



# Social benefits and impacts of mangrove resource utilization in Rio Tuba, Bataraza, Palawan, Philippines

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**Abstract.** The study is designed to investigate the profile and attitude of the community towards the use of mangroves, and their impacts and threats to mangrove forests in a heavily populated coastal area in southern Palawan, Philippines. The study used the Slovin's formula with 5% margin of error to determine the number of household respondents. The descriptive statistics used the percentage, frequency, mean analysis and formulas to compute for charcoal consumption. Respondents were selected by systematic sampling based on the household list from the Village Secretary. More than half (59%) of the respondents are female, 94.7% of which are married. More than half of the respondents are native Palaweno, 8.0% of which belong to the indigenous group, Palao'an. Educational attainment is low, and 27% of the population are recent immigrants, coming from other municipalities of Palawan looking for work. The population of the community is relatively young. The average age of household heads is 39, while female spouses averages 36. Women heads only 2.8% of the households, and 11 is the average age of children. Male-female ratio is 1:1.23, and the average household size is 4.7 family members. The most popular communication device is mobile phone. Household income is from labor and services, in which the average gross annual income is higher than the per capita poverty threshold in Palawan. Majority of the wives are engaged in non-income-generating activities. The respondents view mangrove forests and trees as important and need protection, because it give direct benefits to the community in the form of materials for housing and charcoal. Tan-barking from mangrove is not popular anymore. The knowledge of the community regarding the status, biodiversity function, and socio-economic services of mangrove forests is very low. Rio Tuba uses up 92.2 tons of mangrove charcoal per month. The Rio Tuba community consumes an estimated biomass of equivalent to 1,024 (30 cm-BHD) mangrove trees in a month. Aside from charcoal production, housing material is another major threat to the mangrove forest. List of recommendations are provided in this study.

**Key Words:** mangrove charcoal production, coastal social forestry, community awareness, Philippines.

**Introduction.** Mangroves are ecologically important forests of the tropics (Alongi 2014). They are characterized by their high fidelity to the ecotone influence by tides, and can penetrate inland extensively along riverbanks (Tomlinson 1994). Mangrove forest is one of the major ecosystems critical to coastal zone, interconnecting and interrelating with diverse other wildlife and habitats, including beaches, seagrasses, and coral reefs. From the mangrove forest, one can move easily to contrasted marine and shoreline communities (Tomlinson 1994). They generate product and render various ecological and economic services to humans as well as to other coastal ecological systems.

Mangroves form as a buffer zone that provides protection to the islanders as well as coastal dwellers from the severities of climate change. It controls erosion, recycles nutrients, and provides nursery areas and habitats for various forms of coastal flora and fauna. Mangrove forests are among the most carbon-rich habitats on the planet earth, that have double the living biomass of tropical forest overall (Spalding 2013). Although mangrove occur only 0.5 % of the global coastal area, they contribute 10-15% to coastal sediment carbon storage and exports 10-11% of the particulate terrestrial carbon to the ocean (Alongi 2014). According to Primavera (2012), mangrove together with fisheries

and forestry products, give a total value of Php 500,000 per hectare per year, while Sathirathai & Barbier (2001) estimate the economic value of mangrove forests to a local community to be in the range of US\$27,264-US\$35,921/ha.

The more than 7,000 islands of the Philippines are visited by an average of eight or nine tropical storms making landfall, with another 10 entering its waters each year (world.time.com/2013). This makes mangrove even more critical to the safety of the country. However, they are continuously threatened by economic developments. Mangrove forests, once some of the most abundant riches in this country are now endangered, its ecosystems least appreciated and often considered wasteland and converted into ponds or reclaimed for residential areas (Primavera 2013). In Malaysia, the population boom and rapid economic developments have greatly reduced mangrove areas, despite the government launching a series of programs to protect mangroves in the 1980s and establishing mangrove ecosystems as high-priority areas for improving environmental and living resource management (Jusoff 2013).

