

Anthropogenic Activities Affecting the Growth and Survival of *Bauhinia malabarica* Roxb. in the Grasslands of Nueva Ecija, Philippines

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The study assessed the effects of anthropogenic activities on the regenerative capacity of "Alibangbang" (*Bauhinia malabarica* Roxb.), a pioneer species with known fire-resistant and excellent coppicing qualities, in the remnant forest and grass-dominated watersheds of Carranglan, Nueva Ecija. The various uses and potentials of alibangbang as a local resource was determined through interviews, direct observations, and analysis of secondary information. Results of the study revealed that the low regeneration of alibangbang could be attributed to upland farming, pasture and grazing, and the gathering of alibangbang shoots and leaves, cogon grass, charcoal, and fuelwood in the area. High preference for alibangbang fuelwood and charcoal put pressure on the survival and growth of remaining patches in the area. Local people prefer to use the shoots of alibangbang as a food flavoring resulting in over harvesting and pruning that disturb the tree's photosynthetic activity and inhibits growth. Escape fires from land clearing and kaingin as well as regular browsing and trampling of grazing animals further affected the species' capacity for natural succession resulting in slow colonization, despite the abundance of good mother alibangbang trees in the watershed.

Keywords: natural regeneration, Carranglan watershed, *Bauhinia malabarica* Roxb., anthropogenic activities, fireprone grassland

INTRODUCTION

Restoration of degraded watersheds and forestlands in the Philippines has been a major challenge to both government authorities and forest managers. Although the country had a number of reforestation programs, the expansion of grassland continues to this day. Around the archipelago, there are about 3.9 million ha of grassland areas that comprise nearly 8% of the country's total land area (FMB 2006). Likewise, the country has 475,100 ha of sub-marginal lands and 2.25 million ha of brush lands (PCARRD 2008).

Production of high quality planting stocks is one important factor to consider in achieving successful ecosystem rehabilitation. Species-site compatibility and climate adaptability are also equally important. In a harsh environment like Carranglan Watershed where grassland dominates the landscape, annual grassfire and environmental factors like hot temperature, moisture, and droughty soil should be considered in species selection. Species that coppices after disturbance is also an important attribute to consider when choosing an appropriate reforestation species.

Alibangbang (*Bauhinia malabarica* Roxb.) is a lesser-known species and a prospective pioneer forest tree for restoring open areas of watersheds.

It is a dioecious small tree reaching a height of 10 m and a diameter of 20 to 40 cm (RISE 1994). It is native to Australia, India, Indonesia, Malaysia, Myanmar, Thailand, and the Philippines (Orwa *et al.* 2009).

In the Philippines, alibangbang can be found in Ilocos Region and is reported to be abundant in Nueva Ecija, Bulacan, Rizal, and Laguna (PCARRD 1985). The species occurs naturally, either singly or in clumps, in grassland subject to fire but is periodically found in very dry localities (Orwa *et al.* 2009). Likewise, the species can survive in hot and shaded conditions, and is potentially useful during drought period or El Niño years (PCARRD 2001).

It can withstand heavy cutting and is able to grow on poor soils and denuded lands in dry climates and on seacoasts even with its roots in brackish or salt water (PCARRD 2001). Alibangbang is fire-resistant and therefore, can be considered one of the best species to restore degraded watersheds (Jimena 1976). Epicormic and basal bud emergence with basal diameter of at least 5 cm occurred 8 to 10 days after high intensity fire (Florece 1996). It is recommended as a reforestation species but has not been utilized so far in any watershed restoration program.

It was observed that very few natural regeneration or wildlings of alibangbang could be found in Carranglan Watershed, despite the presence of a good number of mother trees. Thus, this study was done to investigate the different anthropogenic activities of local people in the area that influence low regeneration of the species. It also sought to determine the different uses and potential of alibangbang as reforestation species for fire-prone grassland.

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METHODOLOGY

The Study Area

The study was conducted in Carranglan Watershed in the municipality of Carranglan in the northern portion of Nueva Ecija where alibangbang grows abundantly (Figure 1). It is geographically situated between 120° 52' and 121° 12' longitude and 15° 51' and 16° 09' latitude (Development Master Plan of Carranglan 2003-2007). The area is also part of the Pantabangan-Carranglan Watershed that supports a multi-purpose dam for irrigation and hydroelectric power generation.

