.78	59.0-70.0	40.0-49.0		Oblong leaf type		Oval, no neck blunt top, neck absent
Common type	11.40-17.84	35.35-47.30	23.00-31.30		Oblique leaf type		Ellipsoid, small sized very common light coloured
Nurpur strain	41.10-47.55	58.61-60.32	37.20-40.82		Ovoid shape leaves, medium in size as compared to other types		Narrowly obovate medium in size with acute tip

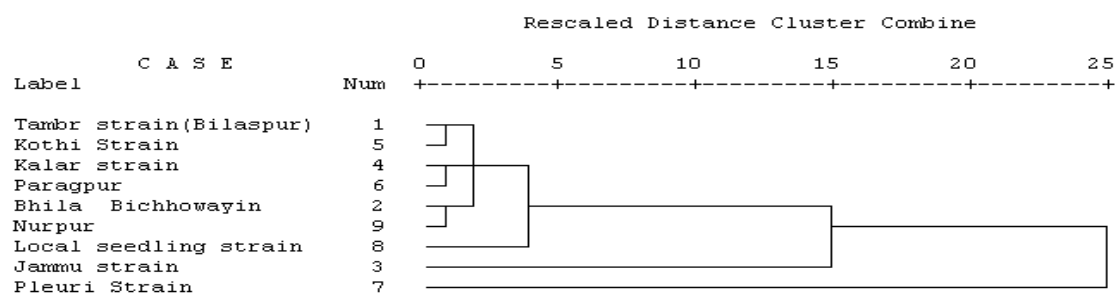


Fig. 2: Dendrogram illustrating the four clusters obtained using first two principal components.

Table 5: Descriptive statistics of the variability of principal components of *Terminalia chebula* strains of the surveyed lower Himalayan region of India

Variable	Minimum	Maximum	Mean	Std. Deviation
Fruit weight(g)	11.40	73.78	30.79	19.08
Fruit length(mm)	35.35	112.26	54.73	23.77
Fruit diameter(mm)	23.00	40.00	27.14	5.46
Leaf length(cm)	11.40	73.78	23.32	19.28
Leaf diameter (cm)	7.56	59.00	18.44	17.46

Table 6: Pearson correlation coefficients between among *Terminalia chebula* descriptors in Himalayan region

	Fruit weight	Fruit length	Fruit diameter	Leaf length	Leaf Diameter
Fruit weight	1.00				
Fruit length	0.254	1.00			
Fruit diameter	.782*	0.085	1.00		
Leaf length	0.849**	0.077	0.952**	1.00	
Leaf Diameter	0.582	-0.105	0.728*	0.819**	1.00

Table 7: Eigenvalues of the principal components (PCs)

PC axis	Eigenvalues	Initial % of variance	Cumulative %
1	3.378	67.55	67.55
2	1.085	21.69	89.24
3	0.329	6.57	95.82
4	0.186	3.72	99.54

Table 8: Communalities of Principal Components

Components	Initial	Extraction
Fruit weight	1.000	0.959
Fruit length	1.000	0.829
Fruit diameter	1.000	0.796
Leaf length	1.000	0.979
Leaf Diameter	1.000	0.899

Table 9: KMO and Bartlett's Test Kaiser-Meyer-Olkin Measure of Sampling Adequacy

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.649
Approx. Chi-Square	28.984
Sig.	0.001

Cordia myxa

Survey was conducted lower Himachal and it was found in Kangra up to Palampur, Hamirpur, Una, lower region of Solan district. Its trees are found in low productive harsh site in "Dola lappiana" area of Kangra district and Rakkad area of Dehra division. There exist large variability of the species in the region. Large fruit genotype is susceptible to borer attack whereas, small fruit genotypes of *Cordia myxa* are resistant to seed borer attack. Propagation through seed is big problem due to heavy seed infestation in the species that is why it is found as single tree rather than in gregarious in nature. Small fruit genotype called "lasuri" was used as root stock and also vegetative shoot cuttings are used for propagation of the species. Attack of insect *Alternaria alternata* have become common

on fruits of *Cordia myxa* . Unripe fruits are eaten as a vegetable, pickle making and “badian” a local recipe for off season use. Leaves are used as fodder to the animals. The ripe fruits are full of vitamins and regular use is supposed to be helpful in good growth of hair. The bark, leaves and fruit have medicinal properties, they are used variously as diuretics, demulcents and in the treatment of stomach aches, coughs and chest complaints. mucilaginous pulp of the fruit is used in the treatment of coughs, sore throats and chest-complaints on account of its demulcent property. The plant is used in shelter-belts in to prevent soil erosion. Its fruits are sold at the rate or Rs. 50-70 rupee per kg in local market. Winter survey revealed that the new variant of *Cordia myxa* was found at Ganagath which bears fruit in winter. The fruit size varied from its hundred fruit weight varied from 1240 to 1409 g whereas hundred seed weight varied from 149 to 680 g .The fruit diameter varied from 9.80 to 11.52 mm and fruit length varied from 28.19 to 31.09 mm .The fruit shape was recorded to be elliptical.



Table: 4 Fruit characteristics of different collections of *Cordia myxa*

Seed Source(g)	100 fruit weight(g)	100 seed weight (g)	Pulp weight (g)/per fruit (g)	Seed Diameter (mm)	Fruit Diameter (mm)	Fruit length(mm)	shape elliptical	Shape graphics	Fruit
Dehra	2089.33	517.67	16.15	10.70	33.73	33.90	Round		
Laapiana collection	1794.10	455.33	13.59	11.71	33.67	29.57	Elliptical fruit shape		
Suliali collection	2092.67	216.00	18.77	8.30	36.52	34.63	Almost round fruit		
Gangath collection (Summer)	1856.00	492.67	13.63	9.60	28.43	28.87	Almost round		
Gangath collection(winter fruit)	1304.67	369.00	10.22	18.02	10.69	29.70	Oblong		
Shahpur collection data	1725.45	530.00	11.95	14.45	28.60	29.76	Elliptical		

Fig3 : A new strain of lasura which also bear fruits in winter



Six strains were identified from six different places of lower hill region of Himachal Pradesh viz Dehra, Gumer, Dola-lappiana, Gangath, Shahpur and Raja Talab. Which had better fruit size than the other trees of the species. Tree height varied from 11.5 m to 18.4 m and the altitudinal range varied from 434 to 607 m above mean sea level. Details of longitudinal and latitudinal data along with tree parameters is given in the Table 2. A detailed survey was conducted in the subtropical region of Himachal Pradesh and six best genotypes were selected from the natural populations. Dehra collection had round fruit with dark green texture. Average fruit size of Dehra collection was 2089.33 g/hundred fruits with 33.73 mm diameter with almost same fruit length. Lappiana strain recorded the maximum size of 33.67mm with average fruit weight of 1794.10 g/hundred fruits. Suliali strain recorded the average fruit size of 36.52 mm with 2092.67gm/hundred fruit. A new type of strain was found in Gangath area with winter fruit bearing (Table 11). The Gangath strain recorded the average fruit weight of 1856/ g/hundred fruits of summer fruiting and 1304.67 g/hundred fruits of winter fruits with average fruit size of 28.43 mm of summer fruits and 23.69 mm. Shahpur strain recorded the average fruit weight of 1725 g per hundred fruits and average fruit diameter of 28.6 mm. Winter fruit bearing Gangath can be a good option of nutritional requirement of stigma sterol found naturally in the *Cordia myxa* fruits (Fig. 3). Crop productivity of *Cordia myxa* can be enhanced by applying grafting techniques. Viz. side veneer grafting, cleft grafting and chip budding etc. These techniques result in the quality improvement of the fruits and early production. Side veneer grafting success is usually up to 70 %t but it can be enhanced up to 90 % if the polythene caps are put on the graft just after grafting the stock under shade house .Grafting success is low under open conditions. Root stock should be of pencil thickness and of around 8-9 months old. In side-veneer graft, a shallow downward and inward cut from 4-6 cm long is made in a smooth area of rootstock. At the base of this cut, a second short inward and downward cut is made, intersecting the first cut that removes the piece of wood and bark. The scion is prepared with a long cut along one side and a very short one at the base of the scion on the opposite side. These scion cuts should be the same length and width as those made in the rootstock so that the vascular cambium layers can be matched as closely as possible. After inserting the scion, the graft is tightly wrapped with polythene (alkathene).scion wood should be harvested from disease free branch Low lying or crowded branches should be avoided .Scion wood Bigger or smaller sized don't match the rootstock. Cleft grafting in older stock has given good results. Chip budding in the month of March gave success up to 80 percent. Grafting period usually starts from first week of March to mid-June under subtropical conditions. Compatibility between the rootstock and scion should be checked to get good success of the graft. Therefore, the physiological stage of vascular cambium of the scion must be same as that of root stock and there should be sap flow in both. New shoot growth of root stock should be checked after the grafting is done. It should be well understood that the grafting point must be few centimeter above ground (Fig. 4).

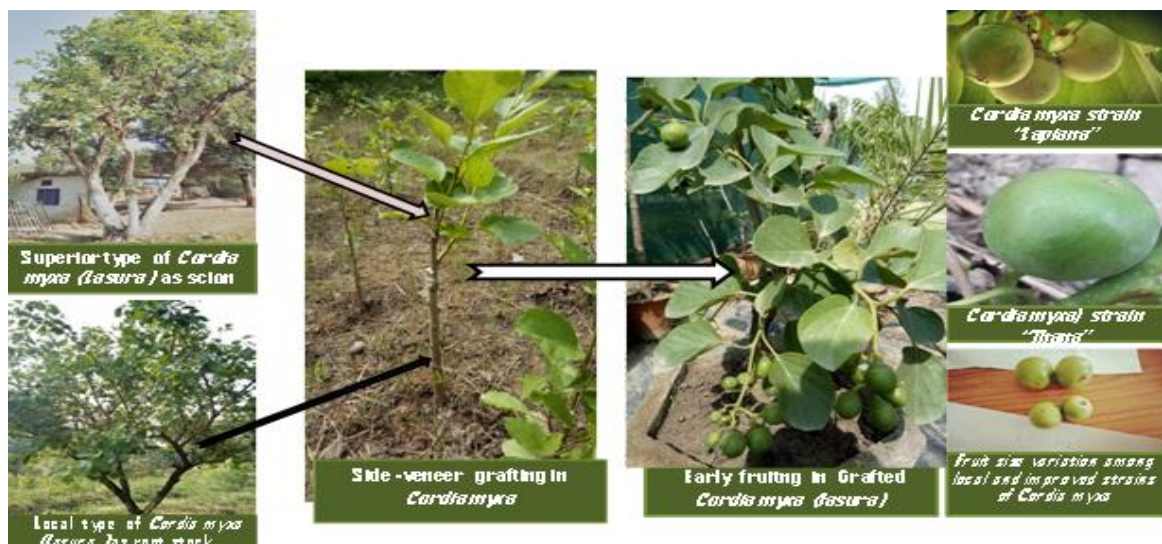


Fig4 Standardization of technological interventions for getting highly productive clonal stock of Cordia myxa (Lasura) with

Cordia myxa (Lasura) strains from different parts of the state has been put under evaluation under different agro-ecological situations representing variable climatic situations at various sites along the altitudinal gradients to test their growth and performance finalize the further selection of suitable types for changing climatic situations. Strains viz Dola lappiana, Thana, Dehra, Gangath and Shahpur selections has been put under evaluation at Baluglowan (Kangra) at 700 m above msl in rainfed and low productive site, Palampur (Kangra), at 1203 m above m.s.l Bijari (Hamirpur) above 768 m. The preliminary observations pertaining to the survival of the stock presented. Perusal of the data in table, it is quite evident that the survival of different collections is varying from 33.33 per cent to 100 percent. Over all Dehra collection has shown highest survival among all the collection. Further evaluations are on and data will be collected in coming season.

Table 10: Field performance of *Cordia myxa* clones under different altitudes

Place	Altitude (m)	Selections put under test	Survival percent till Dec, 2018				
			Dola lappiana	Thana	Dehra	Gangath	Shahpur
Balugloan (Kangra)	700	Dola lappiana, Thana, Raja Talab, Dehra Gangath and Shahpur	50.00	33.33	83.33	66.67	50.00
Darang (Kangra)	1203	-Do-	33.33	50.00	100.00	66.67	50.00
Bijari (Hamirpur)	763	-Do-	33.33	66.67	83.33	83.33	66.67
Nagrota bagwan (Kangra)	980	-Do-	66.67	50.00	66.67	83.33	66.67

Reetha (*Sapindus muckorossi*)

A detailed Survey was conducted lower Himachal and it was found in Palampur(Kangra), Solan, Naina tikker, Nahan, Jamun ki sair(Sirmour), Shilli forest area, Ddhamb(Kangra), Dharmsala and survey of Chuvvari, Chamba, Tissa and Chanju area is under way. The reetha trees showed good seed bearing in the areas having altitude ranging from 790 m above mean seas level to 1400 m above mean seas level. Trees in lower height below than 700 m above mean sea level recorded low seed bearing per tree and also the seed colour was dark brown where as in upper ranges its colour was light in colour and had more saponins. Its trees were found in low sites having moisture around the streams. There exist large variability in the species. Its fruit is used for making detergent and for washing hairs at rural level .It is considered to be the best soap for warm clothing in Chamba region where its fruits are used for washing heavy blankets made up of local sheep hairs in rainy season. The plant is used in shelter-belts in to prevent soil



erosion. Its fruits are sold at the rate or Rs. 70 -90 rupee per kg in local market. The fruit of lasura start appearing during April-June. It is a kind of a drupe, light pale to brown or even pink in color. Seeds are collected from the middle aged trees and pulp is removed before sowing. The seeds are sticky due mucilaginous material inside the fruit so washing of the

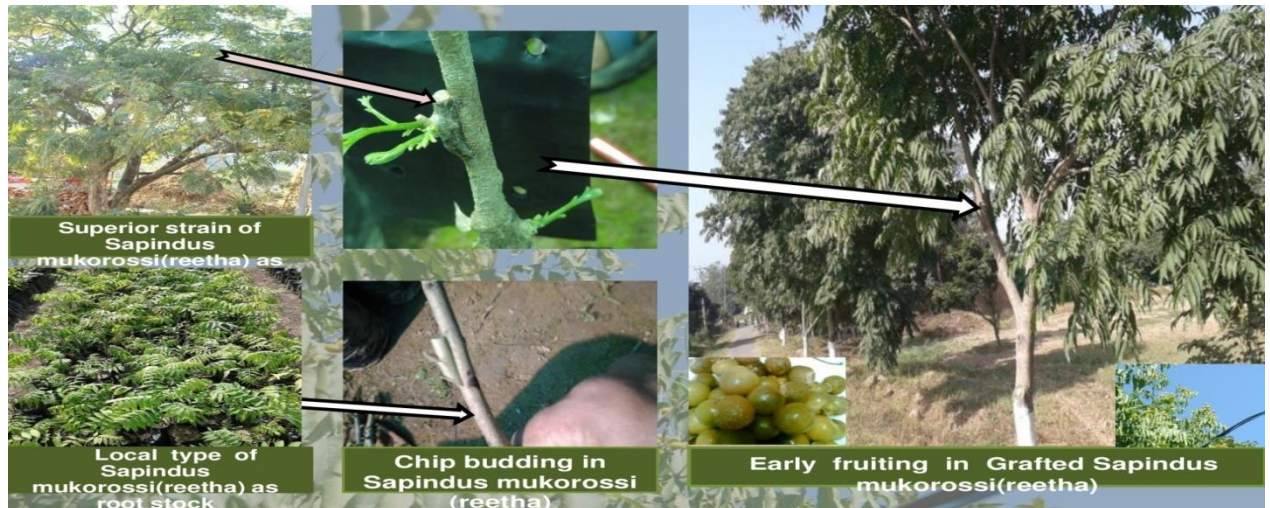
seeds is done before seed sowing. The seed is susceptible to insect attack so it should be stored in air tight containers at cooler places. It can be propagated

through seed as well as through vegetative means. Seed germination is erratic due to heavy infestation and dormancy. Vegetative propagation through cutting is possible only if the cuttings are treated with 3000-4000 ppm IBA solution before planting in coarse sand under heavy moist conditions. Young plants can be transplanted after 4-5 months. Vegetative propagation by side veneer grafting, chip budding and cleft grafting has also given good results. The experiment was set up standardize the technology for vegetative propagation to get early and true to type planting stock of the species. Three methods of propagation viz chip budding, side veneer grafting and cleft grafting was tried on the seedling stock raised in polibags of 9"x4.5" under shade house conditions. Over all chip budding recorded the highest post budding success followed by side veneer grafting. The progress of first year experiment recorded that the poly cap has significant impact on the graft success (Table 4). The polycap was designed by us of 7"x3' size. Chip of 3 cm size recorded the maximum post budding

success when covered with the polycap (Table 4) to the tune of 80%, which was closely followed by 4 cm chip size. Side veneer grafting by using 11 cm long scion wood recorded the maximum grafting success of to the tune of 75% when covered with polycap. Similarly, cleft grafting recorded the maximum success of 68% when 13 cm scion wood was used by covering the stock with ploy cap.

Table 11: Standardization of technology for vegetative propagation of Reetha (*Sapindus mukorossi*)

Type of grafting/budding	Size of budding/grafting scion-wood	Polycap covering (with/without)	Success of graft/budding
Chip budding			
	2 cm	Without polycap	33.33
		With polycap	66.67
	3 cm	Without polycap	66.67
		With polycap	80.00
	4 cm	Without polycap	75.00
		With polycap	75.00
Side veneer grafting			
	9cm	Without polycap	33.33
		With polycap	50.00
	11cm	Without polycap	66.67
		With polycap	75.00
	13cm	Without polycap	60.00
		Without polycap	66.67
Cleft grafting			
	9cm	Without polycap	33.33
		With polycap	55.00
	11cm	Without polycap	56.67
		With polycap	60.00
	13cm	Without cap	62.00
		Without polycap	68.40



Development of highly productive grafted clone of Sapindus mukorossi (Reetha)

To get early and propagate more productive germplasm vegetative propagation techniques viz. side veneer grafting and chip budding etc have been standardised for mass multiplication and preserving promising genotypes of the species. These techniques result in the quality improvement of the fruits and early production. Side veneer grafting success is usually up to 70- 80 per cent but it can be enhanced up to 90 % if the polythene caps are put on the graft just after grafting the stock under shade house (light limiting conditions). Chip budding is also practiced in case of reetha which have yielded good survival success of stock up to 60 per cent. Grafting success is low under open conditions than under shade house under Jachh conditions. Root stock should be of pencil thickness and of around 8-9 months old. In side-veneer graft, a shallow downward and inward cut from 4-6 cm long is made in a smooth area of rootstock. At the base of this cut, a second short inward and downward cut is made, intersecting the first cut that removes the piece of wood and bark. The scion is prepared with a long cut along one side and a very short one at the base of the scion on the opposite side. These scion cuts should be the same length and width as those made in the rootstock so that the vascular cambium layers can be matched as closely as possible. After inserting the scion, the graft is tightly wrapped with polythene (alkathene).scion wood should be harvested from disease-free branch. Avoid Low lying or crowded branches. Scion wood bigger or smaller sized don't match the rootstock. Chip budding in the month of April has given success up to 60%. Chip budding period usually starts from first week of April to July under subtropical conditions. The first cut on both stock and scion is made at a 45° to 60° downward angle to a depth of about 1-3 mm in cambium of root stock. After making this cut on a smooth part of the rootstock, start the second cut about 3-4 cm higher and draw the knife down to meet the first cut. Then remove the chip from scion wood which has one eye and have 3-4 cm length. Chip size in this case is larger than the chip size practiced in case of horticultural crops. Care should be taken to match the bark of both the scion and root stock so that injured tissue combine fast. Cuts on both the scion (to remove the bud) and the rootstock (to insert the bud) should be exactly the same size at just below the current year's growth. Wrapping is extremely important in chip budding. If all exposed edges of the cut are not covered, the bud dries out. The bigger chip than normally done in horticultural crops is more successful in case

of reetha. Compatibility between the rootstock and scion should be checked to get good success of the graft. Therefore, the physiological stage of vascular cambium of the scion must be same as that of root stock and there should be sap flow in both. New shoot growth of root stock should be checked after the grafting is done. It should be well understood that the grafting point must be few centimeter above ground (Fig. 4).

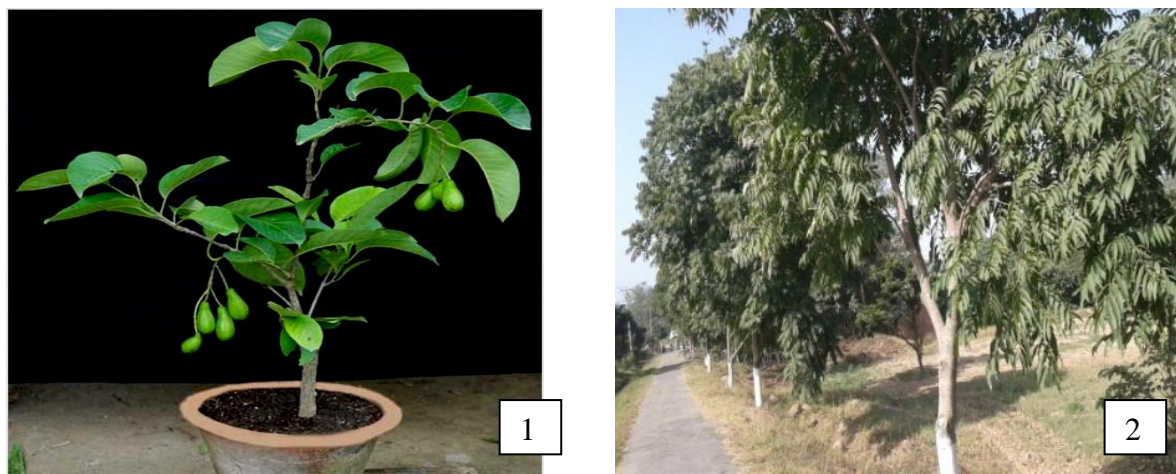


Fig 4: 1.Grafted *Terminalia chebula* fruiting 2nd year and giving true to type fruit and leaves, 2. Chip budded grafted plantation of improved reetha plantation

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Enhancing Impacts of Payment for Forest Environmental Services on Forest Management: Experience of SNRM REDD+ Pilot Implementation in Muong Gion Commune, Son La Province, Vietnam

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Abstract

Payment for Forest Environmental Services (PFES) have been introduced in Vietnam since 2008 aiming to incentivize individuals and communities to sustainably manage and protect their forests by providing compensation for their efforts[1]. According to Provincial REDD+ Action Plan (PRAP) in Son La Province, PFES is the only budget of forest protection[2], suggesting the significant role of PFES in forest management. Son La PPC issued a guideline to use 40% of PFES fund for forest management. However, since PFES buyers and sellers are hardly connected, the impacts of PFES on actual forest management is unknown[3].

Sustainable Natural Resource Management (SNRM) project² funded by JICA supported to form a village authority to promote forest management and livelihood development, establishing village fund and demonstrating sustainable resource use models. The objective of the paper is to assess impacts of PFES on enhancement of forest management based on the experience of SNRM project in Muong Gion Commune, Son La Province.

SNRM found that a village-based authority functioned well when it is implemented with village fund, incorporating the PFES as a core fund of the operation. Although the PFES mechanism is still premature, there exists a potential of having much larger impacts of PFES on forest management.

In order to have greater impacts of PFES on forest management, enhancement of forest status assessment, regular PFES payment, intimation of PFES mechanism to villagers, and demonstration of low cost, high valued, and short rotation land use practices are recommended.

Key words: *Provincial REDD+ Action Plan (PRAP), Village Forest Management, Village Fund*

² SNRM has four components: 1) Forest policy, 2) Sustainable Forest Management and REDD+ at four North West Provinces, 3) Biodiversity at Lang Biang Biosphere Reserve and 4) Knowledge sharing. This paper is based on the finding of Son La part of component 2 (Support for PRAP formulation/implementation and REDD+ pilot activities excluding Development of provincial forest monitoring system)¹.

1. Introduction

Payment for Forest Environmental Services (PFES) has been introduced in Vietnam since 2008 aiming to incentivize individuals and communities to sustainably manage and protect their forests by providing compensation for their efforts [1]. According to Provincial REDD+ Action Plan (PRAP) in Son La Province, the PFES fund accounts for 100% of the fund allocated to forest protection [2], suggesting the significant role of PFES in forest protection. Son La PPC issued a guideline to use 40% of PFES fund for forest management. However, since PFES buyers and sellers are hardly connected, intervention is required at various levels in order to remove existing barriers.

Sustainable Natural Resource Management (SNRM) project funded by JICA initiated project activities in Son La since 2016 supported forming village authorities to promote forest management and livelihood development, establishing village fund to manage the received PFES at village level.

The objective of the paper is to assess impacts of PFES on enhancement of forest management based on the experience of SNRM project in Muong Gion Commune, Son La Province.

In this paper, at first the contents and the budget of PRAP related to PFES were assessed. Then, the utilization of PFES were discussed regarding village authority with forest regulations, as well as the forest management and livelihood development practices supported by SNRM. The status and allocation of PFES qualified forests, and the revenue and expenditure of village fund incorporating PFES in SNRM target villages were analyzed.

2. Methodology and Approach

This paper draws the findings of REDD+ implementation support activities carried out by Sustainable Natural Resource Management (SNRM) project funded by JICA. The project activities at village level in Son La was initiated in September 2016 and will continue until July 2020. SNRM in Son La supported 1) PRAP formulation, and 2) REDD+ Pilot Activities composing setting up village forest management (village management board, forest management regulations, and forest patrolling team) and livelihood development (introducing improved cooking stoves, agroforestry models, enrichment of natural forests, fruit tree/vegetable cultivation, etc.). The series of village meetings, interviews with village leaders, trainings on technical supports to beneficiaries, and field surveys were carried out by the project and substantial data and collaboration have been provided by DARD, FPD, DPC and district FPD of Quynh Nhai District, and CPC of Muong Gion Commune for the implementation of SNRM.

3. Provincial REDD+ Action Plan (PRAP) in Son La Province

Son La Provincial REDD+ Action Plan (PRAP) was formulated in 2017 with two components: 1) Forest protection and development activities and 2) six solution packages with 20 solutions (Table 1, [2])³.