In Palawan, Philippines, there are 63,532 ha of mangrove forest, with 23 mangrove species under 11 families in 2010 (PCSD 2015), while the total mangrove area in Honda and Puerto Princesa Bays was estimated at 5,917 ha (Gonzales 2004a), Honda Bay and Puerto Princesa Bay having 1,500 ha, and 4,417 ha, respectively. Although Palawan is declared as a Mangrove Forest Reserve through Presidential Proclamation 2152 in 1981 (<http://www.gov.ph/1981/12/29/proclamation-no-2152-s-1981>), its mangrove forests are still under threats by the following: shoreline development, cutting of mangrove trees for firewood and charcoal making, materials for building houses, erosion, siltation, pollution, and conversion to fishpond (Gonzales 2004a). Although the coral reef associated fishes, coral cover, diversity of seagrasses and seaweeds, and mangrove swamps of Honda Bay are categorized as fair to moderate conditions, the bay showed signs of deterioration of its fish resource and ecosystem in the past (Gonzales 2004b).

Bataraza, the southern tip municipality of mainland Palawan still harbors relatively thick and pristine mangrove communities, but has previous issues on massive destruction of mangrove due to tan bark-making. Human communities in these municipalities still use the traditional fuel which is charcoal, mainly from mangrove. The presence of numerous earthen kilns in mangrove forest further manifests the popularity of charcoal-making and using in the area. The production capacity of individual kiln range from 0.5 to 6.0 tons of mangrove wood and the process takes 30-40 days (Prasertiamartate et al 2008). This situation poses a great threat not only to the local mangrove forest, but also to the subsequent services that it renders to the community: safety from wave actions and surges, biodiversity, carbon sequestration, and sustained source of livelihood and food, among others. Moreover, health problems of charcoal-makers among indigenous people of Occidental Mindoro, Philippines are highlighted by Calitang & Zabanal (2016).

The Rio Tuba Village of the municipality of Bataraza is fast increasing its built up areas, now being one of the most populated barangays in the province. With these massive developments, resource utilization, including that of mangrove is expected to increase. Hence, in the management point of view, it is imperative to have information regarding the extent of mangrove resource utilization by the community in the area. It is earlier pointed out that the resource utilization of Rio Tuba should be properly managed in order to sustain the support and services that the resources render to the human population (Gonzales & Gonzales 2016). Therefore, the extent of mangrove wood extraction for charcoal production should be known as basis for the management of mangrove forests. However, until now, very few socio-economic and biophysical information regarding mangrove forest in Bataraza is available, making mangrove forest management very difficult.

Forest stand structure is defined by how many trees are present in each age class within a given stand (Snyder 2010). Foresters use trees per acre as one of the attributes of forest stands over all structure. In vegetation science and forest management, tree density is often used as a variable (Hijbeek et al 2013). Hence, the extent of extraction of mangrove tree for charcoal production will substantially affect the status of tree density of the mangrove forest which is very significant in maintaining its natural functions and

grandeur. As such, this study aims to: 1) gather information on the profile of charcoal-makers in the area; 2) gather knowledge on the attitude of community members towards the use of the mangrove trees and forest; 3) estimate the utilization rate of mangrove charcoal and its impact to the tree density of the mangrove forest; and 4) identify other threats to the mangrove forest of Rio Tuba.

**Material and Method.** The study is designed to generally investigate the demographic profile and attitude of the community members towards the use of mangroves and the threats and impacts of charcoal-production on the mangrove forest in a heavily populated coastal area in southern Palawan, Philippines. This study describes the profile of the community who uses and benefits from the mangrove forest and estimates the rate of tree lost due to charcoal-making.

Prior to the actual survey, the team conducted a project briefing/orientation with field enumerators in Rio Tuba on May 18, 2015 to explain the background and objectives of the research as well as lecture on the importance of mangrove. Definition of terms, contents of questionnaires, and expectations were discussed in order to level-off on the overall research direction among enumerators and researchers. Pre-testing and mock interview were done in the same day.

The tree diameter of mangrove is based on Breast Height Diameter (BHD) by English et al (1997), while the classification of adult mangrove tree followed the description of Betts (2006).