The interview was conducted in the 17 barangays of the municipality, namely: R.A. Padilla (Baluarte), Bantug, Bunga, Burgos, Joson (Digdig), General Luna, Minuli, Piut, Puncan, Putlan, Salazar, San Agustin, T.L. Padilla, F.L. Otic, D.L. Maglanoc, and G.S. Rosario.

Interview Schedule, Respondents, and Sampling Procedure

Interviews using a questionnaire were conducted to determine the anthropogenic activities of local people living at the periphery of forested and grassland areas of the watershed. The interview focused on the local residents of Carranglan who directly or indirectly carry out upland activities in the area and who use alibangbang species as a forest resource.

Items asked include dimensions and frequency of collection of alibangbang shoots and leaves, and other forest products such as fuelwood, cogon grass (*Imperata cylindrica* (L.) Raeusch.), and buho (*Schizostachyum lumampao* Blanco) poles.

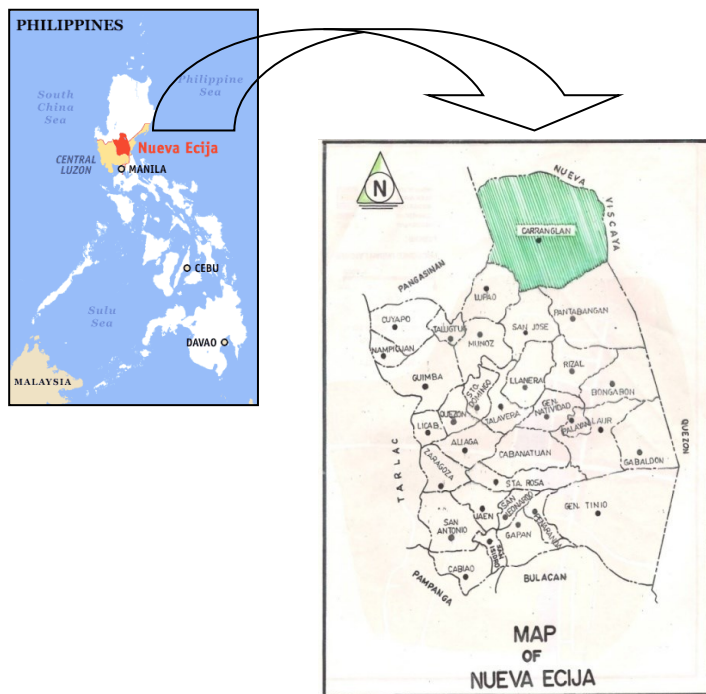


Figure 1. Location of the study area (adapted from Development Master Plan of Carranglan, Nueva Ecija 2003-2007)

Simple random sampling was used to identify respondents with equal number (21) per barangay for a total of 364. The data were analyzed using descriptive statistics such as mean, count, frequency, range, and percentages.

RESULTS AND DISCUSSION

Demographic and Socio-Economic Profile of the Respondents

Table 1 summarizes the demographic and socio-economic characteristics of the respondents. Ages ranged from 20 to 82 years old, with a mean age of 45. Results revealed that they have adequate knowledge on natural regeneration of alibangbang. In terms of gender distribution, respondents were predominantly male (66.48%) while more than a quarter (33.52%) were female. The female respondents knew about alibangbang in the area. The household size ranged from one to 14 members with a mean of 5.0. Family size was within the national average household size of five members per family. Upland farming was the main occupation of 88.50% of the respondents, which meant that majority of them were largely dependent on agriculture for income. Income range was from Php 600 to 34,000 with a mean of Php 3,921 per month.

Human-Induced Disturbances in the Watershed

The livelihood activities of the respondents are shown in Table 2. A great majority (69.60%) of the respondents did not have secondary sources of income, and therefore relied heavily on the watershed for livelihood and needed forest products.

Among the activities in the area were gathering of forest resources and other raw materials, upland farming, pasture raising, and animal grazing. All respondents collected or harvested forest resources from the remaining forest. Although considered illegal, these activities were often done without being noticed by forest officers. People relied heavily on the forest resources to meet family needs and augment whatever resources they have especially during the lean months.

Upland farming (72.52%) served as the main source of livelihood for most of the respondents. Tilling lands for agricultural crops was not limited to lowland areas but done in the town's upland and grassland areas as well.

Since most of the respondents did not have other lands to till, they were left with no other option than to extend their cultivation into grasslands and remaining forest (Medina *et al.* 1999).