³ MARD. 2015. DECISION Approving the guidelines on development of provincial action plan on reducing greenhouse gases emissions through efforts to reduce deforestation and forest degradation,

Table 1: Activities and Solutions of Son La Provincial REDD+ Action Plan: 2017-2020

Category	Activities and Solutions
Component 1: Forest Protection and Development Activities	
1. Forest Protection	- Forest protection contracting - Forest fire prevention and fighting
2. Forest development	- Afforestation/reforestation - Forest regeneration
3. Other related activities	- Scattered tree planting
Component 2: Solution packages	
1. Enhance the effectiveness of afforestation/reforestation	- Ensure technical correctness in tree planting and tending - Ensure that the seedlings are of high quality and suitable to the site conditions - Improve management of timber logging and replanting (production forests) - Support improvement of market for plantation wood. - Support development of silviculture infrastructure
2. Promote forest protection and sustainable use of forest resources	- Promote the use of alternative materials and advanced (energy saving) technology - Develop and strengthen community forest management - Enhance law enforcement - Enhance the effectiveness of awareness raising and communication on forest benefits to local people - Enhance capacity of local people in forest maintenance - Improve forestry/agroforestry livelihoods for local people
3. Control forest fire	- Control the use of fire in upland farming. - Strengthen cooperation and coordination on fire prevention and fighting in border areas - Enhance the capacity for fire prevention and fighting
4. Control conversion of forests to upland fields	- Enhance the agricultural livelihoods for local people - Address the unpractical issues of land use planning, forests and forestry land allocation
5. Mitigate impacts of forest conversion into other land use (road/hydropower plant construction, etc.)	- Improve quality of the offset planting - Enhance protection of forests adjacent to newly converted areas
6. Province-wide Cross-cutting solution package	- Improve the provincial Forest Resource Monitoring System (FRMS) - Conduct awareness raising and capacity building on REDD+

Source: [2] Son La PPC. (2017)

PRAP Budget

According to the Son La PRAP budget, PFES account for 28% of entire budget and twice as large as entire state budget for forest protection and development (100% and 78% of forest

sustainable forest management, and conservation and enhancement of forest carbon stocks (REDD+) No. 5414/QD-BNN-TCLN.

protection and control of forest fires, respectively). PFES was planned to be spent for forest protection and forest fire control (Table 2).

Table 2: Son La PRAP budget 2017-2020

No.	Category	PFES	Other Funding Sources		Private Sector	Local Community	Others	Total
			State Budget	Local Budget				
Component 1		20,395	29,580	2,370	102,776	0	0	155,121
1	Forest protection	20,395	0	0	0	0	0	20,395
2	Afforestation and forest maintenance in SUF and protection forest	0	25,688	0	0	0	0	25,688
3	Afforestation and forest maintenance in Production forest	0	3,893	0	0	0	0	3,893
4	Offset plantation	0	0	0	102,776	0	0	102,776
5	Scattered tree plantation	0	0	2,370	0	0	0	2,370
Component 2		40,000	557	15,838	4,000	0	2,580	62,975
1	Enhance the effectiveness of forest plantation	0	557	2,373	4,000	0	870	7,800
2	Promote sustainable use of forest resources	0	0	749	0	0	1,470	2,219
3	Control forest fire	40,000	0	11,086	0	0	0	51,086
4	Control conversion of forests to upland fields	0	0	1,600	0	0	0	1,600
5	Cross cutting solution package	0	0	30	0	0	240	270
Gran Total		60,395	30,137	18,208	106,776	0	2,580	218,096
%		27.7	13.8	8.3	49.0	0.0	1.2	100.0

Remark: JICA 3 loan was removed since it was not implemented.

Source: [2] Son La PPC. (2017)

4. SNRM REDD+ Pilot Activities

SNRM REDD+ pilot activities were initiated in 13 villages in Muong Gion Commune in August 2016. 13 villages were selected as target villages due to area of forest lands without land conflicts among the villages.

Village Management Boards for Forest Management and Livelihood Development (VMBFMLD)

In each village, in order to sustainably manage the area allocated to villages and households through the promotion of forest management and livelihood development activities, Village Management Boards for Forest Management and Livelihood Development (VMBFMLD) was established through three village meetings (69 members, 36% women). VMBFMLD is being operated with their regulation approved by CPC. The tasks of VMBFMLD are:

1. Promote planning, implementation and monitoring of forest management and livelihood development in the villages
2. Develop regulations on forest use in the villages and ensure that all villagers follow the regulations

3. Promote public awareness of forest management
4. Establish village forest patrol teams (VFPT) to monitor the activities
5. Development of livelihood development activity groups by activity (for example, fruit trees cultivation, vegetables cultivation, etc.)
6. Ensure that livelihood development activities are implemented as in accordance with current plans and regulations as well as with the technical requirements.
7. Establish, manage and operate village funds for forest management
8. Coordinate with VFPTs and CPC to handle violations as in accordance with the rules and regulations on forest management or livelihood development.
9. Coordinate with forest rangers and CPC to carry out forest management and village livelihood development activities.

Village forest regulations (VFR)

Before SNRM project implementation, all the villages had VFRs and VFPTs⁴ but the conditions were varied among the villages. SNRM supported to organize the regulations with four chapters and 12 articles with the responsibilities of VMBFLD and VFPT and integrated them into the general village regulation, which are now seen on the signboard in some villages. VFRs of SNRM target villages is updated annually.

Support for sustainable resource management/land use practices

SNRM supported forest management activities (forest protection, afforestation and ANR) and nine types of livelihood development activities through VMBFLD (Table 3). Technical training and Materials were provided with obligation to contribute to village fund.

Table 3: Sustainable land use practices introduced by SNRM

Activity	Village No.	Scale	SNRM support
Forest management			
Forest protection	12	159 HH 5,027 ha	Re/setting up Patrolling Team Patrolling village forest area in cooperation with commune forest ranger(s) Forest patrol route map
Afforestation	4	165 ha Plantation Pinus masoniana	Forest plantation design Training to villagers Checking and Monitoring
Assisted Natural Regeneration	10	295.4 ha	Survey for designing regeneration Installing sign board and boundary pole along the delineated area Training to villagers Checking and Monitoring
Livelihood development			
Vegetable cultivation	12	451 HH	Training on vegetable cultivation techniques

⁴ In order to mainstream forest fire prevention and fighting throughout the province, 1,850 Village Forest Patrolling Teams had been established by 2015 (Son La PPC, 2017).

Activity	Village No.	Scale	SNRM support
			Supporting seedling for 2 seasons
Fruit tree cultivation	12 (5 grafting)	557HH (27 grafting)	Training on fruit tree planting techniques (including grafting techniques) Supporting seedlings, study trip on grafting
Compost/organic fertilizer production	10	239HH	Training on techniques including study trip equipment
Fodder grass cultivation	9	249HH	Training on cultivation techniques including study trip, Supporting cuttings/seeds and signboard
Improved stove distribution	13	579HH	Supporting design, molding of improved stove to produce at villages, Training, provision of materials
Biogas plant installation	1	2 HH	Study tour to a biogas plant model. Training on biogas installation and maintenance Supporting 50% cost of procurement and material
Contour cropping/ Agroforestry	11	72 HH	Design survey, Technical training Supporting seedling/seeds to participants after the training 15 models - Grafted docynia indica + Ghine grass + Maize, docynia indica and peach, Grafted late fruiting longan + plum + Ghine grass + Maize, Grafted late fruiting longan + pomelo + Soybean Grafted late fruiting longan + grafted Taiwan mango + Plum + Ghine grass + Cassava, Grafted black canari (Canarium tramdenum) + Grafted Taiwan mango + Ghine grass + Soybean, Grafted black canari + Ghine grass + Maize, Late fruiting longan + grafted Taiwan mango + Ghine grass + Maize, Grafted litchi + grafted late fruiting longan + Ghine grass + Cassava, Litchi + grafted Taiwan mango + grafted late fruiting longan + Ghine grass + Maize,
NTFP plantation	1	1 HH	Sa Nhan (Amomum longiligulare) plantation in forest Amomum xanthioides (Sa nhan xanh in Vietnamese) and Amomum longiligulare (Sa nhan) under natural forest canopy Technical training including study trip Supporting seedling
Mushroom production	1	7 HH	Technical training including study trip Providing material and equipment Marketing

Source: Adopted from [4] Pham, et al. (2019)

5. Payment for Forest Environmental Services in Son La Province

The total area of forest land in Son La is 1,037,454 ha (70% of total area) with forest cover 42.4% [2]. 97% of forest land is already allocated [3]. The majority of the population of Son La is ethnic minority, accounting for 75.4%, of which Thai, H'Mong and Muong account for 54.7%, 13.0%, and 8.1%, respectively[3].

Son La is one of the first two provinces of the country to pilot the implementation of PFES policy since 2008. PFES fund management was entrusted to independent department, Son La Provincial Forest Protection and Development Fund (FPDF). The jurisdiction of FPDF was shifted from DARD to PPC in 2018. In 2018, for 106 billion VND was paid to approximately 560,000 ha of forest with 43,000 forest owners as PFES payment for 2017 (FPDF, Personal communication).

Muong Gion Commune has officially received PFES since 2014. Forest owners are required to set up a forest protection team to carry out forest patrolling for forest guard and forest fire prevention⁵. According to Son La PPC guideline⁶, at least 40% of the total amount of annual payment for forest environmental services is to be spent for manage, protect and develop forests, prevent and fight forest fires⁷.

Forest owners are villages and hamlet communities (not organizations assigned by the State to manage forests). In particular, "Management on use of PFES by the beneficiaries⁵" refer to forest owners as village communities.

Forest status of PFES qualified forests

According to the comparison between forest status approved by FPD and PFES approved area, a large gap was found in 2015 (Figure 1, Table 4, 4% difference in total areas). However, the gap became much smaller in 2016 and 2017 (almost same in total area) because PFES in 2015 was based on forest land allocation not by forest status map⁸ but PFES for 2016 and 2017 were paid based on forest status approved by FPD. It suggests the improvement of PFES qualification process through forest assessment from 2016.

⁵ Decree No. 09/2006 /ND-CP of January 16, 2006 Prime Minister

⁶ Guideline on the management mechanism for using payment for forest environmental services by Forest owners (Decision No. 1853 / QD-UBND, August 18, 2015)

⁷ Expenses for forest management and protection teams and teams, procurement of necessary tools and equipment for forest management and protection teams and forest fire prevention and control teams, forest trees and fertilizers to plant forests and enrich forests.

⁸ FPD approved Forest status map 2015 was based on SPOT 5 for 2015 and 2016 and 2017 maps were made on the 2015 map by field surveys.

Figure 1: Forest Status and PFES recognized forest mans 2015-17

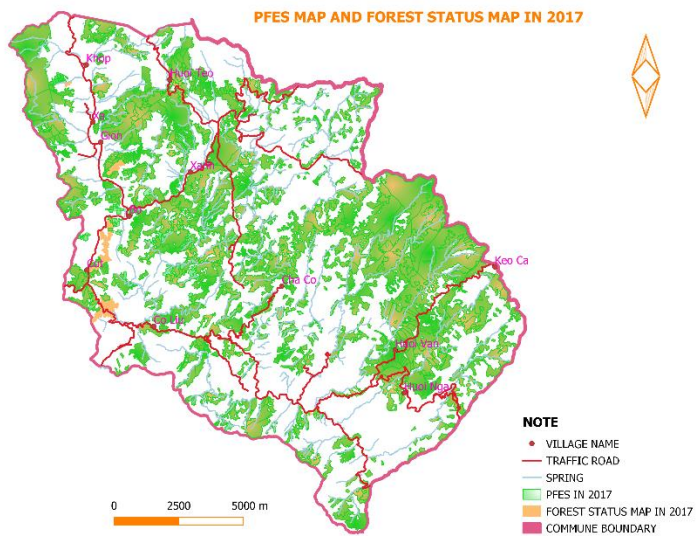
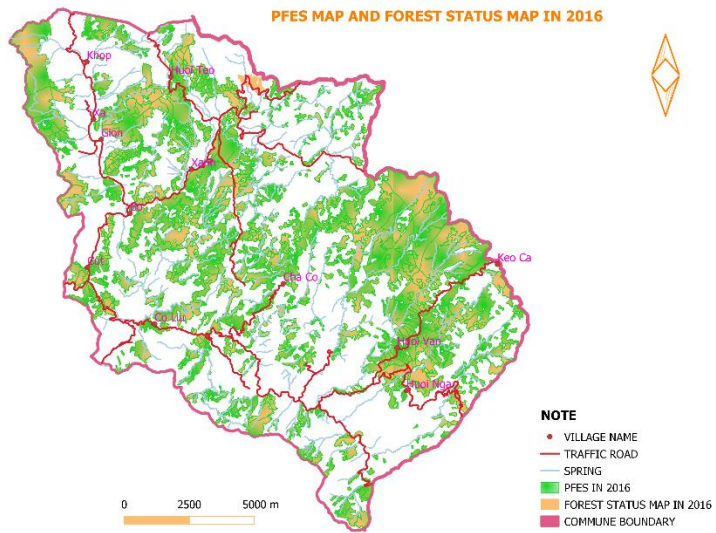
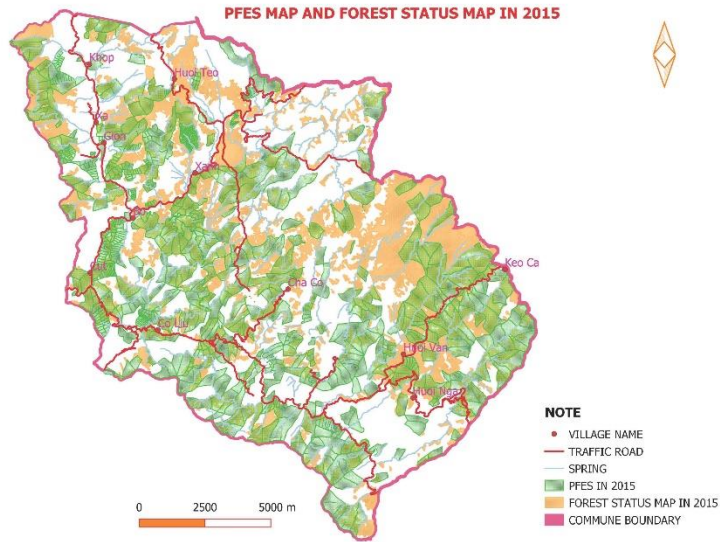


Table 4: Forest Status of PFES recognized forest 2015-17*(Unit ha)*

Map type	Evergreen broadleaves (Poor)	Evergreen broadleaves (Regrowth)	Lime Stone Forests	Plantation	Total	%
2015						
Forest status 2015 (FPD approved)	444	6,170	152	237	7,004	100
PFES area	4,630	1,846	0	225	6,701	96
2016						
Forest status 2016 (FPD approved)	444	6,170	152	264	7,030	100
PFES area	444	6,170	153	237	7,005	100
2017						
Forest status 2017 (FPD approved)	445	6,224	152	264	7,084	100
PFES area	443	6,273	152	149	7,017	99

PFES payment and forest allocation status of SNRM target villages

According to the data of Son La FPDF over the 3 years (2015-2017), the PFES-qualified forest area of Muong Gion Commune has increased by 5% (315 ha, 5,085 ha in total in 2017) and 35% in amount (VND 626,277 million) due to the increased area and unit price per hectare (Table 5).

89% of PFES paid forest are allocated to communities where village control the area (Table 6). The size of PFES forest allocated to each village are varied from 1,026 ha of Keo Ca village to 106 ha of Cut village. Three H'Mong villages own 47% of PFES paid forests in 2017 (Table 6). Average size of PFES received forest allocated to households was 2.3 hectares.

Table 5: Forest area and PFES payment to SNRM target villages in Muong Gion Commune (2015 – 2017)

No.	Village	2015		2016		2017		Compared 2017 /2015
		Area (ha)	Amount (1.000 đ)	Forest (ha)	Amount (1.000 đ)	Area (ha)	Amount (1.000 đ)	Area (ha)
1	Bo	565.7	152,181	497.8	145,841	615.48	213,263	49.75
2	Cha Có	390.1	104,937	315.5	92,433	318.13	110,232	-71.97
3	Co Lúu	120.4	32,377	253.8	74,360	110.83	38,401	-9.53
4	Cút	373.6	100,485	194.2	56,889	147.01	50,939	-226.54
5	Giôn	385.9	103,815	368.3	107,918	358.43	124,195	-27.5
6	Huổi Ngà	421.9	113,483	628.0	183,995	620.34	214,948	198.47
7	Huổi Tèo	216.2	58,152	145.1	42,514	148.48	51,448	-67.7
8	Huổi Vắn	586.4	157,752	742.8	217,632	726.53	251,743	140.09
9	Xanh	398.3	107,129	363.3	106,438	440.23	152,540	41.98
10	Kéo Ca	719.9	193,656	1,025.9	300,574	1025.85	355,457	305.94
11	Khóp	224.3	60,345	309.2	90,596	331.95	115,019	107.62
12	Xa	97.0	26,085	248.1	72,682	241.28	83,604	144.31
Total		4,499.6	1,210,398	5,091.7	1,491,871	5,084.5	1,761,789	584.9

Remark: PFES payment for the Da river watershed in Son La was 269.000 VND/ha in 2015, 293.000 VND/ha in 2016 and 346.500 VND/ha in 2017, respectively.

Source: [5] based on data from Son La FPDF.

Table 6: Forest owners and PFES forest area in SNRM target villages, Muong Gion Commune, Son La

No.	Village Name	Ethnic Group	Allocation Entity			Total
			Village	Household		
			Area (ha)	No.	Area (ha)	Area (ha)
1	Bo	Thai	539.8	56	75.7	615.5
2	Cha Có	Thai	284.0	21	34.2	318.2
3	Co Lúu	Kháng	107.9	3	2.9	110.8
4	Cút	Thai	105.9	20	41.1	147.0
5	Giôn	Thai	340.2	17	18.3	358.4
6	Huổi Ngà	H'Mong	520.0	29	100.4	620.3
7	Huổi Tèo	Thai	106.4	14	42.1	148.5
8	Huổi Vãn	H'Mong	589.9	29	136.6	726.5
9	Xanh	Thai	359.7	27	80.5	440.2
10	Kéo Ca	H'Mong	1,025.9	0	0.0	1,025.9
11	Khóp	Thai	296.3	29	35.7	332.0
12	Xa	Thai	233.8	1	7.5	241.3
SNRM Target Villages			4,510	246	575	5,085
%			89		11	100
Entire commune			6,269	410	748	7,017

Source: [5] based on data from Son La FPDF.

PFES payment and Village Fund in SNRM Target villages

Between 2016 and 2018, PFES was paid for three years. PFES for 2015 in 2016 and PFES for 2016 and 2017 in 2018. All the PFES paid to villages are deposited in Village fund. Overall PFES accounts for 92% of village fund revenue between 2016 and 2018, suggesting a significant contribution of PFES for the village community (Table 7).

Table 7: Revenue of Village Fund by Target Villages, 2016 - 2018**(Unit: 1,000 VND)**

Sources	2016		2017		2018		Total	
	Amount	%	Amount	%	Amount	%	Amount	%
PFES ¹	896,893	89.7	0	0.0	2,853,897	95.7	3,750,790	91.5
SNRM support ²	0	0.0	132,277	62.6	0	0.0	132,277	3.2
Maintaining irrigation system ³	10,010	10.3	16,140	7.7	25,751	0.9	51,901	1.3
Village asset sale ⁴	0	0	62,890	29.7	50,000	1.7	112,890	2.8
Others ⁵	0	0	0	0.0	51,000	1.7	51,000	1.2
Total	906,903	100	211,307	100	2,980,648	100	4,098,858	100

Remark: 1: 2015 PFES paid in 2016. 2016 and 2017 PFES paid in 2018., 2: A part of SNRM supported material price was contributed to VF. 3: contribution to maintenance work, 5 villages, 4: pine resin and wood sales from 661 plantation, two villages, 5: Land rent, no drug addict, etc. 4 villages.

Source:[5] based on village leader interviews.

Expenditure of Village fund

Approximately one third of expenditure of village fund between 2016 and 2018 was for new rural development followed by social activities in village (28%) and distribution to villagers for livelihoods (24%) (Table 8). Spending for forest management is about 13%, 7% for Forest patrolling and 6.3% for fire control.

Table 8: Expenditure of Village Fund of SNRM Target Villages, 2016 - 2018**(Unit: 1,000 VND)**

Expenditure	2016		2017		2018		Total	
	Amount	%	Amount	%	Amount	%	Amount	%
New rural development ¹	282,239	39.4	194,741	26.4	128,129	33.7	605,109	33.0
Forest patrolling ²	50,700	7.1	41,430	5.6	36,480	9.6	128,610	7.0
Fire prevention and fighting ³	69,650	9.7	27,966	3.8	18,660	4.9	116,276	6.3
Social activities ⁴	163,949	22.9	160,197	21.7	194,820	51.2	518,966	28.3
Support for the poor ⁵	0	0	12,300	1.7	0	0	12,300	0.7
Contribute to CPC ⁶	0	0	7,700	1.0	0	0	7,700	0.4
Lending for the poor ⁷	0	0		0.0	2,500	0.7	2,500	0.1
Distribution to villagers ⁸	149,823	20.9	294,680	39.9	0	0	444,503	24.2
Total	716,361	100.0	739,014	100.0	380,589	100.0	1,835,964	100.0

Remark: 1: Material purchase for construction of small infrastructure such as concrete village road, culvert, irrigation dam, etc. 2: Paid to forest patrolling team. 3: Practice of fire prevention and fighting including establishment of fire prevention contours. 4: Mainly for village festival, and Tet, Guest, meeting, etc. 5: only one village. 6: only one village. 7: only one village. 8: Distribute fund to household for livelihoods at two H'Mong villages

Source: [5] based on village leader interviews.

6. Discussion

A role of PFES in forest management: a status of PRAP budget

The PRAP provides a comprehensive mechanism to promote SFM with multi-sector arrangement with participatory manners. It may have a large potential to solve complex problems in increasing/maintaining forest cover which contributes to catchment protection for hydropower dams and disaster prevention.

According to the PRAP budget in Son La, PFES accounts for 27% of PRAP implementation, 100% of forest protection and 78% of control of forest fire, suggesting a significant role of PFES in forest management (Table 2). The PFES accounts twice as high as state budget; PFES plays a role to fulfill a shortfall of public funds in forest protection. Effective use of PFES for forest management needs to more elaborated.

Status of forest land allocation and fund distribution to rural poor

In the SNRM target villages in Muong Gion commune, 89% of forest lands which receives PFES are allocated to groups of households which is treated as villages (Table 6). 11% of PFES are directly paid to individual households to which forests are allocated (2.3 ha on average). Village leaders deposit the received PFES fund to village fund and use it for public needs (e.g. new rural development, social work). At some village which received a large amount of PFES, the remaining are equally paid to villagers for livelihoods. Grouping forest owners for effective organization of PFES payment was initiated in Son La in order to reduce the work for FPDF and to encourage community-based forest management [3].

It has been a question that whether PFES reaches smallholders in rural area [6]. In the case of Son La, PFES clearly reaches smallholders in rural area through village system. It should be noted that village is not legally confirmed body since the civil law 2005 does not recognize village (or community) as a legal entity [6].

Constraints and potential of payment mechanism

Between 2016-2018 PFES was paid twice to the target villages: PFES for 2015 in 2016, PFES for 2016 in 2018. There was no payment in 2017. It is quite unpredictable when PFES fund is actually paid to villages; therefore, it was difficult for villages to plan the use of PFES fund. It is recommendable to complete the process to adjust the forest area on time and make regular payment annually, so that villagers can plan accordingly. According to Son La FPDF, the process is speeding up by 2020; thus, it is expected that the situation would be improved soon (Personal communication, 2019).

Up to the payment in 2018 (PFES 2018 is not paid as of October 2019), PFES was paid by cash from FPDF district office to forest owners. The payment through bank accounts would ensure transparency and speed up fund distribution.

The gap between officially recognized forest and PFES qualified area found in 2015 was reduced from 2016 (Figure 1, Table 4). In order to have more updated sensitive forest status, a methodology to recognize current forest status change reflecting the amount of PFES

payment (e.g. using free high-resolution satellite images in different seasons to evaluate forest status of the year) is expected to be applied.

Village authority as a catalyst to connect PFES with forest management

SNRM supported creating a mechanism of village forest management: 1) establishing a management body, VMBFMLD, 2) village forest regulations to control forests, 4) establishing village funds to support village activities (forest management, livelihood and social) incorporated from PFES and 4) village forest patrolling by forming VFPT with technical guidance. PFES accounts for 92% of village fund (Table 7).

Use of PFES for forest plantation

Muong Gion Commune and 12 SNRM target villages, has a large potential for afforestation since currently it has a very large area of un-forested land (DT1).

SNRM facilitated to establish forest plantation (*Pinus masoniana* 94.6 ha in four villages, Co Lie, Huoi Teo, Khop and Xa) through providing plantation design, seedlings, technical training, without paying labor. Although this practice was not voluntarily expanded by villagers as of now probably due to the long rotation (15 years or longer), the better performance was demonstrated compared to the other program probably due to not only careful seedling selection and monitoring maintenance activities but also expectation to receive PFES in a few years since SNRM advocate the PFES mechanism to villagers[7].

According to the PPC guideline on management mechanism for PFES payment minimum of 40% is spent for 1) forest patrolling and fire prevention/fighting, 2) the procurement of necessary tools, and 3) seedlings, fertilizer, and forest enrichment. Between 2016-18, 13.3% of village fund (14% of PFES) is used for forest management (forest patrolling, 7% and fire prevention and fighting, 6.3%) but no spending for seedling and enrichment (Table 8). The SNRM model of forest plantation may enable to avoid the constraint of state budget for plantation work, and to develop more sustainable plantations with greater ownership by villagers incorporating PFES money. Specific planning and planting plan with using PFES is needed⁹.

Use of PFES for agroforestry and NTFP production

The promotion of sustainable land use practices is absolutely needed for catchment protection. SNRM supported to demonstrate 15 agroforestry models (contour fruit tree (grafted Son Tra (*docynia indica*), Grafted black canari (*Canarium tramdenum*), late fruit longan, pomelo, grafted Taiwan mango, coffee, plum) and grass planting along with crops) on agricultural lands and one NTFP production model (*Amomum xanthioides* (Sa nhan xanh in Vietnamese) and *Amomum longiligulare* (Sa nhan) planting under natural forest canopy) at ten villages. Villagers plan to expand Son Tra, Longan/mango, Coffee and Amomum models

⁹ Pine plantation established by the 661 program were resin tapped and harvested at 10 and 12 years old, respectively in some villages, resulting in low profit for forest owners.

with their own fund (Huoi Teo, Cut, Tong Bua and Huoi Nga villages) because of the successful cultivation with a potential to enhance their livelihoods in a short time [8]. Although most of PFES was paid to community not individual households, PFES payment to villages may make these expansions easier through distribution to each household (natural forest enrichment with *Amomum* at H'Mong villages with large natural forests), specific location with high value product (grafted Son Tra cultivation at high elevation at Huoi Teo village), and high value with easily marketable location (grafted mango/longan cultivation on contour at Cut village). PFES payment combined with successfully demonstrating sustainable land practices strictly with low cost, high value, competitive and short-term rotation can facilitate better land management by local villagers.

Does PFES create incentives to generate larger forest land?

