Tree Owners' Characteristics and Practices that Define Timber Form for *Gmelina arborea* Roxb.

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ABSTRACT

Gmelina (*Gmelina arborea* Roxb.) is the most important timber species in Nueva Vizcaya and neighboring provinces in the northern part of the Philippines in terms of current contribution in wood supply and the available timber stocks in almost all lands where people plant trees. However, seeing possible supply problems in the future because the rate of planting is not making up for harvesting, a study that supports tree improvement for increasing wood yield was conducted.

The study presents different tree forms that tree owners may prefer, namely, bole form, presence or absence of upright branches, crown form and branch angle. These tree forms are alternative to the obvious choice of form for timber yield which is long, straight, and branchless — the form that converts well to lumber. Factors that may affect preferences were also explored. Regeneration techniques, occupation, education, crown diameter, diameter at breast height, and silvicultural practices appeared to be associated with the desired timber form of tree owners.

INTRODUCTION

Gmelina (*Gmelina arborea* Roxb.) is the most widely planted tree species in Nueva Vizcaya province, Philippines. Its role in local wood supply becomes more important as a consequence of the ban on harvesting naturally growing timber. More than 90% of the wood supply in the Cagayan Valley Region where Nueva Vizcaya is one of them, based on reported transactions in 2013, was Gmelina (FMB, 2013). Despite this economic importance, yield per unit area is low due to poor tree management and the mismatch between the species and site (DENR-ERDB, 1998). Potential for tree improvement is great with effort coming from the tree owners themselves and supported by scientific approach in tree improvement. As one of the initial steps, research on ideotype promises to play a key role. In plant breeding, the concept of ideotype refers to the idealized appearance of a plant variety (Dickman, 1985). The desired product must be specified which, in the case of the study, is lumber or wood (Leakey, 2000).

Along this concept, the study explores tree owner or farmer-based tree improvement schemes hoping that key silvicultural and plantation management strategies are going to emanate from tree owners themselves. These tree owners, many of whom are smallholder farmers, are important entities in wood supply because of their number, possession of forest land parcels, and the potential of being receptive to tree management technology. However, planting of Gmelina or establishment of plantations has been declining due to low yield, myths that plantation tends to deplete water tables and invade other plant communities, and promotion of planting of native trees in forest lands.

This study intends to contribute to revitalizing interest in fast growing tree species, in general, and in Gmelina in particular. Gmelina dominates current timber stocks within or outside forest lands in Nueva Vizcaya. Moreover, it constitutes the bulk of wood marketed in low-lying municipalities of the province.

There have been no local studies that investigate farmers' preferences on fast-growing plantation species. Although it is assumed that Gmelina is still on top of the choices as it continuously dominates the local wood supply. This situation can be readily observed in furniture shops and lumber stores and even in households.

The study provides an analysis of preferences of the potentially great suppliers of wood, which are the small farmers in the upland. New knowledge was expected to be generated from analysis of the relationships between preferences and farm or landscape characteristics, and the relationship between tree traits focusing on timber as the product. There would be a large variation of desired traits which would inspire tree breeders or tree improvement practitioners to work on. For silviculturists, these variations may be addressed by matching desired traits with site factors, or in other words, more appropriate positioning of trees in the farm. For sure, development interventions are going to benefit from the study. In addition to technical aspects, outcomes of the research are useful for crafting policies intended to support sustainable wood supply for local communities. The results of the study are also aimed at providing insights on the local wood business as regards to supply, wood quality, marketing, and product prospects.

The specific objectives of this paper are: a) to present the characteristics of tree owners, their farms, and trees or stands; and b) to determine the relationships between tree owners' characteristics and practices, and their preferences on timber forms.

MATERIALS AND METHODS

The study used a survey to collect data about tree owners' characteristics, practices and preferences on tree traits. Illustrations were used to elicit responses. Respondents were selected through an opportunistic sampling method. Correlation analysis was used to determine relationships between variables.

