Forest Products Research and Development Institute

ITTO Project PD 15/96 Rev. 2 (M.I.)

FINAL TECHNICAL REPORT

UTILIZATION, COLLECTION AND TRADE OF TROPICAL NON-WOOD FOREST PRODUCTS IN THE PHILIPPINES

PART I

RESOURCE SURVEY AND INVENTORY OF IMPORTANT NON-WOOD FOREST PRODUCTS IN THE PHILIPPINES AND ASSESSMENT OF THEIR NATURAL REGENERATION

Los Baños, Laguna, Philippines
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ABSTRACT

Resource survey and inventory of important non-wood forest products in selected provinces of the Philippines, viz., Palawan, Western Samar, Quezon, Surigao del Sur, Aurora and Nueva Ecija were conducted by systematic sampling using a 1-ha plot replicated depending on the extent of growth and density of the subject plant species like rattan, bamboo, erect palms, pandan and other forest vines in a given locality. Patterns in natural regeneration were assessed through field observation of the species mature individuals as well as young wildlings or regenerants.

Most of the species were fairly to moderately available in the study sites covered based on density and volume tallied and were capable of regenerating by seeds or rhizomes and suckers as in the case of bamboo and pandan. Many of the forest vines treated in this particular study, however, were rare and could be fast depleting. Under natural condition, availability of material resource probably depends on intensity or rate at which the species are cut or harvested and its ability to reproduce or regenerate new individuals.

Trends in resource utilization and natural regeneration and their implications on sustainability were presented and discussed. Some considerations for sustained-yield collection practices and conservation have been recommended.

INTRODUCTION

Resource survey and inventory constitute a very important aspect of wise utilization and management of any renewable resource whether it be timber or non-timber or the so-called non-wood forest products (NWFP). In focusing to utilize a particular plant species for specific end-use, viz., bamboo for furniture and housewares or buri (*Corypha*) for handicraft products, any economic or commercial venture would dare to determine and have knowledge first and foremost of the species availability. When availability is guaranteed, the next most probable question is where are they? Where can they be found? How much is extractible in a hectare of land for instance? Will the supply and volume meet and sustain the demand for species-product use? Since it is renewable, it means it is regenerating and may be mass-produced by planting. What about information on this aspect? Right now, inventory works on NWFP do not receive the right attention from forest managers unlike timber.

Compared to a general floristic inventory (Prance, 1977) done usually by plant ecologist and systematist for the purpose of determining species diversity in certain region and place, search for resources and inventorying plant species for a particular end-product aims primarily at providing answers to the earlier questions posed. Said queries when taken together with their respective answer will seriously spell successful and sustainable economic utilization of both wood and non-wood forest product species.

OBJECTIVES

The study focuses on conduct of resource survey and inventory of non-wood forest products species (NWFP) such as the erect palms (*Corypha, Livistona, Arenga*), bamboo, pandan (*Pandanus* and *Freycinetia*), climbing palms (rattans) and other economically important forest vines in pre-selected project sites and provinces, viz., Palawan, Western Samar, Surigao del Sur, Aurora, Quezon and Nueva Ecija.

Specifically, it aims to determine the relative supply and volume of the subject plant group/species and make an ecological assessment of their natural regeneration based on field study and observation of their seed fall, germination, flowering and fruiting, seedling/sapling growth and survival, type and condition of habitat with respect to environmental factors of light, temperature and moisture.

METHODOLOGY

Sampling and Site Selection

Sample plot measuring 100 m x 100 m (1 ha) was laid out at selected localities in pre-determined project sites, viz., Palawan, Surigao del Sur, Western Samar, Aurora, Quezon and Nueva Ecija. In each locality, say a barangay (smallest politico-socio-geographic unit of a municipality) replicates were established depending on extent of growth and occurrence of the desired species. This 1-ha plot method has been employed by Rojo and his co-workers (1991) for commercially-less accepted species (CLAS), Aragones and co-researchers (1992) for forest woody vines and Aragones (1996) for *Canarium* species and *Agathis philippinensis* Warb.

Measurement of Inventory Parameters

In choosing a particular locality for sampling, the element of bias could not be eliminated. First, there were target species and doing so basically required presence or occurrence of such species in the area before plot establishment could be decided. Otherwise a locality is rejected when desired species are absent. This selection method in a floristic inventory is technically known as systematic sampling (Prance, 1977).

The following parameters were measured and hereto defined.

Density - number of individuals of a particular species occurring within plot including seedlings and saplings; sapling for the erect palms in particular are referred to those individuals with distinct short stem above ground but total height to the topmost part of crown is less than 3 m.

Density count of considered mature individuals of a species applies to all the subject NWFP with slight modification for bamboo as described below.

Number of culms -number of individual stem of a particular bamboo species.

Number of clumps -the number of clump which refers to growth habit of most bamboos where stems or culms are closely set in-group or cluster.

Number of culm per clump-the number of individual stem counted in a clump or cluster.

For rattan and other forest vines, diameter was taken of the stem's largest part usually near the basal portion.

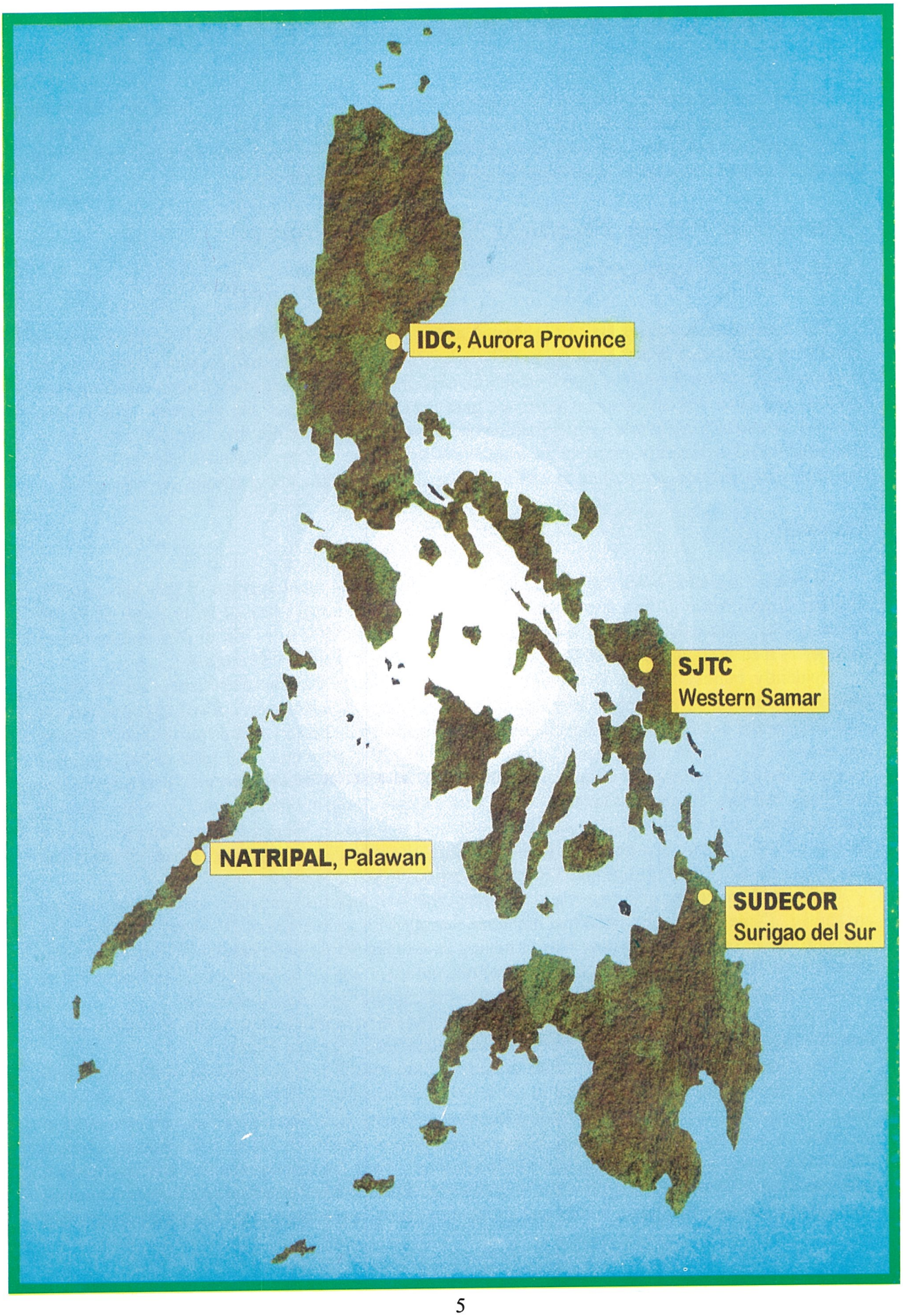
For erect palms, bamboo and pandan total height was measured using Haga altimeter from the base to topmost part of the foliage; for the rattan and other climbers, height or length was approximated based on length of prostrate (lying down) stem and portion of stem that clings on to neighboring trees whose height can actually be measured using an instrument.

