Regional Workshop: Distributions and Biology of Asian Tree Species

Putrajaya, Malaysia 17th-19th April 2018

Bioversity International

APFORGEN
ASIA PACIFIC FOREST GENETIC RESOURCES PROGRAMME

UPM
UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

Federal Ministry of Food and Agriculture

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Background

Thousands of ecologically and socio-economically important tree species in Asia are threatened, yet very little information is available on their historical and current distribution, patterns of genetic diversity, intensity of threats across their distribution ranges, or availability of seed sources to support restoration. Effective conservation strategies for these species and their genetic resources cannot be identified without improving knowledge on the species' distributions and the threats they are facing.

"**APFORGIS – Filling the knowledge gaps for genetic conservation of priority tree species in Asia**" is a regional project aimed at addressing these gaps in knowledge and thereby supporting the conservation and restoration of socio-economically important, native Asian tree species. The project has the following objectives:

(1) Develop dynamic distribution maps for at least 50 Asian tree species, based on available information from government and research institutions, to enable spatially defining conservation priorities
(2) Develop decision-support tools for the establishment of gene conservation units for different species
(3) Develop a Road Map for establishing an Asian network of gene conservation units

The two-year project is implemented from Dec 2017 to Dec 2019. It contributes to the Regional Strategy 2018-2022 of the Asia Pacific Forest Genetic Resources Programme APFORGEN (www.apforgen.org), and the Global Plan of Action on the World's Forest Genetic Resources (FAO 2014). It is implemented by Bioversity International and APFORGEN, and funded by the Government of the Federal Republic of Germany.

This report summarizes the discussions and results of the project's inception workshop, held in Putrajaya, Malaysia, 17-19 April. The workshop brought together more than 30 experts from 11 APFORGEN member countries and regional and international organizations. It was jointly organised by Bioversity International, APFORGEN and Universiti Putra Malaysia (UPM. For the detailed programme and list of participants, see Annexes 1 and 2.

Workshop presentations are available from: https://cgiar-my.sharepoint.com/:f:/g/personal/r_jalonen_cgiar_org/EqauR6Vz3elNvZEz0u5kj4EBNztQVm9bryC-Hkd-twsYgQ?e=D5tRM4

Day 1: 17th April 2018

Workshop objectives and expectations

Participants were welcomed to the workshop by Chris Kettle of Bioversity International and Zheng Yongqi of the Chinese Academy of Forestry, who is also the Chair of APFORGEN. Participants then introduced themselves.

Riina Jalonen of Bioversity International introduced the workshop objectives:

- Share information and experiences about the use of spatial approaches for conservation planning of tree species
- Agree on 50 socio-economically important pilot species for which to develop up-to-date distribution maps through regional collaboration
- Develop a collaborative work plan for compiling distribution data for the pilot species, information on their biology and threats to them

Participants were asked to note down their expectations for the workshop as well as for collaboration across the course of the project *(*Figure 1, Annex 3*)*

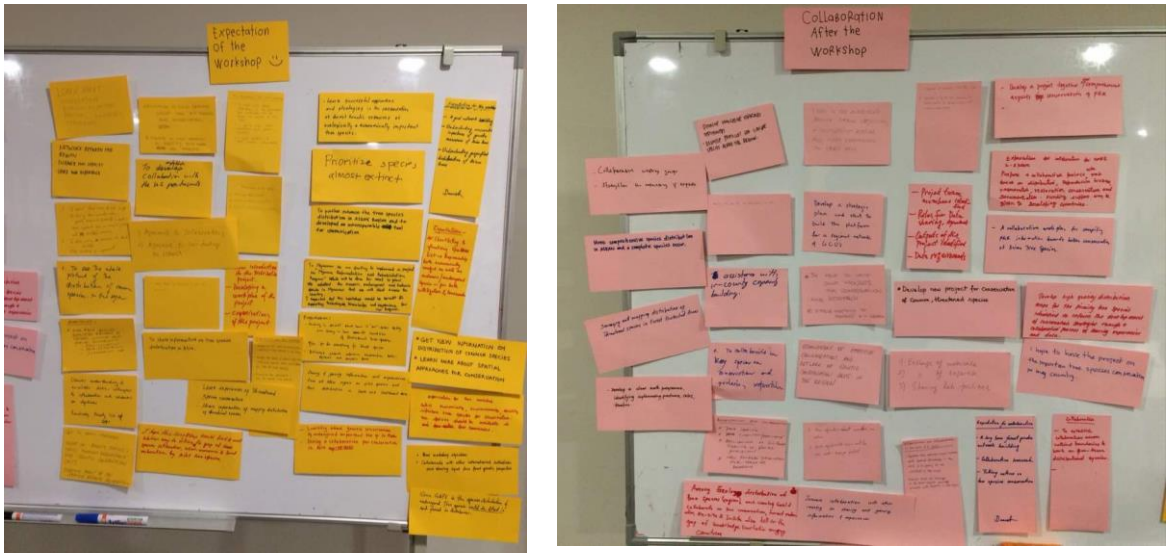

Figure 1: Participant expectations for the workshop & project collaboration

Presentation: Conserving the evolutionary potential of tree species: from genes to landscapes

Chris Kettle, Bioversity International

Forest genetic resources are foundational for resistance to disease and adaptation to climate change and therefore underpin resilient landscapes and the subsequent benefits that societies derive from forest resources, including livelihood support, wellbeing and ecosystem services.

Loss of connectivity within a population due to fragmentation restricts gene flow, leading to increased inbreeding and subsequent erosion of adaptive potential. In dipterocarp species, a combination of ecological and environmental factors result in fine-scale spatial genetic structure where nearby individuals are closely related. High wood density and small flower size are associated with strong fine-scale spatial genetic structure. However, the impact of fragmentation is complex and varies between species and populations, and so it is difficult to make generalizations. Habitat fragmentation has been found to reduce long-distance pollination events, which likely makes some species more vulnerable to fragmentation and inbreeding. Any sites intended as gene conservation units must have enough reproductive trees of the target species for maintaining gene flow and genetic diversity. Species-specific minimum requirements for population sizes need to be defined, based on fine-scale genetic structure and reproductive biology.

Discussion

- Wood density can be difficult to measure and there are rarely datasets that cover the species range.
- Wood density is important because it is associated with the regeneration strategy and carbon storage potential of a forest. Late climatic species invest more in defence than rapid growth and are less dependent on gap opening for regeneration. Thus, they accumulate more fine scale genetic simply through seed dispersal.

Case studies from participants

Application of GIS for building distribution map of threatened species in Protected Areas of Vietnam

Nguyen Quoc Dung, Forest Inventory and planning institute (FIPI), Vietnam

The forest inventory and planning institute (FIPI) is involved in modeling distribution of priority tree species (listed in Vietnam red data book or IUCN) using GIS to inform the establishment and management of protected areas in Vietnam. Satellite imagery is used to identify habitat types based on elevation belt, and distribution and ecological data is compared to the habitat types identified through satellite image and further supported by field transects at select sites.