Drawing Samples

Planting of Gmelina is widespread in the province of Nueva Vizcaya. The tree is found everywhere in various planting configurations. Because planting is so widespread, a complete listing of tree owners does not exist. However, offices that promote tree planting and greening activities such as the Environment and Natural Resources Office in Nueva Vizcaya and the Community Environment and Natural Resources Office of Department of Environment and Natural Resources (DENR-CENRO) hold information about Gmelina such as names of project participants and their addresses. Through the assistance of these offices, the key informants and owners of Gmelina plantation or trees were found.

The researcher located the key informant first. They were tree owners, owners of furniture shops, workers in furniture shops or operators of chainsaws. These key informants provided the names of tree owners in their localities. A sketch map was used in pinpointing the location of houses, farms, and plantations of potential respondents. Though some of the potential respondents were not considered due to accessibility problems.

The study was then able to make a consolidated list of owners where 40 respondents were drawn randomly but only 34 respondents agreed to be interviewed.

Designing Survey Instruments

Designing the survey instruments went through a systematic process. First, literature was searched thoroughly to find

related research methodologies, technical terms, and measurement standards. Second, key informants that are highly knowledgeable on the technical aspects of use of Gmelina wood were interviewed. In the province, the wood is primarily used only for structural applications, furniture and firewood. Examples of technical information were the minimum diameter and lengths of logs taken for sawing, preferred log length, minimum age of trees cut for sawing into lumber, wood defects, and some silvicultural practices directed at improving wood yield. This information was used in writing the survey instruments. Third, careful attention was paid to the detailed procedures of measurement and observation of tree dimensions particularly those that are not commonly observed in plantation inventory such as recording of sweep and crook stems, tree lean, bole circularity, and crown characteristics.

Ten key informant (KI) interviews were made involving owners of and workers in furniture shops, chainsaw operators, and carpenters. Opinions solicited from the respondents include: a) age at which Gmelina is suitable for cutting for lumber, b) preferred length of log, c) minimum length of log, d) concept of bole straightness, and e) uses for which Gmelina wood is put on, and other useful questions. The results of the key informant interviews were used to create the interview schedule intended for owners of trees.

A workshop was organized to further refine the interview instrument. The workshop was attended by members of the two people's organizations, namely, Banila Agroforest Development Incorporated and Palabotan Agroforest Development Association. These organizations are engaged in various forestry projects including planting of Gmelina.

Sixty-five owners of trees joined the workshop on voluntary capacity. They were asked to fill out a questionnaire while each question is being discussed by the author with the aid of a PowerPoint presentation. None of them took part in the ensuing personal interview.

Colored photographs of sample individual trees were prepared to be able to show variation in tree form in an environment that is more or less similar to a reforestation or tree plantation site. Initial line drawing for each candidate species was prepared. Line drawing is widely used in species selection process and in ideotype development as a visual aid for eliciting farmers' preferences on general tree form, crown structure, branch orientation, bole structure and foliage characteristics (Raintree & Taylor, 1992).

Tree Owner Interview and Data

A face to face interview using a structured interview schedule was carried out. The interview drew data on the basic characteristics of the respondents, tree planting objectives, preference on Gmelina and its various traits, some silvicultural practices, tree location in terms of topography, and preferences on tree form (Table 1).

The variables of tree form preferences were carefully thought of based on key informant interview and workshop. For example, everyone would pick tall and straight-bole tree as their first choice; hence, the respondent was presented two possible second choices, e.g., thick-short bole versus thin-long bole, the lumber volumes of which are the same. Had it been a choice between a thick/large-diameter and long bole tree, and a long bole tree with sweep and crook, no one would pick the latter.

Stand Attributes

Stand attributes include diameter at breast height (DBH), merchantable height (MH), total tree height (TH), measures of stem straightness, tree lean, number of stems or forking, upright branches, bole circularity, crown width and crown thickness. Standard methods of measurements were adhered utilizing new techniques of measurements.

