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by

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ABSTRACT

Abandoned biomass resource statistics was compiled for the Philippines. The main goal of the work is to consolidate abandoned biomass resource data from forest plantation, agricultural and urban areas and make it available for analysis and project development especially for household and industrial energy application in order to help reduce denudation and conserve our forest resources. Major abandoned biomass producing regions were identified for the different biomass resources namely, corn cobs, rice hull, sugarcane bagasse, coconut residues, animal manure, forestry wastes, urban refuse and other cellulosic materials.

Data on regional and annual estimated generated volume of the different biomass resources are presented. Potential development and utilization of the resources mentioned is also discussed including barriers in the adoption of biomass utilization technologies. The data is useful in planning energy projects and product development using abandoned biomass for sustainable development using abandoned biomass.

I. Introduction

One very important issues that the Philippines is facing today including the developing countries in the 21st century is the capability to have a dependable and affordable renewable energy sources and sustainable development of the remaining natural resources. Historically, the Philippines has been heavily dependent on imported fossil fuel for its energy needs. In recent years, there is a global search and development for alternative and renewable energy. The Philippines has an abundant abandoned biomass resources from cellulosic residues of agricultural production and processing, animal wastes, forest biomass residues, urban-industrial wastes and aquatic biomass (i.e., water hyacinth, etc.). As early as 10 years ago, sugarcane bagasse and other agro-forestry wastes accounted for 3.5 and 5.6 percent, respectively of the national energy mix (Elauria et al.) and this contribution is expected to increase especially due

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to continued increase in fuel prices. Recently, the Philippines has started to take measures to develop biofuels and other renewable energy sources.

Biomass has been defined as organic products from agriculture and forestry systems developed to provide food, fuel, and organic matter from captured sewage and waste treatment facilities (Bun, 1994). The Philippines, being an agricultural country growing crops like rice, corn, coconut, sugarcane, banana, bamboo, jatropha and fruit and tree crops generates a huge amount of by-products and residues that may be used to generate energy and development of other products. This is still a huge untapped resources. At the same time, the country is also endowed with an extensive livestock industry that could contribute to huge biomass potential utilization of the country.

The Department of Energy (DOE), Department of Environment and Natural Resources (DENR), Department of Science and Technology (DOST), BIMP-EAGA Region and other entities are currently promoting the development and widespread use of biomass resources by pilot testing, demonstration and commercial use of biomass charcoal briquetting, combustion system, gasification and other system for power generation, steam and heat generation including use of biomass for organic composting, hand-made paper, animal feeds, etc..

The production and use charcoal briquettes and gasifiers in the country is increasing due to continuous increase in fuel prices, the availability of technology and abandoned biomass resources especially rice hull for the gasifiers. The technologies gives an opportunity to dispose of cellulosic wastes and at the same time cleans the community of unwanted wastes, conserve the forest and reduce GHG emissions, provide alternative/additional livelihood to the urban and rural poor communities.

This paper discusses the sources and availability of biomass by region in the Philippines and its potential utilization. Hopefully, the information will guide investors in selection of sites for renewable energy projects and in the promotion and commercialization of charcoal briquetting in the Philippines.

II. Abandoned Biomass Resources in the Philippines

The Philippines is largely an agricultural country with the agricultural sector contributing about one-third of GNP. The total area is about 30 million hectares and about half is approximately A & D lands which is devoted to agricultural production and urban development. The remaining areas are forests, shrublands and wetlands. Rice, corn and coconut are the most abundant crops planted with a total area of about 9 million hectares. The major abandoned biomass/wastes resources presented in this paper are: rice hull/husk, rice straw, sugarcane bagasse, coconut wastes, forestry residues and urban waste. Tables 1 and 2 shows abandoned biomass statistics from different sources on a regional basis.

1. Rice Hull

The Filipinos are among the world's biggest rice consumers. The average Filipino consumes about 100 kilograms per year of rice. Metro Manila consumes up to 22,000 tons per day of rice or 16% of the country's rice consumption according to the Asia Rice Foundation (ARF). Rice consumption is increasing at an average of two percent per year. With the population of the Philippines already surpassing the 80 million-mark, rice will continue to be grown and should match production with corresponding increase in population. Rice production increased from 5.32 million tons in 1970 to 12.39 million tons in 2000.

