Review on Assessment Methods of Agriculture Residues

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Abstract

Agriculture residues are the materials left in an agricultural field or orchard after the crop has been harvested. The residue can be ploughed directly into the ground, or burned. The agriculture residues are abundantly available in the tropical country India. The assessment of agriculture residues is required to develop a suitable energy conversion technology. This paper deals with the discussion of different methods to assess agriculture residues. The methods used for the assessment of the agriculture residues are direct survey at source, direct survey at consumption, using grain production correlation, crop plantation area correlation and GIS. The survey method gives the better result but it is expensive and time consuming. The grain production correlation is the better method for assessment of the agriculture residues.

Keywords- Biomass, Agriculture residue, Assessment, GIS, Grain

I. INTRODUCTION

Biomass is the source of energy since from the invention of fire. Later the use of fossil fuels increased because of convenient and lower price. The increase in the consumption of fossil fuels is causing environmental pollution greatly and also empty the fossil fuel source soon. This makes mankind to worry about using the fossil fuels. Thus there is a continuous effort from the researchers to utilize the renewable energy sources for energy. As per the report of the National Council for Applied Economic Research [1], biomass fuel contributed 90% energy in the rural areas and over 40% in the cities and over two third of the households in the country use biomass as the only source of energy. The biomass consumption for energy has been increased to 14% globally and 35% in developing countries [2]. Biomass is the key component of the renewable energy source due to higher potential in developing countries [3]. The biomass utilization for energy reduces the environmental pollution and supplies the required energy for remote area. The biomass may be from the different sources such as forest residues, energy plants, agro industrial wastes, municipal solid wastes and agriculture residues. The agriculture residues are having major contribution in the biomass, MNRE; government of India estimated that about 500 to 540 MT of agriculture residue generating in India every year [4]. The generation of agriculture residues has been increased due to use of modern cultivation methods and fertilizers. The agriculture residues are of different forms and depend upon the type of crop. The residues are classified as the stalks, stubble (stems), leaves, straw, husk, shells, roots, and cobs etc. Agriculture residues can be used for different applications such as domestic cooking, water heating, agriculture crop processing and small industries like brick kilns etc. The excess residues are burnt as the waste in the field or thrown as the waste. Thus there is a disposal problem of these residues and if burnt in the field cause environmental pollution without contributing any energy [5].

The assessment of the agriculture residues is required in order utilize for energy effectively using the proper conversion technology. If we have the sufficient data of availability of agriculture residues, we can develop the suitable energy conversion technology and used for the energy requirement. Also we can plan to supply the surplus residues to the nearest power plant run by the biomass. The geographic information system (GIS) can be used for the ground above biomass assessment [6, 7]. The direct survey includes the either at sources or at consumption. Some correlation equations can also be used for assessment of agriculture residues by using the survey data.

II. MATERIALS AND METHODS

Biomass assessment helps in describing the quality, quantity, change, productivity and condition of bio resources in a given area. The assessment may be for regional or national level. Biomass status assessment is based on compilation and computation of biomass supply for the energy generation. Biomass availability is computed based on the compilation of data on the area and productivity of agriculture and horticulture crops. Biomass supply from agricultural residue and horticulture residue are considered to assess the energy status taluka wise.

The crop residue inventory involves the measurement of both crop yields and crop residues to allow the development of residue-yield ratio estimators as well as area-based estimates of residue yields. The ASF (Area Sampling Frame) methodology

provides a very efficient basis for estimating crop yields. This methodology involves the delineation of permanent or long-term sampling segments from satellite imagery (Multi spectral sensors). These are then used as sampling frames for subsequent agricultural surveys. The crop residues are surveyed during both the Kharif and Rabi season. Field sampling is carried out within one week before harvest to ensure that crop yield and residue measurements are related to fully mature crops. The cultivated area and the biomass yield of each crop influence the biomass potential from agriculture residues. The ratio of the main product to the by-product for each crop grown under local conditions along with their energy equivalents were used to compute the agro residues production. Apart from this, the actual availability of residues as energy supplements would also depend on other factors like efficiency of collection, mode of transportation and storage. Considering these, in the computation of bio residue from agriculture only 50% is accounted for fuel.

Computation of bioenergy from agricultural crops requires inputs such as crop type (i.e. Cotton, Green grams, etc.), spatial extent, crop yield or productivity, residue to crop ratio, energy equivalent (kcal/tonne), while outputs are annual energy - crop wise, region wise, etc.

A. Survey at Source

The data regarding the yield of the crop and the crop plantation area are not available then the survey should be carried out. The survey can be carried out covering the medium to large area progressive farmers. The generation of the residue depends upon the efficiency of the farmer. Thus the farmers chosen in such a way that, the field should be convenient to approach and farmer should efficient cultivator. The residue producer also includes some agro industries sugar factories and rice mills. The survey samples should cover all the possible farmers, rice mills and sugar factories throughout the state or country. The data available to be analyzed and should give the product to residue ratio (RPR) or residue generation per hectare (RGPH).