Table 1. Variables obtained from tree owner interview

Code	Variable Description	Type
Y1 = Bole_form	A choice between thick-short bole and thin-long bole. Presented illustration provides idea of similar volume between trees.	Binary
Y2 = Upright_branch	A choice between presence and absence of upright branches. Presented illustration provides idea of similar volume between trees.	Binary
Y3 = Crown_form	A choice between taller-than-wide crown and wider-than-tall crown. The shapes of the crown are distinct to each other.	Binary
Y4 = Branch_angle	A choice between a predominantly near vertical to less than 45o branches (1) and more than 45o to drooping branches (0).	Binary
Y5=Bole_roundness	Bole roundness at the DBH point of the bole, 1 for more or less elliptic and 0 for highly irregular or fluted.	Binary
Age	Age of respondent in years.	Continuous
Occupation	Occupation of respondents. All occupations deemed highly related to knowledge on tending trees (silviculture) are assigned "1", otherwise "0".	Binary
OwnShop	Whether respondent owns furniture shop (1) or not (0).	Binary
Income	Monthly income in pesos.	Continuous
Education	Education of respondent. Educations deemed highly related to knowledge on tending trees (silviculture) are assigned 1, otherwise 0.	Binary
NoYearsPlant	Number of years the respondent has been planting Gmelina. The value should an integer.	Continuous
FarmArea	Area of the land planted to Gmelina. The land is owned by the respondent or the respondent is care taker of the land.	Continuous
Motivation	Motivation or reason for planting Gmelina. 1 if reason tends to motivate respondent to increase tree volume, 0 otherwise	Binary
TreeAge	Age of trees or stand. Age is taken for trees that constitute the main canopy of the stand.	Continuous
WoodForSale WoodFurniture WoodFuel TreeFence StreamProtect TreeGreening TreeTrellis	Tree planting objective judged as low, medium or high priority for use of land. The respondent may choose more than one objective. 1 if low, 2 if medium, 3 if high.	Ranked
PreferGmelina	Preference to Gmelina. 1 if Gmelina will still be planted despite many alternatives, 0 otherwise.	Binary
HarvestAge	Age at which Gmelina is harvested.	Continuous
SilviPractices	Silvicultural practices intended to promote straight bole of trees. 1 if nothing is done; 2 if things are done to avoid disturbance; 3 if, in case of coppice, only the most vigorous shoot or shoots are selected; 4 if only the most vigorous seedlings, especially those that manifest straight stem, are selected; 5 if branches that are positioned low on stem are pruned; 6 if seedlings are set out at close spacing then thinning is done when needed.	Ranked
LandPrefSlope	Preferred area for planting in terms of slope. 1 if steep, 2 if moderate, 3 if level or nearly so.	Ranked
LandPrefProxi	Preferred area for planting in terms of proximity to water. 1 if too far, 2 if moderately far, 3 if close to the water.	Ranked
RegTechique	Regeneration technique practiced. 1 if wildlings, 2 if coppice, 3 if seeding from mother trees or if direct seeding, 4 if nursery grown seedlings. None of the respondents were using cuttings.	Ranked
ManageSprouts	Whether sprouts, in case of coppice, is managed or not. 1 if sprouts are managed, 0 otherwise.	Binary
HarvestSmall	Size of timber being harvested. 1 if size is suitable for large lumber or board, 0 otherwise.	Binary
Firewood	Whether tree or part of it is intended for firewood. 1 if tree is not intended for firewood, 0 otherwise.	Binary

RESULTS AND DISCUSSIONS

Demographic Characteristics of Respondents

Majority of the respondents (38.82%) were above 50 years old. Eighty-two percent (82%) of the respondents were male and 18% were female, while 94% of the respondents were married. Farming made up around 67% of all occupations. The other occupation categories were employment in government offices (11.76%), employment in private offices (17.65%), and self-employment (2.94%). Out of 34 respondents, ten finished elementary level and 12 completed high school. Four of them were able to complete vocational programs while eight were college graduates. Majority of respondents had income ranging from PhP 5,000.00 to PhP 10,000.00 (61.76%). The rest had monthly income ranging from P 21,000.00 to more than PhP 31,000.00. Most of the respondents who earn PhP 31,000.00 or above per month were retirees or pensioners.