Lineal Meter (l.m.) =unit for the calculated volume of rattan and other forest vines which corresponds actually to the estimated total length of their individuals.

Assessment of Natural Regeneration

Field observation was made of mature individuals including wildlings and saplings of the subject species to gather notes on ecology, viz., phenology (flowering and fruiting), seed fall and germination within plot, pattern of dispersal gauged from dense or crowded germination, growth away from mother plants or widely scattered, etc. animal or insect visitors, environmental factors for natural growth and development such as location of plant with respect to light, temperature and moisture. Direct or actual measurement, however, of biological and physical factors that influence successful plant establishment and resource sustainability for economic use was not made but merely based on qualitative assessment and notes taken of the plant species in nature.

LOCATION OF PROJECT AREAS



DATA GATHERED, ANALYSIS AND INTERPRETATION OF THE RESULTS

The proceeding presentation and discussion of this particular study's results have been based on data and information gathered directly in the field from October 1997 to August 2001. Some secondary information from published literature have been integrated with the field data obtained particularly that which concern ecological assessment of species natural regeneration.

Non-Wood Forest Products Species Resource and Their Inventory

For convenience, the results of the survey and inventory of non-wood forest products species (NWFP) resource such as the erect palms (*Corypha, Livistona and Arenga*), pandan *(Pandanus and Freycinetia)*, bamboo *(Bambusa, Dendrocalamus, Giganthochloa and Schizostachyum)*, climbing palm (rattans) and other important forest vines are here presented by project site province. The results, however, admittedly constitute a small fraction or segment of the entire province or project site area as plots established to provide estimate of the available NWFP resources were located in selected barangays (smallest socio-politico-geographic unit of a municipality) where the target species are represented.

Palawan

Search for available NWFP resource had been conducted in 4 municipalities of Palawan, namely, Aborlan (5 ha), Narra (2 ha), Española (3 ha) and Brooke's Point (3 ha) all lying south of Puerto Princesa City. Individual species encountered and tallied in a 100 m x 100 m plot and inventory parameters measured and recorded for the species are shown in Tables 1 through 4.

Evidently, buho *(Schizostachyum lumampao)* was found to be the most dominant of the 5 bamboo species, viz., patong (*Gigantochloa* atter), awod-boho (*Schizostachyum brachycladum*), bayog (*Bambusa merrilliana*) and kauayan-kiling (*Bambusa vulgaris*) as shown in Table 1. Said species had 270 average number of clump in a hectare and culm per clump of 120 in a hectare. In 3 plots (3 ha) computed average density or number of culms in a hectare was 32,400. A related species, S. brachycladum seemingly was rare, sighted in a hectare of land with a single clump containing only 18 culms. Patong, local name in Palawan for *Gigantochloa atter* was next to buho (*S. lumampao*) in dominance having density of 1,980 culms in a hectare. Kauayan-kiling (*B. vulgaris*) and bayog (*B. merrilliana*) had density per hectare of 660 culms and 330 culms, respectively.

In Table 2, inventory parameters and data on buri (*Corypha elata*) gathered in 3 plots in Aborlan are shown. Quite clearly, the stand had moderate density with an average of 70 mature individuals in a hectare. The trees seemingly were mature having an average height and diameter of 23 m and 45 cm, respectively. The average number of leaves per tree recorded was 23 while seedlings tallied in 3, 5 m x 5 m subplots accounted for 607. Average number of saplings per hectare was 130.

In buri, the leaf stalk and the leaves, themselves, have more utility than its stem. Economic products like bags, hats, fans, etc. are derived from said plant parts. (Brown, 1921).

The density of buho was found to be greater in plots established in Española (Table 3) than in Aborlan. Density per hectare obtained in the former amounted to 37,500 compared to 32,400 in the latter. *Gigantocloa atter*, however, was less in Narra with only 1,216 density per hectare compared to the 1,980 in Aborlan. Kauayan-kiling, likewise, had greater density in Narra (950) than in Aborlan (660) while bayog was less (280 against 330 in Aborlan). Buri , obviously was less also in Española with average density of only 35 against the 73 in Aborlan. The tree-like *Pandanus* and anahaw (*Livistona rotundifolia)*, on the other hand, had 23 and 25.60 individuals, respectively, in a hectare of inventoried

Table 1. Inventory data on 5 bamboo species in a 100m x 100m plot in Aborlan, Palawan

LOCAL NAME/ SPECIES	Ave. Clump Per Hectare	Ave. Stem Per Clump Per Hectare	Ave. Ht./ Length (Meter)	Ave. Diameter (Cm)	Density Per Hectare	Area Covered (Hectare)
Buho (*Schizostachyum lumampao*)	270	120	4	2.5	32,400.00	3
Patong *(Gigantochloa atter)*	55	30	9	8.8	1,980.00	2
Awod boho *(Schizostachyum brachycladum)*	1	18	5	4.5	18.00	1
Bayog *(Bambusa merrilliana)*	15	22	5	8.3	330.00	2
Kauayan-kiling *(Bambusa vulgaris)*	20	33	8.5	9.2	660.00	2

* Clump refers to growth habit of many bamboo species where several culm or stem grows close together or closely set in cluster.

Table 2. Inventory data on buri (*Corypha elata*) obtained in a 100 m x 100 m plot in Aborlan, Palawan

Area covered	:	**3 ha**
Number of mature individuals/ha	:	**73**
Average height	:	**23 m**
Average diameter	:	**45 cm**
Average number of leaves per tree	:	**23**
Average number of saplings/ha	:	**130**
Number of seedlings (based on three (3) 5 m x 5 m subplots)	:	**607**
Average number of leaves (seedling)	:	**5**

Table 3. **Inventory parameters for bamboo, pandan, buri and anahaw in Narra and Española, Palawan**

LOCAL NAME/ SCIENTIFIC NAME	Ave.Ht./ Length (m)	Ave. Diameter (cm)	Density Total	Density /ha	Ave. Clump/ha	*Ave. culm/ Clump/ha*	Area Covered (ha)	Location
Buho *(Schizostachyum lumampao)*	5.0	2.5	75,000	37,500	250	150	2	Española
Patong *(Gigantochloa atter)*	7.5	8.0	4,648	1,216	31	32	3	Narra
Kauayan-kiling *(Bambusa vulgaris)*	8.0	8.5	2,850	950	25	38	3	Narra
Bayog *(Bambusa merrilliana)*	5.0	7.8	840	280	10	28	3	Narra
Pandan *(Pandanus sp.)*	2.5	11.75	69	23.0			3	Española
Buri *(Corypha elata)*	15.0	3.8	70	35.0			2	Española
Anahau *(Livistona rotundifolia var. luzonensis*	4.50	12.5	77	25.60			3	Española

Table 4. **Inventory data for bamboo, buri, anahaw and pandan obtained in a 100 mx 100 m plot in Brooke's Point,Palawan**

LOCAL NAME/ SPECIES	Ave. Ht/ Length(m)	Ave. diameter (cm)	Density Total	Density Per Hectare	Ave. No. Clump /ha	Ave. No. Culm/ clump /ha	Area Covered (ha)
Buho *(Schizostachyum lumampao)*	5.0	2.5	23,994	7,998	86	93	3
Pandan *(Pandanus sp)*	2.5	10.50	120	40	-	-	3
Kauayan kiling *(Bambusa vulgaris)*	9.5	7.75	1,305	435	15	29	3
Bolo *(Gigantochloa levis)*	10.5	9.5	975	325	12.5	26	3
Buri *(Corypha elata)*	18.0	50	87	29	-	-	3
Anahau *(Livistona rotundifolia var. luzonensis*	5.0	12.0	48	16	-	-	3

land. Said species which were not sighted in Aborlan and Narra were again observed in 3,100 m x 100 m plots established in Brooke's Point (Table 4). Pandanus sp. with average height and diameter of 2.5 m and 10.50 cm, respectively, had a total density of 120 individuals in 3 hectares of inventoried land. Anahaw had density of 48 in the same plot area and obviously less than those in Española while Pandanus with 40 individuals per ha was greater in density. Other non-wood forest products species inventoried in Brooke's Point included buho, kauayan-kiling and buri.

While buho was so dominant in Española with estimated total density of 75,000 in 2 hectares of land, its population tremendously dropped to 23,994 in Brooke's Point in a larger land area coverage of 3 hectares. Kauayan-kiling was, likewise, less in number with total density of 1,305 culms against the 2,850 culms in similar plot coverage of 3 hectares in Narra. Interestingly, significant population of bolo (*Gigantochloa levis*) totaling to 975 culms was sighted in Brooke's Point while bayog which was found in Narra was sighted nowhere in Española and Brooke's Point. Buho appears to be the common species to various municipalities surveyed south of Puerto Princesa.