Upland farming in the watershed required deliberately removing undesirable vegetation to give way to crops. Clearing and tilling practices eliminated patches of alibangbang and its wildlings and destroyed other vegetation in the course of clearing.

Slash-and-burn agricultural systems received a great deal of attention due to its observed or hypothesized role in tropical deforestation, biodiversity loss, and global warming (Fujisaka and Escobar 1997). *Kaingin*, the predominant form of agriculture in the Philippines, is responsible for deforestation (Kummer 1992 as cited by Lawrence 1997).

Table 1. Summary of the demographic and socio-economic profile of the respondents

Variable	Frequency (N=364)	Percentage (%)
Mean Age	45 years old	
Gender Distribution		
Male	242	66.48
Female	122	33.52
Civil Status		
Single	15	4.12
Married	335	92.03
Separate	12	3.30
Widow/er	2	0.55
Mean Household Size	5.00 members family ⁻¹	
Level of Education		
Elementary	171	46.98
High School	118	32.42
College	39	10.71
College level	31	8.52
Vocational	5	1.37
Main Occupation		
Upland Farming	322	88.50
Municipal and Barangay Employee	32	8.80
Engaged in Business	10	2.70
Secondary Occupation		
No secondary occupation	253	69.60
Others (<i>sawali</i> maker, charcoal maker, cogon gatherer, farmer, barangay employee, carpenter and fish vendor)	110	30.40
Mean Income	PhP 3,921.00	

The respondents practiced combined permanent agriculture and shifting cultivation. These farming practices hampered the natural regeneration of alibangbang and other forest vegetation during clearing and burning of land. The expansion of grassland in the country was greatly attributed to *kaingin*-making system where fire is a major force. Rapid expansion of grasslands is triggered by interacting factors of rapidly increasing population, system of land holding, unemployment, and declining arable land per farmer in the lowlands (Marchard 1978 as cited by Medina *et al.* 1999).

More than a third (38.60%) of the respondents have claims in the grassland and forest zones (Table 3). They did not own agricultural lands in the low-lying areas, forcing them to cultivate the grassland and adjacent forest, although these lands are clearly under the public domain or government-owned. Size of land cultivation ranged from 0.10 to 250 ha, but the mean size of cultivated areas of the respondents engaged in upland farming is 5.64 has. The size of land under cultivation in the upland corresponds to the extent of disturbance on forest regeneration.

The respondents showed high preference for fire as a land preparation tool, since it is both cheap and non-laborious.

Table 2. Livelihood activities of the respondents in Carranglan Watershed

Livelihood Activities	Frequency*	Percentage (%)
Gathering of raw materials and other forest resources	364	100
Upland farming	264	72.52
Pasture and grazing	114	31.32
Wildlife hunting	35	9.62
N=364		*Multiple responses

This meant that wildlings of alibangbang and other broad-leaved species could hardly grow and survive in the area because of regular burning activity by the respondents. Moreover, fire escaping from the *kaingin* areas posed damage to adjacent patches of alibangbang, reforestation areas, and natural forest.

More than half (54.50%) of the respondents said they were engaged in single cropping and more than a third (39.80%) did semi-annual cropping. More than half (61%) of respondents also said they were engaged in subsistence farming. This meant that almost all (94.32%) of the farmer-respondents were dependent for their sustenance on the resources available in the watershed during lean months of the year.

When it comes to planting perennials, more than half (54%) of the respondents planted mango (*Mangifera indica* L.). Rice was also planted in both upland and lowland areas by more than a third (36.50%) of the respondents. They identified agricultural crops such as vegetables, root crops, and fruit trees as their sources of food. Forest trees were also used for fuel and construction. Respondents seemed to put more priority to planting of annual crops for food and cash even in secondary forest and grasslands.

More than a third of the respondents (35%) were engaged in hunting of wild animals as additional food source. The wildlife commonly gathered included *bayawak* (*Varanus salvator* L.), wild deer (*Rusa marianna* D.), grass owl (*Tyto capensis amaurota* Cabanis), wild chicken (*Gallus gallus* L.), python (*Phyton reticulatus* Schneider), rats (*Rattus* sp.), wild ducks (*Anas luzonica* Fraser), and monkey (*Macaca fascicularis* Raffles).