Discussion

- *How is remote sensing used to identify habitat types?*
  Interpretation is done using a code/colour of the image, which is matched to the vegetation type through field survey. Interpretation of the forest type can then be done automatically

BINHI: A Corporate-led Native Tree Conservation Program in the Philippines

Pastor L. Malabrigo jr., University of Philippines Los Baños

BINHI (Filipino term for seedling) is the country's first comprehensive private sector-led restoration program that focuses on the conservation of the rarest and most threatened trees in the Philippines. For the past 9 years, Energy Development Corporation (EDC) is conducting population inventory and mass propagation of the 96 priority threatened trees. Many of the planted seedlings among EDC's 146 partner institutions (mostly schools and universities) are now source of seeds. With the volume of information gathered by the BINHI program, EDC also participates in the updating of the conservation status (Red Listing) of Philippine trees.

Discussion

- *How many mother trees are maintained within landscapes at the schools/universities to ensure a diversity of offspring?*
  Planting is more about educational awareness amongst pupils than capturing genetic diversity. In some schools only planted 20 individuals, at least 5 individuals per species
- Main concern of the BINHI initiative is to maintain a source of tree seed because the species are highly threatened. Seed trees are not selected based on population size; every seed producing tree is used. Provenances are labelled to record source.

Forest Genetic Resource Management and Conservation in India

Kandasamy Palanisamy, Institute of Forest Genetics and Tree Breeding, Indian Council of Forestry Research and Education (ICFRE)

The Institute of Forest Genetics and Tree Breeding has been involved in establishing the National Forest Genetic Resource Management Network (FGRMN) that has identified thirty-three economically valuable tree species for prioritisation through the programme. One example of FGRMNs work on documentation and characterisation is a study conducted on morphological variation in planted and natural teak populations, which informed the selection of 53 plantations/populations with distinct and desirable characteristics for conservation. Collection and conservation is also carried out through documenting existing genetic resources (CSO, SSO, SPA, Clone bank) and progress towards establishing a gene bank and molecular characterization of germplasm for priority species.

World Café: Examples of spatial approaches in conservation planning

Three short presentations about existing tools and approaches for spatial conservation and restoration planning were given in a World café -format, to provide a space for discussion and questions in smaller groups. Participants visited the presentation stations in groups to hear about and discuss the approaches. The presentations were as follows:

- Centres of diversity of native fruit and nut trees in central Asia
  Hannes Gaisberger, Bioversity International

- Regional conservation priorities for a high value medicinal species, *Prunus africana* *Barbara Vinceti, Bioversity International*
- Identifying seed origin for resilient restoration (Diversity for restoration tool) *Chris Kettle, Bioversity international*

Figure 2: Discussion on Species distribution modelling and threat mapping of Walnut in Central Asia, presented by Hannes Gaisberger.

Regional and international initiatives for species conservation and information systems

EUFGIS – A European information system on forest genetic resources

Barbara Vinceti, Bioversity international

EUFORGEN is a collaborative programme between European countries that was established in 1994 to promote the conservation and sustainable use of forest genetic resources. It is financed and endorsed by governments of member countries and was coordinated by Bioversity International until 2017. From April 2007 to March 2011, EUFORGEN implemented a project called EUFGIS, with the objectives to create an online information system for forest genetic resources inventories in Europe and support the countries in their efforts to implement gene conservation as part of sustainable forest management. The project developed pan-European minimum requirements and data standards for dynamic gene conservation units, developed distribution maps of the species, established a network of

conservation units, and identified conservation gaps and climate threats to the species' populations. The products are available from an online portal (http://portal.eufgis.org/) which currently contains 2360 conservation units and 92 target tree species (April 2018).

Discussion

- EUFORGEN is highly supported politically and financially at the ministerial level, which has contributed to its success
- Research and conservation efforts for species with cross-border distributions are shared through the EUFGIS portal . The portal contains information on the dynamic gene conservation units that meet common criteria, defined and agreed on by the project participants representing the different countries. In addition, some countries are making considerable efforts at national level. These efforts are not captured in the shared information system.
- The network is essential for comprehensively covering the species range and heterogeneity of environmental contexts in which the species with wide distribution occur.
- The environmental characteristics and political climate in Europe is different e.g. several tree species targeted by conservation efforts have a continuous range, most tree species aren't endangered and making data available is not a major concern. The approach will need to be adapted for APFORGEN countries, and a regionally specific agreement on how to share and compile the data needs to be developed
- ASEAN and APFORGEN could act as a platform to support this project. Support is needed on policy/gathering of data

Introduction to the project "APFORGIS- Filling in knowledge gaps for genetic conservation of priority species"

Riina Jalonen, Bioversity International

Designing effective networks of conservation units and seed production areas, studying genetic diversity and assessing climate change impacts on tree species all require an understanding of species natural distribution. Developing conservation strategies at the regional level, through sharing of expert experience and species-specific data, provides the opportunity for synergy and more effective conservation priority setting for species with cross-border distribution than what could be achieved through national efforts only. Species distribution models help plan research, conservation and restoration initiatives and understand threats to the populations. For accurate predictions, the models require data across the species ranges, making regional collaboration important for species with cross-country distributions. Predictions improve in each country of distribution when occurrence data from new countries is added.

APFORGIS will facilitate collaboration between APFORGEN member countries to identify 50 or more pilot species, compile available data on their distributions, and develop dynamic distribution maps and spatially explicit threat maps for them to support conservation and restoration planning. A key output of the project is to identify an approach and a Road Map

for establishing genetic conservation units (GCU), including developing minimum requirements for what they should constitute based on species characteristics and level of threat. Assessment of national capacities and support for the establishment and management of genetic conservation units will be carried out in three pilot countries (to be selected during the project).

Lessons can be learnt from EUFGIS but the model must be adapted to take into account distinct differences in regional characteristics including, the number of tree species, the value and conservation status of species, socio-political diversity, issues of land tenue and the livelihood support that forests provide.

Discussion

- Need to consider what kind of safeguards should be put in place to ensure that vulnerable population are not exposed
- Ground-truthing to verify populations can't be carried out within this project but could be looked into through follow up research

The Global Tree Assessment

Lilian Chua, Forest Research Institute Malaysia on behalf of Megan Barstow, Botanical Gardens Conservation International

The Global Tree Assessment (GTA) initiative was established in 2015 with the aim of assessing the conservation status of every known tree species by the year 2020. It is managed by Botanic Gardens Conservation International (BGCI) in partnership with the IUCN species survival commission Global Tree Specialist Group (GTSG). GTA works with NGOs, national red list programmes, botanic gardens and individuals in the assessment of extinction risk for the worlds tree species. Records of species conservation status can support the setting of conservation priorities, which is particularly pertinent for countries where there is limited funding and capacity for conservation. Red list assessments are based on information such as distribution, threats, use and trade and species interactions. A strong opportunity for collaboration between GTA and APFORGEN lies in the collection and use of this information, as 66% of world's tree species are still unassessed. Databases created by BGCI, namely Global Tree Search (natural distribution data), Threat Search (conservation and threat information) and Plant Search (information on priority species in ex situ collections) can inform APFORGIS activities.

