doi: http://dx.doi.org/10.7719/jpair.v1i1.45

Domestication of Indigenous Timber Species in Degraded Open Karst Lands: A Decade of Experience

Rumila Cilocilo Bullecer PhD
Central Visayas State College of Agriculture, Forestry and Technology, Bilar, Bohol
mslling@yahoo.com

ABSTRACT

This study tested the domestication potential of 43 indigenous timber species in 1.2-ha degraded karst land. Survival, height and diameter growth performance and site factors were periodically monitored Results showed twenty-eight indigenous forest timber species thriving in an open karst area including 8 dipterocarps: narig, mayapis, white lauan, bagtikan, guisok-guisok, kalunti or manggasinoro, red lauan and yakal-kaliot. The non-dipterocarps include bitanghol & kalingag. Species with 100% survival were aniam gubat, bayokbok, ipil, kalumpit, lamog, puso-puso, sagimsim and taluto. White lauan had a survival of 96% and molave had 92%. Kalumpit had the highest increment both in height and diameter. Kalumpit was followed by dao, duguan, milipili. Among the dipterocarps, white lauan got the highest diameter and height growth increment. Narig, with its waxy leaf surface of all the dipterocarps, was tolerant under full solar exposure. Domestication farms should include or integrate fruit trees, vegetable trees (like bago or Gnetum gnemon) and other economic plants. Domestication trials of barit,. anislag, sudiang, other dipterocarps, bago, nito, sig-id, rattan and other sources of raw materials for handicrafts should also be tried.

Keywords: *Indigenous Timber Species*

INTRODUCTION

Upland environment rehabilitation, protection and development always involve the restoration of sufficient high vegetation or tree cover. It is because a good vegetation cover is the base or foundation of stable, productive landscapes and a healthy environment. Trees provide a range of products and services to rural and urban people.

Stable landscapes require at least 40% forest cover. The Philippine forests have been reduced to 8% of its original cover at the close of the 20th century. Bohol in particular had a remaining natural forest of only 4% from its original forested area. Forest denudation led to decimation of flora and fauna population which greatly affects the food or feeding capacity of the natural life support system. Even worse is the loss of biodiversity due to extinction of some species resulting from indiscriminate utilization and habitat modification. Forest loss can also result from changing land-use or development like opening a forest for agriculture or for a housing subdivision, industrial

complex, golf course and others. Furthermore, the loss of a good vegetation cover may also lead to temperature changes and global warming.

To combat environmental degradation and poverty, the government had launched various socialized forest programs which involved individual and group tree planti. Exotic species are inferior in wood quality than the indigenous species like molave (*Vitex parviflora*) and the *dipterocarps* like what lauan, apitong and narig and many others. Recognizing this, the local people continued to cut illegally the remaining indigenous timbers from the remnant natural forests despite the planting of mahogany and gmelina. Aside from being inferior in wood quality, the exotics also don't offer food for wildlife having inedible fruits. The local or native species have been found also most effective in stabilizing ecosystems.

Hence, there is an urgent need to *domesticate* the valued forest-timber species as well as increase its use in watershed rehabilitation projects. A recent research (Bullecer et al, 2002) in the island also revealed that people consider indigenous species as a very important source for medicine. The same survey revealed that inasmuch as the community folks want to domesticate the local timbers for their needs their main difficulty accordingly is the lack of planting materials, the inability to identify wildlings in the forest and the ungrounded common notion that forest-confined timbers are either impossible or difficult to grow in farms and other open areas especially if these are degraded.

OBJECTIVES OF THE STUDY

The **primary aim** of the study was to determine the potential domestication of some forest-grown timber species as a basis for proposing a tree domestication technol

Specifically it sought to determine which endemic forest timber species can thrive in open karst areas; the species which would have the highest survival rate, diameter at breast height (DBH) and total height. Furtheremore, it looked into the climatic, edaphic and other geological factors which characterize a potential domestication farm; the species are most sensitive to moisture stress and the tallest dipterocarp.