Rice hull is a processing by-product of rice milling and accounts for about 20% of the rice production. Rice straw on the other hand are field wastes after the harvesting of rice. The country also has more than 12,000 rice mills spread throughout the country. These processing centers are the point sources of rice hull each year.

2. Sugarcane Bagasse

With the passing of Biofuels Act of 2006, the sugar industry in the Philippines which is the major source of ethanol for e-gasoline and domestic sugar will become a major thriving industry. Large tracts of land is devoted to sugarcane areas amounting to more than 362,000 ha today decreasing slightly from 372,399 ha in 1995.

Bagasse is a major biomass wastes produced and mostly utilized by the sugar mills for their boilers amounted to more than 5.9 million metric tons per year. Bagasse production is 643,900 t/ha (321,950 t/ha, dried). Cane trash is another biomass wastes from sugar production that have not been utilized in the same scale as that of bagasse. Annual yield for cane trash is 391,486 t/ha (274,040 t/ha dry).

3. Coconut Wastes

The Philippines has the largest number of coconut trees in the world. Half a billion of these grow on three million hectares across the Islands. The country produces most of the world market for coconut oil and copra meal. In the Philippine setting, the coconut palms are also called the “tree of life” from the numerous products and by-products that could be derived from it.

The major coconut wastes include coconut shell (12%), coconut husks (35%) and coconut coir dust . Among the three form, coconut shell is the most widely utilized but the reported utilization rate is very low. The most common use is shell charcoal that are also exported and converted into activated carbon.

The coconut tree also sheds its mature fronds of about 40 from time to time that weighs about 10 kg each. It will take 5-6 years before the fronds mature which is one of the field biomass. It is usually used as firewood for household cooking after removing the leaves.

4. Tubang Bakod (*Jatropha curcas*)

Although the world is not about to run out of oil (at least not in the immediate future), production have already reached its peak. As the supply base starts to diminish, price escalation becomes inevitable just as what is happening now including its bad reputation as major source of high CO₂ emissions. In view of the grim scenario, it becomes clear that there is a need to source an alternative, renewable and environment-friendly fuel substitutes.

It has been discovered that the oil of Tubang bakod (*Jatropha curcas*) is an excellent diesel fuel substitutes. It is a clean source of energy. More importantly, it is inexhaustible once

planted and will also help rehabilitate large tract of denuded areas in the Philippines. A boon to the environment but to rural economy as well.

At only about 1% blend of biodiesel from *Jatropha*, it would generate 300,000 mt of wastes by 2008. This would produce an equivalent of 75,000 mt of charcoal briquettes valued at about P1.1 b at current local price. This industry alone would need 947 producers using a 300-kg per day capacity manual briquetters, or 142 producers using a 2t/day capacity hydraulic briquetters. This would create additional jobs in the locality and downstream enterprises and businesses. As the fuel blend increases, the processing wastes will also increase proportionately.

5. Forestry Residues

More than 15 million hectares of land in the Philippines is devoted to forestland and the actual forest cover totals 5.4 million ha only. The Philippines through the DENR is exerting all its efforts to rehabilitate the denuded lands of this country and thereby significantly contributing to the biomass production. The logging wastes and residues amounted to only 104 thousand cubic meters compared with more than 5,200 thousand cubic meters in 1979. If the area previously devoted to forest cover is to be replanted, this would be a significant addition to the country's sustainable energy resource from biomass.

The projected established forest plantation will increased from 2.06 million ha in 2005 to 3.01 million ha in 2015 (PCARRD, 1994). Wood production from new plantations is estimated to increase 6.9 million cu m to 24.78 million cu m thereby increasing abandoned biomass production.

6. Urban Solid Wastes

The Philippines generates more than 11,000 tons of solid wastes per day. About half of that is produced in Metro Manila alone. This translates to more than 4 million metric tons of solid wastes disposed similar to that experienced in Metro Manila. Most of these biomass can be converted into usable energy carriers (biogas, charcoal briquettes, etc.).

7. Livestock Manure

The poultry and livestock industries in the Philippines continued to grow to address the demand for animal protein to support the increasing population. The population of chickens has doubled in 10 years time to 52.34 million heads. The growth rate of the duck population is slower than the chicken. The duck population has increased from a mere 0.71 million heads in the 50's to 8.61 million heads in 1999.