**The study area.** The Rio Tuba village is situated in the Municipality of Bataraza, south of Palawan, Region 4B, Philippines. Its geographical coordinates are 8°31'3" North, 117°26'12" East (Figure 1). Its original name (with diacritics) is Rio Tuba (<http://www.maplandia.com/philippines/region-4/palawan/rio-tuba/>). Base on census, population in Bataraza reached 63,644 in 2010 (Gonzales & Gonzales 2016), while Rio Tuba has an estimated 4,916 households with a total population of 20,071 in 2014, with 11 sitios (villages), sitio Kayasyasan having the highest population of 4,215, while sitio Racob has the lowest, 404. It is about 236 kilometers from Puerto Princesa City, the provincial capital. The town of Bataraza can be reached by bus, jeepney, or shuttle van. Bataraza is about 6-hour drive from Puerto Princesa City ([https://en.wikipedia.org/wiki/Rio\\_Tuba](https://en.wikipedia.org/wiki/Rio_Tuba)).

**Sources of data.** Primary data were collected through household interview using semi-structured questionnaire schedules. The household interview was cross-checked by Key Informant Interview (KII) with village officials, charcoal-makers, store owners, and tribe elders. KII with charcoal-makers included information on volume of mangrove tree converted into sacks of charcoal. Secondary data was drawn from journals, internet, and reports. This study is part of the Rio Tuba Mangrove Rehabilitation Program, Coastal Assessment of Barangay Rio Tuba, Bataraza, Palawan, supported and funded by the SATRE, Technology Resource Development Association, Incorporated (SATRE 2014).

**Analytical techniques.** The study used the Slovin's formula with 5% margin of error to determine the number of interviewed household respondents. The descriptive statistics used the percentage, frequency and mean analysis to compute for charcoal consumption. Respondents were selected in each village by systematic sampling based on the household list from the Village Secretary. The number of respondents per sitio was proportional to the population of each sitio.

Twelve enumerators conducted an administered interview, covering 600 household respondents in 10 sitios of Barangay Rio Tuba, namely: Marabahay, Tagdalongon, Bongkol-bongkol, Canumay, Kayasyasan, Macadam, Bukid-bukid, Kinurong, Tuka-angri, and Racob from May 18 to 22, 2015. The questionnaire was composed of two main components: demography of respondents and mangrove resources utilization. The team conducted daily feed-back session in the late afternoon after every day work.



Figure 1. Map of the Philippines showing the study area in Rio Tuba, Bataraza (in black star), Palawan, Philippines (source: [www.nationsonline.org](http://www.nationsonline.org)).

The Coral Bay in Bataraza is once endowed with rich marine flora and fauna. The fishers from well known Palawan fishing grounds like Panacan Village in Municipality of Narra conduct fishing in this bay when fishing season is lean in their municipal waters in 1980s (Gonzales & Gonzales 2016).

## Results and Discussion

**Demographic profile of the coastal community.** The socio-demographic profile of respondents showed that 59% of the respondents are female, and 94.7% are married. Majority (50.5%) are more than 35 years old (Table 1). More than half are long-time residents of Rio Tuba, living in the area since birth or more than 35 years. More than half (57.5%) were born in Palawan with only 8.0% comprising the indigenous group, the Palao'an (Table 1). Educational attainment is low, with 30.7% reaching elementary education, while more than one-third (35.7%) did not finish high school and 2.3% have no formal schooling (Table 1).

Majority (51%) of the respondents have lived in their respective sitios for more than 10 years (Table 1). More than one-fourth (27%) of the population are new immigrants, or those who had lived in the barangay for less than five years.

The main reason for in-migration to Rio Tuba is work opportunities (84.0%), while other reasons are security of land tenure/land ownership (6.6%) and marriage with local residents (4.7%). Among the sitios, Kayasyasan and Marabahay have the highest number of immigrants. Most of the immigrants come from within the province of Palawan (46.4%), some from Visayas (22.1%), and others (13%) from Tagalog regions. The rest come from other places of the country. This emphasizes that the majority of Rio-Tuba migrants come from other municipalities of Palawan, and not from other provinces of the country.