Significance of the Study

Policy makers from the local government units (LGUs) of the provincial, municipal and barangay levels, the Department of Environment and Natural Resources (DENR) and other line agencies, the Protected Area Management Boards (PAMBs) and non-government organizations (NGOs) governing or working with projects in the various watersheds of the province and beyond would find the research data highly useful in protected area rehabilitation and development programs / projects.People's Organizations (POs) involved in Community-based Forest Management Agreement (CBFMA) and Protected Area Community-based Resource Management (PACBRMA) projects would find the data and the trial planting area also useful in tree farming species and plantation technology selection.

Scope and limitation of the study

The study focused on the possibilities of domesticating indigenous forest confined timbers endemic to Bohol and the rest of the Visayas. It determined the survival, height and growth performance of some indigenous timber species planted in degraded karst areas which mainly characterized the uplands of Bohol these days. Intra- and interspecies effects were not yet part of this investigation.

METHODS

Research Design

A 1.2-hectare tree farm was established in a rainforestation method of faming which employ the selection of various indigenous tree species and planting them in a mixed manner.

The Timber Species Tested and the Research Environment

Some valuable indigenous timber seedlings and wildlings were gathered from the Rajah Sikatuna National Park and Loboc Watershed Forests. Other seedlings were obtained from the Rainforestation Project Nursery of then ViSCA now Leyte State University. The selection of the species was based on the domestication preferences of the tree growers from a previous related study and also from observations of timber extraction at the local forests by the community folks. The planting materials were 8 months to a little more than one year at planting time where most were 0.5 to 1.5 meters high.

The 1.2-hectare research area was part of CVSCAFT Main Campus in Bilar, Bohol. It is a degraded karstic piece of land on a rolling topggraphy with shallow soils and rock outcrops in some places. Prior to the research, the area was generally a scrubland dotted with a few remaining *Swietenia macrophylla* (mahogany) plants from a previous planting. Bilar has an elevation of 350 meters above sea level and belongs to the 4th type of climate receiving an annual rainfall of 2000 mm.

Preparation of Planting Materials

Wildlings. Wildlings of good form were selected from natural regeneration areas of the RSNP and Loboc Watershed forests in the municipalities of Bilar and Sierra-Bullones. The wildlings were carefully extracted making sure that a good number of rootlets remained intact. These were immediately placed in big transparent plastic bags which were held airtight in order to prevent or reduce transpiration which may lead to desiccation. Upon arrival at the nursery area, the leaves were reduced to 1/3 of its number or size to reduce moisture loss. These were root-pruned seeing to it that the primary root is topped-off and rootlets left intact facilitating ease in bagging the materials. These were potted in 5" x 7" polybags perforated at the sides and bottom. The potting media consisted of rich topsoil, compost and sand in a 6:3:1 mixture.

Preparation of the Planting Area.

The area was fenced to keep away stray animals and unwanted trampling by firewood gatherers. Partial brushing was done leaving behind the valuable native species to lend partial shade to some of the growing plants to be planted later. Holes one foot in diameter, foot deep, spaced at 1.5 to 2 meters apart were dug. The holes in some places were irregularly established due to the presence of rock outcrops and the few native vegetation left behind. The top soil was separated from the subsurface soil during digging. After the holes were completed, the top soil, mixed with compost and manure was returned first to the hole.

Planting Technologies

The seedlings were acclimatized to the area one week prior to planting. Before setting in to the hole, the plastic bag was removed by slitting open one side of it. Prior to slitting, the bag was squeezed by the hand sufficiently enough for the potting media to remain intact upon removal of the plastic. Long taproots and excess lateral roots were pruned. Leaf pruning was also made in some of the materials with old leaves or heavy foliage. The seedlings were planted in a mixed manner following the rainforestation method at a distance of 1.5 – 2.0 m.

Initial Data Gathering

Edaphic factors were taken on soil depth, texture, structure, color, NPK content and organic matter content. Elevation was taken with the use of a GPS or Global Positioning System device. Climate and rainfall data were taken from the Rainfall monitoring station of CVSCAFT Main Campus.The total height of each seedling was measured and recorded in meter or a fraction of it. Diameter was not taken as this is insignificant at the seedling stage.