Discussion

- Herbarium samples are the primary source of BGCI data on natural distribution but GBIF is also used as a supplementary source of more generic information

Open publicly available data of tree species occurrences: availability and quality for its use in Species Distribution Models

Josep Serra Diaz, University of Aarhus

There are three axes that need to be thought about when addressing the gaps in biodiversity data: taxonomy, temporal resolution of data and spatial/environmental coverage. There are multiple sources of biodiversity information, including museums botanical gardens, forest inventories, remote sensing and citizen science, which exhibit different levels of uncertainty, for example data associated with citizen science is more likely to be affected by user misidentification. The methodology may also vary between records e.g. older records from museums or herbaria will not have been collected digitally.

Datasets often include errors, for example the existence of coordinates at 0-0, transposed latitude for longitude, trees in the ocean, discrepancy between reported country and actual country and coordinates in the opposite hemisphere. It is important to avoid 'dumping' this data, as errors and suspicious records can be useful in data profiling, to develop protocols for cleaning and improving the data, as well as informing standards for data collection. Country checklists of natural distribution are essential for quality control checks. More specific locational information is needed for presence points within countries comprising of islands i.e. island name. Data sharing requires agreement on the cyberinfrastructure used, how it will be maintained and the degree of privacy needed for each dataset.

Discussion

- *How to deal with duplicated samples from different herbaria with different taxonomic categorisation?*
  If one can model what the traits of the species are that lead to inaccurate categorisation, it is possible to get an idea of uncertainty, but there is no easy correction for this
- *How to approach data gathering when most herbaria have no precise coordinates (only at the province scale)?*
  The only option is to downscale from province using other point records or use as a statistic prior distribution on already georeferenced points. This data could be valuable and shouldn't be 'dumped'.

Case studies from participants

Plant material transfer guidelines for tropical forest species in Malaysia

Lee Chai Ting, Forest Research Institute Malaysia (FRIM)

Plant material transfer guidelines are used to restrict movement of plant materials to ensure that the plants will be adapted to their new environment. Plant material transfer zone represents an area in which natural genetic exchange of a particular plant species occurs, within which transplanting of plant materials should have no important negative impacts on indigenous forest species Malaysia, based on genetic information. FRIM has developed plant material transfer guidelines for five species, which will assist the Forest Departments in

selecting suitable sources of planting materials for enrichment and reforestation purposes, whereby maladaptation can be minimized.

Discussion

- Are there any international guidelines for species e.g. that could be used to guide a provenance trial in Bangladesh?

Global Tree Campaign in Indonesia

Arief Hamidi, Biodiversity and Wildlife Conservation Fauna and Flora International, Indonesia

Fauna & Flora International in partnership with Botanical Gardens Conservation International has established the Global Tree Campaign (GTC) program in Indonesia in order to protect the natural population of threatened tree species worldwide. The program has supported the government to develop a strategic conservation action plan and supports documentation of species and conservation activities on the ground, including redlisting, monitoring, nursery establishment & planting.

Mapping species occurrences in ASEAN protected areas

Christian Elloran, ASEAN Centre for Biodiversity, Philippines

The Mapping Species Occurrences in Protected Areas is an online tool and web service developed by the Biodiversity Information Management Unit of ACB. The objective of the tool is to strengthen the effectiveness of international governance for biodiversity and ecosystem services and strengthening the capacity to mobilize and use biodiversity data, information and forecasts so that they are readily accessible to policymakers, managers, scientist, experts and other users.

Discussion

- *Did georeferenced coordinates undergo a quality control check?*
  Data came from training organised at the university where participants brought their own data, so it depends on the user. Online tools are used for checking taxonomy
- The public can access website but contribution to the database is restricted to specific users/institutions
- Some partners don't want to publish exact location of the species. Defining the location up to the national level is allowed
- There are tools on website to access information of species and populations e.g. identify key biodiversity areas
- Data providers (ministries etc.) segregate the data according to growth form, and ABC then organises the data based on this information
- ABC will refer to SINICA tools (Thailand) that match the taxonomy, or return to data owners to clarify taxonomy

Genetic diversity of Gluta lacquer (Gluta spp.; ANACARDIACEAE) clones in NE Thailand using Start Codon Targeted (SCoT) mark (Poster)

Wichan Eiadthong, Kasetsart University, Thailand

The study on genetic diversity of 70 selected Gluta lacquer clones from NE Thailand consisting of 3 biogeographical sites; upper, west and lower NE Thailand analyzed using by SCoT (Start Codon Targeted) markers. The results indicated that the genetic diversity of Gluta lacquer did not relate on biogeographical and sap yield data. The coefficient of genetic differentiation (Gst) average was 0.1234. Information from this study provides useful genetic database for Gluta lacquer plantation development for raw lacquer production in the future.

Genetic conservation of a threatened species, kayu kuku (*Pericopsis mooniana*) in Indonesia (Poster)

Vivi Yuskianti, Center for Forest Biotechnology and Tree Improvement, Indonesia

Kayu kuku (*Pericopsis mooniana*) is a valuable timber. Since its natural regeneration is scarce and large-scale exploitation has not been followed by replanting, kayu kuku is at risk of being endangered. Conservation of kayu kuku in form of *in situ* and *ex situ* conservation in seed stands and seed orchards has been started in Indonesia since long. However, there are currently no conservation plots that would capture genetic diversity from many natural distributions. A new project is aimed at developing *ex situ* conservation area of kayu kuku. Activities will involve many stakeholders and community in planting kayu kuku in wider scale such as through rehabilitation, plantation, agroforestry program to support genetic conservation program of kayu kuku in Indonesia.

Figure 3. Vivi Yuskianti presenting her poster about the conservation of *Pericopsis mooniana* a threatened species in Indonesia

Tentative pilot species for regional collaboration

Riina Jalonen, Bioversity International

The objective of the APFORGIS project is to develop distribution and threat maps as well as gene conservation guidelines for at least 50 pilot species. A tentative list of 48 pilot species has been drawn based on the national priority species lists that the different APFORGEN member countries have put together. It is difficult to prioritise species, given the extremely high diversity in the region and differing priorities between countries, so it is more constructive to think of this initial set as pilot species for developing and testing the project's approaches, that could then be extended to other species. The gene conservation guidelines developed based on the pilot species list could be applied to species with similar characteristics. The species selected should fulfil the following criteria: native to the region, of cross-border distribution and socio-economically important. Preliminary information on conservation status, uses, natural distribution (from the Global Tree Search) and reproductive biology for the tentative species was compiled as a basis for discussion and refinement. A preliminary compilation of occurrence data from the Global Biodiversity Information Facility (GBIF, www.gbif.org) shows that little occurrence data for the species is readily available from public databases, and existing data often lacks precision, is based on very old records, or both. Sharing of occurrence data among member countries is thus essential for APFORGIS to be effective.