Table 1

Socio-demographic characteristics of 600 respondents in Rio Tuba, Bataraza, Palawan

<i>Socio-demographic characteristics</i>	<i>Frequency</i>	<i>Percent</i>
<i>Gender</i>		
Male	246	41.0
Female	354	59.0
<i>Marital status</i>		
Single	11	1.8
Married	568	94.7
Widow/Widower	18	3.0
Separated	3	0.5
<i>Educational attainment</i>		
No formal schooling	14	2.3
Elementary level	184	30.7
High school graduate	214	35.7
Vocational graduate	41	6.8
College level	16	2.7
College graduate	102	17.0
<i>Years of residency</i>		
1-5 years	162	27.0
6-10 years	132	22.0
11-15 years	50	8.3
16-20 years	31	5.2
21-25 years	30	5.0
26-30 years	25	4.2
31-35 years	28	4.7
36-40 years	24	4.0
41-45 years	13	2.2
> 45 years	4	0.7
Since birth	101	16.8
<i>Ethnic origin</i>		
Tagalog	62	10.3
Cebuano	10	1.7
Boholano	10	1.7
Bicolano	22	3.7
Bisaya	70	11.7
Ilongo	15	2.5
Zamboangeño	15	2.5
Others	51	8.5
Palaweño	345	57.5
Palao'an	(48)	(8.0)

**Household characteristics and age structure.** The average age of household heads in Rio Tuba is 39 years old, while female (spouses/partners) is 36 years old. Seventeen (2.8%) households are headed by females. The average age of children is 11 years old. Male-female ratio is 1:1.23 and the average household size is 4.7.

The population of the community is relatively young, having larger number of younger generation (Table 1 and Figure 2). Respondents with age 30 and below compose 36.8% of the population (Table 1). This is alarming in terms of mangrove conservation, since if this younger population has the same mind set of awareness, attitude, and action with the older population about the use of mangrove forest, the mangrove forest of Rio Tuba is endangered. Hence initiatives on mangrove conservation and rehabilitation should be focused on the younger population of the community, but not undermining the older population that constitutes the leaders and elders of the clans/family of which their words and decisions are respected and influential in the community.

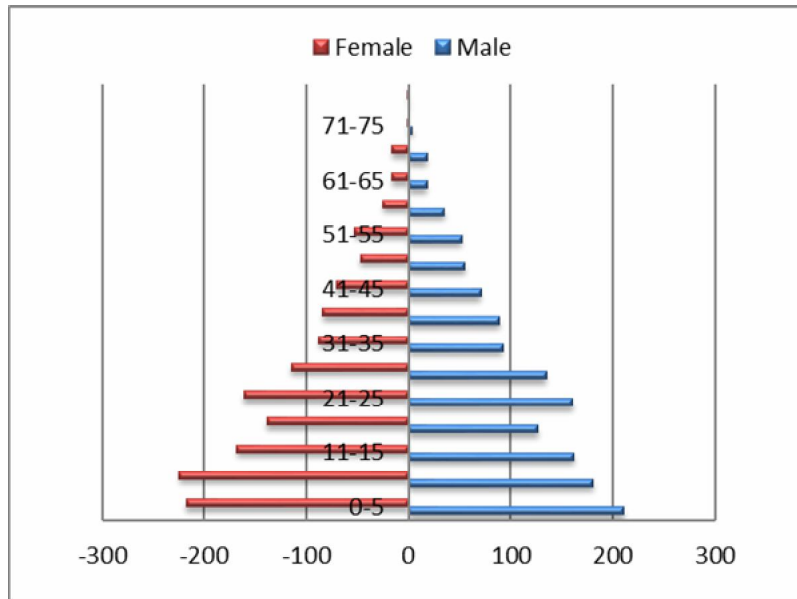


Figure 2. Age structure of RioTuba Village, Bataraza population by sex.

**Occupation and income.** The bulk (68%) of the household head income comes from labor and services (Table 2). Most of the households in Rio Tuba have income ranging between PhP6,000 to PhP10,000, with 18.5% having an income from PhP11,000 to PhP15,000 (Figure 3). Households with monthly income more than PhP20,000.00 are only 5%. The average gross annual income of households is PhP112,099.92.

Since the household size of Rio Tuba consist of 4.7 members, the income allocation of each of the family member is estimated to be PhP23,851.04. This amount is higher than the per capita poverty threshold in Palawan, which is at PhP16,696.00 (NSCB 2013). This implies that households in Rio Tuba are able to meet their basic needs.