Care and Maintenance

During the first year ring-brushing was done every three to 5 months to control the growth of weeds. The cut weeds were mulched at the base of the plant to provide organic fertilizer when fully decomposed. Mulching also conserved soil moisture during the hot months. Vines were also removed from the plants to prevent breakage and stem deformation. Brushing was done 3 times a year during the 2nd to the 4^{th} year from planting. After that it was reduced to twice a year. Mulching and liberation (removal of climbers and vines) were also done. Pruning of lower branches was also done when necessary. Survival was always noted during cleaning and other area visits. Replanting was done within a year from establishment. The subsequent missing hills after the first year were planted but these plants were no longer considered for subsequent measurement.Decayed fence posts were also replaced from time to time.

Subsequent Data Gathering and Data Analysis

Subsequent biometry were taken evry two years. Survival and growth increment were analyzed after 8 nyears of growth. Qualitative observations were also noted on the health and vigor of the plants, reactions to moisture stress and shading or the lack of it.

Figures 1-2. Wildlings of narig (upper picture) and and white lauan (lower)were collected and raised atthe nursery until these were of plantable size

Figure 3. Prior to the establishment of the Rainforest Farm, the area was vegetated with a scrubby pioneer vegetation like balinghasay (*Buchanania arborescens*)

Figure 4. After 9 years, trees of the young timber stage, like the white lauans above, now occupy what used to be a nearly-barren area.

FINDINGS

Physical Characteristics of the Growing Area

Like the rest of Bohol, Bilar belongs to the fourth climatic type which is characterized by rainfall more or less equally distributed throughout the year. The elevation ranges from 300 to 350 meters above sea level. Daytime temperature ranges from 25 to 30 degrees Celsius on the average. The topography comprises of flat to rolling conditions with hills and low mountains interspersing the landscape. The geological base is karst which is characterized with surface features like sinkholes, caves and other forms of depressions.

Table 1 below shows the edaphic factors characterizing the research area where the domestication trial has been established. The pH still bordered around neutral to slightly alkaline after five years. Organic matter content has improved a little while NPK still remained insufficient.

Table 1. Edaphic Factors Characterizing The Domestication Farm

Soli pH Content		OM Content		Nitrogen		Phosphorus		Potassium		
Start	After years	5Start	After years	5Start	After years	5Start	After years	5Start	After years	5
6.8	7.3	2.5%	5.6%	..04	.08	.007	.05	.027	45	

Species Diversity and Initial Biometrics

Table 2 below shows the number of individuals planted per species, the initial heights of the seedlings and the average initial heights of each species. The number of individuals per species planted depended on the availability of wildling regeneration available of the growing season. Tuai, molave, mayapis, yakal-kaliot and Quisumbing guisok had the most number of individuals planted while only a single plantable specimen could be secured for akleng parang, alahan, alipatsau, anaiam-gubat, igyo, lingo-lingo, putat and sagimsim. A total of 534 forest trees with an average height of 0.85 meter, represented by 43 species and 20 families were planted at the research area. Diameter measurement was not taken at establishment time as the biometric feature comes significant only at the sapling / pole stage and onwards in the life of timbers.

