academicJournals

Vol. 6(7), pp. 589-599, August 2014
DOI: 10.5897/IJBC2014.0733
Article Number: 006768D46987
ISSN 2141-243X

http://www.academicjournals.org/IJBC

International Journal of Biodiversity and Conservation

Full Length Research Paper

Rare tree species in nurseries across the Visayas, Philippines

Dennis P. Peque[1,2]* and Dirk Hölscher[2]

[1]College of Forestry and Environmental Science, Visayas State University, Baybay City, 6521-A, Leyte, Philippines.
[2]Tropical Silviculture and Forest Ecology, Georg-August-Universität Göttingen, Büsgenweg 1, 37077, Göttingen, Germany.

Received 4 June, 2014; Accepted 22 July, 2014

Rare tree species make a significant contribution to the species richness in natural tropical forests but often they are endangered. Integrating them into plantation schemes is an important option for biodiversity conservation. In the Visayas, Philippines, we surveyed tree nurseries with a focus on 20 rare native species. Including the focal species, we found a total of 138 tree species in nurseries of which 73% were natives and 25% red-listed. Comparing results with earlier nursery surveys indicated that the cultivation of native tree species in nurseries had increased which may be attributed to the National Greening Program. Native dipterocarps such as *Shorea contorta* and *Parashorea malaanonan* were frequently found. Other species however, which are rare in near-natural remnant forests of the region, were clearly under-represented (for example, *Diplodiscus paniculatus* and *Wallaceodendron celebicum*) or absent (*Dracontomelon edule*) in nurseries. Knowledge gaps were declared by the nursery operators and may partly have influenced the non-production of specific species. We concluded that there is already a considerable number of native tree species in the nurseries of the Visayas. This indicated increase needs for sustenance and we think that extending the National Greening Program, knowledge generation and education may play vital roles.

Key words: Biodiversity conservation, reforestation, planting materials, native species, non-native species.

INTRODUCTION

Deforestation and the increasing extent of degraded land requiring remediation are of utmost concern to natural resource management in the tropics (Lugo, 1997; Parrotta et al., 1997), including the Philippines (Liu et al., 1993). With a view to reinstating the productive capacity and ecosystem services that forests provide and potentially restoring biodiversity, reforestation may represent the best land-use option (Lamb et al., 2005; Neidel et al., 2012; Parrotta, 1997). Reforestation to restore and/or conserve biodiversity can be achieved by planting non-native species in monocultures with a view to allow diverse understories of native trees to develop beneath the canopy (Ashton et al., 2014, in press; Lamb, 1998; Parotta, 1997), or by planting mixtures of native

*Corresponding author. E-mail: dpeque@forst.uni-goettingen.de. Tel: +49 (0)551 39 9556. Fax: +49 (0)551 39 4019.

tree species (Lamb, 1998). The advantage of using non-native tree species is that it is easier to manage and it is probably more profitable than planting native species (Cubbage et al., 2007; Nguyen et al., 2014). However, where regeneration becomes successful beneath plantation canopies, it does not guarantee that species and mixtures of interest are supported. There are many factors that affect seedling establishment, for instance, the distance to the nearest native forest may hinder recruitment, especially for species that lack primary dispersal mechanisms (Elliott et al., 2013; Lamb et al., 2005). For any given species, and particularly rare ones, the outcome is often difficult to predict, and any natural succession can take a long time. However, where the main emphasis of reforestation is on biodiversity conservation, species that are rare in the natural forest must be considered. Rare tree species contribute much to the tree species richness of natural forests (Hubbell, 2013; ter Steege et al., 2013) and they are often endangered due to deforestation.

The potential of using native species in reforestation is widely recognized and more and more species are being tested for their performance, especially in open grasslands (Milan and Margraf, 1994; Schneider et al., 2014; Shono et al., 2007; van Breugel et al., 2011). Native tree species contribute to biodiversity conservation (Milan, 2012) and species that local people are familiar with are usually more readily accepted (Nichols and Vanclay, 2012). However, only a few native species are actually used in reforestation, despite the wide range of species to choose from (Condit et al., 1993). The specific species raised in nurseries depends on many factors including the availability of or access to planting materials, demand for the species and the available technology in producing the focal species (Carandang et al., 2006). Such constraints can potentially affect reforestation initiatives such as National Greening Program (NGP) in the Philippines. NGP is nationwide program which aims to reforest an area covering 1.5 million ha with 1.5 billion trees from 2011 until 2016 (EO 26 2011) using various species including commercial non-native fruit trees and non-native timber trees in production areas but also promotes planting of native species, especially in areas classified as protected forest.

In this context, nursery seedling production may provide the opportunity to establish a plantation that meets certain objectives such as biodiversity conservation. A number of nursery studies have been conducted in the past covering some parts of the Visayas that have focused on production systems and socio-economic and policy issues in the nursery sector, for example Leyte (Gregorio et al., 2004, 2010) and Cebu (Carandang et al., 2006). For the present study, we visited nurseries and carried out interviews with 29 nursery respondents in 18 municipalities across the Visayas in the Philippines in particular to document the presence of 20 selected native tree species in nurseries.