B. Survey at Consumption

This survey method is intended to cover the sale point of biomass and consumption. In this the survey of agro industries such as cogeneration plants, brick kilns, churumuri batties, turmeric boilers and joggery mills are to be covered. All the major consumers are included in the survey and lesser consumers are chosen by random sampling method. The major consumers are cogeneration plants, joggery mills and remaining are the lesser consumers. The joggery mill consumes the part of the residue producing from it. The consumption of the residues per day, per month and per year is collected. The data obtained are analyzed and required residue generation can be obtained at consumption level.

C. Correlations for Finding the Residues

The equations are used to find the residue production by using the RPR and RGPH. The residue generation per kg of crop yield RPR is obtained by direct measurement in the field during harvesting. The RPR of the each crop should be determined separately. The different fields in the taluka, district, state and country are selected randomly for finding the RPR. The average RPR is determined to use for finding the residue generation by the correlation Eqn.1.

Residue generation = Crop yield x RPR kg or tonnes (1)

The residue generation per hectare RGPH is measured directly in the field during harvesting covering possible fields of taluka, district, state and country. The residue generation is obtained by using the relation Eqn.2.

Residue generation= crop plantation area in hectare x RGPH kg or tonnes (2)

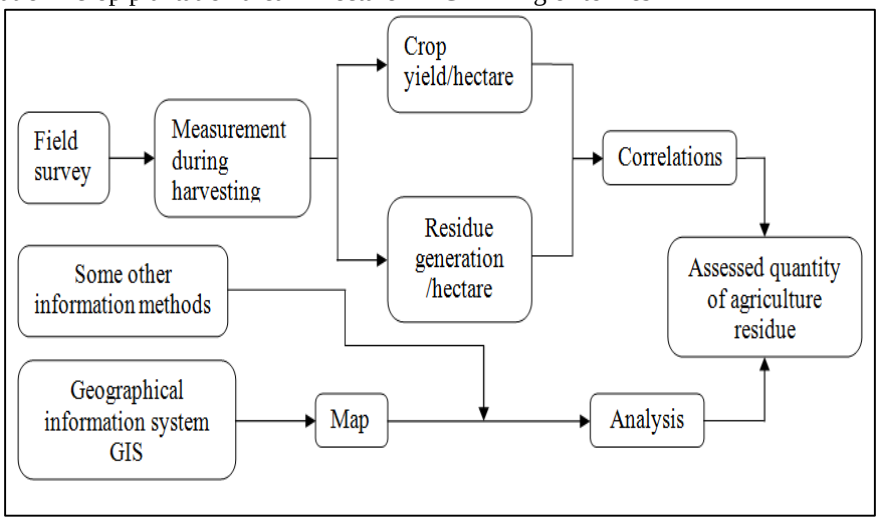

Fig. 1: Agriculture residue assessment process

In this paper the five agriculture crops has been chosen for assessment. The survey has been carried in the Belagavi district of Karnataka state. The crop yield and the residue generation values are obtained from survey. The results are correlated using RPR and RPGH for assessing the agriculture residues Table 1 and Table 2.

Table 1: Agriculture Residue Assessment by RPR

Crop	*Crop yield kg/ha [8]*	*RPR[9]*	*Residue generation lakh kg Eqn.(1)*
Tur	*486*	*1.1*	*4100*
Soyabean	*950*	*1.2*	*2177*
Jowar	*1075*	*1.7*	*20870*
Maize	*3188*	*2*	*86012*
Cotton	*340*	*-*	*22496*

Table 2: Agriculture Residue Assessment by RGPH

Crop	*RGPH (measured)*	*Plantation area lakh hectare*	*Residue generation lakh kg Eqn. (2)*
Tur	*500*	*7.67*	*3835*
Soyabean	*750*	*1.91*	*1432*
Jowar	*2500*	*11.42*	*28550*
Maize	*4000*	*13.49*	*53960*
Cotton	*4200*	*5.92*	*24864*

Referring to the two correlations the estimated residue quantities are having some variations because of climatic condition, soil fertility, seed quality, irrigation type and farmers efficiency.

D. Geographical Information System (GIS)

Geographical Information System (GIS) is an information system that is designed to work with data referenced by spatial or geographical coordinates used to map spatially the resources and demand. It helps to efficiently store, manipulate, analyze and display spatial data accordingly to the user specifications. Maps provided by GIS integrates common database, operations such as query and statistical analysis, with the spatial data (maps). These abilities distinguish GIS from the information systems and make it valuable to wide range of public and private use for planning strategies and managing infrastructure in the region [10].