Discussion

- The maps will be developed based on existing data; there is no funding for additional field research
- It is important not to set an arbitrary cut off data for useful data: historical records can give a good insight into past distribution
- Occurrence data can be for one tree or the central point of a population
- Some species may not have been assessed for their conservation status because of widespread collection of a diversity germplasm for plantation - this is the case for example for Teak in India
- BGCI has not suggested any priority species for APFORGIS based on the Global Trees Assessment. According to BGCI, any information that APFORGIS can compile will be useful for the Global Assessment. Most species have never been assessed for conservation status, and for those that have, there is scope for assessments to be updated if more detailed information is found
- In the preliminary occurrence maps, data for subspecies and varieties from GBIF was pooled at species level if they comprised 10% or less of the overall occurrence points. The approach to subspecies and varieties will be considered in detail when preparing the actual maps, and it may be shown separately on the maps

Regional networking for the conservation and sustainable use of forest genetic resources: Asia Pacific Forest Genetic Resources Programme

Zheng Yongqi, Chinese Academy of Forestry & APFORGEN

APFORGEN is a regional network for the conservation and sustainable use of forest genetic resources in Asia Pacific. The network has been running for 15 years and constitutes 15 member countries and two institutional members. APFORGEN mobilises political and financial support for developing conservation and sustainable use strategies for regionally threatened tree species and strengthening seed supply systems for restoration, local livelihoods support and climate change mitigation and adaptation. APFORGEN's objectives are aligned with the Global Plan of Action for Forest Genetic Resources (FAO 2014). APFORGEN provides a platform for developing and implementing collaborative research between member countries, sharing of findings through symposiums and workshops and training for young scientists and managers. National coordinators for each member countries have been appointed to ensure effective communication within the region. APFORGEN seeks to expand membership within the region and ensure that research is orientated to address regional and national needs and different stakeholder groups, including private sector.

Day 2: 18th April 2018

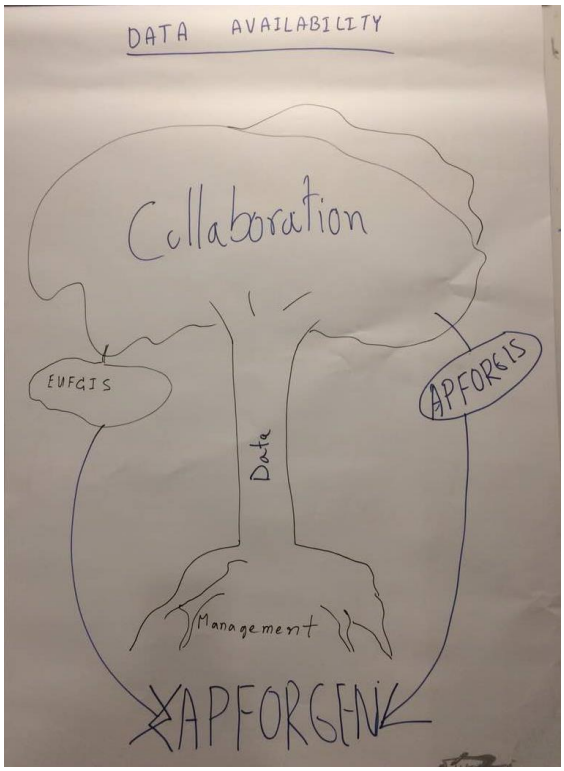

Figure 4: "Data availability leads into regional collaboration that bears many fruits for APFORGEN". Participants' summary of the first day's discussions.

Presentation: Species distribution modelling and threat mapping: methods, data needs and validity

Hannes Gaisberger, Bioversity International

Species distribution models (SDMs) are numerical tools that combine observations of species occurrence with environmental predictors to model and extrapolate a species ecological niche to understand species distribution. Climate predictions, available from Global Climate Models published by IPCC, can be incorporated to model distribution under potential future climate scenarios and threat predictors (e.g. overgrazing, climate, agricultural expansion, fire etc.) can be overlaid to identify which threats, at what magnitude coincide with species presence. Knowledge on which habitats will become unsuitable for species in the future is valuable for identifying suitable sites for genetic conservation units (GUCs). The number and distribution as well as precision and accuracy of species presence points are essential for creating useful models. Generally, the more occurrence points, the more detailed the model, although there is a saturation point after which adding new data does not drastically change the predictions anymore. Software exists to rigorously test the quality of occurrence data based on criteria, such as matching occurrence points with land cover and the administrative boundary recorded. The modelling method could be further improved by incorporating biotic interactions, such as associations between tree density and distribution. Expert opinion is used to validate the distribution models and is often extremely helpful in that. However, for threat models experience shows that the more experts are involved, the more varied are the perceptions of the threats. Looking at the association between species functional traits and threat sensitivity from literature would help to improve the accuracy of the models.

Discussion

- *How much time is devoted to evaluating model through field validation?*
  Time constraints limit this. It is more feasible if the study is at the country level. Models can be used to guide where to go for field validation.
- If a species has a narrow distribution, a few points can already provide a model of reasonable quality
- Areas where many species' ranges overlap could be key sites for establishing gene conservation units
- A bias background file can be used in Maxent to filter presence points e.g. to overcome bias of sampling along roads

Case studies from participants

Challenges with conservation of important NTFP species in Western Ghats

Gudasalamani Ravikanth, Ashoka Trust for Research in Ecology and the Environment (ATREE), India

The spatial distribution of *Myristica malabarica*, one of the important NTFP species has been developed using GIS tools. Population estimates such as population density, regeneration as

well as girth class distribution of the species across the Western Ghats in Southern India has been undertaken. Detailed genetic analysis of the populations across these habitats has been carried out. Based on these results, conservation and restoration programs of the species have been undertaken. The species is being monitored and their genetic variability assessed.

Mapping the trees of conservation concern in Sabah

Colin Maycock, University Malaysia Sabah

Sabah has more than two thousand tree species, so determining which species should be the focus of conservation actions is important if we aim to utilise our limited resources effectively. The presentation provided a brief introduction to the on-going work to map the distribution and assess the conservation status of the trees of Sabah.

Application of genetic diversity assessment for conservation design of tropical trees in Thailand

Suchitra Changtragoon, Royal forest Department, Thailand

The concept and application of genetic assessment using molecular markers for conservation design of tropical trees was addressed, with case studies on some forest tree species in Thailand.

Species selection and availability of information: group discussions

Participants were asked to divide into the three sub-regional groups to discuss and refine the tentative list of pilot species for APFORGIS:

- South Asia: India and Bangladesh
- Greater Mekong Subregion: China, Lao PDR, Myanmar, Thailand, Vietnam
- Malesia: Indonesia, Malaysia, the Philippines

The groups added any important species missing from the tentative list, identified unimportant species to be removed, validated the information already compiled in the table on natural distribution, ranked species according to priority, indicated sensitivity of occurrence data, and listed main threats to each species. Participants were also asked to consider data availability, indicate potential sources of data within their countries, and recommend species specialists who could be engaged in the project.

Figure 5: Group discussion on species selection, Greater Mekong region

Data sharing and safeguards

Riina Jalonen, Bioversity International

A draft data sharing agreement had been prepared prior to the workshop to facilitate discussions. The draft was based on previous regional species conservation projects implemented by Bioversity, and guidance from policy specialists. The draft agreement covered the following areas:

- What information can be shared, at what provision
- Different levels of data privacy for different types of information, depending on the sensitivity - for example, not publishing occurrence data for highly valuable and threatened species
- Access to data by project partners and the public: terms of use and required acknowledgements
- The roles of project partners and coordinating organisation
- Possibility of making also restricted information available 7 years after the project's end, in line with open access requirements (for discussion)

Discussion

Threatened species

- Concern over providing georeferenced points for threatened species. It is difficult even for academics/researchers to get access to this information
- It would be worth collaborating with CITES over threatened species
- It was agreed that the project will only use already published occurrence data at this stage, in order to address concerns of data sharing over endangered species.