These species are the same species we surveyed previously in remnant forests (reported in Peque and Hölscher, 2014) which we found to be generally rare in the region, with some which are either still locally abundant or very rare or absent in some forests. The disproportionate abundance and distribution of these species is largely due to shrinking of forest areas resulting from human activities. Since the remaining natural forests in the Philippines and in the Visayas in particular are limited in area, and scattered with some which are already isolated, we think all the 20 focal tree species merits special consideration with respect to conservation and are important in promoting high-diversity reforestation (Brancalion et al., 2012). These species are mostly red-listed both in International Union for Conservation of Nature (IUCN 2001) and Philippine Red-lists (DAO 2007) and have been used in small-scale forestation and field trials, particularly through “Rainforestation”- an approach that uses a mixed of native species, the aim of which is to mimic natural forests (Milan and Margraf, 1994). For instance, the dipterocarps which is among the most important tree groups in the Philippines, are classified as critically endangered in IUCN but only few of them have been incorporated in reforestation in the Visayas and/or the Philippines. Documenting other native tree species grown in addition to the focal species is important to understand the range of species available in nurseries. This paper aims to answer the following questions: a) What are the tree species produced in the nurseries and are these similar to those used in the past? b) What is the current level of knowledge of respondents on focal species and how it is related to the cultivation of the species in nurseries? c) To what extent are focal species that are available in forests used in nurseries? The implication of these findings is also discussed and comments are made on the challenges of mainstreaming rare tree species in reforestation.

MATERIALS AND METHODS

The Visayas region

The Visayas is one of the three geographical divisions of the Philippines, along with Luzon and Mindanao, which is located in the central part of the country. It consists of six major islands including Samar, Leyte, Cebu, Bohol, Negros and Panay, and several hundred small islands making up the Visayan archipelago. Rugged terrain and high mountains characterize the Visayas, with the exception of Samar, which is hilly, and in general, soils in these islands are derived from volcanic or limestone substrates. In the lowlands, the climate is tropical and monsoonal with an average air temperature of 27.9°C. At higher elevations, annual rainfall reaches +4000 mm and falls to 1000 mm at leeward sites and in sheltered valleys. Little seasonal variation exists across the region, as rainfall is more or less evenly distributed throughout the year and, when occurring, a short dry season lasts for only one to three months either from December to February or from March to May.

The evergreen tropical rainforests of the Visayan hills and uplands mainly comprise the original coastal vegetation. Like other