Western Samar

A total of 18 hectares of second-growth forest and old coconut plantation on flat level lands were inventoried in the municipalities of Paranas and Hinabangan, Western Samar (Tables 5 to 9). The non-wood forest products species observed consisted of anahaw, tarau (*Livistona saribas*) and some 6 species of climbing palms (rattan).

Obviously, the density of anahaw was much greater on a per hectare basis at Brgy. Casandig (Table 5) with an average of 152.5 compared to only 35.0 at Brgy. Lauan (Table 6). Total density and density per hectare for tarau were, likewise, greater at Brgy. Casandig (Table 7) with 320 and 80, respectively, against the 219 and 73 at Brgy. Lauan (Table 8). The same is true for the density of young regenerants. The difference is remarkable with a combined 2600 regenerations at Brgy. Casandig for anahaw and tarau against 196 and 625, respectively for the same species at Brgy. Lauan. The figures, nonetheless, simply indicate where population of said species is greater or where they could be obtained in larger volume.

Table 9, on the other hand, for 6 species of climbing palms (rattan) shows relative volume of the species in lineal meter (l.m.). Palasan (*Calamus merrillii*) was more common with 462.3 l.m. in 4 ha of second-growth forest inventoried. Limuran (*Calamus ornatus* var. *philippinensis*) follows with 195.56 l.m. with great disparity. Other species as shown in Table 9 have low density and volume. Noticeably, the area surveyed possesses young growth of rattans having an average length of only 6.25 m (longest) and 2.48 m (shortest). Average diameter similarly gives an indication of young growth with 1.87 cm as the largest (palasan) and 0.93 cm the smallest for tandulang-gubat (*Calamus dimorphacanthus*).

Surigao del Sur

Table 10 shows the inventory data for rattan, erect palms and pandan obtained from 2 plots, each measuring 100 m x 100 m at Brgys. Suba and Pakwan, Lanuza, Surigao del Sur.

Apparently the area covered by the inventory was only 2 hectares. Nevertheless, the data gathered represent a good sample of second-growth forest within the concession of Surigao Development Corporation (SUDECOR). Probability points to recurrence of the same or even other unaccounted but important NWFP species in the entirety of SUDECOR's logging concession. Thus, actual density and volume may be much greater as what had been shown.

Worthy of mention is the observed abundant growth of kauayan-tinik (*B. blumeana*) and kaong (*Arenga pinnata*) particularly at Brgy. Esperanza, Carmen, Surigao del Sur. Although there were no actual plots established in said area owing to danger posed by presence and operation of lawless elements, ocular survey made from vehicle ride showed considerable number of clumps (kauayan-tinik) and individuals of kaong (*Arenga*) along roadsides and slopes of low hills.

Table 5. Resource inventory data on anahau (*Livistona rotundifolia var. luzonensis*) at Barangay Casandig, Paranas, Western Samar.

Parameters	Measurements
Size of plot	100 m x 100 m (1 ha)
No. of plot	4
Area covered	4 ha
Density of individuals 10 cm. and greater	610
Density per hectare	152.5
Average height (m)	8
Average diameter (cm)	12.0
Average no. of leaves per tree	33
Density of saplings/seedlings (total)	2600 *
Density of saplings per hectare	650

- Total sapling/seedling density is combined for anahau and tarau as young individuals for the two species look very identical.

Table 6. Resource inventory data on anahau (*Livistona rotundifolia var. luzonensis*) at Barangay Lauan, Paranas, Western Samar.

Parameters	Measurements
Size of plot	**100 m x 100 m (1 ha)**
No. of plot	**3**
Total density of individuals 10 cm. and greater in diameter	**105**
Density per hectare	**35**
Average height (m)	**7.5**
Average diameter (cm)	**12.0**
Average no. of leaves per tree	**29.0**
Total density of saplings/ seedlings	**196.0**

Table 7. **Resource inventory data on tarau (*Livistona saribas*) at Barangay Casandig, Paranas, Western Samar.**

Parameters	Measurements
Size of plot	100 m x 100 m
No. of plot	4
Area Covered	4 ha
Density of individuals 10 cm.	320
Density per hectare	80
Average height (m)	6.5
Average diameter (cm)	14.5
Ave. no. leaver per tree	28.0
Density of saplings/seedlings (total)	2600 *
Density of saplings per hectare	650

* **Total sapling/seedling density is combined for anahau and tarau since young regenerants for the two species look very identical.**

Table 8. **Resource inventory data for tarau (*Livistona saribas*) at Barangay Lauan, Paranas, Western Samar.**

Parameters	Measurements
Size of plot	100 m x 100 m (1 ha)
No. of plot	3
Total density of individuals 10 cm. and greater	219
Density per hectare	3
Average height (m)	6.8
Average diameter (cm)	14.5
Average no. of leaves per tree	26.7
Total density of saplings/ seedlings	625.0
Density D Density of saplings/seedlings per hectare	201.66

Table 9. **Resource inventory data on rattan species at Barangay Concorde, Hinabangan, Western Samar in four 100 m x 100 m plot**

Species	Density	Density /ha	Vol. (lineal) meter	Vol./ha. (lineal) meter	Average Length (m)	Ave. Dia (cm)
Palasan (*Calamus merrillil)*	74	18.5	462.3	115.57	6.25	1.87
Limuran (*Calamus ornatus* var. *philippinensis*)	49	12.25	195.56	49.14	4.01	1.28
Ditaan (*Daemonorops mollis)*	28	7.0	109.75	27.43	3.92	1.06
Panlis (*Calamus sp.)*	21	5.25	77.60	19.40	3.70	1.11
Tandulang-gubat (*Calamus dimorphacanthus)*	33	8.25	81.85	20.46	2.48	0.93
Tumalim (*Calamus mindorensis)*	24	6.0	68.90	19.22	2.87	0.98

Table 10. **Inventory data on rattan, other climbers and erect plams at Lanuza, Surigao del Sur covering 2 ha plot.**

Species	Average Diameter (cm)	Average Length (m)	Total Density	Volume (lineal meter)	Area Covered (ha)
Olasi (*Calamus aidae)*	1.6	12.7	9	114.3	2
Dalingdingan (*rattan undetermined prob. Calamus sp.)*	1.2	4.2	7	29.4	2
Pandan (*Pandanus sp.)*	8.0	4.0	12	48.0	2
Sarawag (*Pinanga insignis)*	4.5	3.5	8		2
Tagikgik(*Calamus filispadix)*	1.5	4.2	7	29.4	2
Hagnaya (*Polygala venenos)*	1.6	4.5	6	27.0	2
Pandan baging 1 (*Freycinetia sp.)*	0.2	9.0	17	153.0	2
Pandan baging 2 (*Freycinetia sp.)*	1.2	6.5	19	123.5	2
Kadapi (*Calamus ornatus var. philippinensis)*	1.4	6.5	15	97.0	2
Balanog (*Calamus symphisiphus)*	2.5	13.5	38	531.0	2
Anibong (*Oncosperma figilaria)*	2.0	10.0	27	270.0	2
Armog (*Calamus javensis)*	6.8	6.5	18		
Bagbag (*Daemonorops affinis)*	1.7	5.5	12	66.0	2
Sumulidor (*Daemonorops ochrolepis)*	1.3	4.2	11	46.2	2
	1.2	5.8	9	52.2	2

Aurora

Survey and inventory of NWFP in the logging concession of Industries Development Corporation (IDC) in Aurora province focused on rattan and other economically-important forest climbers (Table 11). Erect palms are not common in the area and are represented by few individuals while bamboo (Kauayan-kiling and Kauayan-tinik) which occur in widely-scattered clumps and pandan (tree-like *Pandanus*) are scarce. Mere ocular survey was made and quantitative data were not gathered.

Of the 4 species of rattans encountered limuran (*Calamus ornatus* var *philippinensis*) and palasan (*C. merrillii*) had the most number of individuals with 18 and 12, respectively in 3-ha forest area covered by the survey. Noticeably, the individuals were relatively young having an average length of only 6 m and 5 m, respectively. The area was a second-growth dipterocarp forest protected by the IDC management for about 10 years. Ditaan (*Daemonorops mollis*) and tumalim (*Calamus mindorensis*) likewise, were found in relatively low density (Table 11).

Other climbers significant as materials for handicraft included the climbing Freycinetia of Pandanaceae, hagnaya (*Polygala venenosa*), amlong (*Raphidophora pinnata*), lukmoi (*Raphidophora merrillii*) and *Piper* sp. (Piperaceae). Interestingly, *Piper* sp. and lukmoi had the most number of individuals, 28 and 26, respectively, with an aggregate volume of 168 l.m. and 390 l.m.

Also worthy of mention is the presence of giant fern (*Cyathea* sp) and bikal (*Schizostachyum diffusum*), a species of climbing bamboo though not in considerable quantity.