Figure 6: Lilian Chua contributing to data sharing discussion

Open access data

- *Concern about data becoming open access – could analyses not be carried out at national level?*
  Species ranges do not follow national boundaries, and a complete picture about conservation status and priorities can only be obtained through sharing of data
- Some data could be shared among partners without making it open access

Benefits

- Need enough of priority species for each country to gather motivation
- Interest in joint publications linked to the project.
- The project's results can importantly support many further research activities, for example developing sampling strategies for genetic diversity studies or regional provenance trials

Partners roles and next steps

- Need to identify and allocate tasks to participants that can be taken back to country and discussed. For many participants there is a need to consult employers and check policy before investing the work to compile data. The purpose of the workshop is to develop a work plan that participants would feel comfortable to present to their institutions
- Formal project-wide data sharing agreement would not be needed, since the project would focus on already published information. Memoranda of Understanding could be developed with partners on a case-by-case basis for sharing other information, where relevant

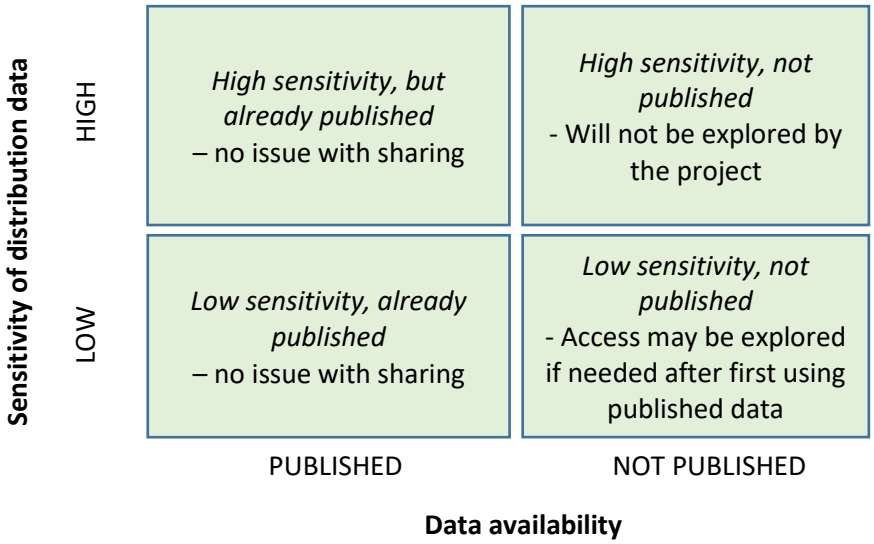

Figure 7: Different types of data and the approach to using those in the APFORGIS project, as agreed by workshop participants

Day 3: 19th April 2018

Overview of progress

Each participant was asked to name a tree species whose conservation status reflected their feeling about the workshop's progress to date. Some participants selected species of 'least concern', indicating that the discussions had been productive. Others felt it was 'unassessed' or 'vulnerable' due to the need for further discussion and consensus on data sharing, clarification of project objective, or that authorities or institutions needed to be consulted before making agreements. One participant described the status as 'critically endangered' because of its high importance for species conservation in the region.

The objectives of the project were then recapped and discussed.

Discussion

- Scope of the project: The project will use existing information, as there are no funds for additional data collection (unless individual countries have the resources for this). Producing quality maps is feasible in this time frame with good data that can be used as part of training protocols. Verification of the distribution models on the ground, or studying the responses of individual species to threats through field studies is outside of the scope of the project. However, the project's results can importantly inform planning of such studies.
- To get around issues of data sharing for sensitive species, it can be possible to obtain site climate information from national climate offices without giving exact location of species

- If possible, compile protected area files for each country to allow an analysis of whether seed zones fall within existing protected areas. The world database of protected areas is not as accurate as national records.
- Countries may have preferences for climate scenarios that they use. Using those in climate modelling can help make the results more relevant for the countries.
- Using distribution models to determine which areas will remain suitable for species is important for establishing gene conservation units that can be maintained over long time.
- ATREE in India is doing niche modelling for some of the species from the pilot list. APFORGIS can benefit from these existing modelling efforts/perspective on modelling to verify and validate. It is more constructive to use a synergistic approach-combining to get the best of both models. Any species for which the whole range is already covered in existing models could be removed and replaced in the priority species list.
- Survey would be conducted to understand existing conservation strategies in member countries and help develop feasible conservation guidelines
- It would be good if this platform could be used to train individuals in the member countries to carry out modelling/mapping and learn about the methodology, so capacity within countries is developed and a network of these experts is established across the member countries. This could be a sustainable long-term plan
- Further discussion needed on whether the project should set up its own portal, or instead contribute to existing efforts. The strategy may be different for different types of species based on conservation status. Published data in certain journals is automatically uploaded to GBIF.

Tentative pilot species: finalization

Working in sub-regional groups, the participants finalised species selection and related information as follows:

- Newly added species from other regions: tick countries of natural distribution, if any
- Species to be removed: agree, or object
- Importance: Indicate high priority species (should have some for each country)
- Sensitive information: Indicate any species for which location data cannot be shared (from national published records)
- Data sources: List organizations and/or individuals who have data for specific species
- Threats: Complete threat list by species
- Threat indicators and data sources: discuss ways to measure threats, and possible sources of data

Figure 8. Finalization of pilot species list, Malesia sub-region

The species were divided into first and second priority species. The first priority list includes species that were ranked as highly important by one or more subregional groups. The final list of the species is shown in Annex 4.

Way forward: group discussion on select topics

Participants discussed in groups four topics that were prioritised for further discussion to support successful project implementation: capacity strengthening, partnership models, indicators and data for assessing threats, and data management. Key points from the discussions are summarised below. Collaborative work plan was developed integrating the activities suggested by each group (Annex 5).

Capacity strengthening within countries

Questions for consideration

- What training needs there are, and who should be trained
- How does capacity strengthening benefit from, and strengthen, other project activities?

Recommendations from the group

- Need training in Species Distribution Modeling and its validation, developing threat maps, identifying genetic conservation units, gap analysis and management plans. A standard methodology should be developed that all partners will follow.
- Training at multiple levels: project partners from all countries (scientists, GIS specialists, ecologists and technical staff involved in decision-making).