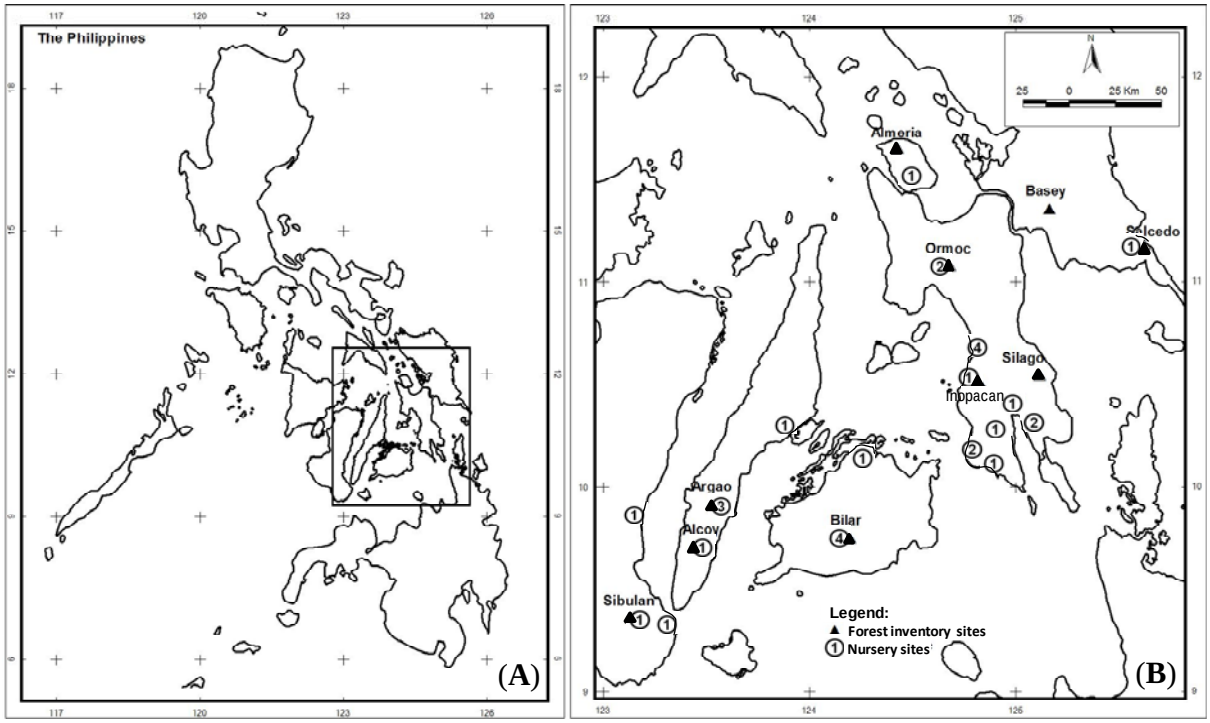

Figure 1. The location of the study area, studied nurseries and assessed remnant forests: (A) Philippines and (B) the study area. The number inside each circle represents the number of respondents in each location. Respondents far from remnant forests are CENRO nurseries and those based in universities while those that are near are either communal or individual/private nurseries. Solid triangles represent the forest inventory sites.

parts of the Philippines, the Visayas have not been spared from the onslaught of deforestation. The once forested landscape of the Visayas is now composed of a mosaic of coconut plantations, agricultural farms, degraded open grasslands covered with a few pioneer species and a little remnant forest. The current estimated forest cover (excluding mangroves) of the Visayas is 697,384 hectares representing some 12% of its total land area which is 1% higher than the 2003 reported figure (FMB 2012).

Selection of respondents and background information of study sites

The study covered 29 nurseries distributed across the Visayas, Philippines (Figure 1), most of which were located near remnant forest and on the same islands where we conducted our forest inventory. Since there were few active nurseries in the Visayas, identification of the sites and nurseries was done by snowball sampling. The number of respondents varied from one to four in each study location. The first respondent group comprised known seedling producers from the region as well as representatives from the Community, Environment and Natural Resources Offices (CENRO) of the Department of Environment and Natural Resources (DENR), as they have jurisdiction over all of the provinces of the Visayas and they maintain forest nurseries for their reforestation projects. Other nursery operators were located by referral by asking previously interviewed respondents about nurseries that existed near their areas. Local guides who helped during our forest inventory work also showed us toward some nursery operators.

Data gathering

Personal interviews were carried out with 29 respondents using a semi-structured interview schedule. The questionnaire was initially tested on a small number of nursery operators to check its appropriateness to the target respondents. The questions given to all respondents were the same and were structured to elicit information on the species they produced in nurseries, and particularly the 20 target study species (Table 1). The species are all presumed rare based on the IUCN and Philippine Red List. Particularly, these species were promoted in rainforestation farming (Milan and Margraf, 1994) and partly belong to the most preferred native tree species for smallholder forestry on Leyte, Philippines (Mangaoang and Pasa, 2003). In the Philippine red list, three species are listed as critically endangered, five as endangered, seven as vulnerable and five species which have not been evaluated. In IUCN (2001), 13 of the species are red-listed with the dipterocarps listed as critically endangered. The questionnaire contained socio-demographic information on the respondents. They were also asked about the species they produced, type and sources of plant material, familiarity of the species, and perception of conservation status of focal species. The summary of the main questions is presented in Table 2. Important observations in each nursery were also noted.

Data analysis

A combination of descriptive statistics, simple correlation and ordination techniques were used to address the objectives of the study. Knowledge was quantified in terms of the familiarity of respondents on the focal species and their perception of the conservation status of the species (Table 2). Principal component analysis (PCA) was conducted to see relationships among knowledge, species preferred by respondents from among the 20 focal species and the focal species that are grown in nurseries.

Table 1. The focal tree species surveyed in nurseries.

Species name	Species Code	Family	Official Common Name	Local names in the study sites	Conservation status*		Use in Reforestation
					DAO (2007)	IUCN (ver. 3.1)	
Dracontomelon dao (Blanco) Merr. & Rolfe	Ddao	Anacardiaceae	Dao	Dao	VU	NE	Yes
Dracontomelon edule Merr.	Dedu	Anacardiaceae	Lamio	Lamyo	VU	NE	Yes
Calophyllum blancoi Planch. & Triana	Cabla	Clusiaceae	Bitanghol	Bitanghol	EN	NE	Yes
Dipterocarpus validus Blume	Dval	Dipterocarpaceae	Hagakhak	Yakal lapad dahon	NE	CR	Yes
Parashorea malaanonan (Blanco) Merr.	Pmal	Dipterocarpaceae	Bagtikan	Bagkitan, Lauan	NE	CR	Yes
Shorea almon Foxw.	Salm	Dipterocarpaceae	Almon	Almon, Lauan	VU	CR	Yes
Shorea contorta Vidal	Shoco	Dipterocarpaceae	White Lauan	Lauan puti	VU	CR	Yes
Shorea palosapis (Blanco) Merr.	Shopa	Dipterocarpaceae	Mayapis	Mayapis, Mana	NE	CR	Yes
Diospyros philippinensis A. DC.	Dphi	Ebenaceae	Kamagong	Mabolo, Ituman	CR	EN	Yes
Intsia bijuga (Colebr.) Kuntze.	Ibij	Fabaceae	Ipil	Ipil	VU	VU	Yes
Pterocarpus indicus Willd.	Pind	Fabaceae	Narra	Narra, Naga	VU	CR	Yes
Wallaceodendron celebicum Koord.	Wacel	Fabaceae	Banuyo	Banuyo	NE	NE	Yes
Afzelia rhomboidea (Blanco) Vidal	Arho	Fabaceae	Tindalo	Bayong, Barayong	EN	VU	Yes
Toona calantas Merr. & Rolfe	Tcal	Meliaceae	Kalantas	Kalantas, Lanipga	CR	NE	Yes
Tristaniopsis decorticata (Merr.) Peter G. Wilson & J.T. Waterh.	Tdec	Myrtaceae	Malabayabas	Tiga	CR	NE	Yes
Artocarpus blancoi (Elmer) Merr.	Abla	Moracaeae	Antipolo	Antipolo, Tipolo	EN	VU	Yes
Palaquium luzoniense (Fern.-Vill.) Vidal	Pluz	Sapotaceae	Nato	Nato, Nato puti	VU	VU	Yes
Diplodiscus paniculatus Turcz.	Dpan	Tiliaceae	Balobo	Balobo, Barobo	EN	VU	Yes
Vitex parviflora Juss.	Vipar	Verbenaceae	Molave	Tugas, Hamorawon	EN	VU	Yes
Vitex quinata (Lour.) F. N. Will.	Vqui	Verbenaceae	Kulipapa	Kulipapa, Lima-lima	NE	NE	No