Majority (71.40%) of the respondents hunt wildlife once a year, a fifth (20%) hunt four times a year, and a few (8.60%) hunt twice a year. The wild animals collected were merely for household consumption (100%). However, the effect of hunting activities on the natural regeneration of alibangbang was not established.

Pasture and Grazing

Grasslands were utilized for pasture and grazing animals. A total of 114 (31.32%) respondents were engaged in these activities that affected the natural regeneration of alibangbang. Goat (84.21%) and cattle (77.31%) were the most common grazing animals raised by respondents (Table 4).

Table 3. Upland farming practices and characteristics of the respondents

Category	Frequency	Percentage (%)
Land Holding (N=264)		
Claimant/Possession	102	38.60
Owner (A and D lands)	75	28.40
Shared Tenure	53	20.30
Leaseholder (A and D lands)	25	9.30
Individual Tenure	9	3.40
Size of Upland Farm (N= 264)	5.64 ha (mean)	
Land Preparation Method (N=264)		
Use fire	208	78.79
Manual brushing	45	17.04
Applied herbicide/weedicide	11	4.17
Frequency of using fire (N=208)		
Once a year	198	95.20
Semi-annually	10	4.80
Cropping Season Practiced (N=264)		
Annual	144	54.50
Semi-annual	105	39.80
Quarterly	15	5.70
Mode of Product Disposition (N=264)		
For subsistence	161	61.00
Sold in nearby towns	103	39.50

In terms of fodder, 80.70% of respondents use cogon grass followed by alibangbang shoots, leaves, and pods (15.78%).

Animals such as goat, carabao, and cattle trample on plants and graze on wildlings. Pasture and grazing animals also exerted pressure on the soil by compaction, hence enhancing surface runoff during rainy season, decreasing water infiltration rate while increasing soil erosion rate.

In addition, cattle owners intentionally burned large tracts of grassland managed by the National Irrigation Administration (NIA), National Power Corporation (NPC), or Department of Environment and Natural Resources (DENR). Within two to three weeks from burning, fresh and palatable grasses for grazing animals would regrow.

Burning as a traditional practice affected natural succession of forest species especially if the fire that escapes from the

Several studies suggest that many tree species are unable to reproduce successfully and maintain populations in pastures over the long-term (Janzen 1986; Wilson 1990 as cited by Esquivel *et al.* 2007).

Grass competition (Camargo *et al.* 1999; Schaller *et al.* as cited by Esquivel *et al.* 2007), cattle grazing (Hall *et al.* 1992; Archer 1995 as cited by Esquivel *et al.* 2007), and pasture management (Teague and Dowhower 2003 as cited by Esquivel *et al.* 2007) may also limit regeneration and reduce tree colonization.

The trees in pastures and grazing areas could still be living dead, that is, alive yet unable to reproduce successfully within these habitats (Janzen 1986 as cited by Esquivel *et al.* 2007). If this is the case, density and diversity of tree cover will quickly diminish over time (Esquivel *et al.* 2007). In Costa Rica, for example, grazing severely reduces woody regeneration in plantation (Haggard *et al.* 1997 as cited by Hardwick *et al.* no date).

Gathering of Forest Resources and Other Raw Materials

The respondents engaged in gathering five kinds of forest resources from the grassland and forested areas of the watershed. These resources included alibangbang shoots and leaves, fuelwood, charcoal, wild fruit, bamboo poles, and cogon grass (Table 5).

Alibangbang Shoots and Leaves

The young shoot was extensively used by respondents for flavoring the popular local fish *biya* (Goby) that thrives in many rivers of the watershed. The young shoot is also used as condiment for pork and chicken, and for cooking the famous Ilocano dish *pinapaitan* using goat meat. Respondents pruned the branches and twigs of alibangbang to induce growth of new shoots. Alibangbang regenerates readily but is next only to

binayuyu (*Antidesma ghaesembilla* Gaertn.) in terms of number of buds or shoots produced after burning (Florece 1996). Alibangbang also had significantly greater number of buds under the intermediate fire intensity burns (Florece 1996). The same author concluded that alibangbang is the best species in terms of the number of sprouts produced. The excellent coppicing ability of alibangbang explains why regular pruning was possible as practiced by respondents.

The mean frequency of shoot collection was 3.06 times a month, but could range from once a month (22.5%) to as high as 15 times a month (0.50%) (Table 6). The amount of shoot collected ranged from 50 to 253 g harvest⁻¹ or an average of 127.40 g harvest⁻¹ (Table 7). This indicated a strong preference of the respondents for alibangbang shoot over condiments sold in the markets for flavoring dishes. This meant that frequent harvesting of shoot might affect photosynthesis and even the flowering of trees because few shoots could reach maturity.