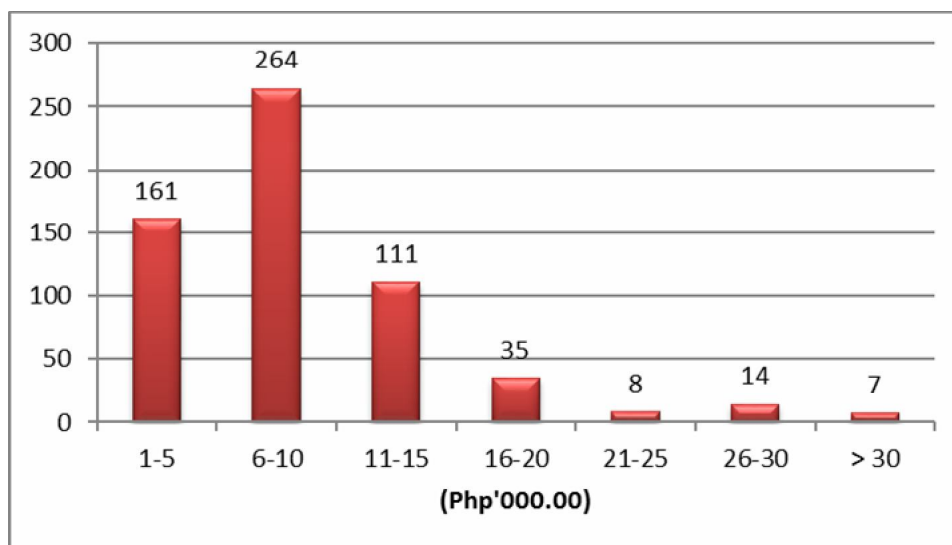


Figure 3. Income distribution of Rio Tuba, Bataraza population.

Table 2

Occupation of household heads (husband) and their spouses (wife), Rio Tuba, Bataraza, Palawan

Occupation	Household head (n = 600)		Spouse (n = 583)	
	Frequency	Percent	Frequency	Percent
Labor and services	408	68.0	108	18.5
Sales and marketing	78	13.0	45	7.7
Fishing	76	12.7		
Farming	31	5.2		
Gov't employee	7	1.2	25	4.3
Housekeeper			405	69.5
Total	600	120	583	120

**Role of women.** Majority of the wives are engaged in non-income generating activities such as housekeeping (69.5%) (Table 2). Others supplement their husband income through marketing/vending, labor/services and employment. Thus the women group could be the focus of livelihood/entrepreneurial activities in future projects.

**Livelihood participation.** Of the 600 respondents, only 36 (6.0%) participate in livelihood activities such as fishing, livestock raising, piggery and weaving. Thus diversified livelihood project could be an opportunity to enjoin charcoal-makers to engage in other entrepreneurial activities.

**Communication equipment and sources of information.** Mobile phone is the most popular communication device use by the community (Table 3), while television, chat with friends and relatives, and radio are the main sources of information. Community members love sports, singing and dancing activities. The above communication devices and pass time activities can be used by future projects in formulation of strategies on how to effectively bring information to the community members.

Table 3

Communication equipment used and sources of information of the respondents (n = 600)

Equipment	Frequency*	Percent
Cellphone	590	95.2
Computer	23	3.7
None	7	1.1
Total	620	100
Information source	Frequency*	Percent
TV	410	45.8
Relatives/Friends	270	30.1
Radio	144	16.1
Barangay	29	3.2
Internet	22	2.5
Cellphone	12	1.3
Magazine/Newspaper	6	0.7
Book	3	0.3
Total	896	120

\*Multiple responses.

**Indigenous culture on mangrove.** Only six of the 600 respondents have knowledge on beliefs about mangroves. They call them *tarok*, *kasing* and *pakiring*, however, none of the respondents indicated knowing information on indigenous songs, dances, stories, etc.

## Mangrove forest utilization

*Attitude of community towards the use of mangrove trees and forest.* Results suggest for majority of the respondents/community view that mangrove trees are material for building houses (22.2 %), for firewood (38.4%) and for making charcoal (39.0%) (Table 4A). Mangrove tree is not use anymore to make tan bark (0.4%; Table 4A).