*CR- Critically endangered; EN - endangered; VU - vulnerable; and NE - not evaluated; DAO 2007-01 - Department of Environment and Natural Resources Administrative Order S. 2007; IUCN - International Union for Conservation of Nature.

Table 2. Summary of the main questions asked during the survey and the possible responses.

Question	Possible answers
Age classes, gender, educational attainment	< 30/30-49/50-69/≥70 years old; male/female; not completed primary/completed primary/not completed secondary/completed secondary/not completed tertiary/completed tertiary/post-graduate
Nursery type, years of operation	DENR/private/communal/NGO/municipal;<5 years/5-10 years/above 10 years
Sources and mode of acquisition, type of planting materials, preferred species	Native forests/trees outside forests; collected/bought; seeds/wildlings/both; list of species
Do you decide what species to produce	Yes/no
Familiarity on 20 focal species, reasons for cultivating or not cultivating	Very familiar/ familiar/ not familiar; availability of planting materials/demand/ lack of knowledge on propagation
Perception of the conservation status of focal species	Critically endangered/endangered/vulnerable/ no idea
Are you interested on focal species if planting materials are available and which species, reasons for interest, expected problem on producing the species of choice	Yes/no; list of species; excellent wood quality/ species are already rare; limited propagation skills/germination problem/germination problem/problem on pests

Figure 2. Use of wildlings in nursery. Freshly collected wildlings of *Diospyros* sp. ready for potting (A), and wildlings with leaves trimmed and transplanted into the pots (B).

Data were first standardized before running PCA. Pearson correlation was also conducted to see relationships between the focal species grown, species preference and knowledge on the species. Test of normality was performed using Shapiro-Wilk and non-normal data was first log-transformed before correlation with other variables was conducted. The categories of the variable "Familiarity" were reduced into familiar (very familiar + familiar) and non-familiar and only the counts of the former for each species were considered for correlation analysis. The same was done for perception wherein the categories critically endangered, endangered, and vulnerable were totaled and served as counts for each species. Relationship between education level and number of species (from 20 focal species) known by respondents were determined using Spearman. Chi-square test between education level and nursery grouping was also performed. We also combined nursery and inventory data by graphing the proportion of nurseries cultivating the 20 focal species and the frequency of occurrence of the said species in the 10 remnant forests in order to visually see relationships between them.

RESULTS AND DISCUSSION

Overview of the nurseries in the study sites

The 29 nurseries surveyed in this study included individual or family-operated (7%), group or communal (45%), non-government organization (NGO) (3%), CENRO-DENR (28%), university-based (14%) and a municipal nursery. Some of these nurseries were relatively new (≤5 years, 38%) while others (24%), such as the DENR nurseries, were long established (>10 years). Majority of the respondents were male (72%) and were in age classes 30-49 (52%) and 50-69 (48%). Unlike the more or less permanent nurseries of the DENR and those based in universities, individual and communal nurseries are generally temporary in nature, with communal lones being mostly dependent on DENR projects, and are likely to cease operations upon withdrawal of support from funding organizations (Edralin and Mercado Jr., 2010). Operators of communal nurseries are mostly members of different people's organizations (POs) that were formerly organized by DENR and which became active again following the recent implementation of the NGP. Most of them are also beneficiaries of Community-based Forest Management Program and the seedlings they produced were the ones to be planted in their respective project areas, paid for by DENR. Nursery operators are also open to seedling production through contracts with other agencies, e.g. with the Department of Agrarian Reform or local government units, both of which take part in NGP activities. For nurseries bound to a project, the species they produce are dictated by support agencies (Mercado and Duque-Piñon, 2008). Academic institutions offering forestry education also maintain nurseries for teaching and research purposes while the DENR mainly produce seedlings for reforestation projects and for limited free distribution to interested individuals or organizations.