Since forest types is not considered for the amount of PFES payment using K factor, equal amount for PFES is paid to all forest types. Regrowth non forest area can be eligible to receive PFES faster by weeding and planting small number of trees (Assisted Natural Regeneration work). SNRM supported to organize ANR by villagers' voluntary work. At Huoi Nga village, villagers worked 1,520 man-days for weeding to generate forest. As a result, 124.8 hectares of forest lands (67 ha in Huoi Nga village) became newly a PFES qualified forest. It showed that the PFES mechanism may encourage villagers to work to develop newly qualified forest.

7. Conclusions

PFES was initiated in Vietnam as a market-based mechanism in order to incentivize forest protection for catchment of hydro-power dams. The paper showed that the PFES plays an important role in forest protection and control of forest fires as well as livelihood and social support to rural villagers.

The experience of SNRM found that a village-based authority for forest management functions well when it is implemented with forest regulations combined with livelihood support and village fund, incorporating the PFES as a core source of development and forest protection fund. Although the PFES mechanism is still premature and the SNRM is only a pilot base, there exists a potential of having much larger impacts of PFES on forest management at village level which is the closest body to publicly manage land use on the ground.

In order to have greater impacts of PFES on forest management, enhancement of forest status assessment, regular PFES payment, intimation of PFES mechanism to villagers, and demonstration of low cost, high valued, and short rotation land use practices under various conditions acceptable by villagers are recommended.

Acknowledgements

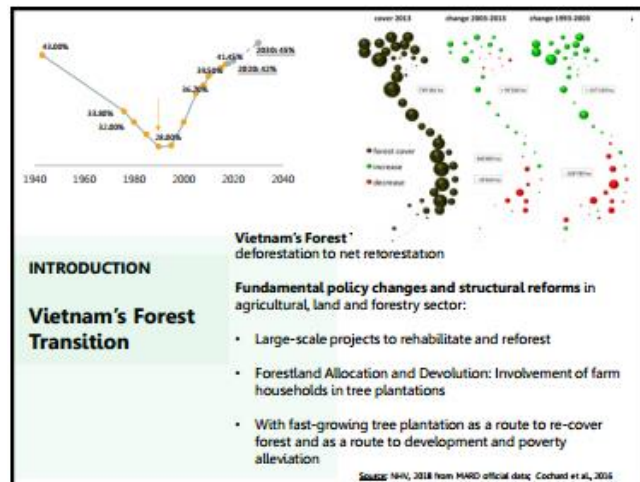
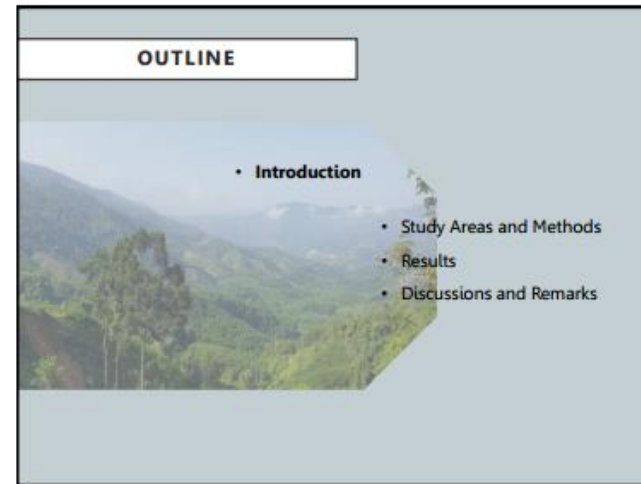
We thank SNRM Son La Provincial Project Management Unit (DARD, FPD), DPC and District FPD of Quynh Nhai District, CPC of Muong Gion Commune, and FPDF Son La for the collaboration for project implementation and the provision of information, as well as JICA and Kokosai Kogyo Company (KKC) to give us an opportunity to implement the project and to present the paper.

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Adaptive Collaborative Approach in Forested Landscape Governance: Case study from A Luoi, Central Vietnam

Nguyen Hai Van, Nguyen Ngoc Quang
People and Nature Reconciliation Vietnam



During the forest transition period...


- Smallholder tree plantation (STP) display rapid societal, environmental and institutional change
- Diversity and sub-national/local difference
- Successful in increase country forest cover, its economic development and in reducing poverty
- Although the achievements especially in mountainous areas have been limited

In the neoliberal era, with the expansion of market forces and the commercial commodity production recently...

Smallholder tree plantation forestry turn to be as one type CROP BOOM? Another factors of DEFORESTATION/FORREST DEGRADATION? And what the governance challenges of the boom?

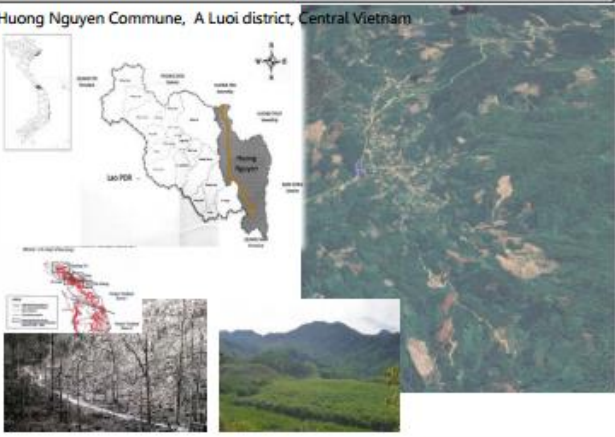
OUTLINE

- Introduction
- Study Areas and Methods
- Results
- Discussions and Remarks




STUDY AREA AND METHODS


Huong Nguyen Commune, A Luoi district, Central Vietnam




HUONG NGUYEN – 5/2002



HUONG NGUYEN – 7/2019






• 04 villages: Ché Du-Nghia, A Bui, Gong and Mu Nu Tu Ka
 • 348 HHs and 1362 pers. (2018)
 • Poverty rate: 34.68%
 • Katu people: 93.39%

Methods

- Participatory observation
- 8 Focus group discussions
- 10 Informal interviews
- 91 HH semi-structure, questionnaire survey and participatory village mapping (using the GE pics)


OUTLINE

- Introduction
 - Analytical framework and research
 - Study Areas and Methods
 - Results
 - Discussions and Remarks



GOVERNANCE CHALLENGES: ACACIA BOOMS and fragmented FORESTS in HUONG NGUYEN

Historical Milestone of Acacia Plantation Boom in Upland Central Vietnam



ACACIA ARRIVAL Through Reforestation Programs (1996)

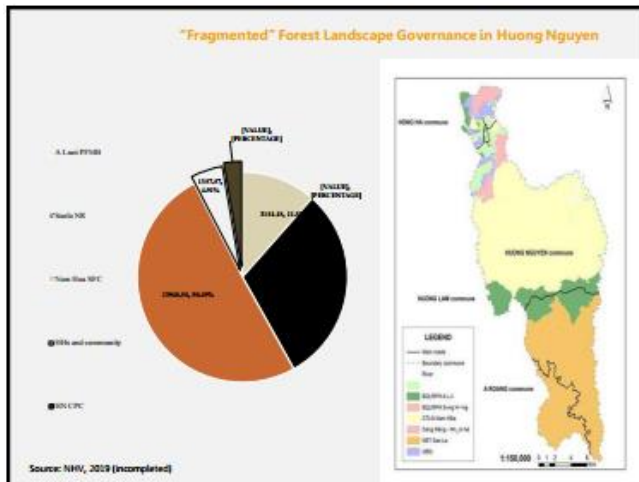
Successive State policies and development programs (2012): Promote the expansion of tree plantations (financial, labor, seedlings, road developments...)

Re-classification and re-territorialization of forests (2014): Strict forest protection regulations, Community-based forest protection model (PES, REDD+)

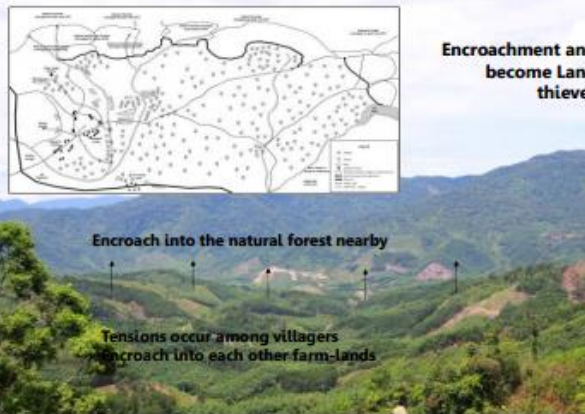
LAND HUNGER (2019): Collecting other natural forest products not for HH demands but for market sale

Swidden is just fading memory

Source: NHV, 2019 from FGDs and interviews



Encroachment and become Land thieves



Encroach into the natural forest nearby

Tensions occur among villagers encroach into each other farm-lands

Source: Authors, 2019 (incomplete)

Situation in Huong Nguyen emerged at certain conjunctures, namely:

- The rise and expansion of smallholder acacia plantation as well as associated agrarian changes in Huong Nguyen
 - The closing of forest frontiers and other processes (such as in this case: community-based forest protection, PFES/REDD+, etc.) that reduce the access of local villagers to new farm
- Practices that enables local people, not some of them but all villagers here are hungry for land and thrown themselves into the land hunt to accumulate land and capitals
- **Big Challenges for sustainable forest governance in this landscape and for REDD+**

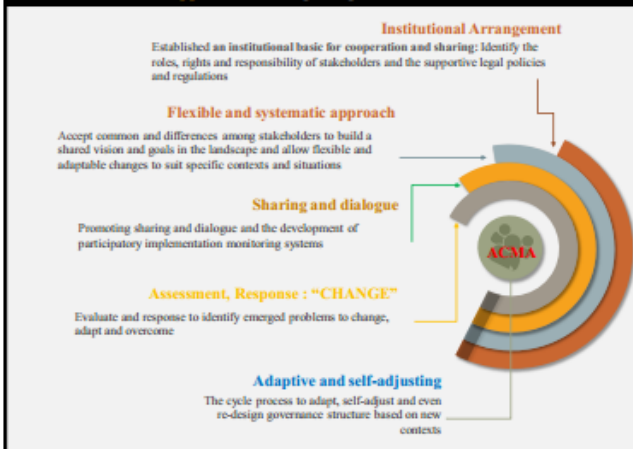
Source: Author, 2019 (incomplete)

OUTLINE

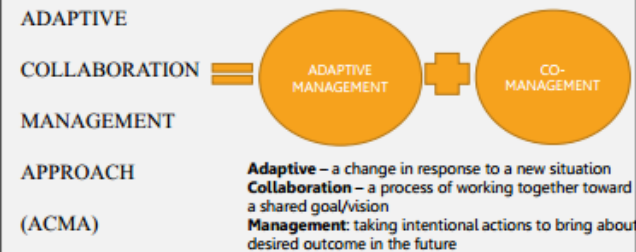
• **Introduction**

- Analytical framework and research
- Study Areas and Methods
- Results
- Discussions and Remarks

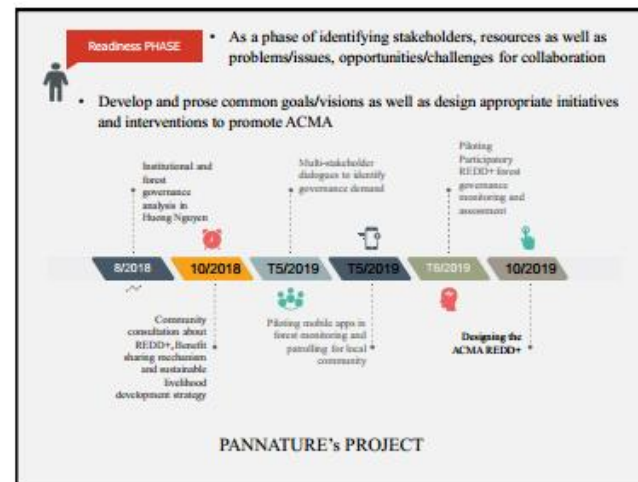
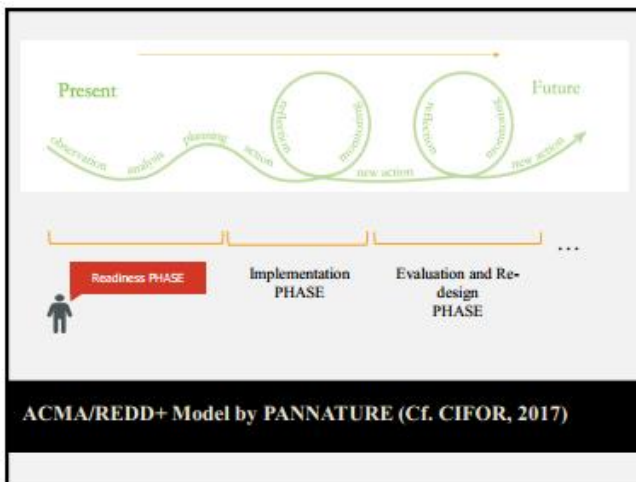
PanNature's ACMA Approach: 5 core principles



PANNATURE'S ACMA APPROACH



Social learning is important in ACMA and it happens when all actors engage in "learning by doing"



THANK YOU FOR YOUR ATTENTION!

Nguyen Thi Hai Van and Nguyen Ngoc Quang!!!

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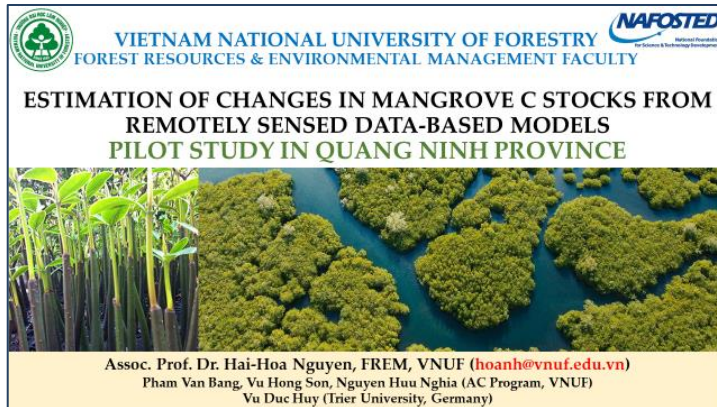
[W: www.nature.org.vn](http://www.nature.org.vn)

Policy Research Department,
People and Nature Reconciliation (PanNature), Vietnam.

Estimation of changes in mangrove biomass and carbon stocks from remotely sensed data-based models: Case study in Quang Ninh province

Assoc. Prof. Nguyen Hai Hoa

Vietnam National University of Forestry



VIETNAM NATIONAL UNIVERSITY OF FORESTRY
FOREST RESOURCES & ENVIRONMENTAL MANAGEMENT FACULTY

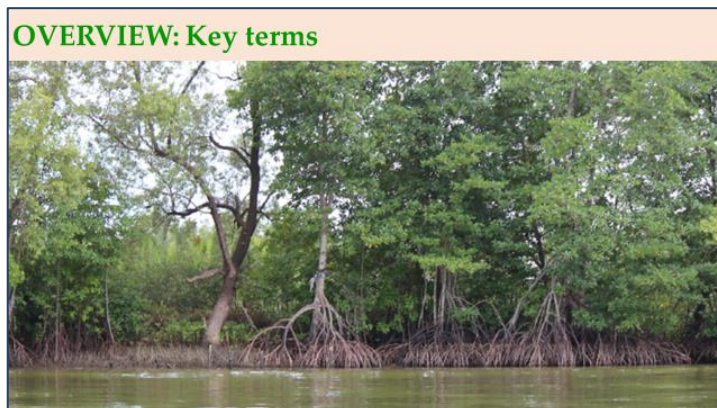
**ESTIMATION OF CHANGES IN MANGROVE C STOCKS FROM REMOTELY SENSED DATA-BASED MODELS
PILOT STUDY IN QUANG NINH PROVINCE**

Assoc. Prof. Dr. Hai-Hoa Nguyen, FREM, VNUF (hoanh@vnuf.edu.vn)
Pham Van Bang, Vu Hong Son, Nguyen Huu Nghia (AC Program, VNUF)
Vu Duc Huy (Trier University, Germany)

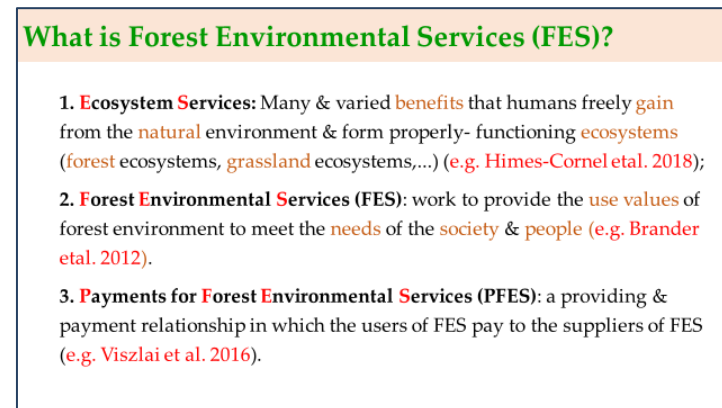


CONTENTS

- Overview: Mangroves, terms, associated PFES;
- Piloting study in Quang Ninh province;
- Implications & further study.



OVERVIEW: Key terms



What is Forest Environmental Services (FES)?

1. **Ecosystem Services:** Many & varied benefits that humans freely gain from the natural environment & form properly- functioning ecosystems (forest ecosystems, grassland ecosystems,...) (e.g. Himes-Cornel et al. 2018);
2. **Forest Environmental Services (FES):** work to provide the use values of forest environment to meet the needs of the society & people (e.g. Brander et al. 2012).
3. **Payments for Forest Environmental Services (PFES):** a providing & payment relationship in which the users of FES pay to the suppliers of FES (e.g. Viszlai et al. 2016).

Blue carbon

Blue carbon: Used to describe very large carbon deposits that associated with mangroves, salt marshes & seagrasses (e.g. Gerald et al. 2019).

These ecosystems sequester & store large quantities of blue carbon in both the plants & the sediment below.

Facts & Figures:

13.8 + 15.2 Mha (mangroves); 40.0 Mha (salt marshes); 17.7 + 60.0 Mha (seagrasses)

Blue carbon associated with coastal ecosystems

However:

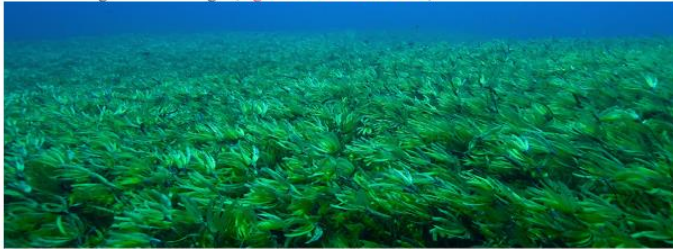
Tidal marshes: lost at a rate of 1+2% year⁻¹, covering 140 mil ha of Earth surface; lost more than 50% of their historical global coverage (e.g. Howard et al. 2014).



<https://www.nature.scot/landscapes-and-habitats>

Blue carbon associated coastal habitats

Seagrasses: covering < 0.2% of ocean floor, but store about 10% of the carbon buried in the oceans each year; lost at a rate of 1.5% year⁻¹; lost about 30% of historical global coverage (e.g. Howard et al. 2014).



<https://www.ecomagazine.com>

Blue carbon in mangrove forests

Mangroves: lost a rate of 2% year⁻¹, mangrove deforestation accounts for up to 10% of emissions from global deforestation, despite of covering just 0.7% of land cover (e.g. Howard et al. 2014).



<https://www.gefbeforests.org/mangroves>

Mangrove forests

Mangroves: a group of trees & shrubs, living in the coastal intertidal zone (coastal saline/brackish water), occurring worldwide in the tropics & subtropics, mainly latitudes 25°N + 25°S (e.g. Duke, 1992).

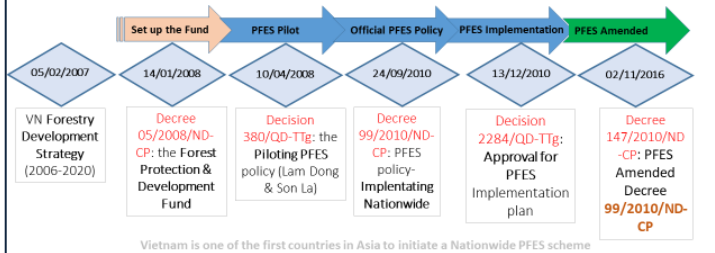


Why coastal ecosystems are important?

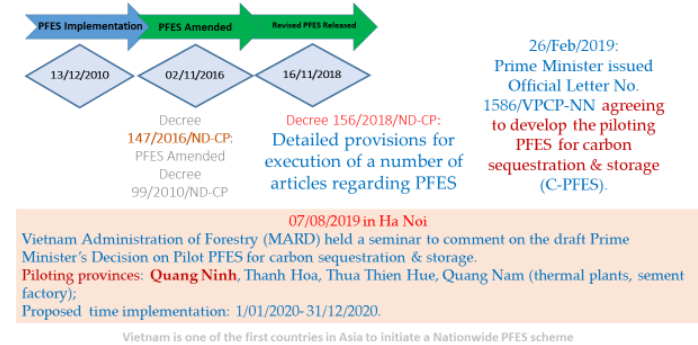
- As protected/restored, blue carbon ecosystems **sequester & store carbon**.
- When degraded/destroyed, these ecosystems **emit** the carbon they have stored for centuries into the atmosphere & oceans; become **sources of GHGs**.
- Experts estimate: as much as **1.02 bil tons** of CO₂ **being released** annually from degraded coastal ecosystems (~**19% of emissions** from tropical deforestation globally).
- Mangroves, tidal marshes & seagrasses are critical along the world's coasts, supporting **coastal water quality, healthy fisheries & coastal protection against floods & storms**
 - eg. mangroves are estimated to be worth at least 1.6 bil US\$ each year in ecosystem services supporting coastal livelihoods & human populations around the world.

How legal Frameworks fit C-PFES, mangrove C-sequestration

Vietnam is a typical country pioneering in Asia as well as in the world for formulating the legal framework on **Forest Protection & Development Fund**; and the policy on **Payments for Forest Environmental Services** (PFES).



How legal Frameworks fit C-PFES, mangrove C-sequestration



Level of Payments for PFES Users

Hydropower Generation	→	20 VND/Kwh, 36VND/kwh (11/2016)
Clean Water Suppliers	→	40 VND/m ³ , 52 VND/m ³ (11/2016)
Industrial Production facilities	→	Be preparing
Eco-tourism Service Providers	→	1-2% of total revenue
Carbon Sequestration Aquaculture	→	4VND/kwh thermal power plants (2USD\$/ton CO ₂); 2100 VND/ton Clanhke for cement factory (1.35USD\$/ton CO ₂)

Rates: 1USD\$ = 23.230 VND

3.35USD/ton CO₂



Significance

Vietnam: about a coastline of 3,260km long, rich contents of alluvial deposits => a favourable conditions for mangrove development;

Functions of mangroves:

well-recognized as habitats for coastal living creatures, food provision,...

Wave prevention, sediments trapping, air regulation, carbon sequestration,...

=> One of the most effective **climate change mitigation options.**



Significance: Quang Ninh province

Mangrove extents: Significant reduction (degradation & mangrove deforestation) => considerable reduction of mangrove functions;

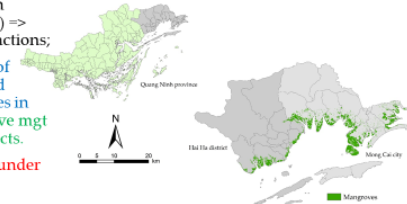
Mangrove database: Limited database of historical mangroves & lack of advanced technologies to detect & monitor changes in mangrove forests => ineffective mangrove mgt & failure of mangrove restoration projects.

=> **Consequently, coastal habitants under greater threats of extreme events,...**

Questions: interested by scientists, decision-markers & local people;

=> **How to sustainable mgt of mangroves to meet needs of local livelihood improvements; but climate change mitigation; hazards mitigation,...** => possible answer: mechanism for C- Stocks payments => very crucial;

=> **Good database (Mangrove extents; their biomass & C-stocks) => bring C-stocks payments into reality in QN => Very IMPORTANT!**



Remotely-sensed imageries used

ID	Image codes	Date	Spa. Res (m)	Notes
1a	S2A20190812T033026 ¹	12/08/2019	10x10	Sentinel (Hai Ha)
1b	S2A20161202T033827 ¹	02/12/2016	10x10	Sentinel (Hai Ha)
2a	LC842504520161009 ¹	09/10/2016	30x30	Landsat 8 (Mong Cai)
2b	LC812504520190815 ¹	15/08/2019	30x30	Landsat 8 (Mong Cai)
3	20170605_062510_0c43_3B_AnalyticMS ²	05/06/2017	3x3	PlanetScope
	20170605_062509_0c43_3B_AnalyticMS ²	05/06/2017	3x3	PlanetScope

Field survey: 30 sampling plots in Mong Cai city & 30 sampling plots in Hai Ha district (900m²) + GPS ground truthing for images classification.

Sampling plots: D_{1,3}; tree species, age & height; other relevant information.