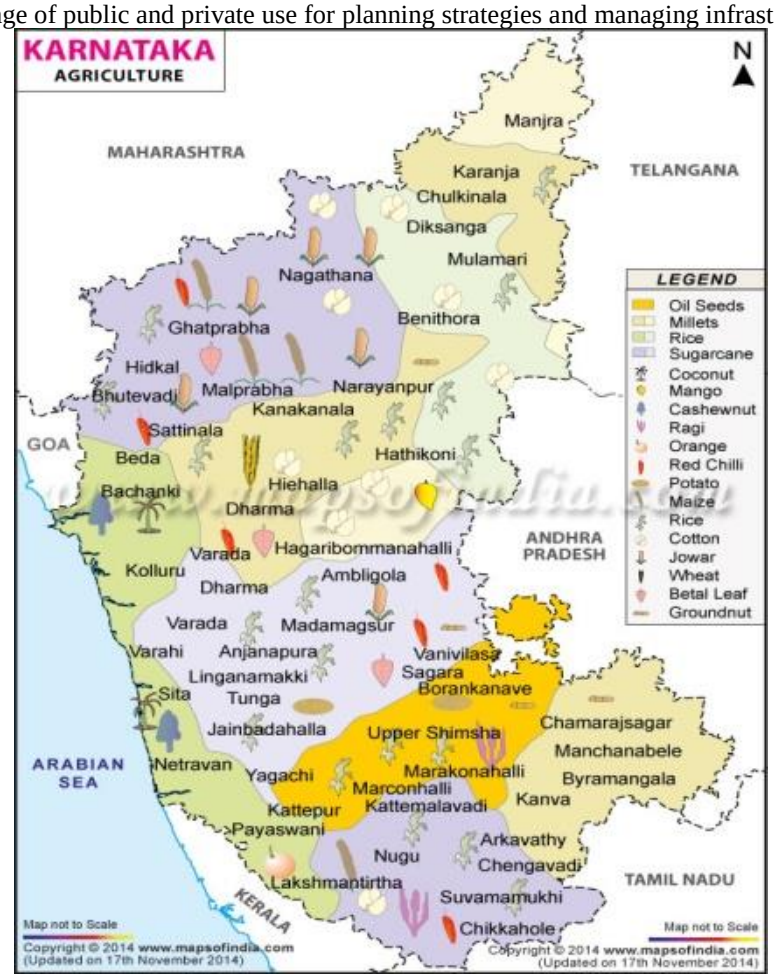

Fig. 2: GIS map of Karnataka showing different crop area

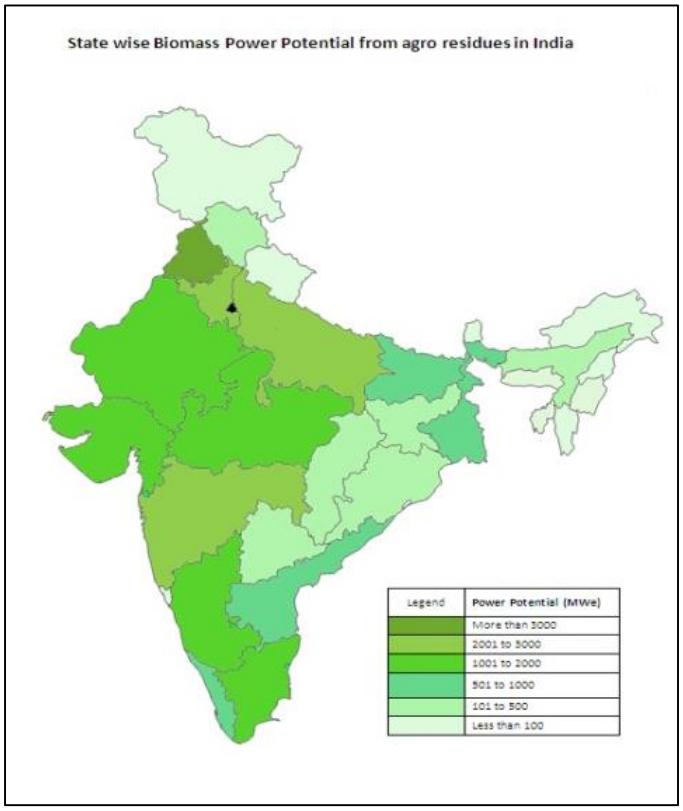

Fig. 3: GIS map of India showing the agro residues power potential

E. Bio Resource Availability

Resource wise analysis of the study area reveals that bio resource from horticulture constitutes the major share of 43.6%, forest 39.8%, agriculture 13.3%, livestock 3.01% and plantation 15%. Table 3 gives the percent biomass contributing to the total bioenergy [11].

Table 3: Total Bioenergy and % Contribution of Each Biomass

Biomass	*Total energy, Mkcal*	*% Contribution*
Agriculture	*26560047*	*13.6*
Forest	*79431779*	*39.8*
Horticulture	*86871417*	*43.6*
Plantation	*312604.22*	*0.15*
Livestock	*5997527.8*	*3.01*

III. CONCLUSION

Although the assessment of agriculture residues involves some approximations, the different assessment methods are reviewed. The survey results are necessary for using RPR and RPGH correlations. The survey is the key factor for agriculture residue assessment. The RPR can be used by knowing the crop yield for residue assessment, which is the better method compared to the other agriculture residue assessment. The discussion also shows that the horticulture is the highest percentage of contribution in the biomass 43.6%.

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