Nurseries utilize any planting material in their production, but in most cases they use wildlings (Figure 2) for native trees as it is easier and faster to produce seedlings than from seeds and it is easier to meet production targets. Another reason is that wildlings can still be available, even when collection is delayed. Seeds of native tree species are only used if they are accessible and respondents know or have experience of growing them (for example, *Pterocarpus indicus* or *Vitex parviflora*). Seeds of dipterocarps are also rarely used due to their long fruiting interval. For the common non-native trees, seeds are usually used as planting material, with the exception of *Swietenia macrophylla* where both seeds and wildings are used. None of the nurseries employed vegetative or clonal propagation techniques.

Positive trend in growing native tree species in nurseries

A variety of tree species are produced in nurseries along with other growth forms, such as bamboo or rattan. A total of 138 tree species were recorded across the nurseries, 73% of which were native species (see some examples in Figure 3) with 25% being included in the list of threatened species of the Philippines (DAO 2007-01). A few of the native species (3%) are grown chiefly for their fruits (for example, *Canarium ovatum* and *Zyzygium cuminii*). In contrast, of the non-native trees, the majority is principally cultivated for fruit production such as coffee or cacao (54%), while 27% are grown for timber with the rest being grown for ornamental purposes, and particularly for urban forestry projects of the DENR.

The high frequency of native tree species produced in the current study is in contrast with that which was observed some ten years ago in the Visayas and part of Mindanao. In the current study, *S. macrophylla* belongs to the top 10 most common tree species grown in nurseries while the rest are native species (Table 3). For instance some dipterocarps such as *Shorea contorta* and *Parashorea malaanonan* are still among the most impor-

Figure 3. Native tree species in nurseries: (A) *Pterocarpus indicus*, (B) *Agathis philippinensis*, (C) *Shorea contorta*, (D) *Shorea almon*. Except for *Pterocarpus indicus* which was produced from seeds, these planting stocks were produced from wildlings.

tant native species produced in nurseries. The dominance of non-native tree cultivation in the past, as demonstrated by Mercado and Duque-Piñon (2008) for Mindanao, was due to the large demand for reforestation and tree farming which was promoted by the government. It should be noted however that the number of respondents in the previous studies were higher as compared to the current study due to the fact that a census of both active and inactive nursery operators was conducted as in the case of Gregorio et al. (2010). Nonetheless, the same groups of respondents were covered in all these studies which allows for comparison with the current study.

Although non-native timber species still represent important cultivars for nurseries in the current study, the numbers of nurseries producing them are much lower than those producing native species. What is also encouraging is the observed change in species preference of nursery producers, which are now more inclined to cultivate native trees. However, we think the large number of nurseries producing native species is more of a result of government programs and, partly, developmental NGOs, rather than an increase in seedling demand by smallholder tree farmers. In particular, the current interest of nursery producers towards native tree species can be attributed to the objectives of the NGP of DENR in increasing the range of species and placing importance on native species in addition to non-native species, which consequently created a market for this kind of planting material. However, it remains uncertain as to whether native trees will continue to be the dominant species in nurseries following the cessation of the NGP project in 2016. The types of species produced by communal nurseries are therefore influenced by the government (e.g. DENR), a situation that can similarly be observed for Vietnam (Hoang et al., 2011) or China (He et al., 2012).

The focal tree species

Nurseries can play a key role in forest conservation (Roshetko et al., 2010) by producing the desired regeneration species, which in our case includes the 20 focal species. The more important focal species produced in nurseries, such as *Pterocarpus indicus* (69%), *Vitex parviflora* (59%) or *Shorea contorta* (55%) (Table 3), also count among the common tree species previously grown in the Visayas (Gregorio et al., 2004, 2010). Five of our focal species (*Toona calantas*, *Afzelia rhomboidea*, *Intsia bijuga*, *P. indicus* and *V. parviflora*) were among the species tested for field trials in the Philippines a century ago (Orden 1960), but only the latter two species remain popular today. Other focal species such as *Diplodiscus paniculatus* (3%), *I. bijuga* (3%), *Vitex quinata* (7%) and *Tristaniopsis decorticata* (7%), were only produced in a few nurseries or none at all, as is the case of *Dracontomelon edule*.

Factors affecting the production of focal species

Nurseries that are distant from natural forests may experience difficulties in accessing planting materials, which could be the case for 28% of nurseries located in towns. A relatively high proportion of respondents mentioned non-availability of planting materials as the main reasons for not producing *A. rhomboidea* (62%) and *T. decorticata* (55%), while 45% cited the same reason for *Shorea almon* and *Diospyros philippinensis*. Respondents also indicated a preference for producing *Wallaceodendron celebicum* (66%), *Parashorea malaanonan* (59%) and *A. rhomboidea* (52%), but they were constrained by the non-availability of planting materials. Thus, most nurseries mainly raise focal species with seeds locally available, as was previously observed in Leyte (Gregorio et al., 2010). As a result, planting materials are also collected from trees outside forests or from any source that could include trees near nurseries (Wightman, 1999).