¹<http://earthexplorer.usgs.gov>; ²<https://www.planet.com/explorer>

Methods

- **Image processing (Sentinel/Landsat):** UTM 1984 Zone 48, rectification, subset to exclude the non-mangrove areas;

- **NDVI + Unsupervised Classification, other vegetation indices:**

$$NDVI = (NIR - RED)/(NIR + RED)$$

- **Post-classification, accuracy assessments:** PlanetScope (3m×3m); GPS, Google Earth; mangrove status maps;

- **Biomass estimation (for sampling plots):**

$$AGB = 0.251 * Q * D_{1,3}^{2.46} \text{ (Komiya et al., 2005)}$$

Methods

- **C-Stocks estimation:**

$$AGC = 0.47 * AGB \text{ (IPCC, 2014)}$$

- Σ CO₂ storage by mangroves:

$$\Sigma CO_2 \text{ absorption: } 3.67 * \Sigma C \text{ (ton)}$$

- **Possible payments for CO₂ stored:**

$$\Sigma CO_2 \text{ stored} * 5 \text{ USD\$/ton vs } \Sigma CO_2 \text{ stored} * 3.35 \text{ USD\$/ton}$$

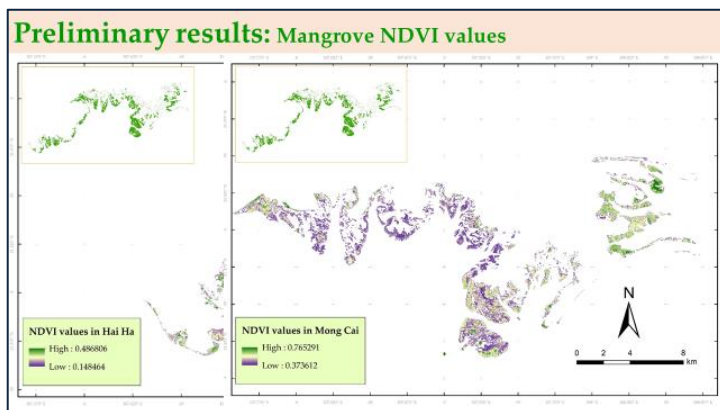
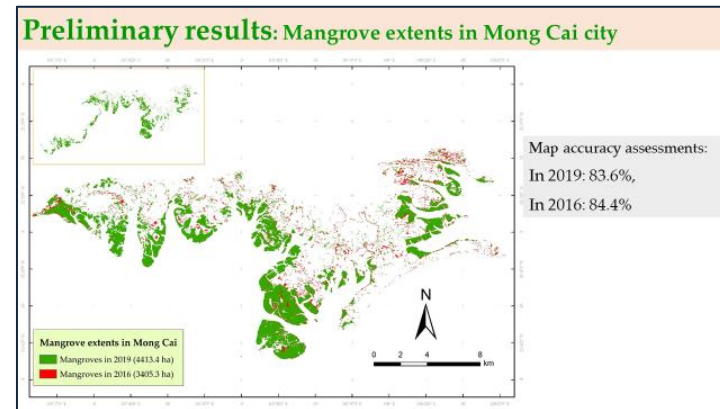
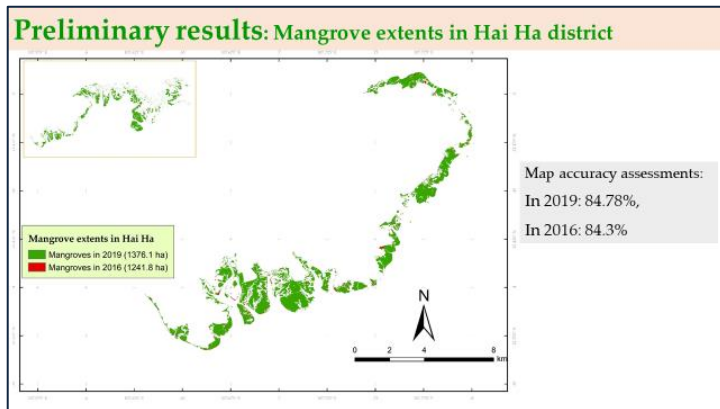
Australia (10USD\$/ton), America (California, 15USD\$/ton), Canada (15- 30USD\$/ton)

Methods

- **Model development:** NDVI + other 10 vegetation index variables + Spectral band variables;



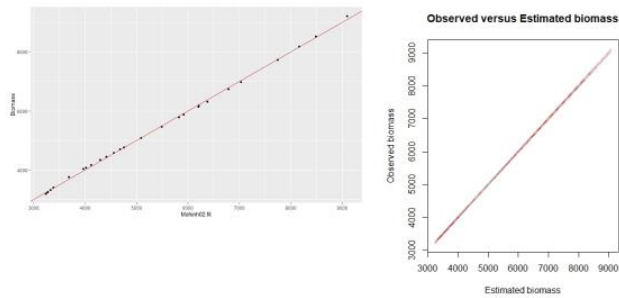
- **Model validation & verification:** selection of models & field validated for final models of C-Stocks based on remotely sensed data.



Preliminary results: Model development

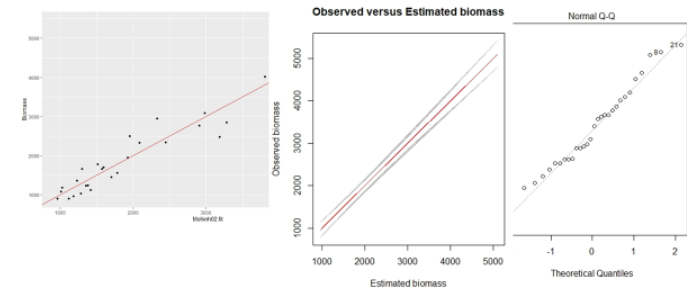
ID	Models	R square	P_value	Study site
1	lm(Biomass - NDVI, data = HAIHA)	0.911	<0.000	Hai Ha
2	lm(Biomass - NDVI+Log(NDVI), data=HAIHA)	0.9319	<0.000	Hai Ha
3	lm(Biomass - NDVI+NDVI^2+Exp(NDVI), data=HAIHA)	0.9124	<0.000	Hai Ha
4	lm(Biomass - NDVI+ Exp(NDVI), data=HAIHA)	0.9291	<0.000	Hai Ha
5	lm(Biomass - NDVI, data=MONGCAI)	0.9791	<0.000	Mong Cai
6	lm(Biomass - NDVI+Log(NDVI), data=MONGCAI)	0.9991	<0.000	Mong Cai
7	lm(Biomass - NDVI+ Exp(NDVI), data=MONGCAI)	0.9999	<0.000	Mong Cai
8	lm(Biomass - NDVI^2, data=MONGCAI)	0.9994	<0.000	Mong Cai

Preliminary results: Model development



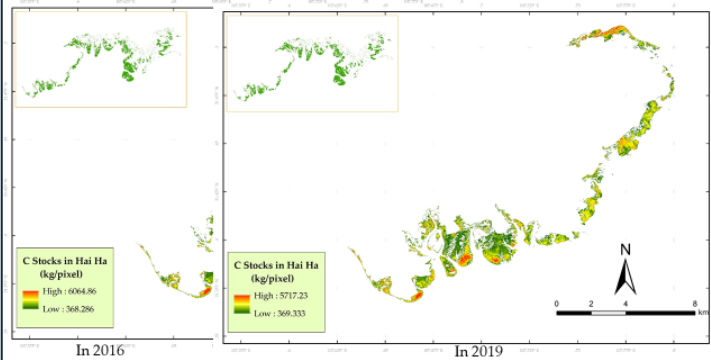
$\ln(\text{Biomass} - \text{NDVI} + \text{Log}(\text{NDVI}))$, data=MONGCAI $R^2=0.9991$ $P_{\text{Value}} < 0.000$ Mong Cai

Preliminary results: Model development

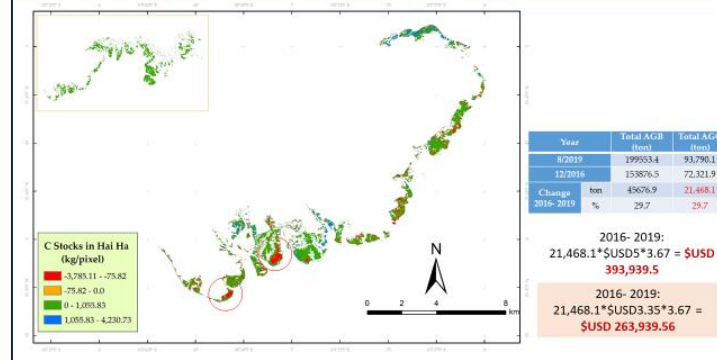


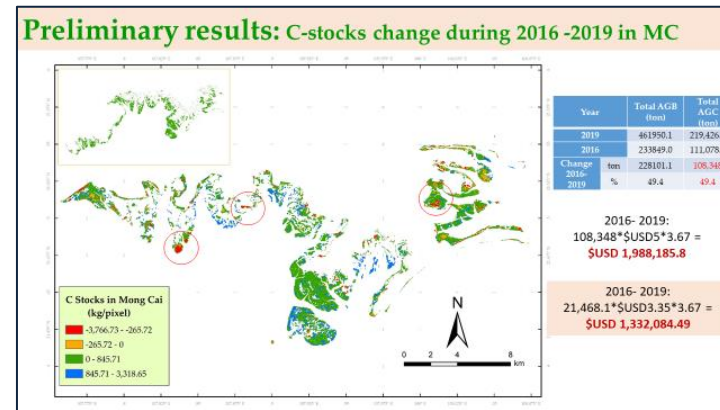
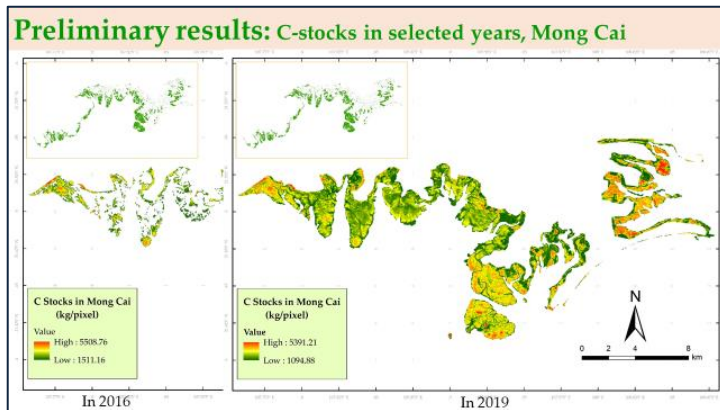
$\ln(\text{Biomass} - \text{NDVI} + \text{Log}(\text{NDVI}))$, data=MONGCAI $R^2=0.9319$ $P_{\text{Value}} < 0.000$ Hai Ha

Preliminary results: C-stocks in selected years, Hai Ha



Preliminary results: C-stocks change during 2016 -2019 in Hai Ha





Implications

- Payments of mangrove C-stocks => an additional budget for mangrove mgt => contribution GHGs reduction;

Study sites	Mangrove extents (ha)	Total C-stocks (tons)	Total CO ₂ (ton) ¹	Estimated values (\$USD)
2019 in Hai Ha	1376.1	93790.1	344,209.6	\$USD 1,721,048.0 (39,928,313,600 VND)
2019 in Mong Cai	4413.4	219126.3	805,294.521	\$USD 4,026,472.6 (93,756,414,607 VND)

¹Rate: 5\$USD/ton CO₂

- C-stocks payments should be carried out in Quang Ninh.
- Geospatial technology should be applied to monitor & detect changes in C-stocks of mangroves.

Further study: Aim to

- Select optimal models for biomass/C-stocks estimation based remotely sensed data (Verification & validation);
- Expand model testing in other coastal districts of Quang Ninh & other provinces under the project;
- Finalise optional models for C-stocks estimation for the North coastal regions of Vietnam;
- Publications.



Conclusions

- ❖ Using remote sensing data (Sentinel 2A, Landsat) to estimate mangrove AGB & C-stocks is **reliable & applicable** to Quang Ninh;
- ❖ Initial models: work well with study sites, but more verified/validated to select **optional models** under the project scope;
- ❖ Mangroves: Mong Cai (**4413.4** ha in 2019, 83.6%) & Hai Ha (**1376.1** ha in 2019, 84.78%);
- ❖ Total C-stocks: **344,209.6** tons CO₂ vs **805,294.521** tons CO₂;
- ❖ Quang Ninh: potential mangrove C- payments; C-payments scheme should be implemented in QN.



Acknowledgments:

This research is funded by **Vietnam National Foundation for Science and Technology Development** (NAFOSTED) under grant number **105.08-2017.05**. The authors also would like to thank the Commune People's Committee and local people in Quang Ninh province for supporting us when collecting data (2017- 2020).

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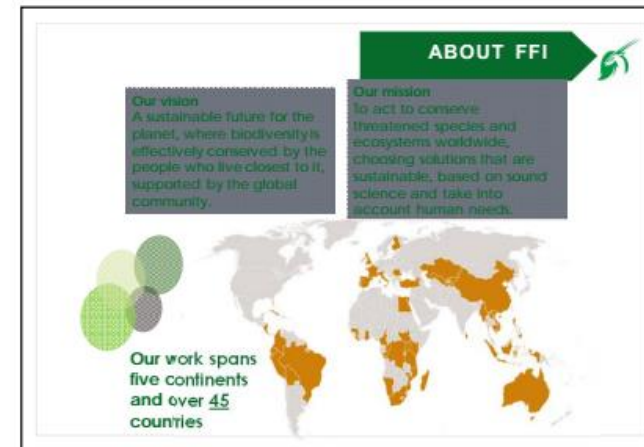
**LINKAGE OF HIGHER EDUCATION, RESEARCH AND
INTERNATIONAL INTEGRATION TO SUSTAINABLE FOREST
MANAGEMENT AND BIOECONOMY**

**SESSION 2: SUSTAINABLE FOREST
RESOURCE MANAGEMENT**

20 years of conservation in Vietnam. A case study of challenges and success from Fauna & Flora International

Dr. Josh Kempinski, Dr Oliver Wearn

FFI Vietnam



PART ONE: Approaches and Success



Ambition 1: Thriving Species



THRIVING SPECIES

- Vietnam has 25 species of primate, 11 are CR, and 5 are also endemic
- The Vietnam Programme: 7 CR/EN primate species & 2 CR trees species – these species define our programme & set our priorities
- These CR species are of highest global importance, but also flagships for the entire cascade of biodiversity below...
- 11 of the long term primate projects have seen population increases since their inception
- Our approach is now *shifting* from 'surviving' (avoiding extinction) to thriving – corridors, expanded PAs and possibly whole new populations established...!
- Terrestrial mammals, like Owston's civet – Also as indicators of 'zero poaching'
- Marine...?



Ambition 2: Resilient ecosystems



RESILIENT ECOSYSTEMS

- Karst landscapes have been and remain a priority (especially where CR primates or trees are present)
- Corridors and connectivity has become a key intervention – reversing fragmentation and reconnecting populations
- Protected Areas as a main pillar and success story for FFI Vietnam: To date six protected areas established, and a further three under current development
- Support PA management on 7 sites, including a new marine project – Con Dao NP & MPA
- FFI developed and maintained the only Sino-Vietnamese transboundary project... potential for Laos and Cambodia too
- Livelihoods and community empowerment around SUFs/HCVFs
- Landscape approaches: Integrated, spatial planning and sustainable financing – e.g. REDD+ and PES

Ambition 3: Locally led conservation



LOCALLY LED

- Community Conservation Teams at all FFI Vietnam sites
- Management Advisory Committees set up for three sites – pioneering approach to co-management in the local context
- Theory of Change with local people and partners, e.g. to develop species action plans
- Working in close partnership with local government and several CSOs or national NGOs (mutually beneficial)
- All FFI managers and implementing staff are Vietnamese
- Supporting improved K-A-B at all sites

Ambition 4: Influencing others



INFLUENCING OTHERS

- 10 years to help develop the National Primate Action Plan
- Protected area development with sub-national government actors
- Working with the private sector and CEOs to develop new funding models, outreach and corporate change
- Awareness raising and a growing focus on outreach and communications...



Ambition 5: Increasing visibility



INCREASING VISIBILITY

- Three short films in the last 18 months
- ...One of these films has over 1.3 million views! (Nat Geo)
- Full time communications and working more with UK 'comms' – regular blogs and social media...
- RuNam partnership – cuddly vooc!
- Billboards – including some very large!



Ambition 6: Investing in our people



INVESTING IN US

- Salary benchmarking and pay increases for staff
- Support staff to join workshops and fora in the region – ICCB, ATCB, IPS, APS, as well as UK training etc
- Annual planning / staff retreat
- Supported career progression



Ambition 7: Securing the resources we need




SECURING RESOURCES

- Goal - Try to balance domestic and international sources of finance (most sustainable)
- Vietnamese philanthropy now around \$300k/year for FFI VN
- Currently around one third each for statutory, trusts/foundations and private donors
- Vietnam Programme is financially secure for at least 2 years



PART TWO: Challenges and Hopes



KEY CHALLENGES

- Often multiple threats and challenges combine at the same site...
 - land use 
- Consumption and trade in wildlife is still huge, and this drives an out of control hunting / snaring crisis
- Economic development bring a need for infrastructure like roads, and the thirst for raw materials and land (incl. for agriculture)
- Coordinating planning and unsuitable, unsustainable
- Local level poverty and a lack of alternatives still driving degradation of forests
- The gov't, at all levels, IS taking nature conservation more seriously, but it still lacks the support it needs (see as lower priority)
- Enforcement of forest / conservation laws is still weak in many contexts
- Awareness is still low...

REASONS FOR HOPE AND IDEAS FOR THE NEXT 5 YEARS

1. Securing and building on our strengths – key SUFs and/or primate sites
2. Gov't agencies and private sector leaders know more and are making better decisions – Continue to support this
3. Facilitate policy development at all levels and more integrated planning
4. Young people are the future! Their attitudes are changing fast - vital that we work with them and help nurture this
5. Spending time to define what success looks like – A more strategic and collaborative approach to conservation (e.g. with local NGOs, universities, etc.)




THANK YOU

Forestry in the European North of Russia. The role of higher education in the development of sustainable forest management

Prof. Dr. Sergey Koptev
Northern (Arctic) Federal University, Russia

Северный (Арктический) федеральный университет имени М.В. Ломоносова

Forestry in European North of Russia: the role of higher education in the development of sustainable forest management

Dr. Sergey Koptev, NARFU

NARFU IS ONE OF 10 FEDERAL UNIVERSITIES AND A MEMBER OF THE RUSSIAN ASSOCIATION OF LEADING UNIVERSITIES

NARFU studies protection of forest genetic and human resources in the north to create a system of sustainable production of wood, energy and other resources.

Total number of students	17 000
Academic staff, total, having D.Sc./Ph.D.	1563 71%
Higher Schools / Institutes / Colleges / Campuses	7 2 / 3 / 3
Research Centers and Labs	50+
Academic programmes, total	over 360

NARFU INTERNATIONAL COOPERATION

160+ partners from 60+ countries

8 International network consortia

6 joint international programmes

70+ large-scale international projects

800+ international students from 50+ countries

INTERNATIONAL ACADEMIC MOBILITY:

ANNUALLY 300+ students

200+ lecturers and researchers

50+ foreign visit lecturers

NARFU COOPERATION WITH REGIONAL BUSINESS AND AUTHORITIES

Shipbuilding Cluster

PomorInnovaLes: Forestry Cluster

Social Cluster

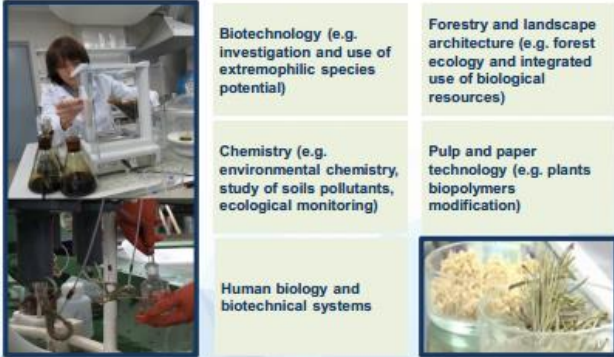
Bioresource and Biotechnological Cluster

NARFU HIGHER SCHOOL OF NATURAL SCIENCES AND TECHNOLOGIES



- Physics (Bachelor and Master)
- Chemistry (Bachelor)
- Fundamental and Applied Chemistry (Specialist)
- Chemical Technology (Bachelor and Master)
- Hydrometeorology (Bachelor)
- Ecology and Environmental Management (Bachelor and Master)
- Biology (Bachelor and Master)
- Biotechnical Systems and Technology (Bachelor)
- Biotechnology (Bachelor and Master)
- Energy and Resource-Efficient Processes in Chemical Engineering, Petrochemistry and Biotechnology (Bachelor and Master)
- Nanotechnology and Microsystem Technology (Bachelor)
- Forestry (Bachelor and Master)
- Landscape Architecture (Bachelor and Master)

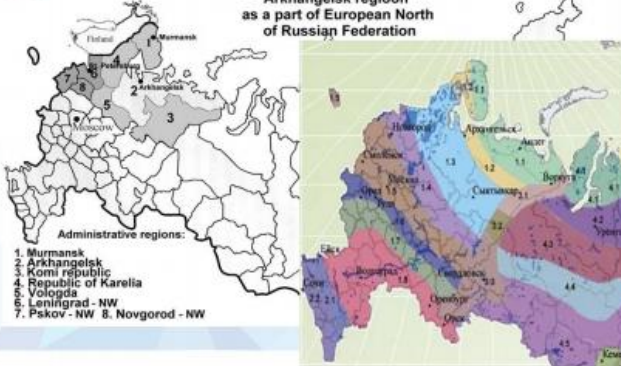
NARFU SCIENTIFIC FIELDS



- Biotechnology** (e.g. investigation and use of extremophilic species potential)
- Forestry and landscape architecture** (e.g. forest ecology and integrated use of biological resources)
- Chemistry** (e.g. environmental chemistry, study of soils pollutants, ecological monitoring)
- Pulp and paper technology** (e.g. plants biopolymers modification)
- Human biology and biotechnical systems**

EUROPEAN NORTH OF RUSSIA

Arkhangelsk region as a part of European North of Russian Federation

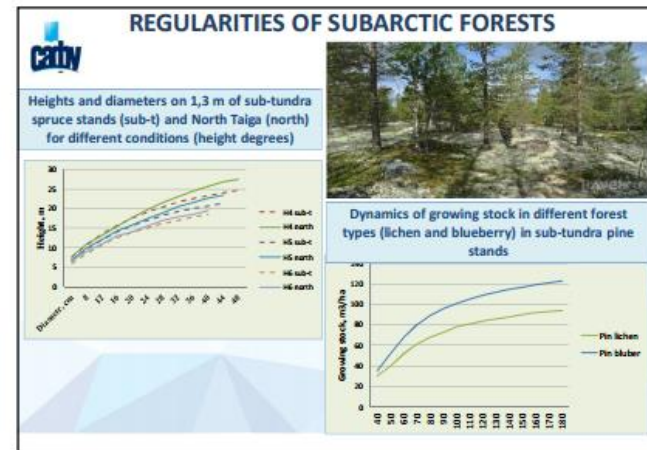
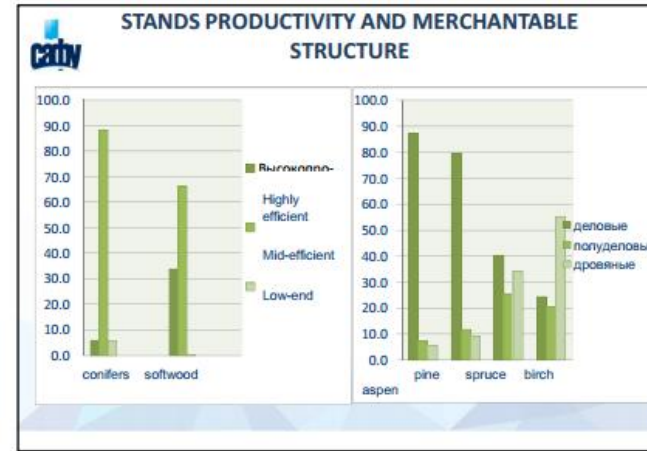
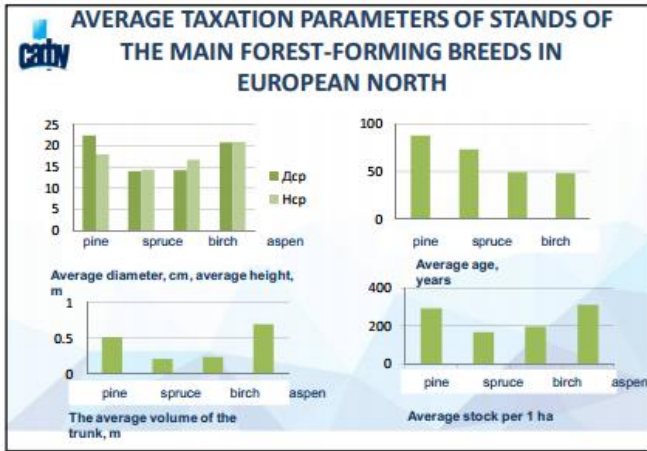


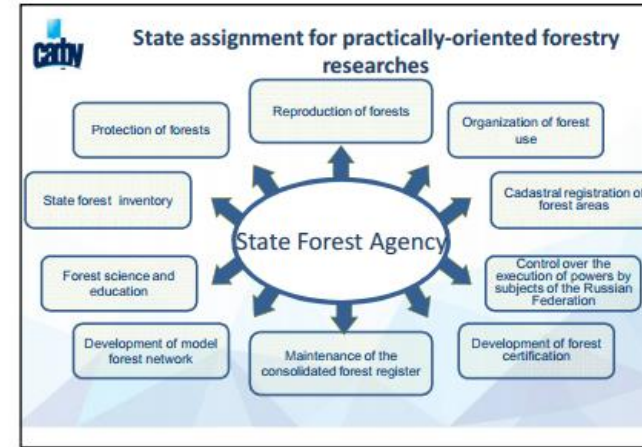
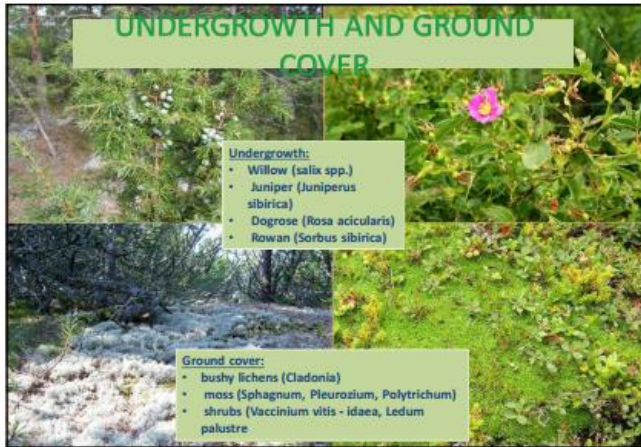
Administrative regions:

1. Murmansk
2. Arkhangelsk
3. Komi republic
4. Republic of Karelia
5. Volgograd
6. Leningrad - NW
7. Pskov - NW
8. Novgorod - NW