Quezon

Although Quezon province was merely an added site, some 20 hectares of second-growth and old coconut plantation where subject species occur had been surveyed and inventoried owing to its accessibility from Laguna. It is also in said province where an array of economically-important non-wood forest products species had been encountered. The various municipalities/localities where surveys had been made were indicated and shown in Tables 12 through 18.

Prominent in Lucban, Quezon are the erect palms kaong (*A. pinnata*) and anahaw (*L. rotundifolia*) including the tree-like *Pandanus* sp. whose leaves are a prized material for weaving various products. Two species of bamboo, viz., kauayan-kiling (*B. vulgaris*) and bolo (*Gigantochloa levis*), likewise, were encountered.

Anahaw had a total of 167 individuals compared to the only 40 of kaong in 4 hectares covered by the survey. Pandan, on the other hand, had 77 individuals while bolo and kauayan-kiling had 55 and 8 clumps, respectively, in 3 hectares covered.

Tayabas had conspicuous growth of buri (*C. elata*) shown in Table 13. In 3, 100 m x 100m plots established the number of mature individuals with an average height of 5.75 m and average diameter of 48.50 cm was 282. Young regenerants were profuse with a total of 818 tallied. The computed number of seedlings per hectare was 272.66.

At 550 m altitude of Mt. Banahaw in Lucban, Quezon (Table 14) survey and inventory of rattan and other important forest climbers in second-growth forest covering 1 hectare showed prominence of limuran (*C. ornatus var. philippinensis*) with 22 individuals having aggregate volume in lineal meter (l.m.) of 277. Similarly, tandulang-gubat (*C. dimorphacanthus*) had 265 l.m. Other climbers shown in Table 14 had relatively less density and volume.

Survey and inventory conducted in Palsabangon, Pagbilao, Quezon emphasizing 5 species of important NWFP are shown in Table 15. Buri showed 724 individuals in 2 hectares covered. Only kauayan-kiling (B. vulgaris) was sighted in the area represented by only 36 culms. Nito (*Lygodium circinatum*) a very important material for handicraft had 30 individuals with average length of 10 m. Baling-uai (*Flagellaria indica*) was also encountered in young second-growth forest. It had 29 individuals having average length of 10.17 m. Lukmoi (*R. merrillii*) had only 6 individuals clinging to tall residual trees. Average length was estimated to be 20.33 m.

Quezon National Park (QNP) in Pagbilao, Quezon although a declared forest reserve was surveyed for economically-important NWFP. Data gathered provide a glimpse of what may be found in

the forested vicinities outside of the national park for the gatherers and users. Table 16 shows the density and volume in lineal meter of some rattan and other forest climbers tallied in a 100 m x 100m plot. Two rattan (climbing palm) species, namely, palasan (*C. merrillii*) and lambutan (local name for *Calamus halconensis*) were encounterd. The former was more conspicuous with 10 inidviduals while the latter had only 3. Volume in l.m. for the 2 respective species was 32 and 17. Other forest climbers of considerable density and volume included lukmoy (*R. merrillii*), agpoi (*Bauhinia cumingiana*), baralta (*Pothoidium lobbianum*) and species of *Tylophora* (Asclepiadaceae). *Piper retrofractum* (Piperaceae) was, likewise, conspicuous with 13 individuals having an aggregate volume of 233 lineal meters.

The erect palms anahaw (*L. rotundifolia*) and buri (*C. elata*) including the tree-like *Pandanus* sp., kauayan-tinik (*B. blumeana*) and bolo (*G. levis*) were prominent in Catanauan, Quezon (Table 17). Buri had 373 individuals in 4 hectares surveyed compared to the 294 of anahaw in the same area covered. Pandan had 270 individuals in 2-hectare plot while kauayan-tinik and bolo had mean individuals of 1,030.75 and 307.50, respectively.

Young second-growth forest in Gumaca, Quezon (Table 18) yielded important climbers useful as material for handicraft. The more prominent species tallied in terms of density and volume are lukmoy, hanopol (*Conociphalus suaveolens*), paminta-pamintahan (*Piper loheri*), kalit-kalit (*Cissus repens*), bayati (*Anamirta cocculus*) and piña-piñahan (*Boerlagiodendron sp.*). Bulakan (*Merremia peltata*) which has high demand for handicraft had only 6 individuals with aggregate volume of 47.4 lineal meter. Nito (*Lygodium circinatum*) had measly 4 individuals.

Others in Table 18 although of economic potential had relatively low density and volume.

Nueva Ecija

Inventory plots established in 3-ha second growth forest in Gabaldon, Nueva Ecija (Table 19) showed considerable growth of important climbers. Conspicuous among those tallied were pandan-baging (*Freycinetia sp.*), baling-uai (*Flagellaria indica*), nito (*L. circinatum*), gogo (*Entada phaseoloides*), kamaksa (*Rourea volubilis*), ligtang (*Anamirta cocculus*), albotra (*Arcangelisia flava*), lukmoy (*R. merrillii*) and kansasaga (*Abrus precatorius*). Each of these species yielded density of more than 10 individuals. The climbing palms encountered included palasan (*Calamus merrillii*), limuran (*C. ornatus var. philippinensis*) and tumalim (*C. mindorensis*) with respective density of 11, 9 and 6. Aggregate volume in lineal meter for the species are 82.5, 61.2 and 31.2, respectively.

Ecological Assessment

Data and information on species ecology gathered from existing literature and observation made of the species in nature focused on patterns in natural regeneration and factors that may affect such process, resource availability and sustainability for commercial or industrial use.

Natural Regeneration

By natural regeneration, we mean the ability of a plant species to reproduce or regenerate in order to perpetuate its kind in a habitat or environment where it is most adapted. Thus, it could be by seed or any other natural means by which a plant species can reproduce young individuals with the death of mature ones.

The subject plant groups, viz., erect palms, bamboo, pandan, rattan and other forest vines have different habit. Their responses to the environment and mechanism for re-growth are, therefore, varied. For convenience, the regeneration pattern observed including information taken from literature are here presented by plant group.

Table 11. Inventory data for rattan and other economically important forest climbers at Brgy. Dimasesat, Dilasag, Aurora

COMMON NAME/ SPECIES	FAMILY	HABIT	DENSITY	LENGTH/ HEIGHT (m)	DIA-METER (cm)	VOLUME (lineal meter)	Area Covered (ha)
Tumalim *(Calamus mindorensis)*	Palmae	climbing	9	4	2	36	3
Palasan*(Calamus merrillii)*	Palmae	climbing	12	6	2.5	72	3
Limuran *(Calamus ornatus var.philippinensis)*	Palmae	climbing	18	5	2	90	3
Ditaan *(Daemonorop smollis)*	Palmae	climbing	8	3	1.3	24	
Anahaw *(L. rotundifolia var. luzonensis*	Palmae	Erect, tree-like	3	seedlings	-	-	-
Pandan baging1 *(Freycinetia sp.)*	Pandanaceae	Climbing	14	12	3	168	3
Pandan baging 2 *(Freycinetia sp.)*	Pandanaceae	Climbing	8	10	5	80	3

COMMON NAME/ SPECIES	FAMILY	HABIT	DENSITY	LENGTH/ HEIGHT (m)	DIA-METER (cm)	VOLUME (lineal meter)	Area Covered (ha)
Lukmoi*(Raphidophora merrillii)*	Araceae	climbing herbaceous	26	15	4	390	3
Amlong*(Raphidophora pinnata)*	Araceae	climbing herbaceous	22	12	4	264	3
Bikal*(Schizosostacyum diffusum)*	Graminae	Climbing bamboo	15	6	2	90	3
***Pandanus* sp.**	Pandanaceae	Erect, tree-like	4	4	7	-	
***Piper* sp.**	Piperaceae	Climbing herbaceous	28	6	1.2	168	3
Hagnaya *(Polygala venenosa)*	Polygalaceae	Climbing, small, woody diameter	19	7	0.7	133	3
Giant fern *(Cyathea sp.)*	Cyatheaceae	Erect, tree-like	13	4	6	-	3

Table 12 . Inventory data on selected non-wood forest products in a 100 m x 100 m plot in Lucban, Quezon.