In our study, this is most likely the case for *P. indicus*, the country's national tree, where there are mature trees as seed sources planted in the premises of many government institutions and in parks and roadsides in urban areas. *V. parviflora* and *D. philippinensis* are also among the species where planting materials are additionally collected from trees outside forests, the latter species being common in schools because of its edible fruits. The practice of collecting planting materials from any sources however is not advisable as it may lead to the production of poor quality seedlings (Graudal et al.,

Table 3. List and ranking of most common tree species produced in the previous and current study in the Visayas (and Mindanao[b]). The same group of nurseries, e.g. government and communal nurseries (also supported by the government, for example, DENR) were covered in these studies. Species indicated by (-) means they are not reported and values inside parenthesis represent the number of nurseries surveyed.

Species	Percent of nurseries producing the species and year study was conducted				Origin of species with respect to the Visayas
	2003 (74)[a]	2006 (48)[b]	2008-2009 (96)[c]	2012 (29)[d]	
Pterocarpus indicus	30	29*	34	69	Native
Swietenia macrophylla	56	35	70	66	Non-native
Vitex parviflora	11	-	-	59	Native
Shorea contorta	15	-	26	55	Native
Diospyros philippinensis	-	-	-	41	Native
Calophyllum blancoi	-	-	-	34	Native
Parashorea malaanonan	-	-	-	28	Native
Artocarpus blancoi	-	-	-	24	Native
Dracontomelon dao	-	-	-	21	Native
Afzelia rhomboidea	-	-	-	21	Native
Cinnamomum mercadoi	-	-	-	21	Native
Gmelina arborea	49	30*	47	17	Non-native
Acacia mangium	32	-	35	17	Non-native
Eucalyptus deglupta	12	48**	-	none	Non-native

[a]Gregorio et al., 2004 (Leyte), [b]Carandang et al., 2006 (year conducted not reported, 75% of nurseries were from Mindanao), [c]Gregorio et al., 2010 (Leyte, data gathered through census and included inactive nurseries or nurseries no longer producing seedlings), [d]Present study. *Estimated (cited as most common species but figures not reported), **as reported but mostly produced in Mindanao.

Table 4. Pearson correlation matrix for the number of respondents growing each focal species, their preference, familiarity and perception on their conservation status. Unit of analysis is number of species (n=20).

Variable	Species grown	Preferred species	Perception of conservation status	Familiarity of species
Species grown				
Preferred species	0.03			
Perception of conservation status	0.90**	0.04		
Familiarity of species	0.90**	0.08	0.99**	

**p<0.01.

2009).

On the other hand, *Artocarpus blancoi* was considered by 51% of the respondents as being non-priority for production due to limited demand because of its abundance outside forests and probably due to its lower utility as compared to the dipterocarps and other known species.

Germination difficulties also discouraged a small proportion of respondents from growing *D. dao* and *V. parviflora.* Nevertheless, the non-familiarity of respondents with many of the focal species was also one of the reasons why some of the focal species were not produced, even if they were available in the nearby forests.

Local knowledge on focal species

Aside from availability of planting materials and demand as mentioned by the respondents, knowledge (in terms of familiarity) of species or lack thereof is among the most important factors why focal species were grown or not in nurseries. A particular species may not be produced even if it is available if nursery producers are not familiar with it.

Here our results show strong relationships ($p<0.01$) between the numbers of respondents familiar to the focal species and the respondents growing the species (Table 4). A strong relationship ($p<0.01$) also existed between species grown and perception of the conservation status

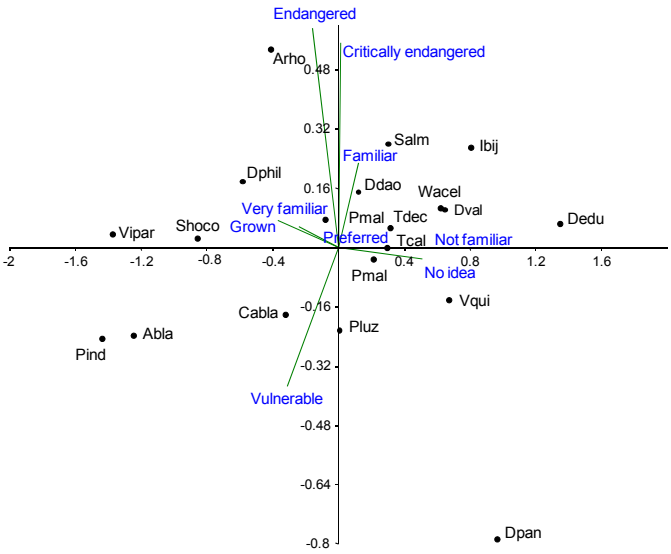

Figure 4. PCA biplot of number of focal species grown by respondents, their familiarity and perception on conservation status of species. Eigenvalues: PC1=0.62, PC2=0.07.