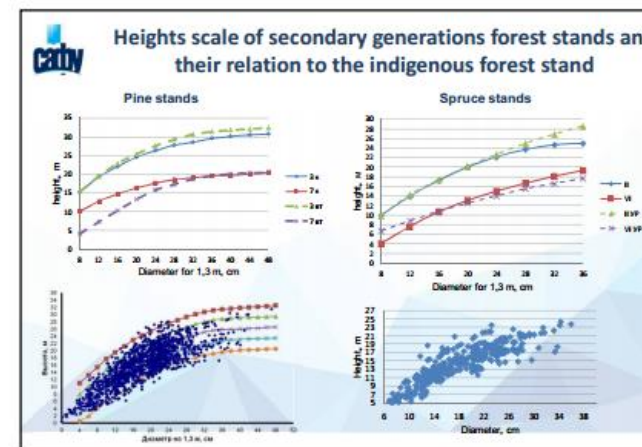
FOREST RESOURCES OF ARKHANGELSK REGION

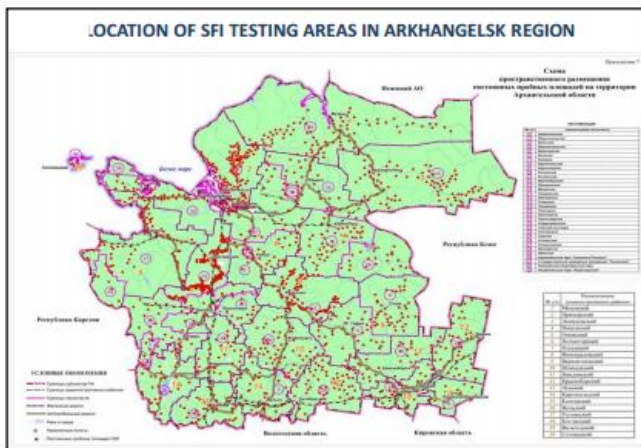
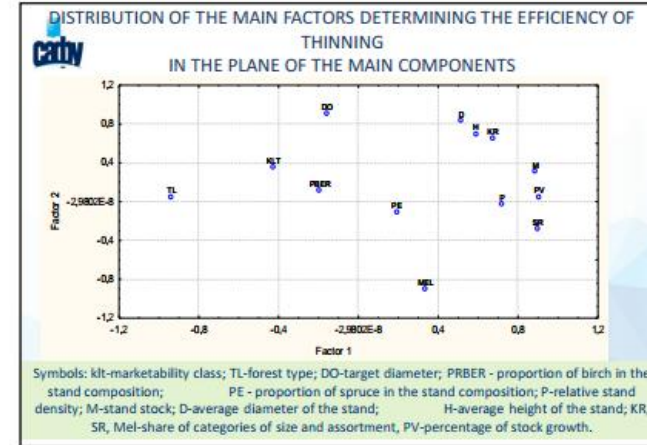
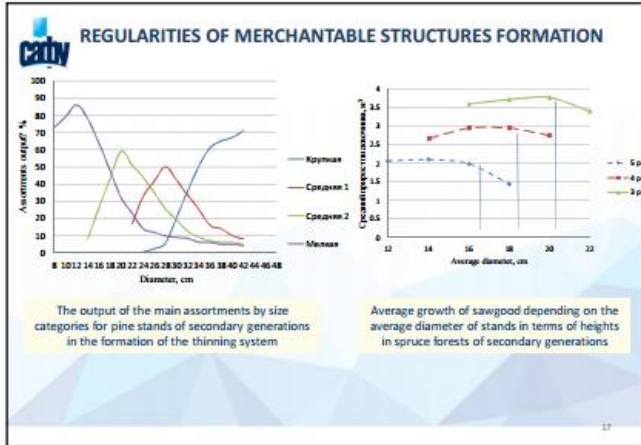
- Forest fund – **28,8 mln. ha**
- Forest covered area- **22,9 mln. ha**
- Protective forests – **32,5%**
- Transferred to lease – **56%**
- Total growing stock – **2,5 billion. cub. m** (1,7 in mature and over mature stands)
- Share of coniferous – **76%** (49,2% - spruce)
- Economical accessibility – **43%**
- Allowable cutting – **25,5 mln. cub.m**
- In mature stands – **23,6** (factual – 10,5)
- In young and premature stands – **1,9** (factual – 0,3)

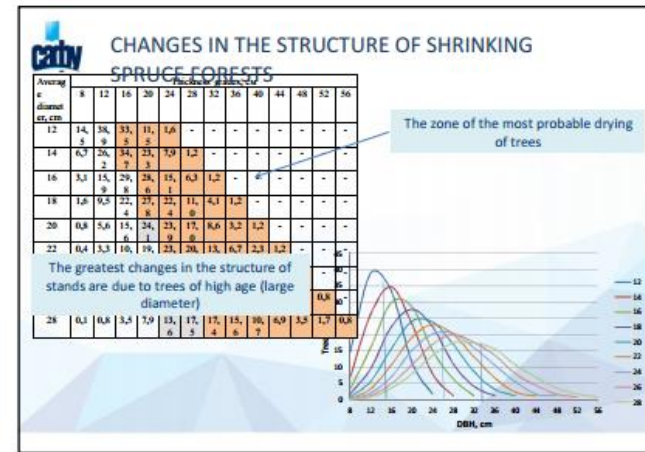
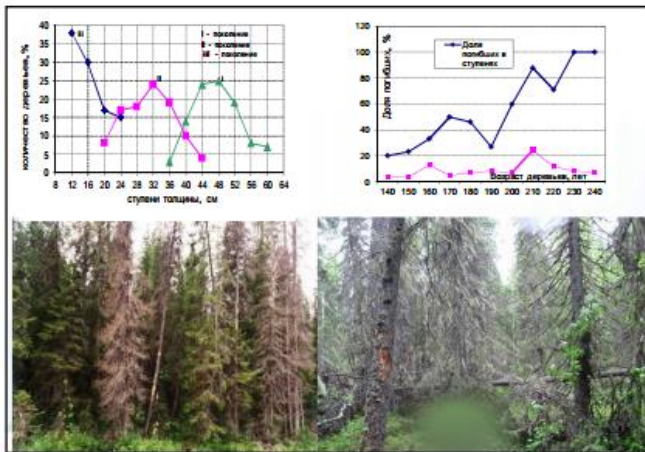




- ### The main directions of scientific and practical research in the framework of the Federal Forestry Agency projects (State ordered scientific researches)
- Development of a framework for sustainable and continuous use of forests. of Scenarios modeling. Forecasts of economic accessibility of forests.
 - Implementation of the model of intensive use and reproduction of forests.
 - Secondary generation forests. Forests care optimization.
 - State forest inventory: improving methodological approaches
 - Forest melioration in the European North
 - Adaptation of forest management system to climate change
 - Improvement of forest monitoring system using remote sensing materials







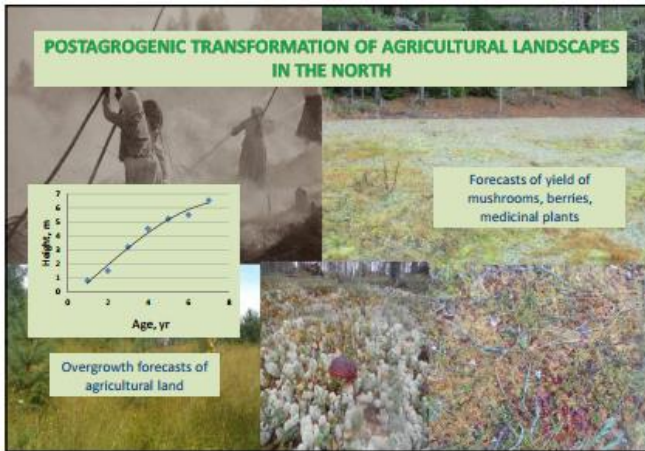
Kolarctic Project: Agroforestry in Barents region (KO1157)

LAPIN AMK **Luke** **NIBIO** **AgroForest**

The next working meeting and seminar on the project will be held in Arkhangelsk, NARFU on April 21-24, 2020

THE TYPES OF FOREST USE ACCEPTABLE FOR AGROFORESTRY

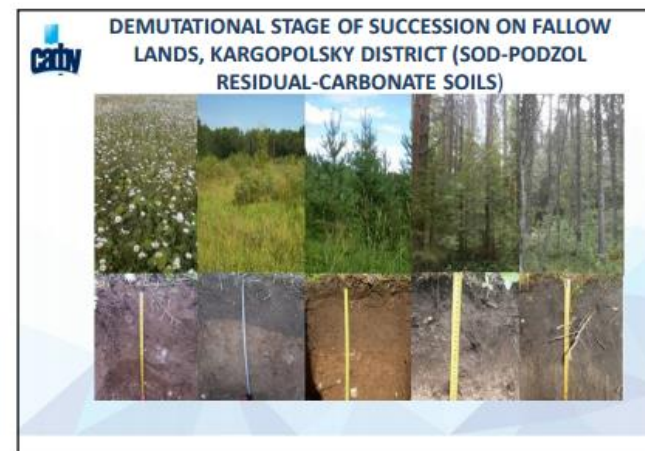
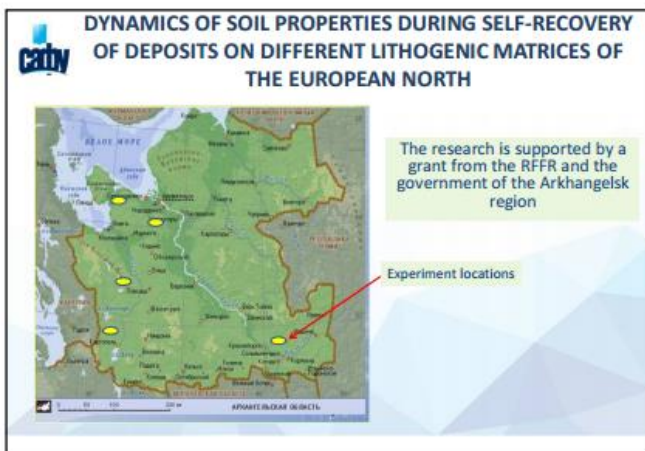
- wood harvesting;
- preparation of oleoresin;
- harvesting and collection of non-wood forest resources;
- harvesting of forest food resources and collection of medicinal plants;
- implementation of activities in the field of hunting;
- farming;
- implementation of research activities, educational activities;
- implementation of recreational activities;
- establishment of forest plantations;
- cultivation of forest fruit, berry, ornamental plants, medicinal plants;
- processing of wood and other forest resources.

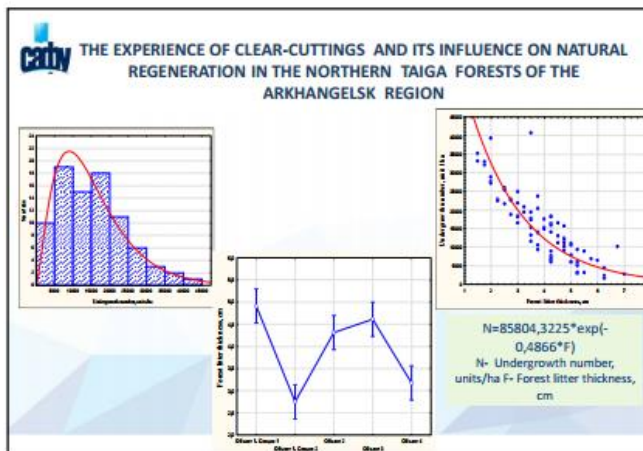
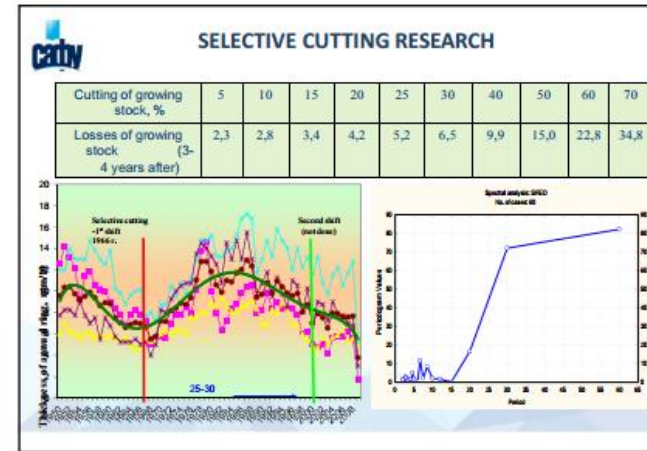


DETERMINATION OF BERRIES YIELD

$P = Yp \cdot S \cdot K_d \cdot K_b \cdot (1 - K_n)$
 P - resources (economic harvest);
 Yp - the productivity of the land type, t/ha;
 S - area, each type of land;
 K_d - the coefficient of availability of land picking berries, depending on the development of the road transport network of the district of the forestry enterprise (in the Arkhangelsk region ranges from 0.1 to 0.5);
 K_b - occurrence rate (% of fruit-bearing areas);
 K_n - natural loss of biological yield (ranges from 0.1 to 0.8).

Type of product	Types of producing land	Land productivity, kg / ha	Producing area, thou hectares	Available collection reserves, thou tons
cowberry	Pine stands, cutting areas	160-400	407	7,5
cranberry	Swampy pine forests, open swamps	50-180	376	5,6
blueberry	Pine and spruce stands	100-230	912	24,7
cloudberry	The pine forests of sphagnum, dwarf shrub-sphagnum and pine trees on a bog	70-180	148	1,5





CATV

CREATION OF METHODS FOR AUTOMATED DETERMINATION OF FOREST PARAMETERS USING AEROSPACE DATA


Objective:
Digitalization of business processes in the field of forestry through the use of new effective methods for obtaining and processing information.

Research Areas:

- Creation of methods for the automated identification of individual trees in aerial photographs based on computer vision (CV).
- Creating a model for interpreting tree parameters based on Data Analysis and the Ontology apparatus.
- Creation of intelligent methods for interpreting remote sensing data based on convolutional neural networks (CNN).
- Software development for the implementation of the results into production.

Projects:
Russian Science Foundation, project 19-71-00040,
Russian Foundation for Basic Research, projects 18-37-00120, 14-07-31076


Contact:
Roman Aleshko, Associate Professor
raleshko@narfu.ru



Height	Diameter	Species	Wood	Height	Species
24.015112	1.023771	1.023771	1.023771	1.023771	1.023771
23.021412	1.023771	1.023771	1.023771	1.023771	1.023771
23.015112	1.023771	1.023771	1.023771	1.023771	1.023771
23.018812	1.023771	1.023771	1.023771	1.023771	1.023771
23.044712	1.023771	1.023771	1.023771	1.023771	1.023771
19.014712	1.023771	1.023771	1.023771	1.023771	1.023771
18.018412	1.023771	1.023771	1.023771	1.023771	1.023771
18.014712	1.023771	1.023771	1.023771	1.023771	1.023771
18.018412	1.023771	1.023771	1.023771	1.023771	1.023771
18.014712	1.023771	1.023771	1.023771	1.023771	1.023771
18.018412	1.023771	1.023771	1.023771	1.023771	1.023771
18.014712	1.023771	1.023771	1.023771	1.023771	1.023771
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18.014712	1.023771	1.023771	1.023771	1.023771	1.023771
18.018412	1.023771	1.023771	1.023771	1.023771	1.023771
18.014712	1.023771	1.023771	1.023771	1.023771	1.023771
18.018412	1.023771	1.023771	1.023771	1.023771	1.023771
18.014712	1.023771	1.023771	1.023771	1.023771	1.023771

CATV

ASSESSMENT OF CUTTING AREAS REFORESTATION BY A UAV




Spruce

Pine

CATV

PROCESSING OF NORTHERN BIORESOURCES AND ENVIRONMENTAL MONITORING CENTER FOR COLLECTIVE USE OF RESEARCH EQUIPMENT «ARKTIKA»

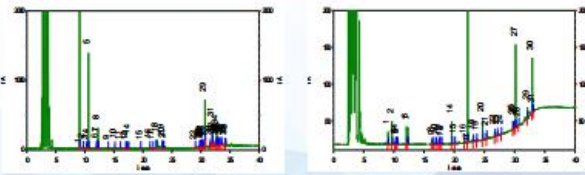


- Eco-monitoring of areas affected by space rocket launch operations
- Developing new methods and tools for monitoring terrestrial marine pollution levels in the Russian Arctic
- Super-critical fluid technologies for detecting and analyzing antioxidants of plant origin
- Hardware and software complexes for monitoring the chemical pollution of the Arctic
- New super-critical fluid technologies of plant raw materials extraction with obtaining of bioactive compounds
- Complex of methodical solutions for monitoring and assessment of environmental footprint of aerospace activities
- New environmentally friendly technologies for wood processing with the application of ionic liquids

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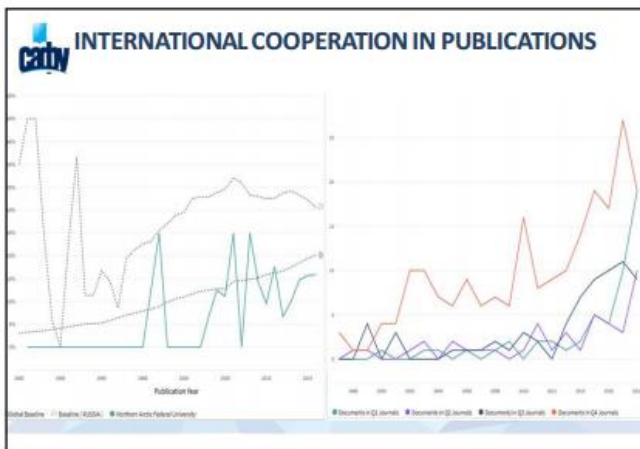
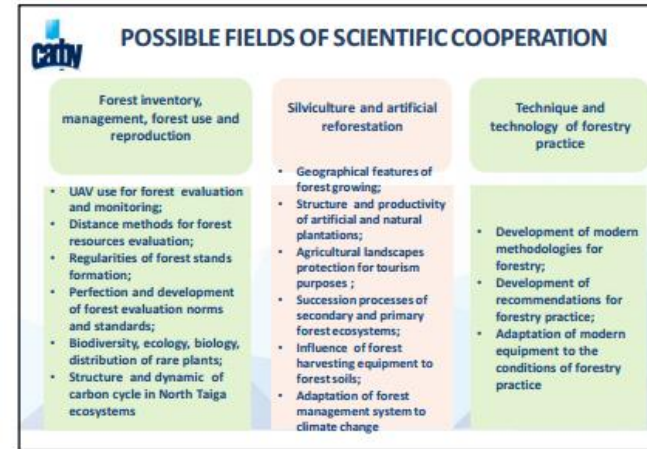
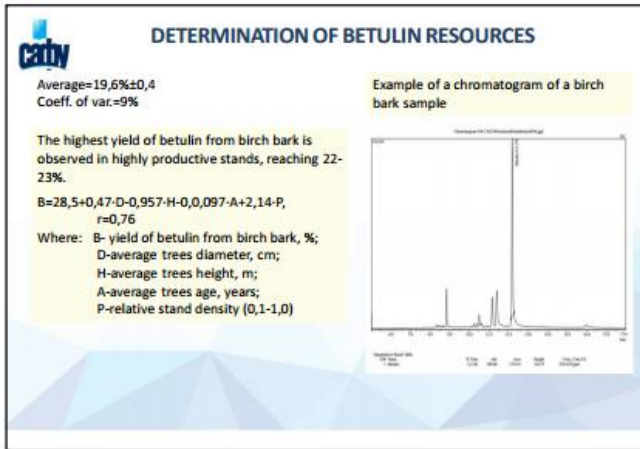
USE OF CHROMATOGRAPHY IN FOREST BREEDING

The share of monoterpenes extracted from the resin and needles of spruce, varies considerably. The highest correlation of the proportion of extracted substances with the parameters of trees (up to 0.70) is observed with the dimensional characteristics of trees-diameter and height in both needles and oleoresins. For trees affected by rot, there is an increased content of α -pinene in the resin. The relationship of $\Delta 3$ Karen content with the age of trees is characterized by a high correlation coefficient.



Chromatogram for spruce oleoresin

Chromatogram of spruce needles



Conservation Enterprises and Sustainable Livelihood Development: Lessons Learned from the USAID Green Annamites Program

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Abstract

Conservation enterprises play an important role in contributing to addressing global sustainable development challenges. Conservation enterprises are defined by a development hypothesis (theory of change) that if income is increased through conservation enterprises, then participants will discontinue environmentally unsustainable activities, leading to reduction in threats (such as reduced overharvesting, poaching, illegal logging, encroachment, and infrastructure development) to the environment¹⁰. USAID Green Annamites Project (GA) built its approach to livelihoods for conservation on this hypothesis. Through this approach, GA has provided technical support to enhance institutional capital (e.g. strengthened capacity of stakeholders and institutionalized cooperatives), improve financial capital (e.g. market-based value chains development for acacia, rattan and medicinal plants, and access to microfinance), and enrich natural capital (e.g. PFES, ecotourism development). After three years of implementation, GA has benefited more than 13,000 people (40% females and 27% ethnic minorities), most of them are dependent on natural resources for livelihoods. GA also mobilized more than US\$ 18.4 million to scale up successfully implemented livelihoods models, contributing to better management of 442, 661 hectares of biological significance as well as reduced threats to biodiversity conservation. One of the key lessons learned is that the conservation enterprises are more sustainable under some key enabling conditions such as (i) meeting local participants' livelihood needs; (ii) enhancing capacity for stakeholders and applying market-based value chain interventions; (iii) and strengthening institutional capacity with strong leadership commitments (USAID, 2018). As a result, these conditions will promote behavior and attitude change towards forest and biodiversity conservation.

Key words: Conservation enterprises, value chain, sustainable livelihood.

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¹⁰ USAID. (2018). THE NATURE OF CONSERVATION ENTERPRISES: A 20-year retrospective evaluation of the theory of change behind this widely used approach to biodiversity conservation. Retrieved from <https://rmpportal.net/biodiversityconservation-gateway/resources/archived-projects/measuring-impact/the-nature-resources/the-nature-resources/the-nature-of-conservation-enterprises-a-20-year-retrospective-evaluation-of-the-theory-of-change-behind-this-widely-used-approach-to-biodiversity-conservation/view>

Biodiversity conservation of forest species of Kazakhstan

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Abstract

Kazakhstan belongs to low forest cover, forest deficit regions. The total area of the forest fund is 29.3 million ha, of which 12.6 million ha are covered with forest; the forest cover of the Republic of Kazakhstan is 4.6%. The most important aspect of biodiversity conservation is the expansion of specially protected areas. Currently, there are 10 state nature reserves, 11 state national natural parks, 5 state natural reservations and other specially protected areas occupying 8.2% of the country's territory. The objects of conservation of the gene pool of valuable genotypes were created for the following main forest-forming species: *Pinus sylvestris*, *Betula pendula*, *Picea obovata*, *Picea schrenkiana*, *Haloxylon*, *Quercus robur*, *Abies sibirica*, *Larix sibirica*, *Juglans regia*. The objects of conservation are located in all regions of Kazakhstan. The work on conservation of wild apple trees has been started.

Keywords: *biodiversity conservation; forest species; specially protected areas; gene pool.*

Introduction

Kazakhstan has a unique set of landscape complexes: from deserts to highlands and ecosystems of inland seas. But forests cover 4.6% of its territory only. Currently, under the influence of anthropogenic impact, the area of natural plantations is decreasing and their degradation (soil erosion, reduction of biodiversity, damage to the habitat of wild animals, desertification, etc.). Therefore, the global target adopted at the 10th Conference of the parties to the Convention on biodiversity, by 2020, provides for the conservation of biodiversity by expanding protected areas to 17% of the total area of terrestrial ecosystems of the world.

Biodiversity conservation of forest species of Kazakhstan

The problems of protection and conservation of nature, rational nature use and reproduction of resources are solved at the state level. Kazakhstan is a party to the Convention on Biological Diversity (CBD), the Convention on the Conservation of Migratory Species of Wild Animals, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Ramsar Convention on Wetlands of International Importance, the Convention concerning the Protection of the World Cultural and Natural Heritage, the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, the United Nations Convention to Combat Desertification.

The Law of the Republic of Kazakhstan on environmental protection defines the legal, economic and social bases for ensuring environmental safety, preventing environmental degradation, preserving biodiversity and organizing rational nature management. The government of the Republic has set the task of accelerating the development of new resource-

saving technologies and their early implementation in large areas, especially in previously degraded and lost natural and ecological properties of landscapes. Recently, a legislative framework has been formed aimed at ensuring the interconnection of environmental political and economic principles of sustainable development of natural resources, conservation and restoration of forests and wildlife. To this end, measures are being taken to assess the state of biodiversity, increase the area of specially protected areas, conservation of rare species in situ and ex situ and restore them to disturbed lands.

Legislation in the field of specially protected natural areas (SPNA) is based on the Constitution of the Republic of Kazakhstan, the Law of the Republic of Kazakhstan on specially protected natural areas (The Law of the Republic of Kazakhstan On Specially Protected Natural Areas No. 175, 2006), the Concept of development and location of specially protected natural areas until 2030.

The process of biodiversity conservation and sustainable use in Kazakhstan consists of the following tasks: (1) formation of a representative national ecological network capable of ensuring biodiversity conservation; (2) integration of the national ecological network of the Republic of Kazakhstan into international ecological networks; (3) conservation and restoration of rare and endangered species; (4) regulatory support for the protection, reproduction and sustainable use of biodiversity; (5) integrated management and sustainable use of biodiversity components; (6) a national biodiversity monitoring system ensuring unity of measurement; (7) conservation of genetic resources, access to and use of them in a fair and equitable manner; (8) implementation of an ecosystem approach and improved efficiency in ecosystem management; (9) assessment and integration of ecosystem services into development planning through economic assessment; (10) mainstreaming of climate change and adaptation into planning; 11) increasing the volume of reforestation and afforestation.

There are more than 300 objects of the state nature reserve Fund of Republican significance and more than 110 specially protected natural areas of national importance in Kazakhstan currently. According to the International Union for Conservation of Nature, it is believed that the country should have at least 10-12% of protected natural areas. The area of specially protected natural territories of Kazakhstan is more than 8.9% of the country's territory, but active work is being done to expand the objects of conservation. By 2020, it is planned to increase the area of specially protected natural areas to 9.5%, including with the status of a legal entity - up to 3.0%. The organization of specially protected natural areas has a multi-purpose purpose: conservation of unique landscapes, standards of untouched biocenoses, species diversity of living organisms (gene pool), protection of rare and endangered relic and endemic species, provision of conditions for their reproduction, promotion of environmental knowledge, etc.

The creation of protected natural areas began in the 20s of the last century in Kazakhstan. The first reserve in Central Asia - "Aksu-Zhabagly" was created in 1926. State national natural parks began to be created later. The first State National Natural Park "Bayanaul" was organized in 1985. There are 12 national parks with a total area of more than 2 million square kilometers on the territory of Kazakhstan currently.

There are 10 reserves with a total area of more than 1.6 million square kilometers in the Republic now. 9 biosphere reserves (Alakol, Ak-Zhaiyk, Aksu-Zhabagly, Altyn-Emel,

Barsakelmes, Korgalzhyn, Katon-Karagay, Karatau and Big Altai) are included in the international network of biosphere reserves, carrying out global environmental monitoring.

Two State Forest Natural Reserves were established to preserve the unique pine belt forests of the Irtysh region in 2003. There are five State Natural Reserves now, the total area of which is more than 2.3 million hectares. Their main purpose is the conservation and restoration of biological and landscape diversity, natural ecological systems (Danchenko and Kabanova 2007).

In addition, biodiversity is conserved in 6 State Botanical Gardens, 26 Natural Monuments of national importance and 53 Natural Monuments of regional significance.

The wildlife preserves conserve and restore especially valuable natural complexes (7 complex wildlife preserves with a total area of more than 2.2 million hectares), as well as valuable, rare and endangered species of plants and animals (11 Botanical wildlife preserves with a total area of more than 100 thousand hectares).

The objects of the State Natural-Reserved Fund include particularly valuable plantations of the State Forest Fund - unique forests, forest-fruity plantations, tugai and subalpine forests. Charyn ash forest cottage, Chinturgensky spruce (Almaty region), Sinegorskaya fir grove (East Kazakhstan region), Serebryany Bor, Sosnovy Bor, Relict array, Zhanazhol (North Kazakhstan region) are included in the List of Objects of State Natural-Reserved Fund of Republican significance. The reserved or custom mode of protection and use is established on sites of especially valuable plantings of the State Forest Fund. Coast buckthorn, Dancing birch grove, Dendrological Park and Arboretum of Kazakh Research Institute of Forestry and Agroforestry, Dendrological Park of College of Ecology and Forestry (Akmola region) and Baum Grove (in Almaty) are included in the List of Objects of State Natural-Reserved Fund of Republican significance also.