Respondent's Motivation in Planting Gmelina

Various reasons for planting Gmelina were cited by the respondents when asked to respond to the open-ended question, "What motivated you to plant Gmelina?" These reasons are categorized in Table 2. Around 26% of responses were about regular source of income, i.e., timber or logs are sold or the wood is processed into products. Owners of plantations or those keeping large number of trees are likely the ones whose purpose is income.

Income may indeed be most important reason for planting fast growing species. Magcale-Macandog and Rocamora (1997) reported that despite decrease in price, smallholder farmers in Claveria in northern Mindanao, Philippines continued to cultivate Gmelina because of financial return, animal weight gain and ecological benefits.

Use of wood for personal consumption was also the major economic reason (20.59%). Wood goes to various uses ranging from fuelwood to furniture and fixtures to general construction applications. Four responses (11.76%) indicated participation in reforestation and greening projects of the government led them to planting the species. Gmelina is one of the major reforestation or greening species in the Philippines and the most widely planted species in Nueva Vizcaya. It was the number one choice for the Tree for Legacy Program. This program was conceptualized and pioneered in Nueva Vizcaya in 1993 (Plantilla, 2008). The program encompasses both economic and environmental objectives. Because of the success of the program, it was recognized and adopted by the DENR as a partnership management approach between itself and the local government (DMO 2003-09). However, the DENR ordered the indefinite suspension of the awarding of areas for Tree for Legacy in 2006 in view of the on-going review of existing policies on planted trees and agroforestry program (Ebreo, 2006).

One respondent cited the situation that Gmelina enjoys somewhat relaxed regulation on cutting and transportation. Because the tree is widely planted in private and government lands, the latter usually under tenure arrangements for individuals, community and corporation, there is an expectation that a lot of cutting and transportation activities are carried out. Strongly regulating cutting and transportation would mean significant cut on wood supply.

Respondents cited fast growth as one of the main reasons for planting Gmelina. Fast growth results in short rotation. Tree owners noted that they harvest the trees between 8 and 15 years. It means that within this range, the tree is able to reach the size and maturity (i.e., hardness of wood) that is suitable for harvesting for furniture, fixture or general construction purposes (Alipon & Bondad, 2011).

When asked about reasons for planting the tree, respondents would simply relate their use of the tree. The primary uses are furniture and fixtures. Furniture is indeed

the major product from Gmelina wood in Nueva Vizcaya (Briones & Vallesteros, 2004). Others are fuelwood and general construction applications. The tree is also used as live fence or often planted to mark boundaries between land properties.

Preference to Gmelina

In order to gauge how strong respondents, prefer Gmelina over other species, an option was offered to them. The option is that seedlings of native timber are provided to the respondents for free to encourage them to plant native trees. When asked whether they would still plant Gmelina the way they do that at present, 97% of the respondents said yes. They cited such as fast growth, ease of propagation, ease of maintenance, assured market, and relative ease of getting cutting and transportation permits.

Age at Which Trees are Harvested

Out of 34 respondents, 76% said that they harvest trees at age ranging from five to ten years (Table 3). In good site, Gmelina may grow in about eight years into 20 to 25 cm DBH (Bertomeu, 2006; Onyekwelu *et al.*, 2006) the size of log suitable for dining tables, beds, panels, and other applications requiring wide lumber pieces.

None of the respondents chose less than five years or more than 20 years. Occurrence of wood rot, especially butt rot and center rot, might be the reason why tree owners do not prefer growing the tree beyond 20 years. However, the crew recorded many "overmature" trees in different stands. Butt rot and center rot may originate from root rot which occurred at much younger age (Su-See Lee, 2003).