Table 2. Population and Initial Biometrics at Establishment Time

Common Name	Scientific Name	Population	Height Range (m)	Ave. initial height (m)
1. Akleng-Parang	*Albizia procera*	1	.7	.7
2. Alahan	*Guioa koelreuteria*	1	1.4	1.4
3. Alipatsau	*Pygeum coccineum*	1	1.5	1.5
4. Aniam- gubat	*Antidesma subolivaceum*	1	1.0	1.0
5. Bagtikan	*Parashorea malaanonan*	18	0.5 – 1.5	0.96
6.. Bani	*Pongamia pinnata*	2	0.7 – 1.0	0.85
7. Bayok-bayokan	*Pterospermum celebicum*	8	0.8 – 1.6	1.34
8. Bayokbok (maksa)	*Elaeocarpus macranthus*	6	0.7 – 1.4	0.98
9. Bitanghol	*C. blancoi*	40	0.2 – 1.8	0.74
10. Bulibuli	-	4	0.2 – 0.8	0.48
11. Dao	*Dracontomelon dao*	11	0.2 - 1.8	0.57
12. Duguan	*M. philippinensis*	38	0.2-1.6	0.59
13. Gisok-gisok	*H. philippinensis*	18	0.2-1.4	0.78
14. Igyo	*Dysoxlum gaudichaudianum*	1	0.8	0.8
15. Ipil	*Intsia bijuga*	3	0.8 - 1.0	0.9
16. Kalingag	*C. mercadoi*	13	0.2 - 1.1	0.61
17. Kalumpit	*T. microcarpa*	6	0.9 - 1.0	1.02
18. Kalunti	*Shorea kalunti*	9	0.2 - 0.6	0.33
19. Lamog	*P. spectabilis*	3	0.3 - 1.2	0.63
20. Lingo- lingo	*Vitex turczeninowii*	1	1.4	1.4

21. Long-leaf nato	*P. elongatum*	2	0.2 - 0.6	0.4
22. Mabunot	*G. luzoniensis*	22	0.4 - 1.2	0.73
23. Malakauayan	*Podocarpus rumphii*	7	0.3 - 0.8	0.5
24. Malugai	*Pometia pinnata*	5	0.2 – 1.1	0.76
25. Mangansira		4	1.1 – 1.3	1.15
26. Mayapis	*Shorea palosapis*	57	0.2 – 1.7	1.02
27. Milipili	*Canirium hirsutum*	9	0.5 – 1.4	0.96
28. Molave	*Vitex parviflora*	59	0.4 – 1.5	0.77
29. Nangka	*Artocarpus heterophyllus*	3	0.5 – 1	0.7
30. Narig	*Vatica mangachapoi*	11	0.3 – 1.2	0.65
31. Nato	*Palaquium luzoniense*	2	0.2 – 0.5	0.35
32. Puso-puso	*Neolitsea vidalii*	2	0.5 – 1.5	1.0
33. Putat	*Barringtonia racemosa*	1	1.5	1.5
34. Rain tree	*Samanea saman*	3	0.6 – 1.4	1.03
35. Red lauan	*Shorea negrosensis*	11	0.2 – 1.2	0.76
36. Sablot	*Litsea glutinosa*	2	1.5 – 1.6	1.5
37. Sagimsim	*Syzygium brevistylum*	1	0.6	0.6
38. Taluto	*Pterocymbium tinctorium*	2	0.7 – 1.2	0.95
39. Taualis	*Osbornia octodonata*	1	.5	0.5
40. Tuai	*Bischofia javanica*	74	0.2 – 1.5	0.61
41. White lauan	*Shorea contorta*	24	0.6 – 1.5	1.1
42. Wisak	*Neonauclea media*	1	1	1.0
43. Yakal Kaliot	*Hopea malibato*	46	0.3 – 1.5	0.84
	TOTAL	**534**		**0.86**

Moisture-Sensitive Plants

During the first two summers or two dry seasons, the following dipterocarps had been observed to be more sensitve to early moisture stress at their seedling and sapling stage than the other plants: yakal-kaliot or Quisumbing guisok, white lauan and kalunti. They showed early wilting than the other dipterocarps. Narig had been observed as the most adaptive of the 8 dipterocarps in terms of moisture stress and growing in open sites. Narig has the thickest leaf cuticle of all the dipterocarps which may have accounted for its survival in open areas and to some degree of moisture stress.

Among the non-dipterocarps, mabunot, kalingag and duguan, puso-puso had been more sensitive to moisture stress than the others.