The location of specially protected natural areas in Kazakhstan cannot be called a full-fledged ecological network currently. But today, active work is being done on the formation of regional intra-state ecological networks in the Zailiyskiy Alatau, Zhongar Alatau and the Altai region. Activities in the field of environmental networks are also carried out within the framework of international cooperation. The Kazakh-Russian transboundary biosphere reserve "Big Altai", which includes "Katon-Karagay" and "Katun" reserves, is included by the Manand Biosphere program of UNESCO in the List of International Reserves. International experts noted the close cooperation between scientists of Kazakhstan and Russia in the preparation of the nomination "Big Altai", which became the first transboundary reserve in Asia. International projects on integrated conservation of globally significant wetlands as waterfowl habitat and creation of econets for long-term biodiversity conservation in ecoregions of Central Asia develop actively.

The Concept of Transition of the Republic of Kazakhstan towards Green Economy was adopted in 2013 (The Concept of Transition of the Republic of Kazakhstan towards Green Economy, 2013). Within the framework of this Concept, the Concept of conservation and sustainable use of biological diversity has been developed, one of the directions of which is the integration of biodiversity conservation into forestry.

Forests of Kazakhstan are important environmental objects of environmental, social and economic importance. More than 5.7 thousand higher plants from them 108 species of trees and 310 species of shrubs grow in Kazakhstan. 387 species of plants are included in the Red Book of Kazakhstan (Red Data Book of Kazakhstan, 2014).

Most tree and shrub species have an intermittent areal and alternate with meadow and steppe vegetation. Birch-aspen forest outliers (comm. *Betula*, *Populus tremula*) grow in the area of forest-steppe. They are *Salix triandra*, *S. caprea*, *S. rosmarinifolia*, *S. alba*, *Rosa acicularis*, *R. spinosissima*, *Spiraea crenata*, *S. hypericifolia*, *Cerasus fruticosa*, *Cotoneaster melanocarpa* and others. In the steppe zone, forest areas are insignificant and are represented by birch-aspen forest outliers (comm. *Betula*, *Populus tremula*), with residual insular and belt massifs of pine forests (*Pinus sylvestris*) and shrubs of *Salix*, *Spiraea*, *Caragana*. In the desert zone the main species is *Haloxylon aphyllum* (Minkw.) Iljin, subjected to a large anthropogenic load due to grazing and felling it for firewood. *Haloxylon ammodendron* is rare and requires protection. In mountain ecosystems, fir and cedar forests are found only in the North-West Altai, spruce forests from *Picea schrenkiana* are common in the Northern Tien Shan. *Larix sibirica* grows in Central and Southern Altai.

There are broad-leaved poplar forests (*Populus nigra* and *Populus alba*), fragments of oak forests (Ural river) and aspen-birch and willows forests in the river valleys in the steppe zone. Floodplain forests - tugai (*Populus*, *Elaeagnus angustifolia*), willow and shrub thickets (*Halimodendron halodendron* and *Tamarix*) grow in the river valleys of the desert zone. There are relic ash forests in the deep canyons (Charyn river).

Kazakhstan is a unique repository of wild fruit trees, the genetic center of origin of many of them. More than 130 species belonging to 30 genera (*Malus*, *Pyrus*, *Prunus*, *Pistacia*, *Juglans regia*, etc.), of which 19 species are endemic, grow in the mountains. Works have begun on the conservation of wild apple plantations (*Malus sieversii*, *Malus niedzwetzkyana*) such as genetic reserves have been allocated, 160 varieties of apple trees grow in collection plantings, which are the richest gene pool and material for genetic and selection works. The genetic resources of *Pistacia vera*, *Amygdalus communis* and *Vitis vinifera* are promising for conservation. The place of growth of these species on the northern borders of the areals suggests the presence of genotypes that cause cold resistance. Conservation of pristine ecosystems is of practical importance in genetic terms, because there is a need to improve the quality of those species that people began to use in artificial cultivation. In other words, it is necessary to conserve wild species in nature as a source of valuable genotypes for breeding purposes.

The Kazakh Research Institute of Forestry and Agroforestry carried out a lot of work to conserve the genetic biodiversity of forest tree species. Together with the Republican Forest Breeding and Seed Center, forest genetic reserves in natural plantations were allocated, plus trees and plantations were selected, permanent forest seed plots, test, provenance trial plantations and clone archives of the main forest-forming species were created. Studies were conducted in protected areas on monitoring over a condition and natural renewal in genetic reserves and *Pinus sylvestris*, *Betula pendula*, *Haloxylon*, study of ground cover, restoration of burnt areas by forest cultural methods, carrying out felling care, forest pathology monitoring was performed. The objects of conservation of valuable gene pool of genotypes were

generated for the following major forest types: *Pinus sylvestris*, *Betula pendula*, *Picea obovata*, *Picea schrenkiana*, *Haloxylon*, *Quercus robur*, *Abies sibirica*, *Larix sibirica*, *Juglans regia*. Plus plantations, forest genetic reserves, permanent forest seed plots and plantations are located in all regions of Kazakhstan. There are more than 600 species of trees and shrubs, including - 6 species from the Red Book, in the collection of the arboretum.

The Kazakh Research Institute of Forestry and Agroforestry works on *in vitro* propagation of *Sibiraea altaiensis* (Kirillov et al. 2019), *Populus pruinosa*, *Amygdalus ledebouriana* and *Euonymus verrucosus* in order to conserve rare and endangered species of trees and shrubs currently.

Conclusion

Based on the above, it can be concluded that in Kazakhstan the issues of biodiversity conservation, environmental education and promotion of sustainable use of biological resources are included in the main strategic documents of the country and international projects. In order to conserve biological diversity, measures are being taken to assess the status and inventory of conservation facilities, increase the network of specially protected natural areas and conserve natural populations of rare species through their artificial and natural reproduction in disturbed areas, taking into account modern natural and anthropogenic processes.

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Enhancing northeast British Columbia's boreal forest resilience and carbon storage in a changing climate

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Abstract

British Columbia (BC) in general, and specifically in northeast BC's boreal forests, free growing standards and timber supply analysis force managers to measure their regenerating plantations' performance against pure conifer stands, or to treat all broadleaf vegetation as competition and take measures to remove it. This leaves little room for the retention of non-crop, broadleaf trees of equal or greater height compared to crop trees. There are economic and biological costs associated with this forest management approach, particularly with a rapidly changing regional climate. Our project's goal is to further our understanding of the dynamic interactions between conifer crop trees and broadleaf competition such that forest productivity, diversity, and health are optimized, and operational costs are minimized. Two study sites each with two different trials were established in northeast BC to observe crop tree "release" and "natural stand" development. Even though there was no difference in spruce DBH at establishment, after 10+ years there was a significant but variable negative relationship between competition and spruce DBH. However deleterious levels of competition far exceeded the standards set by the BC Government. Clearly there is a high level of competition that reduces crop tree growth, but this argues against the current management practice of broadcast removal of all competition and for spot removal of competing vegetation. This approach should result in better crop tree and overall stand growth with greater carbon sequestration, improved structural diversity and forest health, and greater stand resilience. Several challenges or opportunities for the forest education/research community are associated with the proposed new approach. Understanding the factors influencing the dynamics of these complex systems and articulating them to regulators will provide the basis for sustainable forest resource development and conservation in northeast BC.

Introduction

British Columbia (BC) in general, and specifically in northeast BC's boreal forests, free growing standards (a legal requirement in BC) and timber supply analysis force managers to measure their regenerating plantations' performance against pure conifer stands, or in reality, to treat all broadleaf vegetation as competition and take measures to remove it in order to ensure a free growing stand within a set period of time (British Columbia Ministry of Forests 2002, 2005; Simard and Vyse, 2006). Free growing is defined as "a stand of healthy trees of a commercially valuable species, the growth of which is not impeded by competition from plants, shrubs or other trees" (British Columbia Ministry of Forests, 2005). Stands may only be declared free growing if a chemical or manual brushing treatment has been conducted within the preceding five years (British Columbia Ministry of Forests, 2005). This leaves little

room for the retention of non-crop, broadleaf trees of equal or greater height compared to crop trees regardless of observed crop tree performance. The guidelines may cause forest managers to simply apply unnecessary broadcast chemical or manual vegetation removal (brushing) treatments in order to avoid administrative delays. This practice is costly for the licensee. In one study (Hawkins et al., 2012), future value after brushing was only positive with a real interest rate of two percent: a poorer return than forest managers are expecting. There are also potential nonfinancial costs at the landscape level too in terms of the loss of complex stand structures, carbon storage and the associated functional and structural diversity. This, the traditional management approach in BC's complex stands, leads to forest simplification (Simard and Vyse, 2006). It also poses a potential threat to the stability and resilience of BC's forests in a rapidly changing climate. Mean annual temperature increased by about 2.2 C between 1900 and 2010 and the trend accelerated after 1950 (Picketts, 2015). As Gayer (1886, p.5) observed, a mixed forest condition (complex forest) is better able to deal with the uncertainty of future stand development and environmental risk.

Because of the large array of species combinations and structural possibilities for mixed species stands, little is known or actually understood about the dynamics of complex stands (Assmann, 1961). However historically mixed species management has been associated with lower stand yields for desired species. In part, this is due to a legacy of ambiguous reports (Tarrant, 1961; Tarrant and Trappe, 1971; Binkley, 1983; Perry et al., 1987; Frivold and Mielikainen, 1990; Binkley, 1992; Kelty, 1992; Mard, a 1996). However more recent literature suggests that yields may be greater in mixed species stands than in pure stands (Frivold and Kloström, 1999; Man and Lieffers, 1999; Jonsson et al., 2001; Legare et al., 2004; Lygis et al., 2004; Simard et al., 2005; Kelty, 2006). It has been suggested that over a rotation, a mixed species stand may yield greater total wood volume (carbon sequestration), as well as conifer volume, provided broadleaf density is below a competitive threshold, than a single-species stand (Legare et al., 2004) and also provide other stand-level benefits through species' interactions (Man and Lieffers, 1999).

This project seeks to further our understanding of the dynamic interactions between conifer crop trees (spruce) and associated broadleaf competition (trembling aspen or paper birch) in northeast BC and how to link the findings to operational forest management. The primary objective is to define broadleaf density and-or basal area thresholds that are deleterious to spruce growth and long-term productivity (carbon sequestration) in a rapidly changing climate to improve forest management in northeast BC. To achieve this, besides data acquisition, an educational initiative has to be established in order to convince government regulators to change the free growing guidelines such that they optimize forest productivity, diversity, and health and minimize operational costs.

Materials and Methods

The study sites are in the Northeast Forest Region of British Columbia, Canada. The One Island Lake site is situated at 55.3429 N latitude, -120.35074 W longitude and the Mile 88 site is situated at 56.5469 N latitude, -121.55235 W longitude. Regional climate projections suggest a very different future by 2050 (Picketts, 2015), with increased mean annual: temperature (MAT, 1.9-4.7 C), precipitation (MAP, 11-19%), and frost free (FF) days (25-40

days). Currently regional MAT ranges from +3 C in the south to about 0 C in the north with extremes from -52 C to +36 C. MAP across the region is currently about 450 mm with about half falling as snow. The regional FF period is currently variable, 90 to 125 days, depending on local topography rather than latitude. Given the changing climate and the likely negative landscape level impacts of current management regulations and their application, the following trials were initiated in five to 17-year-old post logging stands with a significant component of naturally regenerated broadleaf species.

Single tree sample plots were established using the nearest individual method described in Kent and Coker (1992). Samplers proceed along a bearing for a fixed distance (usually 25 m) and the nearest spruce to this point was the crop tree and the plot centre. Sample (crop) trees were free of defects and taller than 1.3 m because defects may have been induced by pathogens or insects and reduced crop tree growth would not be due to competition (stand density) but poor forest health. Depending on the objective, two different radii plots were established: 1.785 m (10 m² called TSP) and 4.0 m (50 m² called PSP). The objectives respectively for PSP and TSP were to observe crop tree “release” and “natural stand” development. All spruce and broadleaves within both plot types taller than 1.3 m were measured for height and diameter at breast height (DBH, 1.3 m). After initial measurements, randomly selected brush free radii around the crop tree of 0, 1, 2 and 4 m were established in the PSP plots while no vegetation removal was done in the TSP plots. The year of trial establishment and stand age at establishment respectively for One Island Lake and Mile 88 were April 2008 (growth assessed to end of 2007 growing season) and 15 years old, August 2009 (growth assessed to end of 2009 growing season).

In addition to determining the plot density (stems ha⁻¹ or sph) and mean heights and DBHs, relative density index (RDI) Curtis (1982) and stand density index (SDI) (Reineke, 1933, Long, 1985) were calculated at the time of plot establishment and with each re-measurement. Competition density (non crop conifers and broadleaves) was used to calculate the SDI and RDI. There was a strong positive correlation between SDI and RDI when all plots at all sites were combined. As a result, only RDI is used to describe the broadleaf - spruce competitive interaction in this report. The following formula was used to calculate the competition tree RDI:

$$RDI = BA / (QMD)^{0.5}$$

Where, BA = basal area m² ha⁻¹, QMD = quadratic mean diameter in cm, 0.5 = a single slope coefficient, (from Curtis 1982).

Statistical analysis was conducted using simple regression models that integrated competition (sph (density), RDI; independent variables) to current spruce crop tree size (DBH; dependent variable). In this investigation height was well correlated to DBH. Therefore, height is not described in detail to explain broadleaf - spruce competition. Only diameter results are used to describe the impact of broadleaf competition on crop tree performance. We did not use multiple regression because different studies have revealed that a consistent model is not applicable to all sites (Brand, 1986, Simard, 1990). The impact level of broadleaf density (sph) and RDI were identified when the regression analysis changed from significant to nonsignificant in relation to the impact of competition on spruce DBH at each site. The impact levels were identified using a ceiling function which described the upper boundary of

the data and enveloped at least 95 % of the observations (Burton, 1993). Visual tests for normality of data distribution were done using histograms with normal smoothing curves. The most appropriate functional forms between the response variables and each competition index were identified according to Simard et al. (2004).

Results

One Island Lake

TSPs were measured after the 2019 growing season, 12 years since establishment. At establishment, DBH versus RDI or competing density (SPH) was variable but there was no significant trend (Figures 1, 2; Table 1). After 11 years, there was a significant positive relationship between current RDI and DBH (Figure 3; Table 1). Generally, trees with the largest DBH at establishment had larger DBH in 2019, regardless of competition (Table 1).

PSPs were measured after the 2018 growing season, 11 years since establishment. There was no difference in DBH, SPH or RDI among the four brushing radii at trial establishment (Table 2). At the end of the 2018 growing season, there was no difference in mean DBH among the 0, 1 or 2 m brushing treatments and in the 4 m plots, DBH was significantly larger than in the other radii plots (Table 2). Establishment variables SPH, RDI and DBH were significant in predicting DBH in 2019 (Table 3).

Mile 88

TSP were measured after the 2019 growing season, 10 years since establishment. DBH versus competing density (SPH) or RDI at establishment were variable and again there was no significant trend (Figures 4, 5; Table 4). Ten years after trial establishment there was a significant difference in DBH with respect to both establishment and current RDI (Table 4). There was a trend for trees with the largest DBH at establishment to have the largest current DBH, but the relationship was not significant (Figure 6, Table 4).

Discussion

The effect of interspecific competition on DBH provides a more robust vector than height growth when comparing crop tree responses to competition. We therefore used DBH as our competitive response variable (Jobidon, 2000, Valkonen & Ruuska, 2003, Newsome et al., 2010). Radial development is also an integrative index of tree physiological responses to environmental variation (Misson et al., 2003) and it is the first energy sink to be abandoned when tree growth is challenged (Oliver & Larson, 1996).

There was no difference in DBH at TSP establishment with respect to stand density (SPH) or RDI at both sites (Figures 1, 2, 4, 5 and Tables 1, 4). The observation of minimal broadleaf impact on spruce DBH at trial establishment are supported by different studies in Scandinavia (Bergqvist, 1999, Kelty, 2006). Current year measurements indicate there was a significant but variable negative relationship between competition and DBH (Tables 1, 4). A similar relationship was previously described (Legare et al., 2004), both at establishment and

for the later measure. Other studies also suggest that variation in tree growth at a given site can result from many factors other than competition. Some such examples are: genetics (St. Clair & Snieko, 1999) damage or disturbance (Perry, 1985), disease (Simard et al., 2001), insects (Taylor et al., 1996), initial seedling size (Wagner & Radosevich, 1991) interactions with soil organisms (Simard et al., 1997), or microsite quality (Arii & Turkington, 2001). In our studies, spruce DBH growth could have been influenced by some of these other factors. Even though there is more than a decade of difference in the age of the TSP sites at establishment, current DBH growth responses were similar regardless of competition levels even though trees at Mile 88 were much smaller at establishment. Establishment data, particularly from One Island Lake (older site), suggests the BC free growing standards are not biologically based (Lieffers et al., 2002, 2007, Hawkins & Dhar, 2011, 2013). Competition levels greatly exceeded the BC Government standard's maximum competition threshold of 1000 sph (British Columbia Ministry of Forests, 2005).

Similar DBH relationships to competition as observed for the TSPs were seen at One Island Lake's PSP establishment (Table 4). After 11 years, surprisingly there was no difference among DBH for completion removal (brushing) treatments of 0, 1 or 2 m but they all had significantly smaller mean DBH than the 4 m radius treatment. Again, this questions the biological validity of the current free growing standards (Simard et al., 2004, Hawkins & Dhar, 2013). According to the guidelines (British Columbia Ministry of Forests, 2005), there should have been a significant difference in DBH between the 0 and 1 m radii competition free treatments. This may support the observation of Legare et al. (2004) that broadleaf stand components should not only be viewed as tolerable but in some cases as beneficial.

At least with respect to the two study sites of this project, the data indicates there are possible issues with the BC free growing standards in northeast complex stands. It appears at trial establishment and after a decade of growth, broadleaf competition has not had a large significant negative impact on spruce radial growth (DBH) to this stage. This raises the question, what possibly regulates these observations? Newton & Comeau (1990) hypothesized the potential benefit of competing vegetation to the site nutrient balance could lead to long-term productivity gains while others (Matthews, 1989, Simard & Vyse, 2006) suggested nutrient inputs to the system from broadleaf litter are important for maintaining site productivity over several rotations. According to Richards et al. (2010) more than 65% of mixed species studies showed a significant increase of nitrogen (N) and phosphorus (P) use efficiencies when different species are grown in a mixture compared to a monoculture. Therefore, beneficial interactions inherent in species mixes likely will be lost when broadleaf species are removed to meet administrative goals. Moreover, most broadleaves are early seral species and their competitive effect on the target conifer species diminishes after crown closure (Frivold & Frank, 2002, Simard & Vyse, 2006). Perhaps none of the sites had reached full occupancy (stem exclusion stage of stand development with intense inter-tree competition and the beginning of self-thinning, and maximum leaf area [Oliver and Larson, 1996, Kozłowski, 2002, Simard et al., 2004]). Given the observed mortality when measuring in the stands in 2019 (reductions in SPH), this is not likely even at the younger Mile 88 site.

Clearly there is a level of competition that reduces crop tree growth (Tables 1, 3, 4) but the threshold is much greater than those of the standard. This argues against the current management practice of broadcast removal of competition and for spot removal of competing vegetation (Hawkins et al., 2012). This approach should result in better crop tree growth, improved structural diversity and forest health, and greater stand resilience.

If relative density index is considered a surrogate for stand productivity as it is based on basal area and number of trees. In both TSP and PSP trials, RDI was larger when crop trees were smaller (Tables 1, 2 4). This supports past observations that early productivity is greater in a mixed species stand than in a pure stand (Fahlvik et al., 2005, Hawkins et al. 2012). Whether increased productivity continues as a stand matures is subject to debate (Frivold & Frank, 2002). Interestingly, Bergqvist (1999) hypothesized the uppermost leaves of spruce are light saturated and therefore shading (competition) from taller competition has little impact on photosynthetic productivity. Some studies have shown broadleaf growth does slow with increased stand age (Frivold & Frank, 2002, Leiffers et al., 2002, Simard & Vyse, 2006). This suggests the effects of broadleaf competition should lessen with stand age. Further, Man & Lieffers (1999), Legare et al (2004) and Kelty (2006) reported that complex stands are more productive than single species stands.

Greater productivity means greater carbon sequestration. However, given today's economic reality, this likely means at rotation, a complex stand has less value than pure stands of conifer due to the lower worth of broadleaves. This indicates several challenges or opportunities for the forest education/research community: promote the increased resilience associated with a complex stand in a rapidly changing climate; develop broadleaf primary and secondary products to increase their market value; financially credit forest owners for long-term carbon storage; and develop educational initiatives that promote the former. Understanding the factors influencing the dynamics of northeast BC mixedwood systems and articulating them will provide the basis for sustainable forest resource development and conservation (Peng et al., 2002). However, mixedwood stands are difficult to manage as they are highly variable in their environmental requirements, regeneration strategies, growth rates, and life span (Prévost & Pothier, 2003). Regardless, continued research on complex stands in northeast BC is needed to meet future challenges.

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Table 1. Simple linear regression at One Island Lake TSP for RDI and competition density (SPH) on DBH: est, at trial establishment; 19, current year measurement.

Predictor	Response	r ²	F	df	P(F)
RDIest	DBHest=4.422+0.0387*RDI	0.002	1.141	1,78	0.2887
SPHest	DBHest=4.380+0.00003*SPH	0.011	0.837	1,78	0.3632
DBH19	RDI19=23.980-1.3371*DBH	0.225	23.980	1,78	0.0000
DBHest	DBH19=6.951+0.6421*DBH	0.101	9.903	1,78	0.0023

Table 2. Mean ± (standard error of mean) DBH in 2007, 2009 and 2018 and density (SPH) and RDI (per ha equivalent in a 50 m² plot) after establishment treatment (brush free radii of 0, 1, 2 or 4 m) in the PSP at One Island Lake.

Radii	DBH 07	DBH 09	DBH 18	SPH 07 *10 ³	RDI 07
0	5.1 (0.3)	6.2 (0.3)	10.1 (0.5)	13.3 (5.0)	9.92 (3.49)
1	5.3 (0.3)	6.4 (0.4)	10.4 (0.6)	14.8 (5.0)	10.75 (4.33)
2	5.5 (0.4)	6.7 (0.5)	11.3 (0.8)	10.2 (2.9)	7.68 (2.79)
4	5.4 (0.5)	7.0 (0.6)	13.7 (1.0)	0	0

Table 3. Simple linear regression at One Island Lake PSP for RDI and competition density (SPH) and establishment DBH on DBH18: est, at trial establishment; 18, latest measurement. All treatments pooled.

Predictor	Response	r ²	F	df	P(F)
SPHest	DBH18=13.794-0.0003*SPH	0.278	26.007	1,64	0.0000
RDIest	DBH18=13.970-0.3633*RDI	0.339	34.345	1,64	0.0000
DBHest	DBH18=1.233+1.8553*RDI	0.723	170.264	1,64	0.0000

Table 4. Simple linear regression at Mile 88 TSP for RDI and competition density (SPH) on DBH: est, at trial establishment; 19, current year measurement.

Predictor	Response	r ²	F	df	P(F)
SPHest	DBHest=0.881+0.000005*SPH	0.019	0.023	1,52	0.8806
RDIest	DBHest=0.823+0.0071*RDI	0.016	0.180	1,52	0.6728
RDIest	DBH19=9.005-0.5906*RDI	0.339	28.177	1,52	0.0000
DBH19	RDI19=27.378-1.6907*DBH	0.332	27.377	1,52	0.0000
DBHest	DBH19=6.026+2.1971*DBH	0.053	3.986	1,52	0.0511

Figure 1. Crop tree DBH versus competition RDI at trial establishment (fall 2008) at One Island Lake.

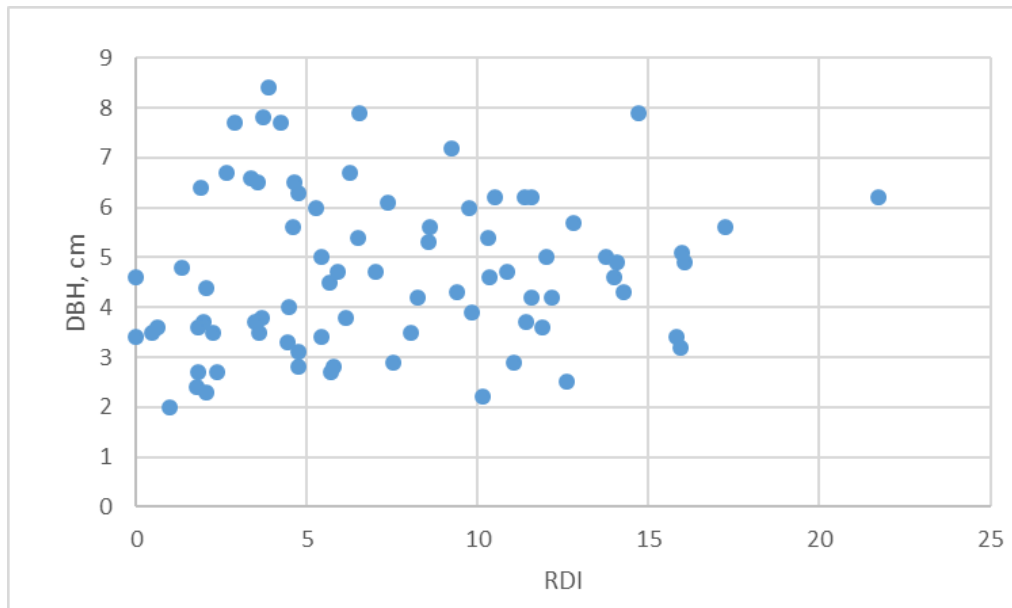


Figure 2. Crop tree DBH versus competition density (SPH) at trial establishment (fall 2008) at One Island Lake.

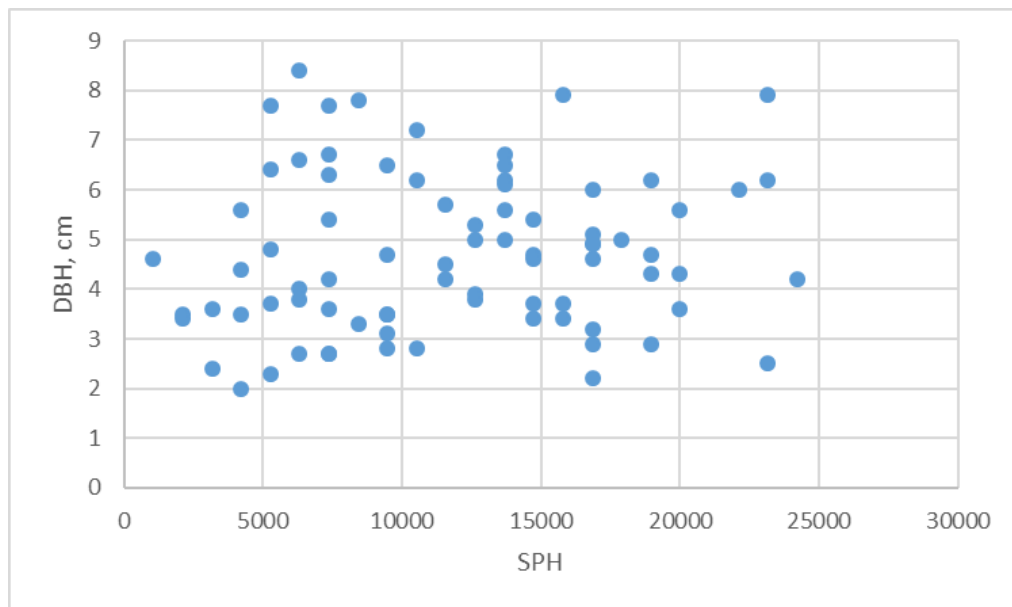


Figure 3. Crop tree DBH versus competition RDI after 11 growing seasons (2019 measurement) at One Island Lake.