of focal species which is not surprising due to strong relationship ($p<0.01$) between perception and familiarity of the focal species. The species which are very familiar to the respondents (for example, *P. indicus, S. contorta, V. parviflora*) are likely to be grown in nurseries and those species which the respondents are not familiar with or have no idea about (for example, *Dracontomelon dao*, *Intsia bijuga, Dipterocarpus validus*) are likely not to be produced. The PCA biplot (Figure 4) showed a gradient of species (left to right of x axis) which are very familiar to not familiar. A study from Gadumire sub-county Uganda by Tabuti (2007) also showed similar results, with a strong relationship between community perceptions and findings from a quantitative study regarding the plant population dynamics of 16 woody species. Species preference did not show any correlation with the focal species grown, familiarity and perception of the conservation status which indicate that respondents may explore or select other tree species if planting materials are available.

Familiarity and perception of the conservation status of the focal species could possibly be influenced by the educational background of respondents. Here, our results showed strong relationship ($p<0.05$) between respondents' educational attainment and the number of focal species familiar to the respondents. We observed that the majority of respondents in government nurseries were highly educated, which was in contrast with respondents operating communal or individual nurseries, where most had low levels of education (Table 5). This result is similar with the finding of Vodouhê et al. (2010), who found that the level of education affects local people's perception of biodiversity and conservation.

Knowledge can also generally be associated with uses or economic value of the species. For instance, the so-called premium tree species (for example, *V. parviflora* and *P. indicus*) are popular because their wood is used for expensive furniture, and this is one of the reasons why they are already endangered.

Rarity of focal species in forests and nurseries and its implication for reforestation

We graphed the relationship between the presence of the focal species grown in nurseries and their actual occurrence in forest remnants (Figure 5). Some focal species (for example, *Palaquium luzoniense, Shorea palosapis* and *Calophyllum blancoi*) that are common and still widespread in natural forests are inadequately represented in nurseries. For high-diversity restoration, such species should be included as their planting materials are expectedly available. Some other rare species (*V. parviflora* and *P. indicus*) still found their way into nurseries as among those widely produced. While it appears that seedling production of these species is not that problematic, what is needed is to ensure that planting materials used are of good quality, both genetically and physically (Kindt et al., 2005). In addition, a few species that are relatively common in the forests are produced in a number of nurseries, suggesting higher chances of seeing established plantations composed of such species in the future. However, there are species (*D. edule, D. dao, A. rhomboidea, Dipterocarpus validus, D. paniculatus* and *W. celebicum*) that are more problematic because they are rare in the forests and even rarer in nurseries. Such species of course deserve special attention with respect to conservation. Many of our focal species are confined to only a few forest remnants or to one or a few islands in the Visayas. In this case, it is suggested as a first step to establish a localized plantation of focal species (Tolentino Jr., 2008), the composition of which will depend on the planting materials available in each area. Expansion to other areas and/or islands in the Visayas can follow later when enough sources of planting materials become available after the established plantations mature.

Challenges in producing the focal species for biodiversity conservation

Interest in some focal species is high and nursery growers are willing to take chances on alternative species where they know that demand or uses of the species exist (Nieuwenhuis and O'Connor, 2000), or where seed sources and, possibly, production technologies are available (Carandang et al., 2006). The bigger challenge is how to sustain such interest and extend it to actual tree planters so that they can include species that are already

Table 5. Results of x^2 tests of comparison between respondents' education level and nursery grouping (n=29). Education level were re-coded into three categories to minimize the number of cells with expected count of less than 5.

Nursery group	Education level			Chi-square	Degree of freedom	Significance
	Primary school and below	Reached/ completed secondary	Tertiary and post-graduate			
Smallholder (private and communal)	5	7	3	11.15	2	0.004**
Government (including NGO)	0	3	11			

