P2 Evaluation of potential and applicability of biomass energy from agriculture residues in Ecuador

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Abstract: Energy is the key of industrial and economic development; therefore it is an indispensable requirement for human activities in order to access to primary needs. The arbitrary utilization of fossil fuels has threatened the planet's natural cycle causing problems of aerial pollution and given rise to global-warming. In Ecuador, energy and economic dependence of oil have leaded exploiting part of its Amazon but at the same time enhanced its income revenue. Environmental issues and a gradually depletion of limited fossil fuels sources imply to place more emphasis on renewable energy when seeking energy security into the future. Non-conventional sources of energy such as biomass can be considered renewable and environmentally friendly. Thus, biomass has a low share on country's energy portfolio; meanwhile agriculture residues are freely burned or wasted regardless other uses. This study estimated the amount of biomass from primary crops residue by using GIS in order to obtain the spatial distribution of biomass sources. Guayas and Los Ríos reported the largest biomass energy ratios. The potential sources were banana stem, rice straw, corn stover and bagasse. The supply-demand energy was around 95% as theoretical potential regardless other biomass uses. The biomass energy potential rates exceeded the energy use in some places causing a significant potential reduction to 62%.

Keywords: Biomass energy potential, agricultural residues, spatial distribution, GIS.

1. Introduction

Biomass mostly is utilized for industrial and transport uses such as steam, electricity and biofuels. Biomass energy currently contributes 9–13% of the global energy supply—accounting for 45±10 EJ per year. Regional percentages of TPES from a low of 0.3% in the middle East to a high of 48% in Africa, with biomass accounting for 18% of TPES in China, 31% in the rest of Asia, and 17 % in Latin America. Biomass resources can be grouped into wood residues, generated from wood products industries—agricultural residues, generated by crops, agro-industries and animal farms—energy crops i.e. crops and trees dedicated to energy production and municipal solid waste MSW. For this research the agricultural residues were the main focus for the evaluation of potential and applicability of biomass energy in Ecuador. The agricultural land accounts 7.4 million hectares in 2008 as a productive land. Ecuador is considered an agricultural country; hence this sector plays an important role on the GDP around 10.7 % in 2008, and the second export goods after oil.

2. Biomass Evaluation Method

The evaluation of biomass energy potential was carried out by using GIS. The analysis of the spatial distribution of biomass resources is determined by collecting land use GIS-data provided by SENPLADES reported on figure 1. The land use features such as agricultural crops, pasture, forest, vegetation, urban area and so on were displayed over a layer, on which the area of each attribute was extracted in order to mainly attain the total area value of major crops land, as well as the rest of the features values in hectares. The first stage for biomass feedstock selection was based on

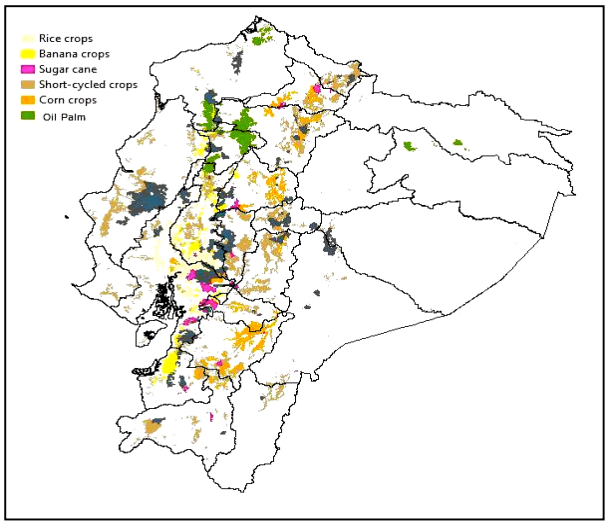

Figure 1 Spatial distribution of major crops in Ecuador

size and availability of crop land as well as the possible biomass residues for energy outputs. Consequently yield crop must be attained in order to assess the quantities of each biomass residue. Annual crop production by provinces was multiplied by the residue generation factor to estimate the total biomass residue from each crop, thus multiply by the calorific value of each feedstock to find the physical and theoretical potential in units of energy per year. The theoretical bioenergy potential from major agro-residues was compared with the consumption of energy in each province with the aim of analyzing the potential balance.

3. Potential of biomass energy from agricultural residues.

The spatial distribution of major crops was determined to be located at the west and central part of Ecuador. The species selected were banana, rice, corn, sugarcane and oil palm and short-cycled crops base on the availability and productivity. The potential of biomass energy from crops residues distributed locally by province. Guayas and Los Ríos located in the coastal region hold biomass energy potential of around 2735,7 ktoe and 2024,9 ktoe, respectively, accounting around 43% of the total biomass energy potential in the country. The outstanding crops are banana, rice, sugar cane. Also highlands provinces account 32% of biomass energy potential where the largest rates of crop residues are from corn and sugar cane shown on figure 2. The total amount of biomass potential from agricultural residues was calculated on 10981 ktoe per year.

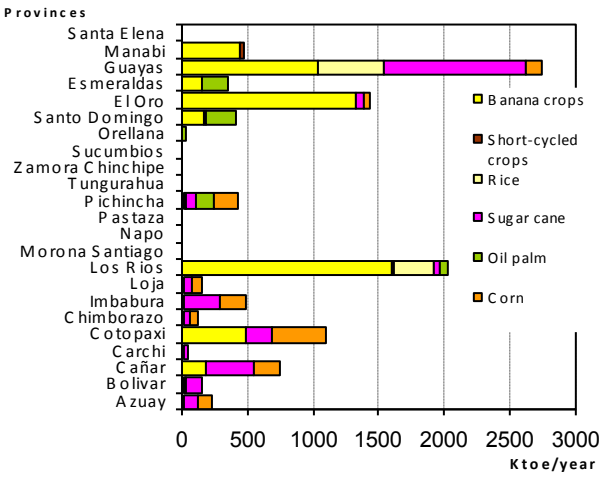

Figure 2 Biomass Energy Potential

4. Conclusion and Discussion

The biomass potential energy was found as 10981 [ktoe/year] theoretically available from agriculture residues, around 95% of the energy demand in the country. In general Ecuador owns a significant potential of biomass that could be transformed into energy carriers such as bio-fuels via hydrolysis or electricity generation from lignin-rich residue, especially from major crops residues such as banana stalks, corn stover, rice straw and bagasse. The spatial distribution of biomass indicates the theoretical potential was mainly concentrated at highlands and coast region along the country with an important rate on Guayas and Los Ríos accounting almost half of the bioenergy supply.