Table 4  
Perceptions of respondents on the use of (A) mangrove tree, (B) mangrove forest, (C) beneficiaries, and (D) condition of mangrove (n = 600)

<i>Category</i>	<i>Frequency*</i>	<i>Percent</i>
<i>A. Use of mangrove tree</i>		
Charcoal	447	39.0
Firewood	440	38.4
Housing material	254	22.2
Dye	5	0.4
Total	1146	100
<i>B. Use of mangrove forest</i>		
Housing material	266	33.5
Protection from typhoons/floods	147	18.5
Firewood/charcoal	139	17.5
Fish habitat	136	17.1
Source of food	42	5.3
Source of income	24	3.0
Crocodile habitat	16	2.0
Fish breeding ground	11	1.4
Prevent siltation in coral reef	10	1.3
Prevent soil erosion	4	0.5
Total	795	100
<i>C. Mangrove beneficiary</i>		
Community	490	78.3
Charcoal maker/producer	69	11.0
Tan barker	29	4.6
Fishermen	17	2.7
Crocodile	12	1.9
Indigenous people	9	1.4
Total	626	100
<i>D. Mangrove condition</i>		
Good	71	11.8
Bad	76	12.7
Very bad	195	32.5
No idea	258	43.0
Total	600	100.0

\*Multiple responses

In terms of mangrove forest utilization (Table 4B), the respondents are consistent in the use of mangrove forest as source of material for housing (33.5%), and firewood/charcoal (17.5%), and though some (18.5%) consider mangrove forest as protection from typhoons/floods and others (17.1%) as fish habitat. These results emphasize that most of the respondents view the mangrove forest (Table 4B) and the mangrove tree (Table 4A) as source of materials for charcoal/firewood and building houses and only few



appreciate them for their physical and ecological roles like protection from typhoons/floods and wildlife habitat.

Furthermore, some (17.1%) respondents perceived the mangrove forest as fish habitat (Table 4B), but they (1.4%) did not view it as fish breeding ground. This inconsistency implies that the community members have insufficient knowledge regarding the biological and ecological importance of the mangrove forest. Hence this must be a concern in future projects.

The majority of the respondents (78.3%) consider the community members as the main beneficiary of the mangrove forests (Table 4C). This is because the mangrove forest provides the community a direct source of housing materials and firewood/charcoal (Table 4A and B). Only 3% view the mangrove forest as source of income. Hence, the community perceives mangrove trees and forest as materials for their basic needs in charcoal, firewood, and housing, and not necessarily see their biophysical, ecological and economic significance.

About a third (32.5%) of the respondents say that the condition of mangrove forest in Rio Tuba is very bad (Table 4D), while the awareness of many (43%) is low regarding the true status of their mangrove forest in the area. Respondents view that it is normal for the community to utilize mangrove for housing materials and charcoal, disregarding its finality. Hence, it is a great challenge to change their perception on the indiscriminate use of mangrove forest, especially the trees. This must be one agenda for future learnings and trainings.

*Impact of charcoal-making to tree biomass of mangrove forest.* Community households (88.5%) mainly use charcoal as fuel for cooking (Table 5A) and almost all members of the community (92%) use charcoal everyday (Table 5C), which are bought from retail stores, while 68% of them use mangrove for charcoal (Tables 5A, B). Around Rio Tuba Village, the households consume 1-6 sacks of mangrove charcoal per month (Table 6). Other materials used as firewood aside from mangroves in Rio Tuba are bamboo, ipil-ipil (*Leucaena leucocephala*), and other forest woods found in the area (Table 5B).