The large animal population showed a positive growth rate between 0.76 to 5.19% during the last 15 years. The estimated amount of wastes from the animal production alone was more than 30 million metric tons per year. The waste treatment processes in the country have been minimal and continue to pose serious problem of environmental pollution in many growth areas in the country. The change is the pattern of livestock and poultry production from small to medium and large-scale operations and the increased concentration of livestock and poultry establishments in a few animal production areas resulted to environmental pollution problems.

Table 1. Breakdown of abandoned biomass by region in the Philippines ('000 metric tons).

REGIONS	Rice Hull	Bagasse	Coco-Shell	Coco-Husk	Coco-Coir	Jatropha
CAR	44.274	-	0.183	0.407	0.407	*
NCR	-	-	-	-	-	-
Region 1	216.378	-	14.853	33.008	23.105	*
Region 2	341.762	55591.406	86.158	15.971	134.023	*
Region 3	368.531	392732.918	546.719	1.075	850.452	*
Region 4	241.495	521779.063	65.018	740.288	101.139	*
Region 5	144.049	74836.265	7.187	253.873	11.180	*
Region 6	306.346	3441250.767	0.484	97.381	0.753	*
Region 7	41.673	687724.005	333.130	136.868	518.202	*
Region 8	101.279	183257.896	114.243	509.605	177.711	*
Region 9	62.229	-	43.822	539.001	68.167	*
Region 10	66.402	42627.445	61.590	191.462	95.807	*
Region 11	136.168	135649.899	229.322	1214.932	356.723	*
Region 12	158.797	66742.885	242.550	144.484	377.01	*
CARAGA	56.042	-	42.970	95.488	66.842	*
ARMM	68.901	-	165.904	368.675	258.072	*
PHILIPPINES	2357.325	5985839.549	1948.867	4330.814	3031.570	300.000

Table 2. Breakdown of abandoned biomass from livestock industry by region in the Philippines ('000 metric tons).

REGIONS	Swine	Cattle	Carabao	Goat	Chicken	Duck
CAR	153.724	213.196	435.647	13.065	53.052	56.604
NCR	-	-	-	-	9.846	-
Region 1	372.249	1236.904	1040.697	131.726	201.214	136.063
Region 2	287.548	549.402	1398.972	34.441	258.627	320.652
Region 3	770.027	606.623	740.720	90.883	770.185	777.407
Region 4	804.394	1103.721	1259.692	63.422	765.521	302.947
Region 5	393.931	454.115	1155.716	30.564	276.314	87.703
Region 6	460.660	693.321	1258.628	121.845	423.388	403.741
Region 7	539.331	1078.356	611.515	167.725	297.661	69.938
Region 8	458.324	113.154	859.352	18.779	175.746	95.621
Region 9	280.802	460.203	901.173	74.146	163.151	82.129
Region 10	331.677	905.437	439.695	57.598	223.466	142.319
Region 11	530.936	729.399	1125.721	146.445	366.494	277.952
Region 12	236.272	370.351	1011.267	65.456	113.147	173.443
CARAGA	199.903	40.545	434.597	31.175	77.803	68.989
ARMM	20.221	340.822	492.842	50.297	52.627	137.863
PHILIPPINES	5840.00	5948.552	12110.483	804.340	4228.241	2685.040

III. Biomass Utilization Technology

Due to abundance of abandoned biomass in the country, various energy conversion technologies have been developed and adopted under local conditions. For fuelwood and charcoal, designs of different stove was also made for the different kinds of biomass. Some of the technologies used in the Philippines are:

1. Direct combustion – This makes use of wood and agricultural residues such as rice hull and corn cobs from the mill and wood wastes and saw dusts from furniture shops and wood processing plants; co-generation using coconut shells in copra mills, bagasse in sugar mills, kiln drying of lumber, tobacco curing, bakeries, restaurants, resorts and other industries for generation of heat and electrical energy. Many direct combustion systems are already operating commercially in the Philippines.
2. Gasification – Biomass undergoes a process to obtain fuel gas which can either be burned in a boiler to produce steam for laundry and hot water in hotels and resorts or used for generating mechanical power using a suitable engine. The resulting product are

called gasifiers and are coupled to fuel suitable engines and are used primarily for sugar, rice and corn milling and irrigation.