Second to alibangbang shoots, cogon was the most collected resource from the watershed, with 60.16% of the respondents saying they collected cogon grass either to be used to thatch their houses or to be sold in nearby towns.

About 8.79% of the respondents used the leaves for traditional medicine and for treating illnesses such as cough and fever. For this purpose, respondents used about 4-15 pieces of leaves or a mean of 5.15 pieces. In Thailand, the leaves of alibangbang are also used for treating wounds, as the leaves contain flavanol derivatives such as 6, 8-di-C-methylkaempferol 3-methy ether, kaempferol, afzelin, quercetin, isoquercitrin, quercitrin, and hyperoside (Kaewamatawong *et al.* 2008).

Table 4. Pasture and grazing animals raised by respondents and fodder employed for livestock

Category	Frequency	Percentage (%)
Size of Upland Farm (N= 114)	5.64 ha	
Pasture and Grazing Animal (N=114)	96*	84.21
Goat	88*	77.31
Cattle	45*	38.59
Carabao		
Fodder for Livestock (N=114)		
Cogon grass	92	80.70
Alibangbang (leaves, shoot, green and ripe pods)	18	15.78
Kakawate leaves	2	1.75
Ipil-ipil leaves	2	1.75

*Multiple responses

Table 5. Resources collected by the respondents from the watershed

Resources	Number of Respondents Who Used the Resources*	Percentage* (%)	Estimated Mean Volume Collected per Collection
Alibangbang shoot	364	100	127.40 grams
Cogon grass	219	60.16	-
Fuelwood (fresh and dry)	115	31.59	5.73 pieces
Alibangbang leaves	29	8.17	5.15 pieces
Bamboo poles (buho)	25	6.86	1350 linear meters
Charcoal	25	6.86	32.12 sacks
Wild fruit (bignay)	7	1.92	-

N=364

*Multiple

The same authors stated that several biological activities of these flavanol derivatives have been previously studied. Quercetin, hyperoside, kaempferol, isoquercitrin, and quercitrin have been known to exhibit antioxidant activity (Yokozawa *et al.* 1997 and Seyoum *et al.* 2006 as cited by Kaewamatawong *et al.* 2008). Likewise, quercetin and hyperoside have been known as nitric oxide synthase inhibitors (Luo *et al.* 2004 as cited by Kaewamatawong *et al.* 2008). Thus, the same authors concluded that these flavanols could be the active compounds of *Bauhinia* for wound healing.

Fuelwood

The respondents gathered fresh and dried woods of alibangbang and other forest trees for their domestic fuel needs. Fuelwood was the third most collected resource in the watershed. The high calorific value of the species (4,700 - 4,850 Kcal kg⁻¹) (Carandang and Carandang 2004) explains why the species is a good source of fuelwood. Majority (72.80%) of the respondents admitted that alibangbang trees were being cut for fuelwood. The size of the fuelwood varied depending on its availability in the watershed. The length of fuelwood from various species that the respondents collected ranged from 0.50 to 2.00 m with a mean length of 2.22 m. The diameter ranged from 5 to 20 cm with a mean of 12.40 cm.

The mean number of dried branches/twigs and stem collected was 5.73 pieces. Hence, the average volume of fuelwood per collection was 0.15 m³ or 65.48 bf per respondent. The mean frequency of collecting fuelwood was 3.30 times per month, but this ranged from once a month to as high as five times a month (Table 6). Excellent fuelwood species are those that regenerate by basal sprouting, which is frequently observed in alibangbang (Florece 1996). At a retail price of PhP 318.36 m⁻³ (FMB 2008)

in Central Luzon, fuelwood harvesting could very well provide additional income to farmers, although respondents claimed that the fuelwood was intended for household use only.

Charcoal

The respondents made charcoal out of alibangbang wood and other tree species. Alibangbang wood was one of the preferred species for charcoal-making by all respondents. They said the mean number of trees of alibangbang that were cut for charcoal was 4.91 trees per harvest (or from 2 to 20 trees per harvest). The diameter varied depending on what was available in the watershed. March and April were peak production months for charcoal-making because of high demand. Thus, charcoal also commanded a higher price during summer months.