Table 3 below reveals an average diameter increment of 1.61 cm and height increment of 3.0 meters. Kalumpit had the highest increment both in height and diameter at 5.80 meters and 4.32 cm respectively . In terms of diameter increment, kalumpit was followed by dao (3.20 cm, duguan (2.65 cm), milipili (2.62 cm) and buli-

buli (2.62 cm) This was followed by dao, duguan, buli-buli, bayok-bayokan, millipili and mayapis. In terms of height increment , kalumpit was followed by milipili (5.74 m), bayok-bayokan (5.0 m), dao (4.10 m) and buli-buli at 4.08 m.

TABLE 3 Survival and Growth Increment of the Plants 8 Years from Establishment

Scientific name	Percent Survival	Ave.DBH (cm)	Ave. DBH Incre. (cm)	Ave. Total Height	Ave. Height Incre. (m)
Antidesma subolivaceum	100%	2.5	1.1	3.5	2.5
Parashorea malaanonan	78%	3.6	1.76	3.81	2.85
Pongamia pinnata	50%	2.5	1.2	4.0	3.15
Pterospermum celebicum	88%	4.4	2.43	6.34	5.01
Elaeocarpus macranthus	100%	3.98	1.73	4.98	4.0
Calophyllum blancoi	75%	2.38	1.10	4.03	3.29
	75%	4.26	2.53	4.56	4.08
Dracontomelon dao	82%	5.16	3.20	4.67	4.10
Myristica philippinensis	84%	4.33	2.65	4.32	3.73
Hopea philippinensis	78%	3.0	1.59	2.72	1.94
Instia bijuga	100%	2.37	0.70	2.87	1.97
Cinnamomum mercadoi	77%	1.63	0.86	1.84	1.23
Terminalia microcarpa	100%	7.08	4.32	6.82	5.80
Shorea calunti	78%	1.52	1.12	1.84	1.51
Planchonia spectabilis	100%	1.90	0.25	1.63	1.0
Gomphandra luzoniensis	77%	2.3	1.06	2.67	1.94
Podocarpus rumphii	71%	2.8	1.79	1.9	1.4
Shorea palosapis	88%	4.90	2.26	5.05	4.03
Canarium hirsutum	89%	5.7	2.62	6.7	5.74
Vitex parviflora	90%	2.74	1.08	2.56	1.79
Vatica mangachapoi	82%	3.18	1.52	3.46	2.81
Neolitsea vidalii	100%	1.75	0.85	3.4	2.4
Shorea negrosensis	73%	2.61	1.18	3.25	2.49
Syzygium brevistylum	100%	2.1	1.20	2.3	1.7
Pterocymbium tinctorium	100%	2.95	1.25	3.05	2.10
Bischofia javanica	70%	2.32	0.88	2.34	1.73
Shorea contorta	96%	7.24	1.94	8.57	7.47
Hopea malibato	85%	2.63	0.78	3.65	2.81
	85%	**3.35**	**1.61**	**3.82**	**3.0**

Over all results have shown that forest timbers can be grown even in degraded karst lands.

CONCLUSIONS

Based on the findings of the study, the following conclusions are forwarded:

1. Some twenty-eight species of indigenous forest timbers thrived in an open karst area. These included the following eight (8) dipterocarps: narig, mayapis, white lauan, bagtikan, guisok-guisok, manggasinoro, red lauan and quisumbing guisok. The non-dipterocarps include bitanghol, kalingag, sagimsim, bayok-bayokan and dao.
2. Species with 100% survival were aniam-gubat, bayokbok, ipil, kalumpit, lamog, puso-puso, sagimsim and taluto. White lauan had a survival of 96% and molave had 92%. Kalumpit had the highest increment both in heiht and diameter and followed by dao, duguan, milipili and buli-buli.
3. The research site had a 4th climatic type with an elevation of 350 meters above sea level. The soil pH revolved around neutrality with a slight increase in soil organic matter. After 5 years, nitrogen, phosphorous and potassium still remains insufficient.
4. At the seedling and sapling stage, quisumbing guisok, white lauan, kalunti or manggasinoro, mabunot, kalingag, dugu-an and puso-puso were noted to be most sensitive to moisture stress.
5. Among the dipterocarps, white lauan ot the highest diameter and height growth increment. Narig, with its waxy leaf surface, was tolerant under full solar exposure even at the seedling stage.