In the Philippines, gasifiers designed by DOST, CPU and other private entities are used in pottery and brick making, wood processing plants, fruit and lumber drying, charcoal briquette drying, fish, palay, corn and handicraft drying. With high cost of fossil-fuel based energy, availability of trained technicians and sustained promotion in the countryside, the use of gasifiers using biomass maybe widely adopted.

3. Biogas – Biogas technology is already a commercial venture in the Philippines. This is widely promoted by the DA-BAI and other SCUs that offers agricultural engineering curriculum. DENR also promotes it for mitigation of wastes and GHGs from landfills, waste dumpsites and the livestock industry.
4. Liquid Biofuels – As defined in the Biofuels Act of 2006, biofuel shall refer to bioethanol and biodiesel and other fuels made from biomass and primarily used for motive, thermal and power generation, with quality specifications in accordance to the Philippine National Standard (PNS). This is when alcohol (ethanol) and biodiesel (Fatty Acid Methyl Ester) derived from vegetable oil, animal fats and other biomass-derived oils that are technically proven and approved by the DOE for use in diesel engines (now called Bioethanol and Biodiesel, respectively), and blended with petroleum products for use as fuel in engines.
5. Carbonization of Cellulosic Biomass – Charcoal is traditionally used as household fuel and for other applications. To reduce cutting of trees from the forest, charcoal making from agro-forest wastes is gaining public acceptance. This will put into good use the abandoned materials that are often dumped into the rivers and community surroundings. There are many possible applications of carbonized materials such as fertilizer, water quality improvement, water filtration, heavy metal recovery, etc. At the same time, liquid smoke recovery is now possible during carbonization to reduce, if not eliminate emissions and used as foliar fertilizer, insecticide, insect repellent, fungicide, medicine, food preservation and other applications.

6. Charcoal Briquetting of Carbonized Biomass – Low cost equipment are now available for community-based charcoal briquetting project. DENR has piloted locally designed equipment and technology (200-300 kg/day capacity) for CBFM and LGU-implemented solid waste management projects. This will reduce the volume of cellulosic wastes in the community at the same time generate livelihood for the community.
7. Other utilization includes production of compost and organic fertilizer, animal feeds, hand-made paper, toys and gifts and other novelty items.

IV. Obstacles in the Adoption of Biomass Utilization Technologies

There are significant efforts made by various agencies both government and private to promote and demonstrate the potential use of biomass-based energy technologies. Some of these technologies are already commercialized. However, there is perceived misconception that biomass-based energy are not as reliable as the conventional energy sources. Some of the barriers that need to be addressed are the following:

- Lack of information as to source and type of materials, market outlet and access to the technology);
- Difficulty in sourcing out of fund for biomass utilization projects especially for the rural communities where the biomass resources are available in abundance;
- Lack of policies that provide incentives for the development of biomass as alternative energy sources and/or as energy conservation strategy;
- Lack of institutional mechanism to promote biomass utilization as energy source; and
- Poor implementation of existing policies in the restriction of illegal collection of wood in the forest for charcoal production.

V. Concluding Remarks

Biomass is an important source of energy for the energy supply in the Philippines. The country has an abundant supply of biomass resources as indicated in the compiled statistics. The main goal of the work is to consolidate abandoned biomass resource data from agricultural

and urban areas and make it available for analysis and project development especially for household and industrial fuel development at the same time conserve our forest resources. Major abandoned biomass producing regions were identified for the different biomass resources namely, corn cobs, rice hull, sugarcane bagasse, coconut residues, animal manure, forestry wastes, urban refuse, etc.

There are perceived misconceptions that biomass energy sources are not as reliable as conventional energy sources. This may be caused by lack of information (source and type of materials, market and access to the technology); difficulty of accessing financing for the project especially for the rural communities where the biomass resources are available in abundance; lack of policies that provide incentives for development of biomass energy resources and/or energy conserving strategies; and lack of institutional set-up that could promote biomass utilization for energy. These should be addressed to develop the biomass energy potential of the country.

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