Table 2. Reasons for planting Gmelina among the respondents

Reasons	Count (no.)	Percentage (%)
Economic reasons		
One of the regular sources of income	9	26.47
Source of earnings in case of unforeseen or sudden need	1	2.94
Attractive demand and market for wood	1	2.94
Harvesting and transportation of wood not highly regulated	1	2.94
Wood for personal consumption	7	20.59
Engagement or participation in greening projects		
Reforestation and greening program	4	11.76
Tree for Legacy	8	23.53
Rate of growth and rotation		
Fast growing (not necessarily expecting cutting at young age)	9	26.47
Short rotation period	1	1.79
Specific uses of the tree or wood		
Recommended for live fence or boundary planting	3	8.82
Wood is excellent for furniture	6	17.65
Wood is highly suitable for general construction	4	11.76
Wood is very good for firewood	2	5.88

n = 34; multiple response variables

Table 3. Age (years) at which Gmelina is harvested.

Age Range	Count	Percentage
<5 years	0	0
5-10 years	26	76.47
11-15 years	6	17.65
16-20 years	2	5.88
>20 years	0	0
Total	34	100.00

Preferred Main Stem Form

Different forms of the main stem presented to the respondents (Figure 1). The stems are drawn in such a way that the lengths of the merchantable bole are comparable and the bends are highlighted, as well as the forking of branches above a certain MH. The respondents were asked to select two forms that they prefer.

One-hundred percent (100%) of the respondents selected Form 1 while half of them selected Form 5. Only three (8.82%) chose Form 3. Obviously, Form 1 is the best in terms of lumber recovery while Form 5, despite potential large volume reduction because of knots, was the second choice because the stem is much thicker than the others. Form 3 contains upright or vertically oriented branches that may grow into merchantable size. However, despite of brief explanation, only eight (23.53%) respondents

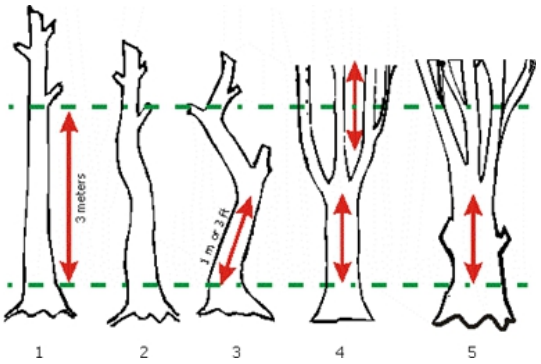

Figure 1. Five different main stem forms presented to respondents

picked out this form. Form 2 was selected by 9 (26.47%) respondents. Sweep, especially if they are at close interval, considerably reduces log quality as logs tend to be too short. Form 4 is the least preferred. Heavily crooked main stem reflects bad tree forms, often the characteristics of heavily disturbed trees.

Practices Toward Making the Bole Straight, Long and Less Branchy

There are various silvicultural techniques for controlling stem straightness. Tree owners and caretakers may be aware and actually practicing one or a number of these techniques. Presented in Table 4 are choices which are not mutually exclusive, hence, directed respondents to select as many as they want. Pruning of branches

Table 4. Techniques practiced by the respondents in ensuring bole to become straight, long and less branchy

Technique	Count (no.)	Percentage (%)
Plant and maintain trees in close spacing	22	64.71
Prune branches that are positioned low on stem	30	88.24
Select vigorous seedlings only especially the ones that manifest straight stem	23	67.65
In case of coppice, select the most vigorous shoot only, especially the one that manifests straight stem	21	61.76
Avoid disturbance to the tree	18	52.94
Other responses	5	14.71

n = 34; multiple response variables

that are positioned low on stem came out to be the majority's choice (88.24%). Pruning of branches is easy to perform.

Pruning of lateral branches encourages apical dominance. However, at relatively young age, Gmelina demonstrates self-pruning when planted at dense spacing (Hossain, 1999). Field observation would easily find out that planting and maintaining trees at close spacing results in long and straight boles while widely spaced trees tend to develop lateral branches, the size of which is dependent on the number of branches

In addition, majority of the respondents were aware of other silvicultural techniques ranging from nursery activities to tree protection. Setting out only the healthy seedlings in the field is believed to result in better tree quality while thinning the sprouts emerging from stump avoids overcrowding that results in formation of sweep and crook stems.