- Two trainings and one validation workshop would be needed. International experts would train trainers in the first workshop and the second would involve building collaborative maps. This will develop capacity within countries to apply the same method for endemic species.
- Opportunity to produce papers in collaboration for the select species.
- Develop a methodology that looks at conservation from the ecosystem level, as opposed to the species level
- It would be valuable to appoint a global ecologist, to filter out the source of data and coordinate the validation of occurrence data, to work alongside the GIS specialist
- Working with different universities and other institutions through undergraduate projects can help obtain data, especially distribution data. Some support on taxonomic classification would be needed

Discussion

- In India, APFORGIS will be more successful if there is collaboration between researchers and forest departments. Does this apply to other countries?
- A specialist could be appointed from each on county for the pilot species. These specialists would then form an international team of experts. Recommendations for specialists are needed
- Appointing specialists on families that are important across the whole region would be beneficial
- Specialists should come to workshop prepared with ground knowledge and reference data that will complement tools provided in the workshop

Figure 9. Suchitra Changtragoon reports back from the group discussion on capacity strengthening within countries

Partnership models

Questions for consideration

- What are the opportunities for participation of different groups e.g. providing data, expert panel for validation of models, training or ground-truthing activities?
- How can the project facilitate this participation?
- How to reach out to different end users?

Recommendations from the group

- Species working group
- Joint research related to APFORGIS
- Trainings
- Agreement between partners, stakeholders and government to secure funding
- Communication: website, email groups

Discussion

- APFROGEN species working groups could act as a structure under which a panel of experts for different species would be established. Develop terms of reference for each group and members
- Identify activities and projects within species working group
- The group of experts on each species could be those validating the outputs of this project
- Financial support is needed for this

Indicators and data for assessing threats

Questions for consideration

- What threat indicators would be relevant?
- What data is available on these?

Recommendations from the group

- Predictors: Overharvesting, overgrazing, fuelwood, fire, habitat encroachment, mining, climate change
- Historical and future analysis will be carried out for the modelling
- Quantify these impacts: critical for regions to bring ground-truthing/reference data to the table to improve accuracy of models
- There is data in the public domain that can be used: soils, fire, accessibility (connectivity)

Discussion

- Action points: generate maps and then validate through expert knowledge of what is happening on the ground in each country
- Appoint national focal points for data compilation

Data management

Questions for consideration

- What type of database, portal, website or system that we would need?
- What are the pros and cons of the different options?

Recommendations from the group

- Use Darwin core as data standard
- APFORGEN or Chinese Academy of Forestry as portal
- Data is cleaned and then available to those doing the analysis/mapping
- When no longer using the data it will be moved to global database (GBIF, ASEAN) in order to reduce maintenance effort. This is a way to contribute to cyberinfrastructure that APFORGIS will have mobilised data from. Some of databases allow custodians to maintain privacy by only making data available on request. Data for extremely sensitive species will not be uploaded at all

Discussion

- Data used will be already published, so uploading to cyberinfrastructure will not be a problem.

Annex 1: Workshop programme

Tuesday 17 April

9.00-9.30	Welcome and introductions
9.30-10.00	Conserving the evolutionary potential of tree species: from genes to landscapes *Chris Kettle, Bioversity International*
10.00-10.30	Case studies from participants
10.30-11.00	*Tea break*
11.00-12.00	Examples and experiences of spatial approaches in conservation planning: • Centres of diversity of native fruit and nut trees in Central Asia • Regional conservation priorities for high value medicinal species *Prunus africana* • Identifying seed origin for resilient restoration (*Diversity for Restoration* tool)
12.00-12.30	EUFGIS – A European information system on forest genetic resources *Barbara Vinceti, Bioversity International*
12.30-13.30	*Lunch*
13.30-14.00	Introduction to the project "APFORGIS – Filling in knowledge gaps for genetic conservation of priority species" *Riina Jalonen, Bioversity International*
14.00-14.20	Conservation status of Asian tree species *Lillian Chua, Forest Research Institute Malaysia, and Megan Barstow, Botanical Gardens Conservation International*
14.20-14.40	Open public available data of tree species occurrences: availability and quality for its use in Species Distribution Models *Josep Serra Diaz, University of Aarhus*
14.40-15.45	Case studies from participants
15.45-16.15	*Tea break*
16.15-16.40	Tentative pilot species for regional collaboration *Riina Jalonen, Bioversity International*
16.40-17.00	Regional networking for the conservation and sustainable use of forest genetic resources: Asia Pacific Forest Genetic Resources Programme (APFORGEN) *Zheng Yongqi, Chinese Academy of Forestry & APFORGEN*
17.00-17.15	Conclusions of the day
19.00	*Welcome dinner*

Wednesday 18 April

8.30-8.45	Recap of the first day
8.45-9.30	Species distribution modelling and threat mapping: methods, data needs and validity *Hannes Gaisberger, Bioversity International*
9.30-10.00	Case studies from participants
10.00-11.30	Species selection and availability of information: *Group discussions* *(Tea break in groups at 10.30)*
11.30-12.30	Species selection and availability of information: *Reporting back and plenary discussion*
12.30-13.30	Lunch
13.30-14.15	Data needs and availability for conservation and restoration planning: *Group discussions*
14.15-15.00	Data needs and availability for conservation and restoration planning: *Reporting back and plenary discussion*
15.00-15.30	Data sharing and safeguards: *Introduction*
15.30-16.00	Tea break
16.00-17.00	Data sharing and safeguards: *Group and plenary discussions*
17.00-17.15	Conclusions of the day and revisiting plan for the third day

Thursday 19 April

8.30-9.30	Overview of progress
9.30-10.30	Group discussions on selected topics
10.30-11.00	*Tea break*
11.00-12.00	Reporting back and development of a collaborative work plan
12.00-12.30	Closing plenary
12.30-13.30	*Lunch*
13.30-17.30	Field trip

Annex 2: List of participants

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Annex 3: Expectations for workshop & for collaboration after workshop

A. Expectations for workshop

Collaboration

- Network between the region; Enhance own capacity; Share own experience
- Get to know partners; Agree on priority species & discuss 'minimum requirements' for genetic conservation units; Starting point of an effective regional collaboration
- Establish a solid working group for A.P. research and conservation; Create a first approach to identify data needs for modelling
- Agreement to collaborations; Agreement to co-funding for research

Species

- Select economically, environmentally, socially important tree species for conservation. The species should be available in a few countries
- Sharing and discuss about how is 'our' trees today, how many and the condition of threatened tree species; Plan to do something for those species; Discuss about advanced conservation tools: special and scientific
- Shortlisting & finalising the species list representing both economically useful as well as endemic/endangered species for both utilisation & conservation
- Learn experiences of threatened species conservation ; Share information of mapping distribution of threatened species
- Sharing & gaining information and experiences from all other regions on pilot species and their distribution in south and southeast Asia
- Identify important spp. for conservation; Up to date on regional conservation status; Collaboration on data sharing/research projects
- Clearer understanding of available data, willingness to collaborate and consensus on objectives; Finalising priority list of species
- I hope this workshop would find a solution to filling the gap of tree species utilisation for socio-economic purposes and forest restoration for the pilot tree species
- Prioritise species almost extinct
- To further enhance the tree species distribution in ASEAN region and to develop an interoperable toll for communication
- Some gaps in the species distribution of endangered tree species would be filled in and placed in databases
- To see the whole picture of the distribution of common species in the region

Learning

- Learn successful approaches and strategies in the conservation of forest genetic resources of ecologically & economically important tree species
- Learn about conservation experiences in the region, constraints & challenges