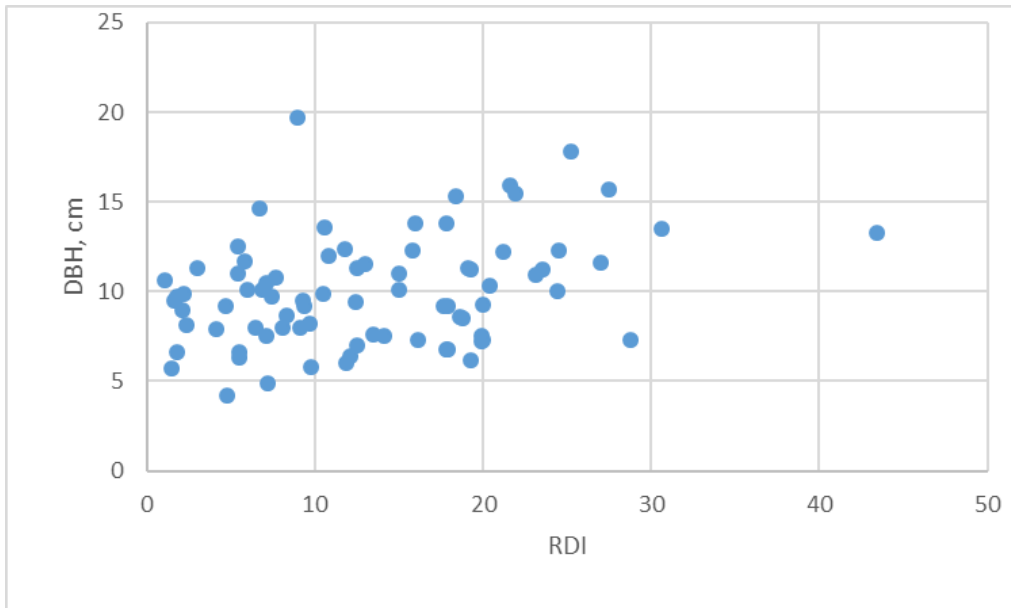


Figure 4. Crop tree DBH versus competition density (SPH) at trial establishment (fall 2009) at Mile 88.

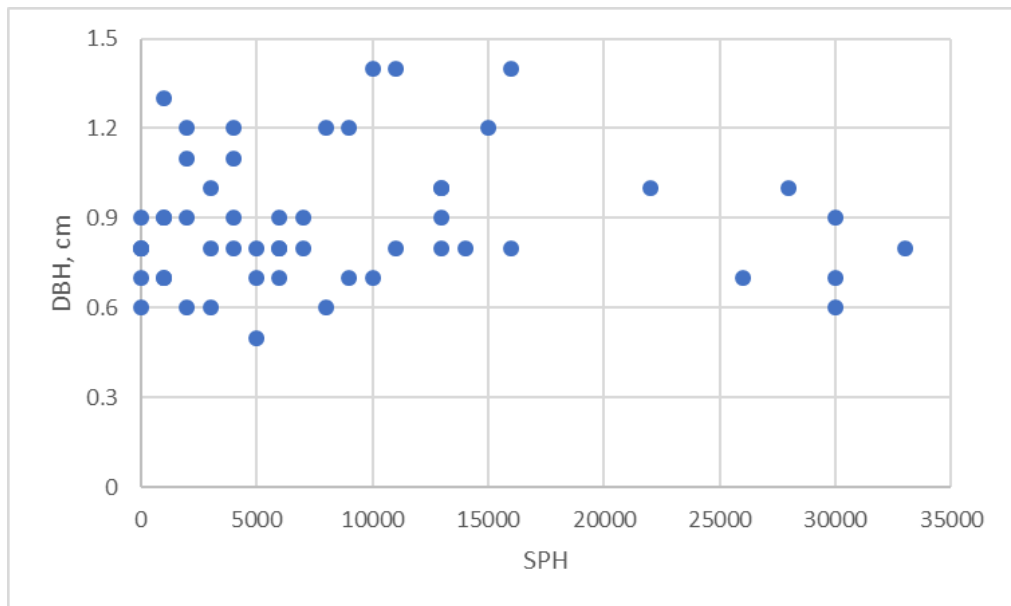


Figure 5. Crop tree DBH versus competition RDI at trial establishment (fall 2009) at Mile 88.

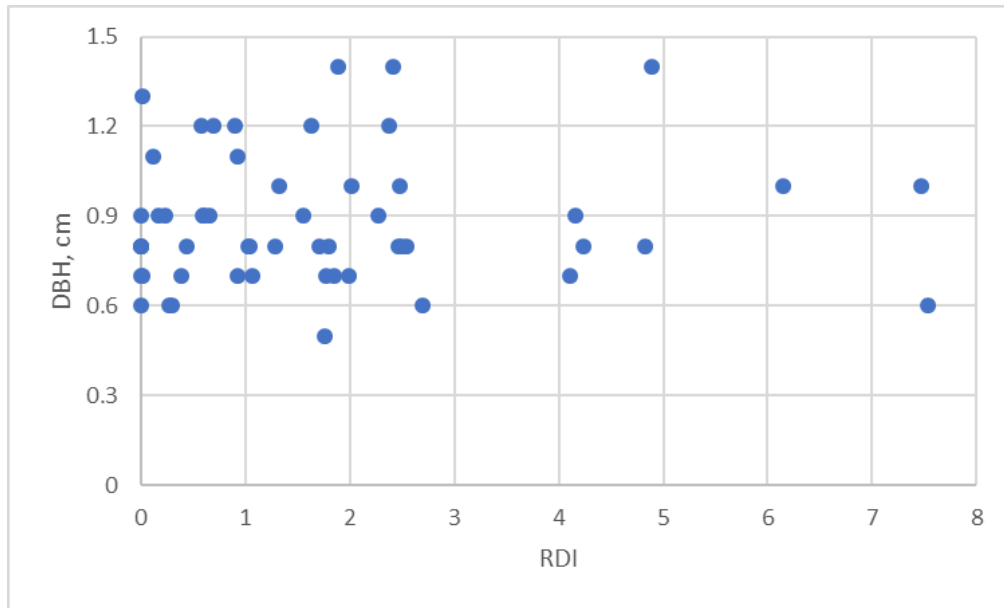
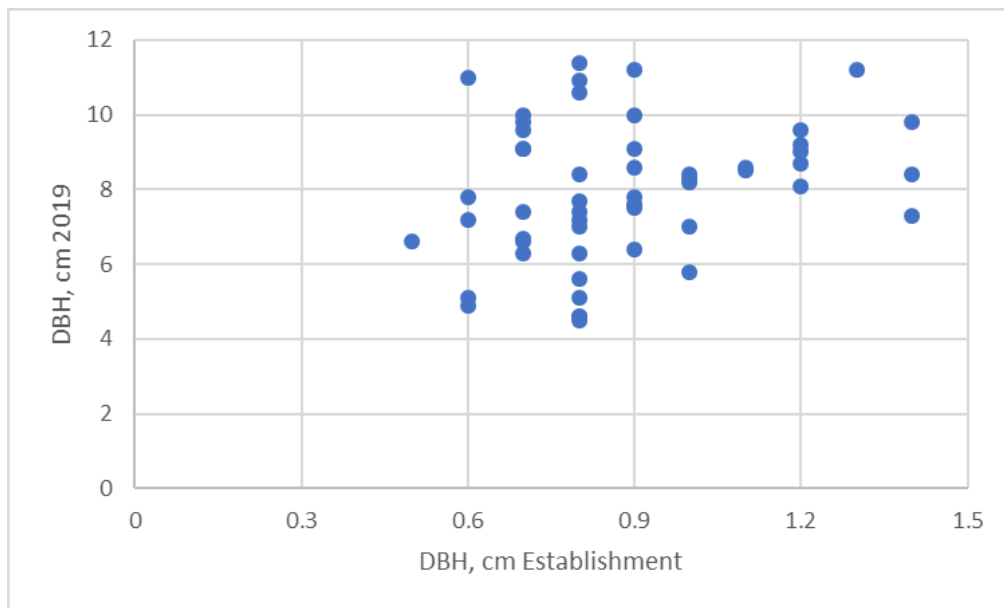


Figure 6. Current crop tree DBH versus crop tree DBH at trial establishment at Mile 88.



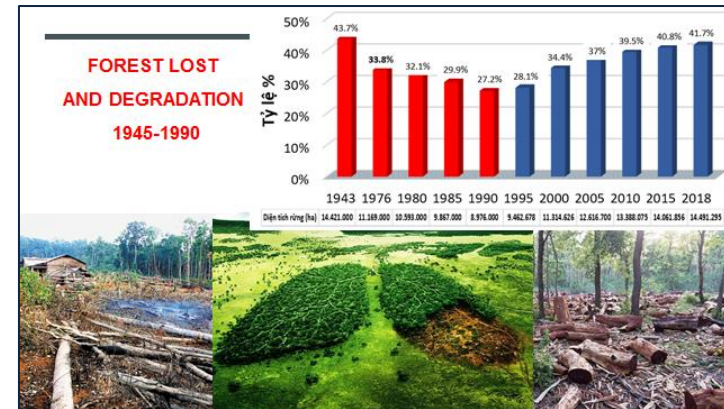
Outstanding achievements of Vietnam Forestry from 1991 to present; Potentials and advantages, opportunities and challenges for forestry development after 2020

Prof. Dr. Nguyen Ba Ngai

Vice Chairman of Viet Nam Forest Owners Association

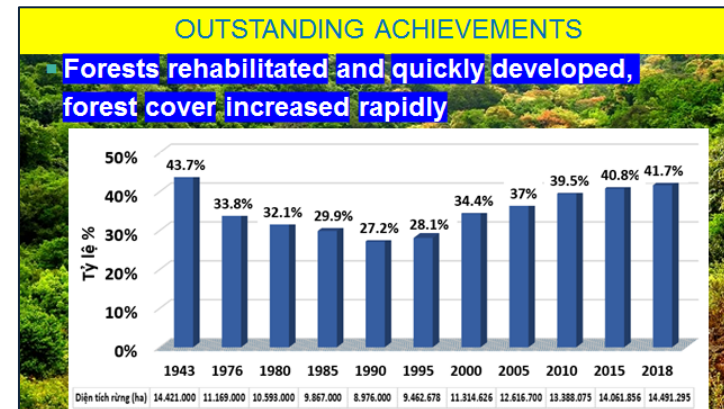
OUTSTANDING ACHIEVEMENTS OF VIETNAM'S FORESTRY FROM 1991 TO PRESENT; POTENTIALS AND ADVANTAGES, OPPORTUNITIES AND CHALLENGES FOR FORESTRY DEVELOPMENT AFTER 2020

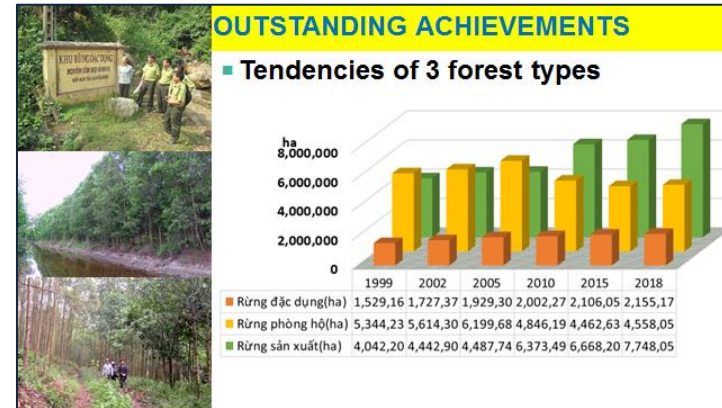
PROF. DR. NGUYEN BANG NGAI



POINTS OF VIEW, DIRECTION AND IMPLEMENTATION

- Transition from state forestry to forestry with participation of different stakeholders engaged towards sustainable development
- 3 Laws: Law on Forest protection and development 1991, Law on Forest protection and development 2004 and Law on Forestry 2017.
- 4 National Forestry Programs;
- Conventions: Bio-diversity, UNFCCC, UNCCD, VPA/FLEGT







OUTSTANDING ACHIEVEMENTS

- Forestry contributions to Job creation, hunger elimination, poverty reduction for people depending forests (maily ethnics)
- National Program of 5 Mill haforest:** 1.249.600 HHs with 4.657.200 labourers paricipatæd (38,6% poor)
- PFES 2012-2018:** 5.366 Bill VND paided to 120.000 HHs and communitæ to protect 3.3 Mill ha forests

OUTSTANDING ACHIEVEMENTS

- Forestry has a particularly important role in responding to climate change and protecting the country's environment
- Forestry has a 36.3% reduction in the total emissions of KNK The scheme of forest restoration and coastal mangroves development in phase 2008-2015;
- The scheme for the protection and development of coastal forest in response to climate change stage 2015-2020 to present.
- Program:** Reducing emissions from deforestation and degradation (REDD+). UN-REDD implemented in Vietnam

POTENTIALS AND ADVANTAGES

- Forest restored and fast-growing and stable; 40 million m³ of wood round/year from 2025 and 50 million m³ of wood/year since 2030
- 3.094.893 ha have not used or used not effectively.
- Systems of forest management system; forest bussiness organization; wood processing and trade h]ave been essentially set up in a stable, consistent setting
- Forestry legal system is improved
- PFES is strong and sustainable source of financing
- Science and technology.

OPPORTUNITES

- Economic growth at a high level
- Perspective and strategic orientation of the Party and Government,
- The Government of Vietnam participates actively in Free Trade Agreements:
TPP Agreement,
VPA/FLEGT

CHALLENGES

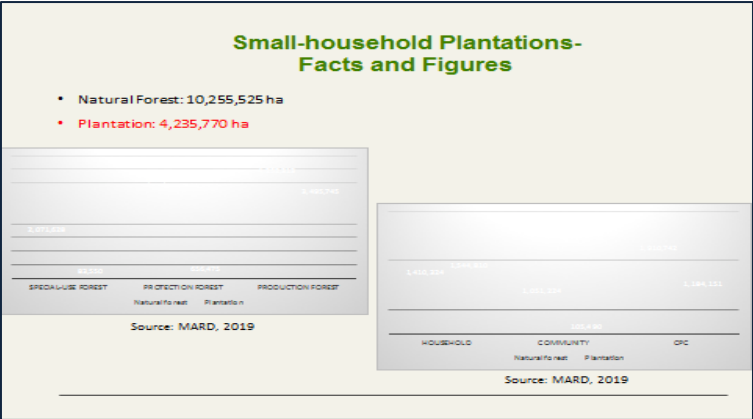
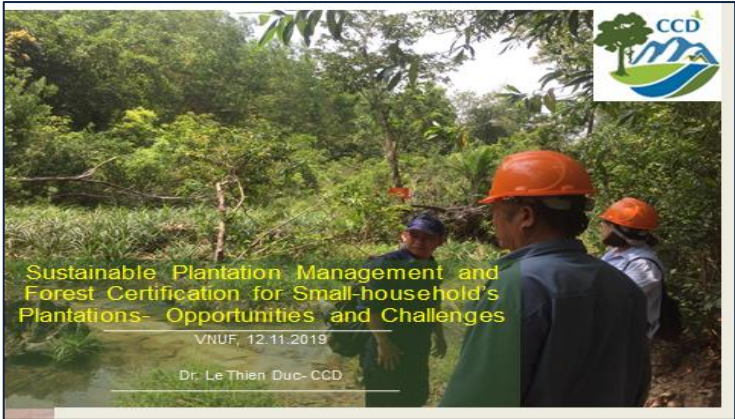
- Protecting the natural forest continues to have difficulties
- Yield and quality of plantation is still low
- Forest cerification is slow
- FTA readiness
- Lack of Infrastructure in forest areas
- Lack of high quality manpower.



Sustainable Plantation Management and Forest Certification for Small-household's Plantations- Opportunities and Challenges

Dr. Le Thien Duc

Center for Nature Conservation and Development



Small-household Plantations- Characteristics

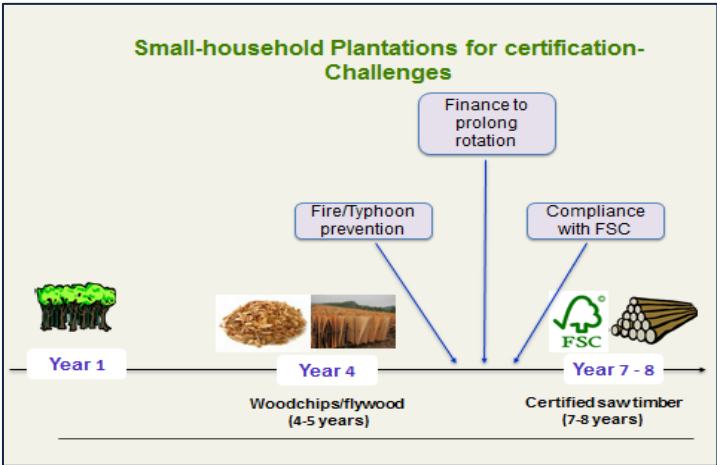
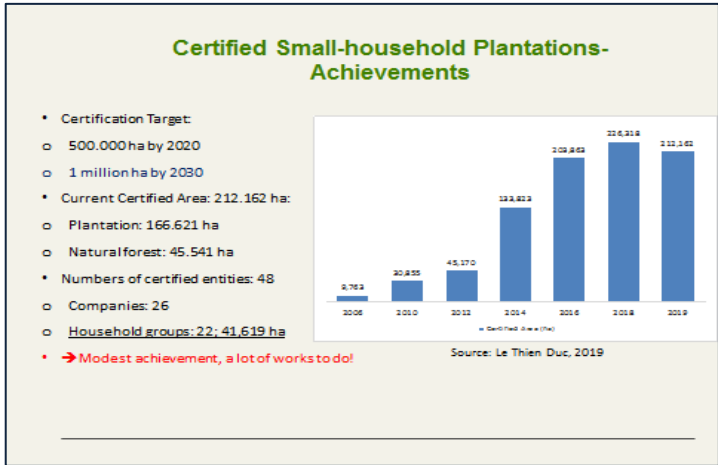
- Small and scatter
- Mono species
- Low quality of seedlings
- Lack of investment and out-of-date management
- Short rotation
- Burning before planting
- Lack of fire breaks
- No care about buffer-zone
- Difficulty in selling to direct buyers
- → Improper and un-sustainable management!!

Photo: Tran Nam Thang

Small-household Plantations- Opportunities

- Total plantation area is big, accounting for 1.5 million ha (44%)
- High demand on timbers and woodchips- good income
- Many cares and supports, especially from NGOs, projects, financial institutions.
- Wood processing, pellet, woodchip factories would like to have trade link.
- → good income and livelihood for tree growers

Photo: Loc Vu Trung- WWF



Small-household Plantations- Way forward!

- Grouping: Forest Owner Association, Forestry Cooperative
- Capacity building for certification group with technical support of consultants
- Production improvement: seedling quality, silviculture measures
- Promotion of land tenure process
- Market-link with wood processing companies: creation of material production area, buying contract
- Sustainable finance: joint venture with buyers, financial institutions, group micro finance

Thank you!


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Measuring sustainability of forestry development in Vietnam

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Measuring sustainability of forestry development in Vietnam

International conference on
 Linkage of Higher Education, Research and International Integration to Sustainable Forest Resources Management and Bio-economy
 12. November 2019, Hanoi



Vo Thi Phuong Nhung & Tomas Zuklin
 Vietnam National University of Forestry

Content

- ▶ About...
- ▶ **Local picture:** Development of forestry in Vietnam
- ▶ **Global picture:** Sustainable development (of not only forestry)
- ▶ **Future picture:** Proposed set of indicators for measuring sustainability of forestry development in Vietnam
- ▶ **Case study:** Ha Tinh province
- ▶ Conclusion

About...

- ▶ **About us:**
 - ▶ Mrs. Vo Thi Phuong Nhung
 - ▶ Mr. Tomas Zuklin
- ▶ **About the research:**
 - ▶ Research in progress
 - ▶ Aiming to develop (and apply) comprehensive measurement method in line with Vietnam's goals and with the global sustainability theory




Local picture: Forestry development in Vietnam

- ▶ **Vietnam's goals for forestry development by 2020** (Decision No. 18/2007/QĐ-TTg)
 - ▶ Build, administer, protect, develop and use sustainably zoning areas for forestry
 - ▶ Forestry gross output increases 4%
 - ▶ Contribution of Forestry to GDP to reach 2-3%
 - ▶ Forest cover reaches 47%
 - ▶ Contribute to eradicate hunger, alleviate poverty and improve the living standards of people who live in rural, mountainous areas.
- ▶ **Vietnam's Goals for sustainable forestry development by 2020** (Decision No. 886/QĐ-TTg)
 - ▶ Forestry gross output reaches 6%
 - ▶ Average productivity of plantations reaches 20 m³/ha/year
 - ▶ Export turnover reaches 8 billion USD
 - ▶ Forest cover reaches 42%
 - ▶ Create jobs, improve income of people who in forestry sector which contributes to hunger eradication, alleviate poverty and increase living standards, mitigate natural disasters, protect ecological environment, cope with climate change and rising sea levels, ensure defense and security.

Local picture: Forestry development in Vietnam

Achieved!
2.3 % in 2013-2018
(Do Anh Tuan, 2019)

Forestry development by 2020 (07/QĐ-TTg)

- Build, administer, protect, develop and use sustainably zoning areas for forestry
- Forestry gross output increases 4%
- Contribution of Forestry to GDP to reach 2-3%
- Forest cover reaches 47%

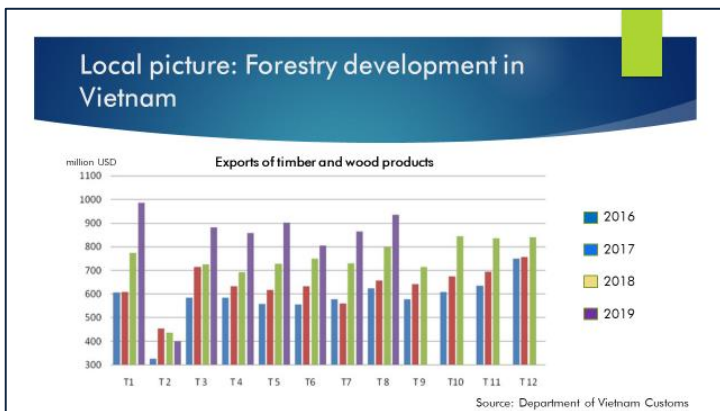
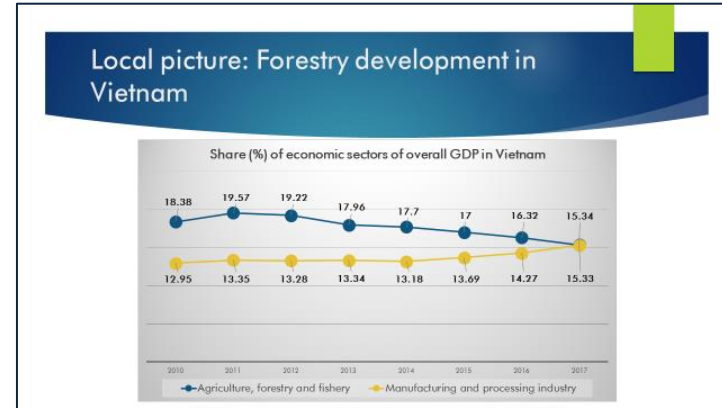
Vietnam's Goals for sustainable forestry development by 2020 (Decision No. 886/QĐ-TTg)

- Forestry gross output reaches 6%
- Average productivity of plantations reaches 20 m³/ha/year
- Export turnover reaches 8 billion USD
- Forest cover reaches 42%

Contribute to eradicate hunger, alleviate poverty and improve the living standards of people who live in rural, mountainous areas.

Create jobs, improve income of people who in forestry sector which contributes to hunger eradication, alleviate poverty and increase living standards, ecological change and rising sea levels, ensure defense and security.

Lack of quantifiable indicators



Now we know about the development of forestry sector in Vietnam....

But what about the SUSTAINABILITY of forestry development?