Removing Trees with Bad Form

Respondents were asked about whether trees with bad forms are retained or removed from the stand. In order to better elicit response, sample photographs (Figure 2) were shown to them depicting trees with severe sweep and crook stems, short bole or just around 1 m long, and tree with a lot of large major branches positioned low on stem. Seventy-six percent (76%) of the respondents said they retain the trees with those kinds of forms. Reasons cited for not removing trees include labor insufficiency, lack of money, lack of technical knowledge on stand management technique, and that the trees can still provide useful products.

Those who said they remove the trees with bad form were further asked to choose which tree with certain defect is likely to be removed first (Figure 3). The tree with abrupt bend in trunk came out to be the first choice followed by the tree that is too branchy. Both of them contain short logs.

(a)

(b)

Figure 2. Photographs showing: (a) severe sweep and (b) severe crook with log length only around 1 m long

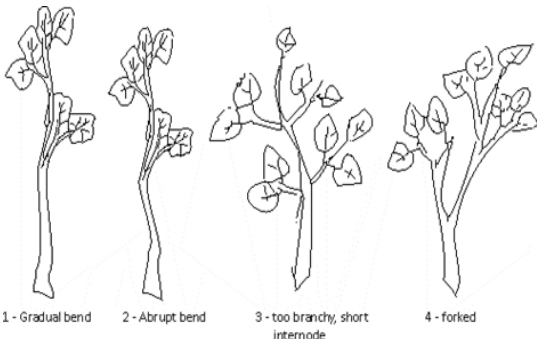

Figure 3. Drawings of tree forms used to elicit responses on what tree is likely to be removed first by the respondents as part of stand or plantation maintenance

Propagation Technique

Almost all respondents (94%) are using seedlings grown in nursery to stock their stands or plantations. They also use other planting materials or practice other regeneration techniques. In addition to nursery grown seedlings, coppice was identified by around 56% of the respondents while stocking the stand or plantation by means of direct seeding from mother trees is practiced by 26% of the respondents. None of the respondents are using high stump coppice and cuttings.

Those who practice coppice were further asked about what they do to thin the sprouts if necessary. Most of them said that they select sprouts that manifest straight stem. Only one or two stems are likely to be left on the stump and they do the final thinning when they are sure that the remaining sprouts will grow big. As regards mother tree, those who practice natural regeneration are leaving 10 to 20 trees per hectare.

Topographic Situation

Guided by an illustration, the respondents were asked about their opinion on which topographic situation do trees appear to be growing (i.e., height growth) best and poorly. Best growth is achieved along river, particularly in nearly level and gently sloping areas (Table 5). Growth is also desirable in nearly level slopes (far from river), gently sloping to moderately steep slopes, and along depressions such as gullies and creeks. Water availability seems to be an important determinant of tree growth along with soil nutrients. In contrasts, the respondents observed that growth of Gmelina is poorest in areas with steep slopes. These areas are generally characterized by low soil nutrients.

Minimum Size of Logs for Sawing

Most people in Nueva Vizcaya harvest Gmelina for various uses of wood primarily furniture and structural applications (Briones & Vallesteros, 2004). These uses require some minimum size for sawing, hence, respondents were asked to specify what they think are the minimum diameter and minimum length of logs. Most of the respondents said 30cm is the minimum diameter (73%) while 3m is the minimum length 90%. In contrast, the key informants from wood working shops said that the minimum diameter is

Table 5. Topographic situations judged as either best or poorly for planting Gmelina

Topographic situation	Best		Poorly	
	Count (no.)	Percentage (%)	Count (no.)	Percentage (%)
Nearly level	13	38.24	5	14.71
Gently sloping to moderately steep slopes	11	32.35	4	11.76
Steep slopes	3	8.82	26	76.47
Along depressions such as gullies and creeks	12	35.29	1	2.94
Along river (wide channel stream)	15	44.12	0	0.00

n = 34

Table 6. Different uses for which Gmelina is put on

Uses of Wood	Frequency (no.)	Percentage (%)
Structural lumber	32	94.12
Furniture and fixtures	31	91.18
Firewood	31	91.18
Panel boards	20	58.82
Kitchen wares, tool handles and similar products	9	26.47
Chips	2	5.88
Others (slab used for fences)	7	20.59

n = 34; multiple response variables

25cm while the minimum length is 3ft (or equivalent to 1m). Small and short logs, according to them, are useful for furniture such as chair and cabinet. Maturity is considered in taking small timber for sawing.