LOCAL NAME/ SPECIES	No. of Indivls. or Clump	No. culm Per clump	Average Length/ Ht. Culm or Stem (Meter)	Ave. Diameter Culm or Stem (Cm)	Density or Number Indivls. or Clump per Hectare	Area Covered (Ha)
Anahau *(Livistona rotundifolia var. luzonensis*)	167		4.47	14.00	41.75	4
Kaong (*Arenga pinnata*)	40		5.56	24.83	10.00	4
Pandan (*Pandanus sp.)*	77		2.70	12.88	19.25	4
Bolo *(Gigantochloa levis)*	55	23.33	8.62	7.25	18.33	3
Kauayan-kiling *(Bambusa vulgaris)*	8	16.62	7.46	4.76	2.66	3

Table 13. Inventory data on buri (*Corypha elata*) obtained from three (3), 100 m x 100 m plot in Tayabas, Quezon

Area covered (hectare)	:	**3**
Number of mature individuals	:	**282**
Density per hectare	:	**94**
Average height (meter)	:	**5.75**
Average diameter (centimeter)	:	**48.50**
Average number of leaves per tree	:	**26.10**
Number of seedlings	:	**818.00**
Number of seedlings/ha	:	**272.66**

Bamboo (Rambusoideae: Gramineae)

In all the project sites where bamboos are found, they seem to be most adapted to low, more or less level land in open habitats. Wong (1995) gave an affirmative statement to this finding. Apparently, it reflects the nature of bamboo growth nowadays where most of the species are generally cultivated. Natural-grown true forest dwellers among the bamboos are rare. Rojo (2000) only cited *Schizostachyum lima, Schizostachyum lumampao* and *Yushania niitakayamensis* in the category of true forest dwellers. Incidentally the 2 species of *Schizostachyum* cited may, likewise, be found in cultivation and, therefore, not strictly found in the wild.

Buho (S. lumampao) abundantly grows wild in the province of Palawan, south of Puerto Princesa City. Together with kauayan-tinik (*B. blumeana*), kauayan-kiling (*B. vulgaris*), bayog (*B. merrilliana*) and bolo (*G. levis*), they constitute the species common as well to Aurora, Quezon, Surigao del Sur and Western Samar provinces.

Most bamboos form a dense, long stretch of grove near rivers or waterways indicative of preference for moist soil condition. On the other hand, when found far from water courses, they appear in widely-scattered patches or clumps with relatively few culms. Similar observations had been reported by Wong (1995).

The largest and tallest of the grass family (Gramineae), bamboos easily regenerate by production of young shoots or by sucker. Such is brought about by its characteristic rhizomatous growth that leads to formation of clump or culms grouped and set close together by a common rhizome or root system (Wong, 1995). The young culm shoot produced usually at the base of a mature culm is popularly known in the country as "labong." In many Philippine localities, it is eaten and very common in local markets especially during the rainy months giving an indication of profuse development of young shoot in that time of the year (Wong, 1995; Rojo, 2000).

Some bamboos die after setting flowers and seeding. None of the bamboo species, nonetheless, covered in this particular study were observed to flower from 1997 to 2001. Rojo and his co-workers (2000), however, classified buho (*S. lumampao*) to have a gregarious flowering, that is, whole population flowers over a period of 2 – 3 years and then dies although the rhizomes may still be alive capable of reproducing new growth or sprout. This was based on observation of said species in Abra from 1991 to 1996. The previous population has been gradually replaced by new plants from the seeds produced by the culms that flowered and eventually died or the rhizomes which are still alive (Rojo et al., 2000).

Pandan (Pandanaceae)

Two species belonging to the genera Pandanus and the climbing (vine) *Freycinetia* of Pandanaceae have been the subject of field ecological observation particularly in the province of Quezon, where they abound. Plantation-grown *Pandanus* in Laguna (municipalities of Cavinti and Luisiana), were, likewise, observed. Literature on natural reproduction of tree-like *Pandanus* and the climbing *Freycinetia*, both acknowledged good material for weaving and handicraft are wanting.

Mature individuals of *Pandanus* in Lucban, Quezon and Luisiana, Laguna displayed ability to flower and bear fruit more or less regularly each year from 1998 to 2001 particularly during rainy months. Fruit is similar to that of the jackfruit (Artocarpus heterophylla) and is frequently visited by various insects. It contains numerous seeds that drop off the ground when fruit falls and decomposes with the action of micro-organisms. Surprisingly, sight of young germinating seedlings was not observed near mother trees. Seemingly, the species is not able to reproduce by seed which pandan growers in the area attested (personal communication). Rather, the tree-like Pandanus tends to perpetuate its kind by sucker growth that sprouts near the base of the stem. A small sucker had been frequently observed to protrude producing young independent individual.

The climbing *Freycinetia* species, on the other hand, displayed young seedling growth on the forest floor not far from mature mother plants indicative of its ability to reproduce by seeds. Moreover, seedlings were observed to germinate and grow under moist, shaded condition in all of the project sites where the species were found to occur.

Table 14. Density and volume (lineal meter) of rattan and other forest vines in a 100 m x 100 m plot in Mt. Banahaw, Lucban, Quezon at 550 m elevation.

LOCAL NAME/ SPECIES	Family	Density	Volume (l.m.)	No. of Seedling
Ampelocissus sp. 1	**Vitaceae**	**3**	**55**	
Ampelocissus sp. 2	**Vitaceae**	**2**	**50**	
Aristolochia tagala	**Aristolochiaceae**	**2**	**16**	
Calamus dimorphacanthus	**Palmae**	**4**	**265**	**5**
Limuran *(C. ornatus var. philippinensis)*	**Palmae**	**22**	**277**	**61**
Connarus trifoliatus	**Connaraceae**	**11**	**197**	
Dinochloa sp.	**Gramineae**	**12**	**157**	
Dioscorea sp.	**Dioscoreaceae**	**15**	**217**	
Nami	**Dioscoreaceae**	**2**	**32**	
(Dioscorea. hispida)		**4**	**62**	
Dregea volubilis	**Asclepiadaceae**			
Baling-uai	**Flagellariaceae**	**2**	**18**	
(Flagellaria indica)		**1**	**10**	
Mezoneuron cucullatum	**Caesalpiniaceae**	**5**	**54**	
Micrehites micrantha	**Apocynaceae**	**2**	**50**	
Piper sp.	**Piperaceae**	**2**	**50**	
Raphidophora merrillii	**Araceae**	**2**	**50**	
Raphidophora pinnata	**Araceae**			
Bana		**8**	**64**	
(Rubus pectinellus)	**Rosaceae**			
Hampas-tikbalang		**1**	**20**	
(Smilax bracteata)	**Smileaceae**			
Kamot-kabag		**2**	**18**	
(Smilax leucophylla)	**Smileaceae**			
Kalit-kalit		**1**	**12**	
(Tetrastigma harmandii)	**Vitaceae**			

Table 15. Inventory data on selected non-wood forest products in a 100 m x 100 m plot in Pagbilao, Quezon.

LOCAL NAME/ SPECIES	Area Covered(ha)	Total Density	Density /Hectare	Mean length/ Height (meter)	Mean Diameter (centimeter)
Kauayan-kiling *(Bambusa vulgaris)*	1	36	36	7.00	5.00
Buri *Corypha elata)*	2	727	364.50	4.42	74.32
Nito *(Lygodium circinatum)*	1	30	30	10.00	
Baling-uai *(Flagellaria indica)*	1	29	29	10.17	
Lukmoy *(Raphidophora merrillii)*	1	6	6	20.33	

Table 16. Density and volume (lineal meter) of forest vines in 100 m x 100 m plot at Quezon National Park (QNP), Pagbilao, Quezon.

LOCAL NAME/ SPECIES	Family	Area Covered (ha)	Density	Volume (l.m.)
Albotra *(Arcangelisia flava)*	Menispermaceae	1	2	4
Agpoi *(Bauhinia cumingiana)*	Caesalpiniaceae	2	16	102
Palasan *(Calamus merrillii)*	Palmae	2	10	32
Dinochloa sp.	Graminae	2	24	235
Balingayo*(Erythrophalum scandens)*	Olacaceae	2	6	88
Nito 1 (Lygodium merillii)	Schizaeceae	1	9	81
Nito 2 *(Lygodium japonicum)*	Schizaeceae	1	5	68
Phytocrene sp.	Icacinaceae	1	6	59
Piper retrofractum	Piperaceae	2	13	230

Continuation of Table 16

LOCAL NAME/ SPECIES	Family	Area Covered (ha)	Density	Volume (l.m.)
Patai-butu *(Piper sarmentosum)*	**Piperaceae**	**2**	**6**	**38**
Baralta *(Pothoidium lobbianum)*	**Araceae**	**1**	**10**	**102**
Lukmoy *(Raphidophora merrillii)*	**Araceae**	**2**	**18**	**330**
Amlong *(Raphidophora pinnata)*	**Araceae**	**1**	**7**	**28**
Adadinko *(Sageretia theezans)*	**Rhamnaceae**	**2**	**8**	**182**
Thylophora sp.	**Asclepiadaceae**	**1**	**16**	**128**
Saga-saga *(Abrus precatorius)*	**Papilionaceae**	**1**	**10**	**180**
Alagag *(Artabotrys cumingiana)*	**Annonaceae**	**1**	**5**	**44**
Lambutan *(Calamus halconensis)*	**Palmae**	**1**	**3**	**17**
Takilis(*Phylaceum bracteosum)*	**Leguminosae**	**1**	**7**	**41**
Tilob *(Dicranopteris linearis)*	**Gleicheniaceae**	**1**	**3**	**18**

Table 17. Inventory data on selected non-wood forest products in Catanauan, Quezon

LOCAL NAME/ SPECIES	No. of Individuals or Clump	No. culm or stem Per clump	Average Length/ Ht. of Culm or Stem (Meter)	Ave. Diameter (Cm)	Area Covered (ha)	Density Per (ha)
Buri *(Corypha elata)*	**373**	**-**	**13.5**	**40**	**4**	**93.25**
Anahau *(Livistona rotundifolia var. luzonensis)*	**294**	**-**	**10.5**	**11.6**	**4**	**75.50**
Pandan *(Pandanus sp.)*	**270**	**-**	**4.0**	**8.0**	**2**	**135.00**
Kauayan-tinik *(Bambusa blumeana)*	**76**	**54.25**	**12.0**	**8.6**	**4**	**1030.75**
Bolo *(Gigantochloa levis)*	**15**	**41.00**	**10.5**	**8.0**	**2**	**307.50**

Erect Palms (Arenga, Corypha, Livistona)

Livistona species represented in this particular study by anahau (*L. rotundifolia*) and tarau (*L. saribas*) are non-monocarpic (Whitmore, 1973). In other words, individuals of said species continue to live even after setting flowers and fruits unlike its monocarpic relatives that die after flowering and fruiting stage of its life cycle.