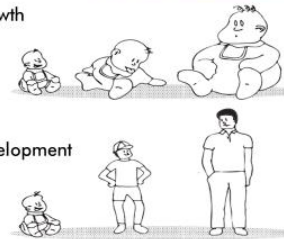
Global picture: Sustainable development (of not only forestry)

Global picture: Sustainable development (of not only forestry)

Growth

VS

Development



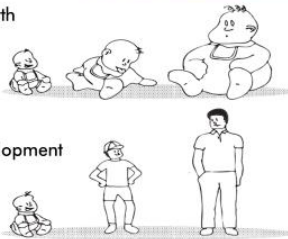
(Barron, 2009)

Global picture: Sustainable development (of not only forestry)

Growth

VS

Development



(Barron, 2009)



Global picture: Sustainable development (of not only forestry)

Indicators of Sustainable Development (UN, 2007)

- ▶ Poverty
- ▶ Governance
- ▶ Health
- ▶ Education
- ▶ Demographics
- ▶ Natural hazards
- ▶ Atmosphere
- ▶ Land
- ▶ Oceans, seas and coasts
- ▶ Freshwater
- ▶ Biodiversity
- ▶ Economic development
- ▶ Global economic partnership
- ▶ Consumption and production patterns

Global picture: Sustainable development (of not only forestry)

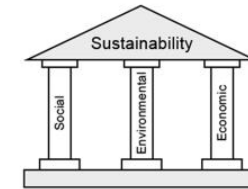
Indicators of Sustainable Development (UN, 2007)

- ▶ Poverty
- ▶ Governance
- ▶ Health
- ▶ Education
- ▶ Demographics
- ▶ Natural hazards
- ▶ Atmosphere
- Land**
 - ▶ Oceans, seas and coasts
 - ▶ Freshwater
- Biodiversity**
- Economic development**
 - ▶ Global economic partnership
- Consumption and production patterns**

Future picture: Proposed set of indicators

Yang, Jian and Zhang, 2003
Fang et al., 2013
Zhao et al., 2013
Zhou, X.M., 2013

- ▶ Based on research conducted in China
 - ▶ Why China?
 - ▶ Similar socio-political settings with Vietnam
- ▶ **Criteria / Dimensions:**
 - ▶ A. Economic criteria
 - ▶ B. Social criteria
 - ▶ C. Environmental criteria
- ▶ **Indicators:**
 - ▶ 20 measurable indicators
 - ▶ Min-max method for each indicator
 - ▶ Aggregation of results



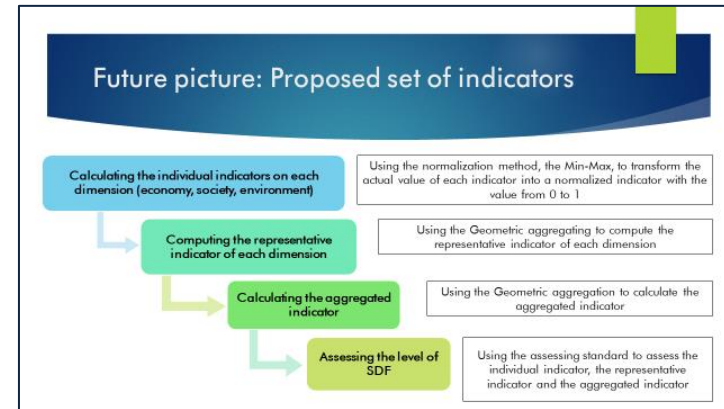
A Indicators of the economic dimension

A1	Exploitation change rate	Shows changes in forest exploitation (year-to-year change).
A2	Forestry gross output change rate	Showing changes in gross output of forestry sector (year-to-year change).
A3	Land use rate	Actual forested area compared to official planning/zoning.
A4	Business diversification rate	Shows the contribution rate of the non-timber forest business.
A5	Export turnover of forestry products	Shows ability of the forestry industry to get foreign currency.
A6	Gross output of forestry per hectare	Shows the productivity of forestry per hectare.
A7	Processed wood rate	Shows the amount of harvested timber used for further production.
A8	Contribution rate to GRDP	Shows the contribution of the forestry sector to the district economy.

B Indicators of the social dimension

B1	Average PFES per hectare	Shows the monetary benefit of forests to communities.
B2	Forest area per capita	Shows how the forestry sector contributes to improvement of the quality of living environment.
B3	Budget allocation for forestry	Shows the extent to which local governments support the forestry sector.
B4	Land use rights allocation	Shows how local governments create favorable conditions for communities' access to forest resources.
B5	Local owners rate	Shows to what extent have local communities access to forest resources exploitation.
B6	Forest area change rate	The current generation's concern the benefits of future generations seen through efforts to increase forest area.

C Indicators of the environmental dimension		
C1	Forest cover rate	Shows the actual forest cover in the area.
C2	Mixed species plantation rate	Shows the effort of maintaining biodiversity in plantations and restricting monoculture plantations
C3	Wildfire and disease rate	The proportion of forestry land area impacted by forest fires and pests. Indicate efforts spent to protect forests.
C4	Infringing forestry laws	Shows the extent of deforestation control in terms of illegal logging cases
C5	Rate of 'green certification'	Shows the proportion of forestry land area receiving 'Green certification'
C6	Exploitation rate compared to area change rate	To maintain the environmental balance, the exploitation rate should be smaller than the area change rate.



Future picture: Proposed set of indicators

► **Min-Max**

- Positive indicator (x)

$$x = \frac{X - Min}{Max - Min}$$

- Negative indicator(x')

$$x' = 1 - \frac{X - Min}{Max - Min}$$

Geometric aggregation

$$I_{RI} = \sqrt[k]{\prod_{i=1}^k x_i}$$

I_{RI} Representative indicator of three dimensions

x_i - Normalized indicator
k - Number of indicators in each group

$$I_{AI} = \sqrt[k]{\prod I_{RI}}$$

I_{AI} Aggregated indicator


- ### Future picture: Proposed set of indicators
- The representative indicators of each group and the aggregated indicator had the value between 0 and 1.
 - The higher the value, the more sustainable development they showed.
 - To assess the sustainability of forestry development, the study used the scale with 5 levels:
 - [0.0; 0.2] Development of forestry is **very unsustainable**;
 - [0.2; 0.4] Development of forestry is **quite unsustainable**;
 - [0.4 ; 0.6] Development of forestry is **relatively sustainable**;
 - [0.6 ; 0.8] Development of forestry is **quite sustainable**;
 - [0.8 ; 1.0] Development of forestry is **very sustainable**.

Measuring SFD: Ha Tinh province

- ▶ Ca. 1.3 million inhabitants
- ▶ One of the poorest provinces in Vietnam
 - ▶ 11% poverty rate in 2016 (= monthly income <27 USD in rural areas)
 - ▶ Down from 26% in 2010 (= monthly income <20 USD* in rural areas)
 - ▶ 122 USD average monthly salary per capita in 2018
 - ▶ Up from 36 USD* in 2010 (= 239% increase)
- ▶ Agriculture, forestry and fisheries (AFF)
 - ▶ ca. 35% of province's GDP (national average is 15.3%)
 - ▶ 22 USD average monthly income per capita in 2018 from AFF sectors
 - ▶ Up from 9.2 USD* in 2010 (= 139% increase)

* 2010 exchange rate

General Statistics Office, 2017



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Measuring SFD: Ha Tinh province

▶ Data collected from 2012 to 2018 from governmental sources

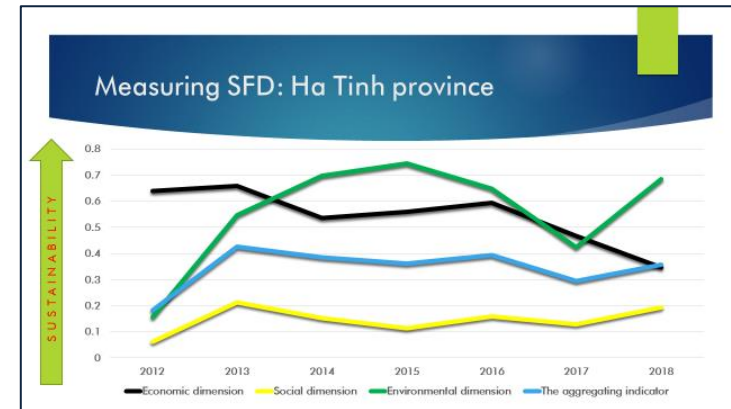
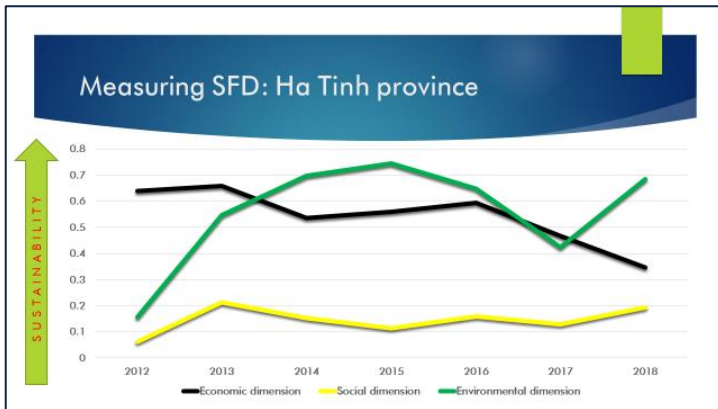


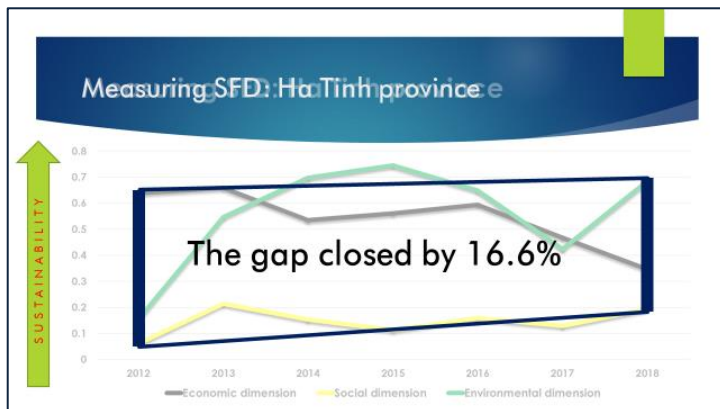
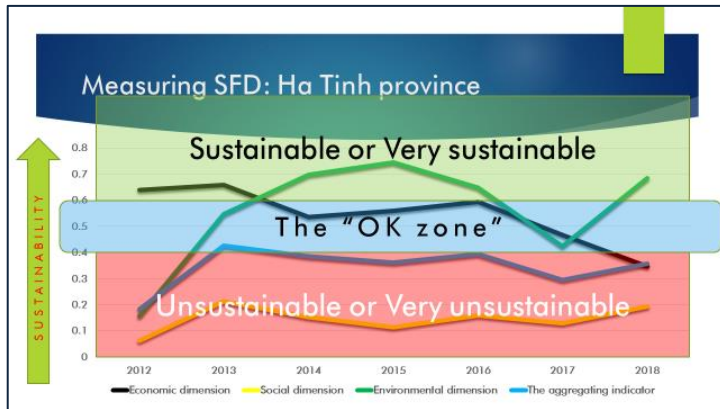
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B1	B2	B3	C1	C2	C3	A1	A2	A3
B4	B5	B6	C4	C5	C6	A4	A5	A6
						A7	A8	





- ### Conclusion
- ▶ Although Vietnam has sustainable forestry development goals, there is a problem with their quantification
 - ▶ At least in Ha Tinh province
 - ▶ Environmental sustainability is increasing
 - ▶ Economic sustainability is slowly decreasing
 - ▶ Social sustainability is mostly stagnating
 - ▶ Overall sustainability index: unfavorable but getting better!
 - ▶ This set will help the government **identify the weak & strong points** in order to achieve SFD
 - ▶ More research needs to be done on the local level and connection of all three sustainability pillars must be observed

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THE END

Thank you for your attention!

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Forest certification in Vietnam: status, opportunities and challenges

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Abstract

Sustainable forest management (SFM) and forest certification are not only a global trend in forest governance, but also a necessary requirement of the international timber and forest product market towards ensuring good forest management and market access and premium price for certified products. In recent years, the implementation of SFM and forest certification in Vietnam has received the significant attention of many international organizations, businesses and the government. Although there are many opportunities for promoting the implementation of SFM and forest certification in Vietnam from both market demand for certified timbers and the government's legal framework, the certified forest area in Vietnam is rather small and has not meet the demand of the country's wood industry due to many constraints at national level (e.g. lack of financial incentive provisions for forest owners, incomplete national standards system, inadequate national certification bodies) and at forest management unit level (like high cost of SFM and certification practices and audits, shortage of human resources). Therefore, to develop SFM and forest certification, it is necessary to implement many solutions at both the policy level and operational level to remove the constraints.

Keywords: *sustainable forest management, forest certification, opportunities, challenges, Vietnam*

1. Status of SFM and forest certification in Vietnam

Sustainable development began to increase in importance at the end of the 1980s and at the beginning of the 1990s with the Brundtland report (1987) and the Earth Summit held in Rio de Janeiro, Brazil, in 1992. Concept of sustainable forest management (SFM) has been developed as a response to negative influences of the past uses of forest resources on biodiversity, environment and society, as well as the needs for continued use of these resources for future generations. This first definition was based on the principle of sustainable forest yield, with the main goal being sustained timber production. However, increasing environmental awareness and improved scientific knowledge on impacts of forest lost on the environment has changed society's values and the global structural policy and institutions, which in turn have significantly influenced forest management objectives towards maintaining and increasing not only economic benefits but also environmental and social benefits of forest ecosystems in long-term (Wang and Wilson, 2007). Although there is no universally accepted definition of SFM, the two following concepts are widely accepted: *"the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment"* (ITTO, 1992),

and “*the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems*” (MCPFE, 1993). More recently, SFM has become both the objective and the principle of forestry industry; it has been a global movement in forest resource governance in associated with internationally accepted forest management standards.

The implementation of SFM is generally achieved applying set of criteria and indicators (C&I). Criteria are categories of conditions or processes whereby SFM can be assessed; whereas indicators are quantity or qualitative variables chosen to provide measurable features of the criteria and can be monitored (Forest Europe, 2011). Many C&I sets for framing SFM have been developed by different international processes/institutions, and of which the sets of ITTO, MCPFFE, and Montreal processes are the most well-known. Although the different processes have very different origins and have developed their own criteria, there are some similarities between the three major SFM programs on aspects of enabling forest management conditions, maintaining and enhancing forest products and forest environment services, and maintaining and improving social-economic conditions of forest owners and local communities. In addition to the efforts of different processes to develop C&Is which are mainly used for guiding forest policy makers/managers in forest management at national, regional and global levels in the last two decades, a parallel process has been developed to promote SFM from perspective of market promotion for forest products. This process is termed “forest certification”. Forest certification was introduced in 1990s and has become an important policy tool for promoting SFM and value chain of forest products. This term can be defined as *a voluntary system conducted by a qualified and independent third party (called certification body-CB) who verifies that forest management is based on a predetermined sustainable forest management standard and identifies the products with a label*. A sustainable forest standard is based on the C&I approach and the label, which can be identified by the consumer, is used to identify products. Thus, the two main objectives of forest certification are to improve forest management (reaching SFM) and to ensure market access for certified products (Gafo et. al., 2011). And in many cases, forest certification also create more added value for forestry enterprises/owners through receiving premium price of the certified products (Tuan. D.A, 2011).

Different from traditional forest management approach, which are mainly based on legal regulations instruments (such as forestry laws ...), certification is “carrot” policy instrument on basis of economic incentive creation for certified products producers, voluntary and international recognition. It is implemented at forest management unit (FMU) level, verifying forest management practices in accordance with good forest management standard/schemes, and can be accepted by free timber market. Presently, there are two globally recognized forest certification schemes, namely Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification (PEFC, previously termed Pan European Forest Certification). In addition, there are also regional and national level initiatives, such as Sustainable Forestry Initiatives (SFI) in the US and Canada, Malaysia Timber Certification Council (MTCC) in Malaysia, and a number of national FSC/PEFC standards endorsed by FSC or PEFC international. There are two key types of the certification, certification of forest

management (FM) guaranteeing the quality of the management and Certification of Chain of Custody (CoC) guaranteeing the origin of forest raw material. Originally, forest certification schemes were developed for certifying timber, and more recently these are expanded for non-timber forest products (NTFPs) (e.g. bamboo, rattan) and even for forest environment service (biodiversity conservation, water preservation) (Tuan, *et al.* 2014). Globally, the area of certified forest increased rapidly in the 1990s and from then on more gradually, reaching 509 million hectares in 2018 (200 million FSC certified hectares and 309 million PEFC certified hectares), mainly in Europe and North America (FSC 2019 and FEFC 2019).

Vietnam is a tropical country with a large forest area. According to the forest area data of the Ministry of Agriculture and Rural Development (MARD), the total forest area of Vietnam at the end of 2017 was 14,415,381 ha (equal to the forest cover of 41.45%), including 2,141,324 ha of special use forest, 4,567,106 ha of protection forest, 6,765,936 ha of production forest and 941,015 ha of other forests. And Vietnam's wood industry has grown very fast in the last few years, becoming the leading wood product exporter in Southeast Asia or second one in Asia, with a total export turnover of US\$ 8,476 billion in 2018 (Phuc *et. al.*, 2019). In the context of Vietnam's deeply integration into global trade and the Government's strategic policy on wood industry development in the near future, the implementation of SFM and forest certification is considered important for providing certified timber for the national wood industry, which can lead to rapid plantation development and livelihood improvement for Vietnam rural people in the mountainous regions. So far, SFM and forest certification has been practiced in Vietnam since the 2000s (from the initiative of the GTZ Sustainable Forestry Project). It has been set as a priority of Vietnam's Forestry Development Strategy period of 2006 - 2020 with the goal of achieving a certified forest area of about 30% of the total production forest area by 2020. However, by the end of 2012 the total certified forest area was just about 45,000 ha (less than 1% of the total forest area in Vietnam). Currently, the total certified forest area in Vietnam is 228,848 ha (both natural and planted forests) of 41 forest management units) (FSC, 2019; PEFC, 2019). This figure just accounts for only 5% of the total area of production forests, and it is too far to reach the government's goal of having 1 million ha of certified production plantation by 2030.

2. Forest certification in Vietnam: opportunities and challenges

2.1. Some opportunities

Although the certified forest area in Vietnam has been still small, there are many opportunities to promote the implementation of SFM and forest certification in the near future, from both market demand for certified timber and the requirements of the national forestry policies.

i) High market demand of certified timber

Firstly, certified timber will be favor in the future. It is a significant trend in the furniture market due to the increasing demands of consumers and governments on the origin, legality of wood products and growing public concerns on social and environmental responsibility of timber producers. Vietnam has more and more deeply integrated into global market through a number of bilateral and multilateral trade agreements, providing a high opportunity to

expand the export market for Vietnamese wood products. For example, the Voluntary Partnership Agreement (VPA) between Vietnam and the European Union on the implementation of the Forestry Law Enforcement, Governance and Trade in Forest Products (FLEGT) signed on 19 Oct. 2018, which help improve forest governance, address illegal logging and promote trade in verified legal timber products from Vietnam to the EU, and other markets.

Secondly, there is a shortage of domestic certified timber for Vietnam wood industry. In 2018, Vietnam's export turnover of wood products reached US\$ 8.476 billion, increasing 14.5% (equivalent to US \$ 1.07 billion) compared to the figure in 2017. However, in 2018 Vietnam also imported 4.68 million certified m³ (including 2.28 million m³ of log timber, and 2.4 million m³ of sawn timber) with the total cost of US\$ 2.2 billion for the wood industry due to lack of certified domestic timber material supply. Of the 228,848 hectares of certified forest area in Vietnam, only about 160,000 hectares are planted, mainly Acacia, Eucalyptus and Pine, with the estimated of annual maximum harvestable yield of 2.285 million m³ of timber. Thus, the current domestic timber supply capacity just meets only 30% of the current demand for logs and sawn timber for the wood industry. It means that there will be high demand for certified domestic timber in near future, especially when the increasing the production of the wood industry.

Thirdly, it is the trend of shifting wood processing factories out of China to Vietnam and some other countries in Southeast Asia due to the trade war between the US and China. Many investors in China have moved their wood processing factories from China to Vietnam to avoid being imposed high taxes by the US. This factor will contribute to the increasing demand for certified plantation timber in Vietnam in the future.

ii) Supporting legal framework for SFM and forest certification

Vietnamese government has paid more attention to the important role of the forestry sector for natural forest protection and wood industry development. Therefore, promoting SFM and forest certification is considered an important policy to achieve the national goals of sustainable management and use of forest resources, biodiversity conservation, and meeting market demand for legal timber for wood industry development. For achieving goal of development of Vietnam being a world leading wood industry center, Vietnamese government and MARD have issued a number of legal documents and strategic plans for implementation of SFM and forest certification. In 2017, the National Assembly approved the Forestry Law, considering forestry as an economic sector and managing the timber value chain from forest establishment to forest product and service trade. Especially, there are two articles (Article 27 and Article 28) in Section 3, Chapter III of the law, definitely regulating SFM and forest certification. It clearly states that all forestry organizations shall formulate and implement SFM plans, and the other forest owners are encouraged to develop and implement SFM plans and forest certificates. The MARD in 2018 issued Circular No. 28/2018 /TT-BNNPTNT on SFM to guide forest owners to develop and implement SFM plans and forest certificates. On October 1, 2018 the Prime Minister issued Decision No.1288/QĐ-TTg on approval of national strategic SFM and forest certification project with the specific objective of developing and implementing SFM for 7,216,889 hectares of forests and achieving 1,000,000 certified hectares by 2030.

iii) Promising model of group forest certification

At FMU level, in the past only few big forestry companies were selected to implement SFM and apply for forest certification with both financial and technical supports from foreign funded projects (e.g. GIZ, WWF). More recently, there is growing number of group certifications on the basis of cooperation between a wood processing company and plantation households. It is a promising certification model with some advantages of financial and technical support from wood processing companies and close and responsible linkage between plantation households (as timber sellers) and the companies (as timber buyers) in the certified timber value chain through timber contracts. Currently, over 50% the certificate forest area is in form of group certification.

2.2. Key challenges

Although SFM and forest certification has been implementing in Vietnam for nearly 20 with the high demand for certified timber and the institutional support for SFM and forest certification, the certified forest area is still very small because of the key following bottlenecks at both national and FMU levels:

i) *Inadequate of detailed incentive creation policy (enabling conditions) for promoting SFM and forest certification:* Although the forestry law and under law documents have been issued, requiring and guiding forest owners to implement SFM and forest certification, the government has not applied sufficient and detailed policy instruments to encourage forest owners to implement SFM and forest certification. In Vietnam, the majority (about 85%) of forest owners are small-scale household forest owners with an average forest area of about 2-5 ha per household. Therefore, households do not have both technical and financial capacity to implement SFM and forest certification due to complicate technical requirements and high costs in practices of SFM and forest certification. Meanwhile the government has not provided detailed supporting policy tools for creating economic incentive for both plantation households and wood processing companies involving in SFM and forest certification, such as favor credit/loans with low interest, tax reduction on timber trade, etc.

ii) *Lack of FSC and PEFC national standards:* Vietnam's FSC national standard was officially approved by international FSC policy committee in June 2019 and will be public effective in the first quarter of 2020. The PEFC national standards, however, is under development. The absence of the national SFM standards has led to some significant difficulties in FM/CoC certification auditing in the field. So far, all CBs operating in Vietnam are foreign ones (e.g. GFA, SGS, Soil Association, BVQI), and they use their own interim FSC standards for auditing due to lack of existing national standards on SFM. Applying these interim ones has create some difficulties in practices of SFM and forest certification in Vietnam. All the interim have some points that do not fit into the specific context of Vietnam forestry. In addition, the Vietnamese translations of all the interim standards are not really clear and understandable for Vietnamese foresters. These, of course, affect the effectiveness and cost of implementing SFM and certification.

iii) *Lack of national certification services (capacity to certify):* Currently Vietnam has no domestic unit, capable of meeting the requirements to become an accredited CB.

Therefore, all the audits have been carried by the international CBs with high audit cost offer. Thus, almost small-scale forest owners in Vietnam cannot afford the high audit costs (normally covering all international travels, payment for foreign auditors and translator, high overhead cost). Furthermore, English language is also a barrier for almost Vietnamese forest owners in contact, and discussion with foreign auditors. These are significant bottlenecks, limiting the expansion of the certified forest area in Vietnam

iv) *Lack of a productive network for experience sharing on SFM and forest certification:* In Vietnam, the design and implementation of SFM plans and forest certification of FMUs are mainly provided by national consultants. Vietnam has no sufficient information base, such as a productive center and/or network for information sharing and guiding forest owners in practice of SFM and forest certification at a low cost of service.

v) *Shortage and quality of human resources and financial viability (capacity to implement SFM and forest certification) at FMU level:* SFM and forest certification are still a relatively new concepts to most local forest managers and forest owners. In general, the practical requirements and principles of international forest management standard are more broad and strict than the Vietnam conventional forestry prescriptions on forest management which mainly focus on economic aspects. Almost the forest owners are not familiar with the requirements of ILOs, reduced impact logging (RIL), high conservation forest values (HCVFs) and internal operation monitoring and assessment. In addition, as most of the forest owners in Vietnam are small-scale household, they do not have enough information, human and financial resources to self-implement SFM and forest certification. This is the key factor blocking development of SFM and certification Vietnam.

vi) *Lack of experienced experts:* It can be said that the demand for human resources to develop and implement SFM and forest certification in the forestry sector is significant. However, the current human resource in this field is seriously deficient. Nationwide, there are less than 10 national experienced experts in this field; meanwhile there is not any institution providing in-depth training in SFM and forest certification. Course on SFM and forest certification has been introduced in a few education institutions, e.g. Vietnam National University of Forestry, but still more focus on theory aspects. The implementation of SFM and forest certification, on the other hand, requires more applicable knowledge and skills on silviculture, site management, biodiversity, social-economic and resource governance in accordance with international standards and good field practices.

3. Some recommendations for promoting forest certification in Vietnam

For promoting SFM and forest certification in Vietnam, there must be some specific solutions to take advantage of the opportunities and to remove the current existing bottlenecks to meet the strategic development of wood industry and sustainable forest resources governance:

i) Developing detailed policy instruments to create incentive for promoting both plantation owners and wood processors in implementation of SFM and forest certification, such as reduction of income tax and favor credit/loan for forest owners and factory owners as mean to partly offset the high cost of implementing SFM and forest certification at the FMU level.

ii) Quickly finalizing the national SFM standards: If having the national standards approved by FSC or PEFC with some indicators adopted to the specific forestry conditions of Vietnam, all CBs have to use the national standard, and it will be more easy and convenient to understand and practice SFM and forest certification in Vietnam.

iii) It is necessary to establish national certification bodies accredited by FSC and/or PEFC capacity to certify. So, the audit costs will be significantly lower (compared to the audit cost conducted by foreign CBs), and more forest owners can afford.

iv) Human resources development and establishment of network and information base on SFM and forest certification for forest owners and other stakeholders is also needed to fill the gaps of shortage of human resources and information exchange for promoting SFM and certification. In long-run, this solution can contribute to reduce cost of SFM and forest certification implementation.

v) Encouraging model of group certification between a wood processing company and plantation households is a good way to ensure technical and financial sources and linkage of timber value chain in SFM and forest certification practices.

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- **Forests play a vital role**
for rural as well as urban populations all over the world. They are an essential natural resource providing multiple benefits to people.
- **Their conservation and sustainable management**
are closely linked with global issues such as food supply and environmental protection.
- **Scientific knowledge is needed**
all over the world to effectively address these issues globally and regionally and provide the technical basis for political decisions.
- **Close international cooperation**
in forest science and related disciplines is required to enable forests to satisfy the manifold human needs in a sustainable way.

IUFRO is “the” global network for forest science cooperation. It unites more than 15,000 scientists in almost 700 Member Organizations in over 110 countries, who cooperate in IUFRO on a voluntary basis.

Our Mission

is to promote the coordination of and the international cooperation in scientific studies embracing the whole field of research related to forests and trees for the well-being of forests and the people that depend on them.

IUFRO is open to all individuals and organizations dedicated to forest and forest products research and related disciplines. It is a non-profit, non-governmental and non-discriminatory organization with a long tradition dating back to 1892.

Our Stakeholders

are research organizations, universities and individual scientists, NGOs, decision making authorities, forest land-owners and other people who depend on forests.

IUFRO attains its objectives by networking activities including the generation, exchange and dissemination of scientific knowledge, the provision of access to relevant information, and the assistance to scientists and institutions to strengthen their research capacities.

Our Vision

is of science-based sustainable management of the world’s forest resources for economic, environmental and social benefits.

IUFRO is exceptional,

because it is the only world-wide international organization devoted to forest research and related sciences. It contributes to the promotion of the use of science in the formulation of forest-related policies.