Table 5

Type of fuel used in cooking, raw material for charcoal, and frequency of charcoal used in Rio Tuba, Bataraza, Palawan (n = 600)

<i>Category</i>	<i>Frequency</i>	<i>Percent</i>
<i>A. Type of cooking fuel</i>		
Charcoal	531	88.5
Charcoal and firewood	38	6.3
Firewood	18	3.0
Charcoal and LPG	8	1.3
LPG	5	0.8
Total	600	100
<i>B. Material for charcoal making*</i>		
Mangrove	447	68.5
Coconut Shell	28	4.3
Forest wood	110	16.8
Ipil-ipil ( <i>Leucaena leucocephala</i> )	68	10.4
Total	653	100
<i>C. Frequency use of charcoal in cooking (mangrove charcoal users only)</i>		
Everyday	531	92.0
Few times a week	38	6.6
Few times a month	8	1.4
Total	577	100

\*Multiple responses

According to KII, a mangrove lumber measuring 1.5 m with 30 cm can produce one sack of charcoal. It can therefore be hypothetically estimated that a nine-meter mangrove tree (30 cm-diameter) can produce six sacks of charcoal. Betts (2006) identifies all mangrove trees above 1 m in height with a BHD greater than or equal to 2.5 cm as mature trees (as stated by Australian Institute of Marine Science; IMS). Hence the size diameter of the harvested mangrove trees for charcoal-making in Rio Tuba signifies that they are all matured trees.

Table 6 shows the estimated consumption rate of charcoal by the sub-household population of Rio Tuba (n+577). Based on computation of the frequency and percentage consumption, the sub-population consumes 1,293 sacks of charcoal per month (Table 6). Since 88.5% of the respondents use charcoal (= 1,144 sacks/month), and only 92% of them use charcoal every day (= 1,053 sacks/month), while 68.5% of whom use mangrove charcoal, the final number of sacks use by the 577 households is 721 sacks per month, equivalent to 1.25 sacks per household/month. Since there are an estimated 4,916 households in Rio Tuba, the whole village consumes 6,145 sacks of mangrove charcoal per month. The mean weight of one sack of mangrove charcoal is 15 kilograms, hence the whole community uses up 92,175 kilograms or 92.2 tons of mangrove charcoal per month. This consumption is at par with the increase demand of mangrove in an Indonesian Village Batu Ampar from 20 to 30 tons per month in 1990 to 100 tons in 2000 (Prasetiamartate 2008).

Table 6

Source of charcoal and number of charcoal sacks consumed by households per month (n = 577)

<i>Category</i>	<i>Frequency</i>	<i>Percent</i>	
<i>Source of charcoal</i>			
Direct from producer	92	15.9	
Self-made	28	4.9	
Bought from retail store	457	79.2	
Total	577	100	
<i>Number of sack consume/household/month</i>			<i>Equivalent number of charcoal sacks consumed per month</i>
< 1	18	3.1	161
1	143	24.8	
2	237	41.1	474
3	35	6.1	105
4	107	18.5	428
5	7	1.2	35
6	15	2.6	180
> 6	15	2.6	
Total	577	100	1,293

Since the biomass of one (30 cm BHD) mangrove tree is estimated to produce six sacks of charcoal, the Rio Tuba community consumes an estimated biomass of equivalent to 1,024 (30 cm-BHD) mangrove forest trees in a month. This estimate does not yet include mangrove timbers used for housing materials. The municipality of Bataraza has 7,357.57 ha of mangrove and nipa swamp (Bataraza CLUP 2009-2018), with a tree density of 1,546 trees per hectare in 2014 (PCSD 2015).

Respondents (74.5%) are aware that mangrove are being utilized as charcoal raw material, while some of them (39.0%) are fully aware that mangrove trees are used as charcoal (Table 4A). Table 7 shows that 50.5% of the community members have no idea on how frequent charcoal making is being done in the community, while 21.3% said it is once a month (30 days), which is consistent to the report of Prasetiamartate (2008) that mangrove charcoal-making process takes 30-40 days.

The community use sacks and plastic bags to sell charcoal to the consumers. The price of charcoal bought directly from producer ranges from PhP60-80 per sack, while those from retail store range from PhP90-120 per sack. Retail stores sell charcoal in re-

packed plastic bags at PhP10.00 per bag. One sack contains approximately 15 retail plastic bags.