- Good network building; Understanding conservation importance of genetic resources of Asian trees; Understanding geographic distribution of Asian trees
- Get new information on distribution of common species; Learn more about spatial approaches for conservation

B. Expectations for collaboration after the workshop

Availability of species information

- More information available online; Some agreements come out to use under Nagoya protocol
- Update the species information and spatial database in the next 2-3 years to be included in map; Monitor land use change in SE Asia region through contacts with experts in the region
- Produce the maps of tree distribution in Asia
- More comprehensive species distribution in ASEAN and a complete species occur

Joint conservation efforts

- Develop a strategic plan and start to build the platform for a regional network of GCU's
- Establishment of effective collaboration and network of genetic conservation units region
- To establish collaboration across national boundaries to work on pan-Asean distributional species
- Develop protocols for similar species across the region
- Collaboration on spp. like dipterocarps for sample collection for genetics work/herbarium sample
- Surveying and mapping distribution of threatened species in forest protected areas
- To collaborate in key species on conservation, protection & restoration

New projects

- Develop new project for conservation of common, threatened species
- I hope to have the project on the importance of tree species conservation in many countries
- Prepare a collaborative project with a main focus on distribution, reproductive biology, regeneration, restoration, conservation and documentation. Funding support may be given to developing countries
- Develop a project together for comprehensive aspects of conservation of FGR
- Be able to write joint projects for conservation and research

Networking

- Stable meetings to advance A-P research
- Exchange of materials & expertise; Sharing of lab facilities
- Develop knowledge sharing opportunities
- Collaborative working groups; Strengthen the networking of experts;
- Increase collaboration with other country on sharing and gaining information & experiences

- Long term forest genetic network building; Collaborative research; Taking action on tree species conservation

Capacities

- Assistance with in-country capacity building
- Among distribution of tree species (region), each country could collaborate on tree conservation, forest restoration, ex-situ & in-situ. Also fill in the gap of knowledge limitation among countries

Short-term

- A collaborative work plan for compiling FGR information towards better conservation of Asian tree species
- Project team members identified; Rules for data sharing agreement ; Outputs of the project identified; Data requirements
- I hope to see agreement around common objectives, a collaborative attitude, and clear framework to share data
- Develop a clear work programme, identifying implementing partners, roles and a timeline

Annex 4: Pilots species for regional collaboration

Species	Family	Conserv. Status*	Natural distribution															
			Bangladesh	Bhutan	India	Nepal	Sri Lanka	Cambodia	China	Lao PDR	Myanmar	Thailand	Vietnam	Brunei	Indonesia	Malaysia	Philippines	Other
FIRST PRIORITY																		
Afzelia xylocarpa	Fabaceae	EN(1998)						x		x	x	x	x					
Ailanthus excelsa	Simaroubaceae	Not assessed	x		x		x											
Albizia lebbeck	Fabaceae	Not assessed	x	x	x	x	x				x	x			x		?	Maldives, Pakistan, Timor-Leste.
Anisoptera costata	Dipterocarpaceae	EN(2017)	x		x			x		x	x	x	x	x	x	x	x	
Aquilaria crassna	Thymelaceae	CR(1998) CITES II						x		x		x	x					
Aquilaria malaccensis	Thymelaceae	CR(2018) CITES II	x	x	x						x			x	x	x	x	Iran
Azadirachta indica	Meliaceae	LC(2018)	x	x	x			x		x	x	x						
Cinnamomum perrectum	Lauraceae	Not assessed									x	x			x			
Dalbergia cochinchinensis	Fabaceae	VU(1998) CITES II						x		x	x	x	x					
Dalbergia latifolia	Fabaceae	VU(1998) CITES II			x	x									x			
Dalbergia oliveri	Fabaceae	EN(1998) CITES II						x		x	x	x	x					
Dalbergia sissoo	Fabaceae	Not assessed; CITES II	x	x	x	x					x				x			Afghanistan, Iran, Pakistan
Dalbergia tonkinensis	Fabaceae	Not assessed CITES II								x			x					
Diospyros cauliflora	Ebenaceae	Not assessed												x	x	x	x	

Species	Family	Conserv. Status*	Natural distribution															
			Bangladesh	Bhutan	India	Nepal	Sri Lanka	Cambodia	China	Lao PDR	Myanmar	Thailand	Vietnam	Brunei	Indonesia	Malaysia	Philippines	Other
Dipterocarpus alatus	Dipterocarpaceae	VU(2017)	x		x		x	x		x	x	x	x	x		x	x	
Dipterocarpus grandiflorus	Dipterocarpaceae	EN (2017)			x						x	x	x	x	x	x	x	Singapore
Dipterocarpus turbinatus	Dipterocarpaceae	VU(2017)	x		x		x	x		x	x	x	x					
Dryobalanops aromatica	Dipterocarpaceae	Not assessed												x	x	x		
Dyera costulata	Apocynaceae	LC(1998)										x		x	x	x		
Eurycoma longifolia	Simaroubaceae	Not assessed						x		x	x	x	x	x	x	x	x	
Eusideroxylon zwageri	Lauraceae	VU(1998)												x	x	x	x	
Fagraea fragrans	Gentianaceae	Not assessed			x			x		x	x	x	x	x	x	x	x	
Garcinia indica	Clusiaceae	VU (2014)			x		x											
Gluta usitata	Anacardiaceae	Not assessed									x	x	x					
Gonystylus bancanus	Thymelaceae	CR(2018) CITES II												x	x	x		
Hopea odorata	Dipterocarpaceae	VU(2017)	x		x			x		x	x	x	x		x	x		
Intsia bijuga	Fabaceae	VU(1998)			x			x			x	x	x		x	x	x	Pacific Islands, Japan, Madagascar, Tanzania
Intsia palembanica	Fabaceae	Not assessed			x						x	x			x	x	x	
Koompassia malaccensis	Fabaceae	LC(1998)										x		x	x	x		
Myristica malabarica	Myristicaceae	VU(1998)			x		x											
Neolamarckia cadamba	Rubiaceae	Not assessed		x	x		x		x		x	x	x		x	x		
Parkia speciose	Fabaceae	Not assessed									x	x		x	x	x	x	
Pericopsis mooniana	Fabaceae	VU (1998)					x								x	x	x	Micronesia, Palau, Papua New Guinea
Phyllanthus emblica	Phyllanthaceae	Not assessed	x	x	x	x	x	x	x	x	x	x			x	x	x	Taiwan, Hong Kong
Pinus kesiya	Pinaceae	LC(2013)			x				x	x	x	x	x			x	x	Sub-species in Philippines