RECOMMENDATIONS

In view of the aforegoing conclusions, the following recommendations are offered:

1. In completely open areas, the sun-loving / sun-tolerant trees like kalumpit, bitanghol, dao, molave, milipil, bayok-bayokan and narig should be planted 2-3 years ahead to lend partial shade to other seedlings which require partial shade at the incipient stage.
2. To optimize the growth potentials of the plants, timber stand improvement (TSI) practices like ring-brushing, pruning, thinning, removal of vines and other chokers and use of organic fertilization should also be practiced in domestication farms.
3. Domestication farms should include or integrate fruit trees, vegetable trees like bago (*Gnetum gnemon*) and other economic plants which are sources of food, local medicine or raw materials for handicrafts.
4. Further studies should be conducted on the following:
    a. domestication trials of barit or kolalabang, anislag, sudiang, other dipterocarps, bago, nito, sig-id, rattan and other sources of raw materials for handicrafts;
    b. integration of domesticated trees in agroforestry farms
    c. comparative studies of forest-confined species and domesticated ones.

REFERENCES

Aldemer, Marshal K. " *Institutionalization Options of Domestication Programs*". Fiji.1999http://www.worldagroforestry.org/treesandmarkets/focal_areas/tree_domestication

Bullecer, Rumila C. et al . "*Local Knowledge on Indigenous Trees in the Central Philippines*". A Study conducted under the ICRAF Tree Domestication Program. Summary Report Submitted to ICRAF Southeast Asia Regional Office, Bogor, Indonesia. January 2002. pp. 12-14

Buot, I.E Jr. and Osumi, K. " *Satoyama Landscapes in the Philippines*". Joint Research Project of the Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Banos, College, Laguna, Philippines and the Kansai Research Center, Forestry and Forest Products Research Institute, Nagai-Kyutarou 68, Momoyama, Fushimi, Kyoto, Japan. 2003.

Evans, Bradley R. " *Edible nut trees in Solomon Islands: a variety collection of Canarium, Terminalia and Barringtonia*. ACIAR Technical Reports, No.44 1999 Canberra

Harwood, Charles. E. " Domestication of Australian Tree species for Agroforestry" .Australia Forestry Journal, No. 23 1999. Sydney University Press.

Lerom, Romeo R. Ethno-Botany of Some Underutilized Fruit Trees in Rizal, Palawan, Philippines. Western Philippines University (formerly the State Polytechnic College of Palawan, SPCP), Aborlan, Palawan.. 2002

Midgley, S. J. *Acacia crassicarpa: a tree in the domestication fast lane*. Australian Tree Resources News No. 6, Australian Tree Seed Centre, CSIRO Forestry and Forest Products, Canberra. 2000

Minquan, Y. & Yutian, Z. (1991) Results from a four-year-old tropical *Acacia* species/provenance trial on Hainan Island, China. In Turnbull, J. W. (ed.), *Advances in Tropical Acacia Research: proceedings of an international workshop held in Bangkok, Thailand, 11-15 February 1991*. ACIAR Proceedings No. 35, Canberra

Pollisco, Mitzi T. "*Tree Domestication: The Experience of ERDB cum VGL Farms*". Canopy International, Vol. 28 No.1 January-February 2002. Ecosystems Research and Development Bureau, DENR. pp. 5,9.

Sy, Manolito U. " *What's the Rainforestation Farming Strategy*?" Canopy International, Vol. 28 No.1 January-February 2002. Ecosystems Research and Development Bureau, DENR. pp 4, 10.

Thomson, L. A. J. (1994b) *Improving species/provenance selection, species/site matching and silvicultural practices in Project WFP 4304.* Consultant's report to UNDP/FAO Project VIE/92/022 - Provision of Technical Support to Project Wood Food Program 4304 'Reforestation in the Central Coast of Vietnam'. Food and Agriculture Organization of the United Nations, Hanoi.