The price of alibangbang charcoal mixed with ipil-ipil, teak, acacia, and yemane in Carranglan ranged from PhP 65 to PhP 120 while pure alibangbang charcoal ranged from PhP 120 to PhP 150. Charcoal was sold in the town proper of Carranglan, San Jose, and Cabanatuan City. The price of charcoal per sack in Central Luzon is PhP 122.61 (FMB 2008).

Twenty-five respondents (or 6.87% of those interviewed), admitted to be charcoal-makers and produced 9-80 sacks per year or a mean of 32.12 sacks of charcoal from various tree species, including alibangbang (Table 8).

More than half (52%) of the respondents produced 9 to 25 sacks of charcoal per year, almost a third (32%) produced 43-96 sacks per year, and less than a quarter (24%) produced 26-42 sacks (Table 8). Similarly, 56% of the respondents said they engaged in charcoal-making once a year while 12% were into charcoal making thrice a year (Table 9).

Table 6. Frequency of collection of alibangbang shoots and mixed species of fuelwood

Frequency of Collection/ Month	Alibangbang Shoot*		Fuelwood**	
	Number of Respondents	Percentage (%)	Number of Respondents	Percentage (%)
Once	82	22.50	4	3.49
Twice	90	24.70	23	20.00
Thrice	47	12.90	32	27.82
Four times	93	25.50	48	41.74
Five times	19	5.20	8	6.95
Six times	12	3.30	-	-
Seven times	3	0.80	-	-
Eight times	5	1.40	-	-
Ten times	8	2.20	-	-
Twelve times	3	0.80	-	-
Fifteen times	2	0.50	-	-

*N=364 **N=115

Table 7. Amount of Alibangbang shoots being collected by the respondents per month

Amount of Shoot Collected (g)	Frequency	Percentage (%)
50-61	65	17.86
62-73	0	0.00
74-85	0	0.00
86-97	0	0.00
98-109	101	27.75
110-121	0	0.00
122-133	1	0.27
134-145	0	0.00
146-157	148	40.66
158-169	0	0.00
170-181	0	0.00
182-193	0	0.00
194-205	26	7.14
206-217	0	0.00
218-229	0	0.00
230-241	0	0.00
242-253	24	6.59
N=364		

Charcoal was one of the preferred sources of energy for heating and cooking. Aside from being cheap, the energy value of alibangbang wood is about 18,100 kJ kg⁻¹ (Orwa *et al.* 2009).

The government thru DENR does not allow the cutting of trees without permit, especially in critical watersheds. Local residents and charcoal-makers in Carranglan are allowed to gather only dead trees, branches, and twigs for fuel and charcoal needs. Failure to regularly monitor the watershed, however, resulted in proliferation of illegal activities and rampant cutting of all kinds of trees in the area. DENR Region 3 reported that 230 sacks of charcoal worth PhP 28,200.30 were confiscated in the area between 2006 and 2010.

The soaring price of liquefied petroleum gas (LPG) forced respondents to use fuelwood and charcoal for cooking, which they believe could be collected freely in the absence of forest guards.

In addition, alibangbang is known to have excellent coppicing ability. However, goats and cattle regularly browsed on newly sprouted shoots and leaves, including wildlings, thus limiting its natural process of regeneration. This meant that humans and animals alike depended heavily on this species for food and sustenance.

Cogon grass

The cogon (*I. cylindrica*) grass was another resource harvested. Among the respondents, 219 individuals said they collected the grass for use as roofing material (thatch) for houses and animal barns (Table 9).

All respondents believed that burning cogon to eliminate old leaves would allow for new sprouts that would ensure the production of good quality thatch material the following year. This meant that fire was not only used to clear and prepare land but also to maintain cogon grass.

Respondents would collect cogon up to five times a year (Table 9). Almost half (47%) of the respondents collected cogon only once a year while a quarter (25%) said they collected cogon thrice a year. Seventeen percent (17%) of the respondents said they gathered cogon twice a year and 11% from 4 to 5 times a year. Cogon collection and selling also provided alternative livelihood to local residents. The price of cogon per bundle measuring 40-50 cm in diameter with an average length of 1.35 m was PhP 15-30. Collection would start from March to April or during the dry season. The peak period for selling cogon was from May to July. Cogon, when used as roofing material, could last from three to five years.