Table 7

Frequency of charcoal production in Rio Tuba, Bataraza, Palawan (n = 600)

<i>Frequency</i>	<i>Frequency</i>	<i>Percent</i>
Everyday	15	2.5
Once a week	65	10.9
Once a month	128	21.3
Twice a month	89	14.8
No idea	303	50.5
Total	600	100.0

According to KII, mangrove trees utilized as housing material can be bought by piece or by bulk. The price per piece depends on the size (diameter and length), ranging from Php25-230.00. Those sold in bulk depends on the size of the house to be built, ranging from Php4,500 to 7,000 proportional to the lumber requirement of one unit house. Hence, the mangrove forests are not only threatened by charcoal production, but also by building of houses out of mangrove timbers.

**Conclusions.** More than half (59%) of the community members are female, 94.7% of which are married. Majority are more than 35 years old. More than half of the respondents are native Palawano, and 8.0% belong to the indigenous group, Palao'an. Educational attainment is low. Twenty seven percent of the population are recent immigrants, coming from different province of Palawan looking for work.

The population of the community is relatively young. The average age of household heads is 39; female spouses average 36, where women head only 2.8% of the households, and 11 is the average age of children. Majority of the wives are housekeepers. Male-female ratio is 1:1.23, while the average household size is 4.7 members. Most popular communication device consist of the mobile phone, while main sources of information are television, from friends and relatives, and radio. On the other hand, the community members love sports, singing, and dancing activities. The bulk of the household income is from labor and services. The average gross annual income of households is higher than the per capita poverty threshold of Palawan.

The respondents view the mangrove forest and trees as important and need protection, because they give direct benefits to the community in the form of materials for housing and charcoal. Tan-barking from mangrove is not popular anymore. The knowledge of the community regarding the status, biodiversity function and socio-economic services of the mangrove forest is very low.

Rio Tuba uses up around 92.2 tons of mangrove charcoal every month. The Rio Tuba community consumes an estimated biomass of equivalent to 1,024 (30 cm-BHD) mangrove forest trees in a month. Aside from charcoal production, housing material is another major threat to the mangrove forest. The destruction of forest trees through charcoal making has further impact, since these trees also lose the opportunity to sequester carbons from the environment.

Although the income of households of Rio Tuba is above the poverty threshold in Palawan, they are still highly dependent on mangrove resources for basic needs. Hence, it is interesting to conduct a follow-up study on possible inter-relationship(s) of mangrove forest utilization and poverty incidence of the village.

**Recommendations.** Information, education, and communication about the current status, biophysical and economic services, extent of damage, threats and consequences brought about by cutting trees from mangrove forests shall be a priority program among younger populations, the leaders and elders of the clans/family. This shall be reinforced with projects to increase educational attainment among members of the community.

The existing mindset on the use of mangrove forest should be changed in favor of long-term and sustainable mangrove utilization among the residents.

Mobile phone and other main sources of information: television, from friends and relatives, and radio, and such activities as sports, singing, and dancing shall be used as media in information and communication drives.

A strategic program should be designed to suit the situation of Rio Tuba in terms of livelihood development, focusing on wives and mangrove cutters to engage in eco-friendly income generating activities.

More studies on socio-economic forestry and on age distribution and density of tree species shall be conducted in order to get information for detailed reforestation planning and management. Immediate rehabilitation and restoration of the mangrove forests shall be done.

Policies like regulating sizes to be cut or a licensing scheme for legitimate charcoal-makers are also options.

**Acknowledgements.** The authors wish to thank the Western Philippines University through its President Dr. Elsa P. Manarpaac for supporting this study. We thank SATRE Inc. for funding the study. We are indebted to Ms. Rica Cortes Rentzing and Mr. Jun Evangelista of SATRE Technology Resource Development Association, Incorporated for the opportunity to conduct this study, overall guidance, and being with us during the fieldwork. We thank Dr. Mildred J. Gonzales for English language review of the manuscript. We are also grateful to all enumerators, respondents, and Barangay Chairman and Officials of Rio-Tuba, Bataraza, Palawan, Philippines.

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Received: 04 June 2017. Accepted: 03 July 2017. Published online: 12 August 2017.

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How to cite this article:

Gonzales B. J., Sariego R. S., Montaña B. S., 2017 Social benefits and impacts of mangrove resource utilization in Rio Tuba, Bataraza, Palawan, Philippines. *AES Bioflux* 9(2):135-147.