In the field particularly in Quezon province, observations indicated strong ability of the species to regenerate by seeds. Young seedlings were prominent and conspicuous under dense stand of Livistona in all the project sites where the species occur. Reproduction and perpetuity, hence, depend on the individual's ability to produce flower and fruit. Field observations, likewise, showed propensity of the species to bear numerous fruits, hence, seeds. Like other palm species, fruits are borne in long, pendulous, branched stalks which on maturity drop off the ground. Fruit dispersal by wind perhaps could not be possible as fruits are rounded, more or less of button size and of considerable mass. The only probable way by which fruit or seed can be transported to a distance is by action of strong water current and soil erosion which are usual during strong, heavy rain. Birds and other animals may also be able to carry fruits farther from their mother source. These animal visitors, however, were not observed in the sites studied. Rather, profuse and crowded growths of seedlings were observed near mature mother plants or just a little farther.

The abundant production of seeds under favorable environmental factors could ensure continuous growth and persistent occurrence of *Livistona* species.

Buri (*Corypha elata*) of the palm family in contrast is absolutely a monocarpic species (Whitmore, 1973). Particularly in Quezon province where several mature individuals had been observed, death of tree follows after flowering and fruiting. A mature individual normally sheds off its foliage in exchange for the flowers it bears. When fruits set, they become the more conspicuous sight. A single tree based on field observations could bear about a thousand fruit as infructescence is composed of several, long, branched stalks where fruits are borne. When leaves had defoliated, this large infructescence attractively occupies the topmost part of the tree's crown.

Germination of seeds that drop off the ground seemingly is not a problem for the species as seeds were observed to readily germinate in moist soil condition. During, hot, dry summer months beginning February until about June, flowering and fruiting period ensues. Seeds that drop off are provided ample moisture by the rains that pour in the succeeding months paving the way for seed germination and growth of a new generation of the species.

While both *Corypha* and *Livistona* are found in relatively open environment where sunlight could be intense during the day, kaong (*Arenga pinnata*) in contrast was observed to occur in moist, shaded condition of a regenerating second-growth forest in project sites where this palm is found to occur. In Quezon province where it is popularly known as "irok" or "cabo "negro" individuals are common along creeks and waterways although they are found as well far from water courses but where moisture is evidently not limiting.

Kaong can regenerate naturally by seeds as mature individuals normally bear hundreds of fruits and seeds that could germinate readily under wet soil condition. Young, growing seedlings that are common near mother trees indicate the species ability to reproduce by seeds. Fruits are hard-coated though and the length of time it takes seeds to germinate is undocumented. Birds and other animals were not observed to visit or feed on the fruit. In several instances, flowers were seen visited by flying insects, possibly its pollinators while fruits were frequented by black ants.

Rattan (Climbing Palm)

The Lepidocaryoid climbing palm collectively called "rattan" regenerate by seeds (Whitmore, 1973). There is no available local literature on asexual reproduction in rattan. In all the project sites surveyed, rattans were observed to grow particularly under the canopy of second-growth forest indicative of their preference for shaded and moist condition of the soil. The work of Whitmore on the palms of Malaya (1973) attests to such environmental preference for growth. As climbers, they understand-

Table 18. Inventory data on important forest vines in 2-ha second-growth forest in Gumaca, Quezon.

LOCAL NAME/ SPECIES	Family	Ave. Length (m)	Density	Volume (l.m.)	Average Diameter (cm)
Lukmoy *(Raphidophora merrillii)*	Araceae	11.5	29	333.5	2.04
Gogo *(Entada phaseoloides)*	Leguminosae	9.0	9	81.0	3.91
Piña-piñahan *(Boerlagiedendron sp.)*	Araliaciae	7.0	16	112.0	2.58
Tawag-ama *(Aspidoptera ovata)*	Malphigiacee	8.8	9	79.2	1.94
Baleteng-baging *(Ficus indica)*	Moraceae	6.2	3	18.6	3.27
Kalit-kalit *(Cissus repens)*	Vitaceae	9.0	18	162.0	2.28
Bayati *(Anamirta cocculus)*	Menispermaceae	7.6	16	121.6	2.59
Paminta-pamintahan *(Piper loheri)*	Piperaceae	5.0	21	105.0	1.23
Hanopol *(Conocephalus suaveolens)*	Moraceae	8.3	26	215.8	2.83
Galamai-amo *(Schefflera odorata)*	Araliaceae	5.7	7	39.9	2.59
Bulakan *(Merremria peltata)*	Menispermaceae	7.9	6	47.4	1.75
Katmon-baging *(Tetracera scandens)*	Dilleniaceae	6.8	5	34.0	2.16
Kamaksa *(Rourea volubilis)*	Connaraceae	8.4	12.0	100.8	0.23
Nito *(Lygodium circinatum)*	Schizaeaceae	4.3	4.0	17.2	0.10
Banot *(Bauhinia aherniana)*	Leguminosae	6.7	9.0	60.3	0.30
Tilob *(Dicranopteris linearis)*	Gleicheniaceae	4.5	5	33.8	0.45

Table 19. Inventory data on important forest climbers in three (3) 100 m x 100 m plots in the hill forest of Gabaldon, Nueva Ecija.

LOCAL NAME/ SPECIES	Family	Ave. Length (m)	Density	Volume (l.m.)	Average Diameter (cm)
Albotra *(Arcangelisia flava)*	Menispermaceae	8.4	3.5	12	100.8
Hinggiu *(Ichnocarpus volubilis)*	Apocynaceae	7.6	2.5	9	68.4
Lukmoy *(Raphidophora merrillii)*	Araceae	5.2	1.7	11	57.2
Liktang *(Anamirta cocculus)*	Menispermaceae	7.8	2.30	13	101.4
Gogo *(Entada phaseoloides)*	Leguminosae	9.5	2.7	14	133.0
Makabuhai *(Tinosphora rumphii)*	Menispermaceae	9.8	2.12	7	68.6
Nito *(Lygodium circinatum)*	Schizaeaceae	4.2	0.75	10	42.0
Baling-uai *(Flagelleria indica)*	Flagellariaceae	6.3	1.20	15	94.5
Hagnaya *(Polygala venenosa)*	Polygalaceae	7.5	1.90	8	60.0
Palasan *(Calamus merrillii)*	Palmae	7.5	2.6	11	82.5
Limuran *(Calamus ornatus var.) philippinensis)*	Palmae	6.8	2.4	9	61.2
Tumalim *(Calamus mindorensis)*	Palmae	5.2	2.0	6	31.2
Kamaksa *(Rourea volubilis)*	Connaraceae	8.8	1.9	13	114.4
Kurotan-baging *(Linociera sp.)*	Oleaceae	9.5	1.0	7	66.5
Agpoi *(Bauhinia aherniana)*	Leguminesae	6.3	3.0	5	31.5
Saga *(Abrus precatorius)*	Leguminosae	5.6	5.6	12	67.2
Pandan baging *(Freycinetia sp)*	Pandanaceae	8.7	3.2	16	139.2
Nito *(Lygodium circnatum)*	Schizaeaceae	4.0	0.6	14	56.0

ably require presence of trees to cling on or provide them mechanical support. Young, regenerating individuals, however, were seen to grow in an erect, upright direction until further growth and increased in length enable the individual to cling using its flagella. In the absence of a tree to cling on, the bulk of its cane length lies prostrate on the ground while its ends climb and entwine whatever erect structure it could reach for mechanical support.