**Significant at p<0.01; minimum expected count is 2.4.

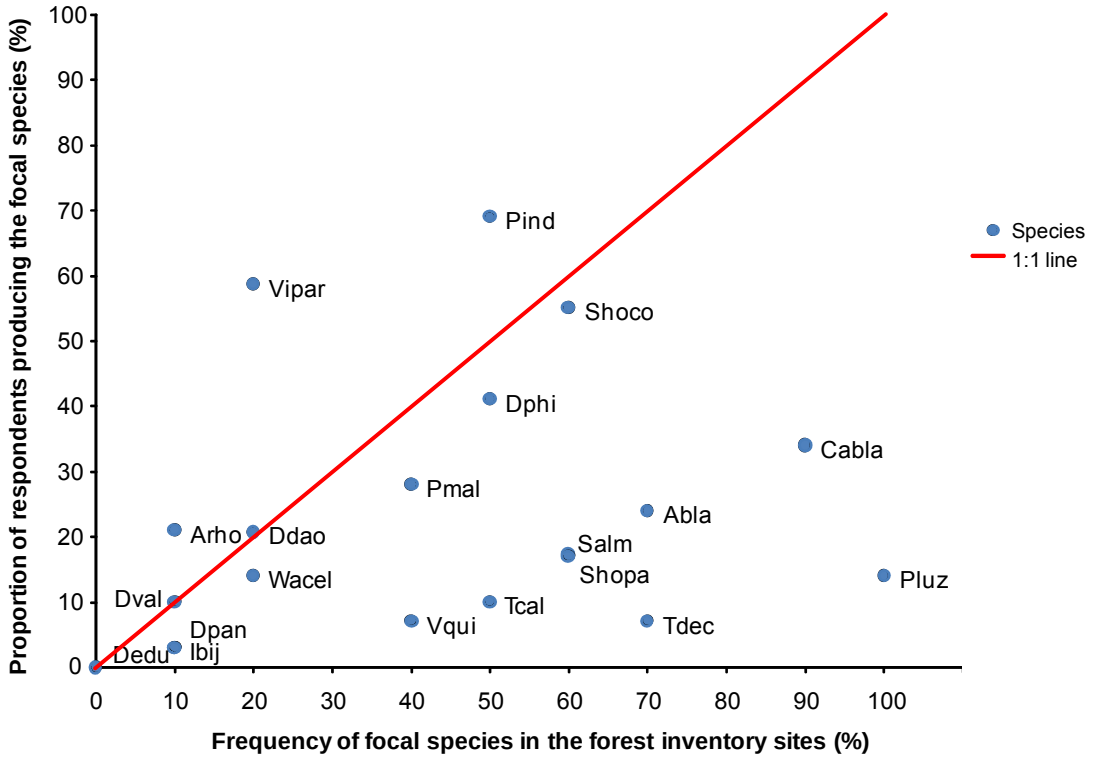

Figure 5. Relationship between the frequency of 20 rare tree species in remnant forests and in nurseries across the Visayas. Refer to Table 1 for species codes.

rare or endangered. Another obstacle is the common belief that growing native species is particularly difficult (Shono et al., 2007; Neidel et al., 2012; Schneider et al., 2014), which may discourage most tree planters. Information from recent studies in Leyte showed a positive performance of some native tree species in open grasslands (Schneider et al., 2014), which could serve as a guide for future tree planting programs. In addition, the concept of payment for environmental services seems fitting and a better alternative for tree planters' vis-a-vis harvesting planted trees (Yonariza and Singzon, 2012). Availability of planting materials is also another concern that affects the kind of species and sustainability of seedling production (Carandang et al., 2006; Gregorio et al., 2004; Harrison et al., 2008). This problem is aggravated by the lack of experience of many respondents in growing rare species, particularly from seeds. Thus, it is imperative to identify mother trees (Gregorio et al., 2004) within the region and make the information available to all.

The above issues are even more difficult than one might think and addressing them by a one-fits-all solution will probably not work. Mainstreaming rare trees in reforestation may only be possible when interest in such species transcends from nurseries to actual tree planters, which can possibly be achieved with help from various key players such as the DENR, developmental NGOs or universities that have a focus on forestry-related programs and activities in terms of advocacy, technical, market and legal support (Degrande et al., 2013).

Conclusion

The current study suggests that the production of native tree species has increased but we found that our focal species, irrespective of their status in the forests, are disproportionately cultivated in nurseries. Some species that are inadequately represented in nurseries, and especially the non-dipterocarps, are similarly rare in native forests while some species that are still common in forests are also rare in nurseries. Although the number of rare native tree species in the nurseries of the Visayas has increased, there is still a need to include more rare species. The production of seedlings in nurseries is influenced by a legion of factors including the availability of planting materials, knowledge on the species and, more prominently, the available market opportunities that resulted from the implementation of the NGP. In relation to the NGP and future forestry programs that may involve the planting of native species, it is essential to consider tree species identified as locally rare and endangered as priority species for production. Education has been found to influence knowledge on focal species, and together with training, they can play a key role in mainstreaming native species in reforestation programs. This is even more possible in relation to the implementation of NGP as DENR tasked selected universities in the country to help them augment their capacity to produce many quality planting stocks of native tree species (Philippines Official Gazette, 2012). Universities can play a crucial role in identifying and recommending to DENR priority tree species for conservation that are rare and endangered while developing and/or enhancing production technologies for these species. The production of rare species requires knowledge on the location of mother trees and potential seed sources as well as skills in collecting planting materials and production techniques to ensure that quality seedlings are produced.

Conflict of Interests

The author(s) have not declared any conflict of interests.

ACKNOWLEDGEMENTS

We thank Junar Lendio for his invaluable assistance in the conduct of this research and the Deutsche Akademischer Austauschdienst (DAAD) for the scholarship received by the first author. This publication was supported financially by the Open Access Grant Program of the German Research Foundation (DFG) and the Open Access Publication Fund of the University of Göttingen.

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