Uses of Wood

Gmelina is suitable to many uses, the most common of which were presented to the respondents. Three categories of products were picked by the respondents as the most common uses they intend their timber for (Table 6). These products are structural lumber, firewood, and furniture and fixtures. Percentages of responses on these three products or applications were almost the same suggesting that owners intend to use Gmelina for multiple uses. Secondary uses include firewood, panel board and fence material. Presence of buyers of products not locally manufactured at present, e.g., kitchen wares and tool handles, may affect the distribution of uses of Gmelina wood.

Bole Roundness

Majority of respondents (91%) picked circular bole over other bole shapes. Circular bole converts well to lumber or boards. However, two respondents (6%) chose oblong or nearly elliptic while one (3%) preferred bulging bole, reasoning out that these shapes are usually associated with big-diameter trees.

Juvenile Wood

Due to high demand, there is a tendency that trees are cut at young age, e.g., less than eight years. Technically, wood is juvenile and being so, performance is compromised. In order to assess the issue, respondents were asked to identify defects that they observe in wood that are associated with juvenile wood. Most of the respondents (71%) believe that young wood is indeed soft for structural application and for furniture and fixture. Warping and discoloration are also likely. In some cases, pith is being incorporated in lumber.

It must be noted that good practices in lumber processing are wanting in the locality. Good practices such as kiln drying, preservative treatment, and lumber grading are not practiced. In many instances, as related by the key informants, lumbers are not even dried fully before using or assembly. Improper drying results in dimensional changes in both juvenile and mature wood.

Tree Form and Preferences by Tree Owners

Interview respondents indicated their preferences on five traits, namely: bole form, presence or absence of upright branches, crown form, branch angle, and bole roundness. These choices are binary in nature allowing perception of distinct traits between only two choices. Empirical data indicate that trees in a stand may tend to be divided into the traits used here, e.g., presence or absence of upright branches, ovate versus laterally expanded crown, nearly vertical versus nearly horizontal first-order branches.

The variables pertaining to tree owners are a mix of characteristics, perceptions, practices and observations or field measurements. Examples of characteristics are age and occupation of tree owners or respondents. Examples of perceptions and practices are preference towards Gmelina and management of sprouts, respectively. Observations include MH, crown traits, forking, and many more.

Respondents made choice between thick-short bole and thin-long bole, wherein the drawing presented to the respondents provides idea of similarity of volume between the two boles. Both boles are straight and clear of branches for some distance. Tree owner, whose objective of tree growing is timber production, would always choose a tree with bole that is long and straight; hence, this trait is not fitted against bole that is sweep and/or crooked because these defects result in significant reduction in lumber volume.

The preference of participants of workshops and KIs did not tend to establish a clear choice between presence and absence of upright branches, between taller-than-wide crown and wider-than-tall crown, and between predominantly near vertical to less than 45° branches and more than 45° to drooping branches. Because of this, they were presented in the tree owner interview.

The study intended to see pattern of preferences between a certain tree trait and any of the following groups: tree owner socio-demographic characteristics, characteristics of the trees or stands, and physical characteristics of the land. The result indicates lacks of pattern between preference and tree traits. Socio-demographic variables such as age, ownership of furniture shop, income, number of years planting Gmelina, and motivation to plant the species did not seem to be related to any form options presented to the respondents. However, it must be noted that Bole_form (Y1) and Bole_roundness (Y4) are second choices as the form described as both long and straight and circular bole are the first choices, respectively. These forms must be targeted in tree improvement program.