A flowering and fruiting individual incidentally has not been observed in the field in this particular study. Reports had it, nevertheless, that fruits when ripe obtain yellow to yellow-orange color (Palaypayon and Cadiz, 1988). Moreover, fruits or seeds become mature during October and November, that is, for palasan (*Calamus merrillii*) and limuran (*Calamus ornatus* var. *philippinensis*). In this particular study, the high frequency of observed seedlings in the field apparently point to high capacity of seeds to germinate under natural condition. Palaypayon and Cadiz (1988), nonetheless, stated that many rattan species exhibit dormancy and may take sometime to germinate even after sowing in the nursery. They further added that rattan canes are commercially harvestable after 15 to 20 years growth.

Other Forest Vines

Forest vines are notably abundant in relatively disturbed forest areas in low to medium altitudes (Aragones et al., 1992) which described all of the project sites in this particular study. Thus, they are actually seldom found under closed forest canopy which prevents penetration of sunlight through the middle layer down the forest floor.

The forest vine species, for instance, like nito (*Lygodium circinatum*), hagnaya (*Polygala venenosa*), bulakan (*Merremia peltata*), hingiu (*Ichnocarpus volubilis*), ligtang (*Anamirta cocculus*) and others were encounterd in young regenerating forest particularly in various municipalities of Quezon province and Nueva Ecija where these vines are collected for handicraft purposes.

Just like the climbing palms (rattan), asexual reproduction is not popular among the forest vines as they regenerate naturally by seeds. The sight of young wildlings of nito, hagnaya, bulakan, albotra (*Arcangelisia flava*), gogo (*Entada phaseoloides*) and others observed in the project sites could probably attest to their ability to reproduce by seed. Of the environmental factors that influence germination and growth of forest vines, light and moisture seem to have the greatest effect (Aragones et al., 1992). Incidentally, length of time seeds of forest vines germinate is rarely if not at all investigated.

Trends in Resource Utilization

Non-wood forest products species (NWFP) which constitute the bulk of materials for the furniture and handicraft industry like rattan, erect palm, bamboo, pandan and other forest vines are undoubtedly of great demand in the past and until the present time (Baja-Lapis, 1995, 1999; Prebble, 1999; Prebble et al., 1999). The demand is warranted not only by its huge contribution to the economy of the nation but by the dwindling timber resource that focused the attention of many industrialists to these non-timber forest product commodities.

Indiscriminate use of our timber resource has brought various consequential problems that affect not only our socio-economic stability but more importantly the environment (Angeles, 2000). Flash of floods and natural calamities in so far as they relate to proper use and management of the environment particularly of the forest resources have put forest managers and policy-makers in the dilemma of sacrificing resource benefits for the sake of the environment and people.

For the purpose of clarity and more comprehensive discussion of the trends in resource utilization of NWFP in relation to their natural regeneration and subsequent implications on resource sustainability, the species or plant group dealt with in this particular study are presented separately.

Bamboo

Bamboo, claimed to be our poor ancestors primary housing material (Rojo et al., 2000) is, likewise, utilized intensively for furniture, houseware and other products. In several provinces of the Philippines where bamboo resource is available, there appear no rules and policies in its harvesting or

cutting. This probably stems from the fact that most bamboos in the country have been planted and those observed particularly in the country sides are actually regenerants of those cut in the past which occupy private, titled lands. It is interesting to note that in this particular study, only buho (*Schizostachyum lumampao*) had been observed to grow naturally on slopes and low hills of Palawan. The rest are either planted or regenerants of past population that had been harvested on stream banks, creeks and other relatively open sites.

Harvesting of bamboo is indeed destructive as like timbers its stems or culms serve the utility for which the material is desired. Yet, there seems to be no problem thus far (personal communication) in their resource availability in the project sites surveyed. For one, people engaged in their collection and trade have gained knowledge on how to sustain or maintain the resource. Full knowledge that the next batch of harvest depends on the culms left and continuous production of young shoots provides bamboo enough time to regenerate. Furthermore, bamboo plantation owners realize the paramount importance of rhizome system vigour in producing new shoots or culms. Second, the time it takes for a young shoot to develop and be ready for harvest is known to these bamboo gatherers and traders. Their long familiarity with bamboos have made them an expert in their own right in recommending species for a particular use or product. Many of them stated that young shoots are ready for the next cut within 2 – 3 year for bolo (*Gigantochloa levis*) and kauayan-tinik (*Bambusa blumeana*).

Wong (1995) reported density of 150-400 clumps of *Dendrocalamus strictus* in a hectare of land in India while a density of 320 clumps per hectare for *Bambusa blumeana* in spontaneous stands in Cardona, Rizal had, likewise, been reported by de Guzman and his co-workers as cited in the work of Wong (1995). Suzuki and Jacalne (1986) again as cited in the same work of Wong (1995) reported 9,290 culms per ha and 38,017 per ha density for *G. levis* and *Schizostachyum lumampao*, respectively. This particular study alone tallied 37,500 culms per hectare of *S. lumampao* in Aborlan, Palawan.

Pandan (Pandanaceae

Resource sustainability in relation to trend in utilization and natural regeneration is probably not a problem as far as the tree-like pandan (*Pandanus* sp.) is concerned. The basic products manufactured from pandan are mats, hats, bags, ornamental decors, belts, etc. which do not make use of the stem or trunk. These products are all derived from the leaves gathered periodically by weavers and handicraft artists particularly in Luisiana, Laguna and Lucban, Quezon. In the former, dense stands are available in large plantation maintained for several years now while fair to moderate density can be found in Lucban, Quezon.

The gatherers and pandan-dependent weavers of Laguna and Quezon provinces (Luzon Island) through time have acquired knowledge of the plant's leaf shoot production after harvesting. Cutting of leaves for weaving is regulated to leave behind enough photosynthetic leaves that will sustain growth of individuals. Leaves are not harvested for the second time from the same individuals until young leaf shoots have emerged and grew one-half of its mature size (personal communication). This could take at least 3 – 4 months after shoot emergence. In other words, leaves harvested though may be in hundreds are distributed among the many mature individuals. Sustainability of resource, hence, is achieved by the gatherers, weavers and traders.

The climbing pandan represented in this particular study by species of *Freycinetia* called locally as "pandan-baging" is harvested destructively. The whole plant is pulled down from where it has cling on and utilized as material for handicraft making. But then, the material is used only occasionally due to its reported rarity (personal communication; Aragones, 2001). Nonetheless, whenever available, handicraft industrialists always find use for the stems of *Freycinetia* species either as handicraft product accessory or basic material for manufacturing handcrafted animals (deers and sheeps) for lawn decors and ornaments especially during Christmas season.

The rarity of the species which in this study totaled to only about 34 individuals (2 species) in a hectare of forest land in Mt. Banahaw, Lucban, Quezon most probably will pose serious threat on its sustainability. Natural regeneration by seed and production of future plants for economic utilization could most likely not cope with the demand for the material unless the species is introduced in plantation.

Erect Palms

The erect palms treated in this report included *Livistona rotundifolia* var. *luzonensis, Livistona saribas, Corypha elata* and *Arenga pinnata*, all important species for commercial and industrial purposes. In so far as these palm species are concerned, supply does not seem to be a problem at the moment. A good volume of buri is obtainable in Quezon and Palawan provinces. Since it is the leaves especially the leaf stalk that is the source of fibers known popularly as "buntal" (Brown, 1920), the tree is more or less ensured of survival. The stem does not offer commercial value at the moment and, therefore, not cut or felled. Gatherers, on the other hand, have gained knowledge of proper leaf harvesting leaving behind enough leaves for normal photosynthetic activity to proceed. The time it takes for new leaf shoot to emerge and develop ranges from 3 – 5 months (personal communication) and collectors particularly in Quezon province are well aware of such, allowing them to properly schedule the next cutting of leaves. It is basically for this reason that the buntal fiber industry which showcases elegant bags, hats and other products has continued to exist and survive through many years.

Livistona species, on the other hand, whose stem and leaves are both utilized for commercial purposes most likely will confront serious problem in sustainability. Although fair to moderate density is available in Samar, Quezon and Palawan depletion of stand poses a big threat if stems shall continuously be cut and felled to satisfy the demand of fish pen and restaurant entrepreneurs for posts and construction materials. Utilization of the leaves for thatching and roofing may not affect the life of the tree since defoliation as observed in the field was more or less regulated to allow growth and development of new leaf shoots. Stem harvesting, however, will definitely threaten its continuous existence. Although regeneration by seeds has been observed profusely, seedling growth and maturity could probably take several years (Whitmore, 1973). Development of a new stand for future harvest, hence, will take longer period of time.

Like buri (*C. elata)*, the stem of kaong (*Arenga pinnata*) is not utilized for commercial purposes. Rather, the black fibers that surround the stem called "cabo negro" are gathered for manufacture of brooms and scrubbing material (Brown, 1920; Razal, 2000). Similarly, the leaves are collected and the long midribs are tied together on the bigger end to produce a stick broom. They are common sight in local market especially in the rural areas. Moreover, the white meat taken from the tree's small nut are edible and, likewise, sold in the market.