Species	Family	Conserv. Status*	Natural distribution															
			Bangladesh	Bhutan	India	Nepal	Sri Lanka	Cambodia	China	Lao PDR	Myanmar	Thailand	Vietnam	Brunei	Indonesia	Malaysia	Philippines	Other
Pinus merkusii	Pinaceae	VU(2013)								x			x		x		x	
Podocarpus neriifolius	Podocarpaceae	LC (2011)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Fiji, Hong Kong, PNG, Solomon Islands
Pometia pinnata	Sapindaceae	Not assessed			x		x		x	x	x	x	x	x	x	x	x	Pacific Islands
Pongamia pinnata	Fabaceae	Not assessed	x		x		x		x		x	x	?	x	x	x	x	Fiji, Japan, Seychelles
Pterocarpus indicus	Fabaceae	VU(1998)			x		x	x		x	x	x	x	x	x	x	x	Pacific Islands
Pterocarpus macrocarpus	Fabaceae	VU (preliminary)						x		x	x	x	x					
Santalum album	Santalaceae	VU(1998)			x		x								x			
Scaphium macropodum	Malvaceae	LC(1998)						x				x	x		x	x		
Shorea leprosula	Dipterocarpaceae	EN(1998)										x		x	x	x		
Shorea macrophylla	Dipterocarpaceae	VU (1998)												x	x	x		
Shorea ovalis	Dipterocarpaceae	Not assessed												x	x	x		
Shorea parvifolia	Dipterocarpaceae	LC(2018)										x			x	x		
Shorea pinanga	Dipterocarpaceae	Not assessed												x	x	x		
Shorea roxburghii	Dipterocarpaceae	VU(2017)			x			x		x	x	x	x		x	x		
Sindora siamensis	Fabaceae	LC(1998)						x		x		x	x		x	?		
Tectona grandis	Lamiaceae	Not assessed			x			x		x	x	x	x					
Terminalia chebula	Combretaceae	Not assessed	x	x	x	x	x	x	x	x	x	x	x					
Vatica mangachapoi	Dipterocarpaceae	VU (2017)							x			x		x	x	x	x	
Xylia xylocarpa	Fabaceae	Not assessed	x		x			x		x	x	x	x					

Species	Family	Conserv. Status*	Natural distribution															
			Bangladesh	Bhutan	India	Nepal	Sri Lanka	Cambodia	China	Lao PDR	Myanmar	Thailand	Vietnam	Brunei	Indonesia	Malaysia	Philippines	Other
second priority																		
Adenanthera pavonina	Fabaceae	Not assessed	x		x		x	x		x	x	x	x		x	x		Australia, Maldives, PNG, Puerto Rico, Solomon Islands, Timor-Leste
Agathis borneensis	Araucariaceae	EN(2013)												x	x	x		
Alstonia scholaris	Apocynaceae	LC(1998)	x		x	x	x	x	x	x	x	x	x	x	x	x	x	Solomon Islands, Timor-Leste
Dalbergia cultrata	Fabaceae	NT(2012) CITES II						x	x	x	x	x	x					
Diospyros mollis	Ebenaceae	Not assessed						x		x	x	x	x			x		
Dipterocarpus turbuculatus	Dipterocarpaceae	Not assessed								x	x	x						
Durio zibethinus	Malvaceae	Not assessed													x	x		
Gluta laccifera	Anacardiaceae	Not assessed									x	x	x					
Heritiera javanica	Malvaceae	Not assessed										x	x	x	x	x	x	
Hopea ferrea	Dipterocarpaceae	EN(2017)						x		x		x	x			x		
Mansonia gagei	Malvaceae	Not assessed								x	x	x						
Melaleuca cajuputi	Myrtaceae	Not assessed						x			x	x	x	x	x	x		Australia, PNG, Singapore, Timor-Leste
Millettia leucantha	Fabaceae	Not assessed							x	x	x	x				?		
Palaquium rostratum	Sapotaceae	Not assessed										x		x	x	x		
Parashorea stellate	Dipterocarpaceae	Not assessed						x		x	x	x	x			x		
Rhizophora apiculata	Rhizophoraceae	LC(2010)	x		x		x	x	x		x	x	x	x	x	x	x	Australia, Guam, Kiribati, Maldives, Micronesia, Nauru, New Caledonia, Northern Mariana Islands, Palau, PNG,

Species	Family	Conserv. Status*	Natural distribution															
			Bangladesh	Bhutan	India	Nepal	Sri Lanka	Cambodia	China	Lao PDR	Myanmar	Thailand	Vietnam	Brunei	Indonesia	Malaysia	Philippines	Other
																		Singapore, Solomon Islands, Timor-Leste, Vanuatu
Stryrax tokinensis	Styracaceae	Not assessed								x			x					

* Conservation status:

LC = least concern, NT = near threatened, VU = vulnerable, EN = endangered, CR = critically endangered

Annex 5: Collaborative work plan

Topic	What	Who	When	Notes
Workshop report	Share presentations Share photos Prepare workshop report	Bioversity UPM, anyone Bioversity	April 2018 April 2018 May 2018	
Species list	Compile sub-regional lists Circulate to APFORGEN coordinators for comments Finalise list based on comments	Bioversity Bioversity Bioversity	April 2018 May 2018 May 2018	Share with stakeholders: BGCI, FAO, ITTO, CITES, others?
Partnerships	Develop a system for sharing information between project partners Develop Terms of Reference for Species Expert Group under APFORGEN Establish the group and invite participants Develop guidelines for joint publications and co-authorship	Bioversity Bioversity with input from workshop participants and APFORGEN coordinators APFORGEN Secretariat and Bioversity Bioversity with input from workshop participants and APFORGEN coordinators	May 2018 May 2018 June 2018 May 2018	Shared drive and email list Species-wise working groups based on interest
Project information / invitations	Develop comms materials to communicate project purpose and objectives Develop letter of invitation for partners, outlining different ways to participate, roles, benefits	Bioversity Bioversity	May 2018 May 2018	

Topic	What	Who	When	Notes
	Identify potential partners for sending invitations	workshop participants, APFORGEN coordinators)	May 2018	
Data compilation	Develop metadata structure	Bioversity	May 2018	Darwin Core or CAPFITOGEN as basis
	Collect literature / published data from national sources	workshop participants, project partners	May-June 2018	
	Provide contact information for institutions having data	workshop participants, project partners	May-June 2018	
	Compile available data from literature	Bioversity	May-June 2018	
	Compile/download environmental predictor variables for SDM modeling (current and future climate) at 1 km resolution	Bioversity	May-June 2018	
Database structure	Create internal database for storing cleaned data and sharing among partners	Bioversity	May-June 2018	
	Fill in and manage database	Bioversity	May-July 2018	
	Create portal for sharing project results (maps, tools)	Bioversity	Sept-Oct 2018	
	Identify long-term host of the portal	APFORGEN	Sept-Oct 2018	
Capacity strengthening	Plan training on SDM	Bioversity	planning in Aug-Sept 2018	May be combined with validation workshop

Topic	What	Who	When	Notes
	Plan training on threat mapping, gap analysis and management options	Bioversity with input from partners	planning in Feb-March 2019	
	Identify training participants	project partners	Ongoing basis	training of trainers; ecologists, taxonomists, GIS specialists, decision-makers; reach out to forestry departments and other end-users
	Identify funding and other resources for trainings	Bioversity, APFORGEN	Ongoing basis	
	Identify potential collaborating institutions	project partners, Bioversity, APFORGEN	Ongoing basis	universities, undergraduate projects etc Joint publications as outputs from trainings
Validation workshop	Identify participants Organise workshop	project partners Bioversity	by Sept 2018 Tentatively Jan 2019	 Venue tbd (offers welcome)