Buho poles and wild fruits

Respondents would weave *buho* (*S. lumampao*) to make *sawali*, a local material used as walls for houses. The pole was used as fence. The mean length of buho collected by the respondents was 3.40 m while the mean number of pieces collected was 135.80. This meant that respondents would gather 461.72 linear meters per collection. The mean frequency of collection was 1.64 times a year. More than half (56%) of the respondents collected *buho* twice a year while 44% collected thrice a year.

There were three different dimensions of *sawali* produced by the respondents, namely: 5ft × 10ft (1.52m × 3.05m) sold at PhP 130-160; 6ft × 10ft (1.83m × 3.05m) sold at PhP 150-170; and 8ft × 10ft (2.44m × 3.05m) sold at PhP 200-250. These were brought to the towns of Carranglan, Cabanatuan, and San Jose City, as well as in Nueva Vizcaya province and Baguio City. The peak season for selling *sawali* was from April to May. Few (1.92%) respondents collected bignay fruit (*Antidesma bunius* (L.) Spreng). More than half (57.14%) of the respondents said they collected wild fruit twice a year while 14.28% said thrice a year (Table 9).

Table 8. Volume of charcoal produced by the respondents per year

Volume of Charcoal Produced (sack)	Frequency (N=25)	Percentage (%)
9-25	13	52.00
26-42	6	24.00
43-59	3	12.00
60-76	2	8.00
77-96	3	12.00

Table 9. Frequency of charcoal-making and collection of cogon grass and wild fruit in the watershed

Frequency of Collection/Year	Charcoal-making (N=25)		Cogon Grass (N=219)		Wildfruit (N=7)	
	Number of Respondents	%	Number of Respondents	%	Number of Respondents	%
Once	14	56.00	102	47.00	2	28.57
Twice	8	32.00	38	17.40	4	57.14
Thrice	3	12.00	55	25.1	1	14.28
Four times	-	-	12	5.5	-	-
Five times	-	-	12	5.5	-	-

Grassfire in Carranglan

All of the respondents confirmed that grassfire was very frequent in the watershed. The estimated area razed by fire every year ranged from 10 to 2,500 ha with a mean of 768.70 ha. Based on the data from DENR Region 3, the six barangays were considered fire-prone: Joson, R. A. Padilla, San Agustin, Gen. Luna, Burgos, and Bunga. Fire season normally falls during the dry months, beginning in early December until May.

The respondents identified five causes of grassfire, namely: 1) burning of grassland for pasture and cattle-raising, 2) *kaingin*-making, 3) charcoal-making, 4) escape fire from land preparation, and 5) cogon gathering. Majority (72.80%) of the respondents said that the number one cause of grassfire in Carranglan was intentional burning for pasture and cattle-raising. The least cause of grassfire was cogon gathering as reported by more than a quarter (26.92%) of the respondents (Table 10). This meant that fire was important in pasture and grazing activities. Burning allowed regrowth of new palatable grasses for cattle. However, this traditional practice did not only burn grasses but also adjacent trees and surviving regeneration of alibangbang and other vegetation scattered in the grassland.

Escape fire from land preparation of rice fields, *kaingin*, and charcoal making, likewise, hindered the regeneration and survival of alibangbang and other broad-leaved tree species. Fire was often left uncontrolled and would spread to other areas. This simply meant that fire was the dominant force affecting the natural succession in the watershed.

Poor Seedling Regeneration of Alibangbang

Majority (60.44%) of the respondents identified the frequent occurrence of grassfire as the main cause for the poor establishment and colonization of Alibangbang, followed by charcoal-making (54.94%), and pasture and grazing (21%) (Table 11).

Almost all (94.78%) of the respondents agreed that alibangbang was a good reforestation species for rehabilitation of denuded watershed, with only 5.22% saying otherwise. Of those who agreed, 69.23% perceived that the species was fire-tolerant, although there were also respondents who said they had no idea whether alibangbang was a good reforestation species.

They noted that this species had never been considered as reforestation species even during the 16-year RP-Japan Forestry Development Program in Carranglan.

Only a few (9.89%) of the respondents raised seedlings of alibangbang. Those who did were involved in the Pampanga River Basin Upland Development and Protected Area Management Board Projects of the DENR.

CONCLUSION

Most efforts to rehabilitate grasslands in the Philippines, particularly in Carranglan Watershed, failed because of anthropogenic activities hindering natural succession and the establishment and maintenance of reforested sites (Figure 2).