Profuse growth of wildlings of kaong most probably will add up to the existing stands as trees are not cut. Sustainability of material resource from kaong, hence, may not be a problem at the moment and current stands may be reduced only by natural death of old and over mature individuals.

Rattan (Climbing Palm)

Rattan which is one of the Philippines top dollar earners non-timber commodity is sought greatly by the furniture manufacturers (Brown, 1920; Palaypayon & Cadiz, 1988; Baja-Lapis, 1995, 1999; Razal, 2000) here and abroad. Since the stems called "canes" are utilized as materials, destructive harvesting understandably is expected. The whole cane is pulled down from where it clings or hangs killing the plant in return. There is no way the life of rattan may be spared to serve the purpose of the industrialists.

In this particular study, rattans mostly belonging to the genus *Calamus* were found in fair to moderate density in Quezon, Nueva Ecija, Samar, Aurora and Surigao del Sur provinces. Surprisingly, it seems sight of rattan furnitures is still common not only in the project sites covered but probably in other provinces of the country. Rattan apparently maintains its rank and economic contribution among the commodities listed in the Philippine Forestry Statistics (1995). Scarcity of rattan canes, nonetheless, has been cited by Palaypayon & Cadiz (1988) as a serious problem that beset the rattan industry. Yet, personal communication with some rattan traders in Quezon and Aurora provinces revealed continuous reliance of gatherers and manufacturers from supply in the natural forest. Rattan plantations surprisingly have never been their source. Although plantations may actually be existent rattan collectors and suppliers evidently depend on what are available in the natural forest. Hence, the problem of

depletion of supply certainly confronts the rattan industrialists probably in the future.

The climbing palms called "rattans" regenerate by seeds. This was evidenced by observed growth of rattan wildlings in all the project sites the species were encountered. There is no local report yet of asexual reproduction in rattans. The high frequency of observed wildlings seemingly point to high germination of seeds which when allowed to grow to maturity can replace those previously harvested. However, it takes about 15 - 20 years (Palaypayon & Cadiz, 1988) before rattans become ready for harvest. This probably explains collection and use of young, immature canes which could contribute to fast dwindling of our rattan resources. Sustainability of the rattan industry obviously may only be achieved through establishment of plantations all over the country.

Other Forest Vines

Just like the rattans other forest vines of commercial importance like hagnaya (P. venenosa), nito (*L. circinatum*), bulakan (*M. peltata*), hingiu (*I. volubilis*), ligtang (*A. cocculus*) and many others are harvested destructively since their stems serve as materials for weaving and various handicraft items. There is great demand for these vines (Furniture and Handicraft Forum, 2001) though there is obviously a problem in their supply. The current source of materials is the second-growth forest where a number of them had been tallied in the provinces of Quezon, Aurora, Nueva Ecija and Surigao del Sur.

Considering the vines regeneration by seeds and their undetermined length of time to grow and develop into mature future stock, sustainability of materials undoubtedly becomes a big threat to the handicraft industry. Natural supply of the species may not be sufficient to meet the demand for certain products.

Considerations for Sustained–Yield Collection Practices and Conservation

Sustainable management and utilization of material resources will always have to consider the collection practices and appropriate conservation measures. Evidently, non-wood forest products (NWFP) species like anahaw (*Livistona rotundifolia* var. *luzonensis*), tarau (*Livistona saribas*), rattan, bamboo, pandan and other forest vines may be harvested commercially either for their leaves, stems or both. When harvested for stem utilization as in anahaw, tarau, bamboo and other forest climbers, depletion of supply certainly becomes a big threat when done indiscriminately and sustainability of the industries that rely on the available material resource is at stake.

Collection for stem utilization should be based on age or size of the plant material. In doing so, it ensures perpetuity giving time for the young ones to grow and attain full maturity size that can serve as future stock for harvest. The same should be done when collecting for the leaves to make sure photosynthetic activity that sustains the life of the plant proceeds normally. There should always be consideration for residuals. Care should, likewise, be taken to protect growth of young seedlings or wildlings when felling stems or pulling down rattans and other vines. Always give allowance for the next generations of crops as excessive cutting or harvesting will devastate the stand and will not guarantee material for future harvest.

Laws and regulations concerning harvesting and utilization of NWFP should be implemented strictly to the letters in order to conserve and protect existing stands. The government should exert effort initiating establishment of plantation of these species for a more sustainable management and use of these non-timber resources. This goes in hand with investigations and experiment on the nursery and silvicultural requirements of these NWFP.

CONCLUSION

Resource survey and inventory of economically-important non-wood forest products (NWFP) species conducted intermittently from October 1997 to August 2001 in various municipalities of the provinces of Palawan, Aurora, Western Samar, Surigao del Sur, Quezon and Nueva Ecija provided very valuable and useful quantitative data on the species availability and supply. The results obtained answer the usual queries on where to find them, what could be found and how much can be gathered. Many of the species treated in this particular study are available in fair to moderate quantity in the six project sites or provinces covered based on density and volume. Similarly, they are capable of reproducing by seeds or rhizome and sucker as in the case of bamboo and pandan. Many of the forest vines, however, were rare and could be fast depleting.

This particular study, likewise, provided an ecological assessment of the different species regeneration pattern and potential for sustainability of resources. Sustained-yield collection practices and measures to conserve the species for continuous supply of material depend largely on the growth habit and regeneration characteristic of the species concerned. In general, cutting and harvesting should be regulated based on volume of mature individuals and population density of young regenerating wildlings.

RECOMMENDATIONS

Sourcing of materials for commerce and the industry will always play a very significant role in non-wood forest products utilization for the success of any economic venture depends greatly on availability of material resource.

The data presented admittedly cover a very small segment of the country. Similar study in the future should include as many provinces and regions as possible.

A pre-project on the requirements and cost of establishing in plantation some of the species studied for sustainable utilization like buri in particular which is the source of the famous raffia fibers for handicraft is very important to carry out.

ANNEXES

1A. Kauayan-tinik (*Bambusa blumeana Schultes*) growing in clump

1B. Regenerating shoot of Kauayan-tinik (*B.blumeana Schultes*)

2. Bolo (*Gigantochloa levis* Merr.) showing young culm and characteristic sheath

3. Buho (*Schizostachyum lumampao* (Blanco) Merr. showing large, enclosing culm sheath

4. A clump of bayog (Bambusa merrilliana (Elmer) Rojo and Roxas comb. nov.

5 A & 5B. Typical bamboo rest house and shed that is a common sight along raods going to Lucena City, Quezon Province

6A& 6B. Mature individuals of pandan (*Pandanmus sp.)* bearing large fruit.

7A. Mature stand of anahau (*Livistona rotundifolia* var. *luzonensis)* Becc.

7B. Young regeneration of anahau (*Livistona rotundifolia* var. *luzonesis* Becc.) under partial shade.

8A. Close up view of *Livistona* spp. Stems and crown.

8B. Leaves of *Livistona* being used as roofing material for bamboo rest house.

9. Piles of felled stems of *Livistona* ready for transport.

10A. Mature stand of buri (*Corypha elata* Roxb.) showing stout stem and crown form.

10B. A close up view of characteristic inflorescence of buri (Corypha elata Roxb.) Notice very profuse fruit bearing habit of the species.

11. Buri (*Corypha elata* Roxb.) showing yellowish-green leaf stalks and basal portion of cut off stalks

12A. Profuse germination of *Corypha elata* Roxb. seedlings under full shade.

12B. Young wildings of *Corypha* on partly-shaded area.

13. Fruiting tree of kaong (*Arenga pinnata* (Wurmb) Merr.). Notice long, hanging characteristic infructescence.

14A. Close up view of *Arenga* showing large, pinnate leaves and dull green fruits.

14B. View of whole fruit and longitudinal section of *Arenga* showing fleshy meat.

15. Young wildlings of *Calamus* (rattan) growing under shade of young secondary forest in Western Samar

16. The climbing *Freycinetia sp.* of Pandanaceae, a very important material for handicraft.

17A. A species of *Piper* (Piperaceae), a common vine in second growth forest of Quezon province which is a good material for handicraft.

17B. Another species of *Piper* (Piperaceae), a forest climber that is a potential material for handicraft.

18. Hingiu (*Ichnocarpus volubilis* (Lour.) Merr.), a highly prized material for handicraft (Photo courtesy of Dr. R.P. Escobin FPRDI-DOST.)

19. Tilob (*Dicranopteris linearis* (Burm.) Under., a climbing fern that is a higly-prized material for handicraft. (Photo courtesy of Dr. R.P. Escobin).

20. Hagnaya (*Polygala venenosa* Juss.), a climbing fern commonly utilized for handicraft (Photo courtesy of Dr. R.P. Escobin FPRDI-DOST).

21. A soft chair made primarily from a species of *Calamus (*rattan)

22. Files of harvested gogo (*Entada phaseoloides (*L.) Merr stems, a highly-prized material for handicraft.

23. Attractively-colored hats from buri (*Corypha elata* Roxb) on display in a public market.

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