The choice between thick-short bole and thin-long bole appears to be influenced by the regeneration technique; the former seems to be associated with establishment and regeneration techniques that promote crowded stand such as coppice and direct seeding (Table 7). On the other hand, farmers tend to space the nursery grown seedlings in systematic manner and at wider spacing resulting in larger diameter growth of trees.

Five independent variables came out to be significantly correlated with the presence or absence of upright branches, the direction of relationship is either positive or negative. Respondents whose occupations are perceived to be related to possession of knowledge on tree tending or management, e.g., forestry and horticulture, tend to prefer the "more normal" branching condition or they seem to dislike forking even at point positioned high on stem. Foresters, for example, tend to promote apical dominance in crop trees. With the foregoing, the result for Education is as expected. In contrast, the correlation coefficient of WoodForSale came out to be negative. This may be because trees are usually harvested at young age and, as observed by the researcher, formation of forked branches located high on main trunk comes at later age. The results for RegTechnique and CrownDiameter were expected. Occurrence and volume of upright branches are positively related to large diameter trees, which in turn are associated with wider spacing and larger crown of trees in general.

SilviPractices and DBH significantly correlated with crown form. Managed stands are associated with tall trees with long bole and small crown. In contrast, disturbance and absence of pruning and thinning result in trees having crown that is expanded laterally. Moreover, tree DBH enlarges in response to enlarging crown, which elaborates the food of the tree.

All of the expected relationships happened between branch angle and selected independent variables. Earlier, it was discussed that people whose education is forestry or related to it are inclined to prefer a more ideal tree form which includes branch arrangement. Tree age and branch angle are negatively related. Old trees would likely possess horizontal branches because of continuous lateral expansion of the branches, hence, gaining in weight. With regard to slope, it was observed in the field that Gmelina is

indeed likely to develop drooping branches especially in leaning trees. When it comes to the relationship between branch angle and MH and TH, whether the sign is positive or negative depends on the age of the tree or stand. It appears that what came out is negative because majority of the stands observed in the study were quite old. Aging tend to promote first order branches to grow in all directions.

CONCLUSION AND RECOMMENDATION

Preferences of tree owners on tree forms were creatively elicited and related to their characteristics and silvicultural practices. These tree forms appear to be highly workable for tree improvement research and the models can be directed to increase wood yield. The models do not only include one that contain thick, long and clear bole, which converts well to lumber but also those forms that can be considered as second choices. The first model is expected for well-managed stands located in good sites. The second-choice models are recommended in situations where control of stand characteristics is less optimal such as in coppice and wide-spacing situations. For example, the practice of coppice is characterized by lack of sprout management and irregular spacing. On the other hand, wide-spacing situations are associated with shorter bole and large branches, but improvement is likely by way of inducing the development of branches that assume the role of the main stem or bole.

The study contains rich information vital to tree improvement process. The status that Gmelina enjoys, that is being the primary source of wood for large number of uses, shall inspire efforts in revitalizing attention to the species so that sustained wood supply is achieved.

Table 7. Significant correlations between tree owners' preferences on form and tree owners' characteristics and perceptions, their practices, and the characteristics of their lands and stands

Y Variables	X Variables*	Coefficient	Probability
Y1 = Bole_form	RegTechnique	-0.42	0.01
	DBH	-0.37	0.03
	Crown diameter	-0.44	0.01
Y2 = Upright_branch	Occupation	-0.48	0.004
	Education	-0.38	0.02
	WoodForSale	-0.34	0.049
	RegTechnique	0.35	0.04
	Crown diameter	0.37	0.03
Y3 = Crown_form	SilviPractices	0.36	0.03
	DBH	-0.36	0.04
Y4 = Branch_angle	Education	0.38	0.02
	TreeAge	-0.39	0.02
	MH	-0.52	0.002
	TH	-0.37	0.03
Y5 = Bole_roundness	TreeGreening	-0.37	0.03

** Variables found in Table 1 are coded.*

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