Upland farming, pasture and grazing, and gathering of raw materials and forest resources (*i.e.*, Alibangbang shoots and leaves, cogon grass, charcoal, and fuelwood) as perceived by the respondents were the factors that hindered natural succession of promising indigenous species like alibangbang. Found to be fire-resistant and with multiple-uses, the tree species provided the much-needed additional income to forest-dependent people, hence their tendency to over harvest and prune beyond the tree's regenerative capacity.

Table 10. Causes of grassfire in Carranglan watershed

Causes	Frequency*	Percentage (%)
Intentional burning of grassland for pasture and cattle raising	265	72.80
Kaingin-making	210	57.69
Charcoal-making	177	48.63
Escape fire from land preparation	112	30.77
Cogon gathering	98	26.92

Table 11. Reasons for low regeneration of alibangbang in the watershed as perceived by the respondents

Causes of Low Regeneration	Frequency*	Percentage (%)
Grassfire	220	60.44
Charcoal-making	200	54.94
Fuelwood gathering	18	4.94
Vegetation change (conversion to mango orchard)	8	2.20
Kaingin-making	10	2.75
Cogon gathering	21	5.77
Pasture and grazing	77	21.15
Do not know	105	28.85

N=364 *Multiple-response

Alibangbang is a locally accepted reforestation species because of its many traditional uses and it being a source of food, fuel, and fodder. Therefore, alibangbang, even with its excellent coppicing and fire-resistant qualities would make a poor candidate as a reforestation species because local people see it as source of food, fuel, and fodder instead of as forest species to be protected.

This meant further that alibangbang would be in a continuous threat of over harvesting even when the government finally decides to use alibangbang to reforest Carranglan Watershed.

Since fire is one major threat to natural succession, one intervention that could be done is to teach the local people of fire prevention and the fundamentals of prescribed burning for land preparation and for maintenance of cogon grass.

This way, fire as land preparation and maintenance tool would not adversely affect reforestation projects and the natural regeneration of equally important native species. Records from the DENR showed that 10-25,000 ha⁻¹ of Carranglan Watershed are annually ravaged by fire.

Since the use of fire is socially condoned in the area, it is necessary to train local residents on its scientific use and to provide them with appropriate tools for containing fire during prescribed burning.

The management of grassland requires participation of the local community so that areas that are originally sources of cogon for roofing and fuelwood, and traditionally used for grazing and pasture would be properly delineated and protected. This would maximize the use of the watershed while contributing to the improvement of rural income.

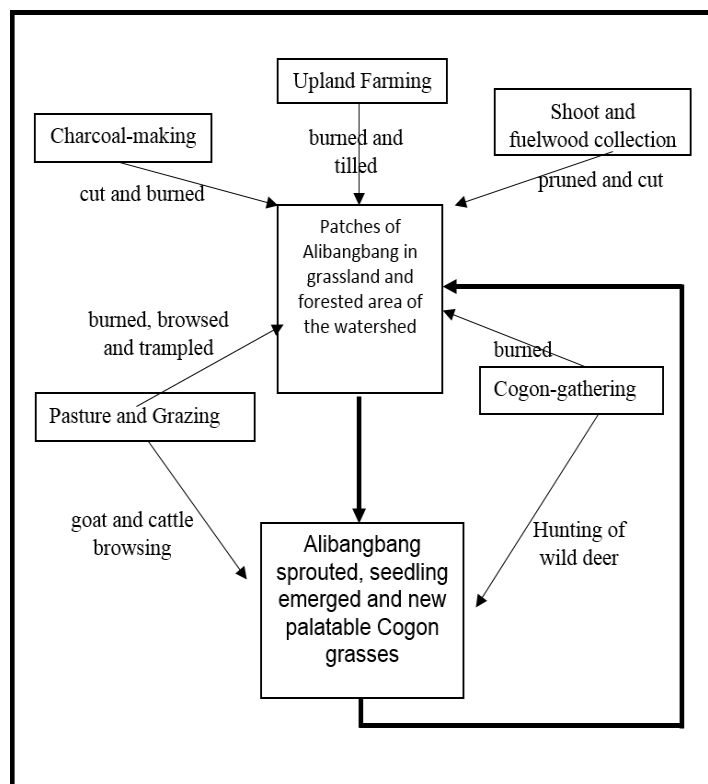


Figure 2. Interplay of various human activities in Carranglan Watershed that influence natural regeneration and colonization of alibangbang.

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