Agricultural Waste Management in order to sustainable agriculture in Karnataka

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Abstract— *Renewable energy as an alternative of fossil fuel for minimizing pollution and related issues, has got significant role in recent years. Agricultural residues as a source of biomass can be used to produce biogas. Every year while production of agriculture product generates lots of agro-residues and in many cases either left behind with no use or burn. Whereas can be prevented losing this source of energy by converting to the other types of energy. Nevertheless in present study assessing the potential of producing biogas out of biomass (agricultural residue) during one year in Karnataka state has conducted. For this purpose, production of agricultural crop residues data during one year depends on volatile solid (VS), extracted and according to the related coefficient, potential of biogas (methane) production computed. Results showed Maximum extracted methane respectively belonged to the rice, jowar, ragi, peanut and cotton residues. The total potential of methane production during the one year, 6391403732 cubic meters estimated.*

Keywords— agriculture residues, waste management, biomass, biogas.

I. INTRODUCTION

Limitation of fossil resources, their non-renewability, increasing petroleum fuel prices, emissions from combustion of fossil fuels all cause energy policy makers and planners to focus on structural studies, to change the energy carriers, and move towards cleaner fuels (Rahi, Garshasbi,2011;shaygan et al., 1997). Burning fossil fuels results in the emission of carbon dioxide (CO2), nitrous oxide (N2O) and methane (CH4) that act as barriers to thermal radiation and prevent it from leaving the Earth's atmosphere, the so-called greenhouse' effect (IPCC, 1997).The current policy within agriculture seeks to develop crop production systems that minimize fossil energy input for a high level of output(Dalgaard, 2000). Biomass has the largest potential land can only be considered as the best option form meeting the demand and insurance of future energy/fuel supply in a sustainable manner. The modernization of biomass technologies leading to more efficient biomass production and conversion is one possible direction for efficient utilization of biomass resources .Agricultural biomass is a relatively broad category of biomass that includes the food based portion(oil and simple carbohydrates)of crops (such as corn, sugarcane ,beets)and the non- food based portion(complex carbohydrates)of crops(such as the leaves ,stalks ,and cobs of corn Stover, or chard trimmings ,rice husk, straw),perennial grasses, and animal waste (Chandra, Takeuchi, & Hasegawa, 2012). Energy can be obtained from biomass in five ways: production of crops which yield starch, sugar, cellulose and oil; solid waste which can be burnt; an aerobic digesters which produce biogas which can be used to generate heat/electricity; landfill production for methane ;and biofuel production which includes ethanol, methanol, biodiesel and their derivatives (Demirbaş, 2001). Direct combustion of biomass for heat or combined heat and power generation is the most common way of using biomass for energy today, but a large, unutilized energy potential lies in semi-solid agricultural residues, with dry matter contents below 25%, making the energy potential difficult to exploit in its current form (Chynoweth, Owens, & Legrand, 2001; Gunaseelan, 1997).Conversion to a useful energy carrier must first be performed .recently Converting biomass to biogas is one the reliable methods. Biogas is currently produced by anaerobic degradation of millions of tons of organic solid waste arising from municipal, industrial and agricultural sources(Chynoweth et al., 2001; Gunaseelan, 1997) .Biogas as one of the major sources of energy can be used directly to provide heating and electricity energy and is a good option to be used in internal combustion generators, micro-turbines, fuel cells and other power producing facilities as well (Rahi, Garshasbi,2011;shaygan et al., 1997). Biogas contains 50–70% methane and 30–50% carbon dioxide, as well as small amounts of other gases (Sasse, 1988). And typically has a calorific value of 21–24 MJ/m3. Biogas burns with a clean, blue flame and stoves have been considered as the best means of exploiting biogas in rural areas of developing countries (Kossmann et al., 1999). In 2012, about 194.8 million ton of renewable energy was consumed in the world and about 0.1 million ton was consumed in Iran (Dudley, 2012). To increase the biogas yield (Mohseni, Magnusson, Görling, & Alvfors, 2012) .Methane derived via anaerobic digestion has proved to be competitive with heat (via burning), steam and ethanol production in efficiency, cost and environmental impact of the conversion of waste streams to energy forms (Chynoweth et al., 2001; Edelmann, Schleiss, & Joss, 2000).

II. MATERIAL AND METHOD

This study evaluates agro-residue biomass production in Karnataka state located in Sothern of India. In the present study, all agriculture residue data, brought up from the Indian biomass atlas (2000-2004). Depends on the data for years of 1998-1999, assumed production ratio have not change in 6 years period and it would be considered as a consistence production, Accordingly different production ratio correlation between in two these period of time examined and significant correlation data confirmed, so production ratio experienced a slightly variation. Hence slightly variation for the next years considered too. Biomass production through agricultural residues data monitored and evaluated then methane production potential coefficient of each and every major crops residue according to cubic meters per ton Unit for volatile solid (m3/ton Vs) extracted from different sources (table 1) . According to the calculation of biomass potential of agro-residues depends on volatile solid measurement, content of biomass production (VS) for each and every product computed and used for estimating of methane potential of agro-residue.

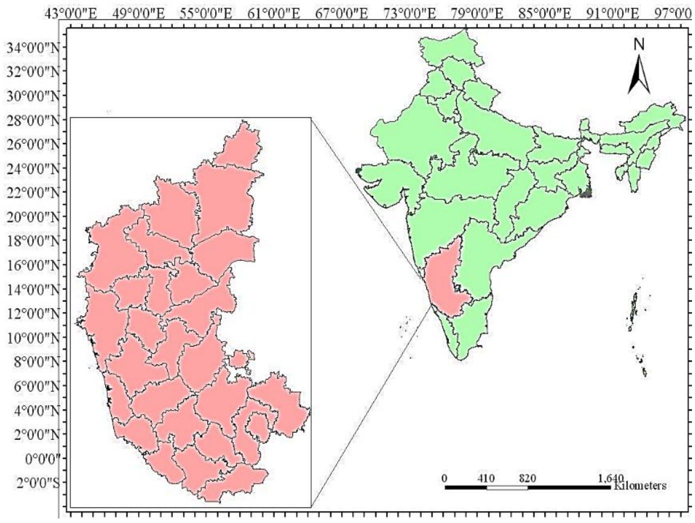

FIG 1: KARNATAKA GEOGRAPHICAL LOCATION

Methane coefficient of Finger millet residue, was not found, so in this case methane coefficient of millet residue was used (Table 1). In addition methane coefficient of peanut, gram and sugarcane residues were not found, so to obtain methane content biogas production ratio was used to calculate methane potential content of the mentioned agricultural residues (Methane content in biogas extracted from the agricultural residue is between 60 to 75 %) (Anonymous, 2016).

TABLE 1
MAJOR CROPS RESIDUE METHANE YIELDED, KARNATAKA

Agro-residue	Methane yield (m3/ton vs*)	References
Bajra	390	(Lehtomäki, 2006)
Cotton	170	(Oosterkamp, 2014)
Gram	273	(Braun *et al.*, 2008)
Groundnut	256	(Anonymus, 2016b)
Jowar	415	(Lehtomäki, 2006)
Maize	166	(Sawatdeenarunat *et al.*, 2015)
Millet	390	(Nallathambi Gunaseelan, 1997)
Paddy	303	(Nallathambi Gunaseelan, 1997; Lehtomäki, 2006; Sawatdeenarunat *et al.*, 2015)
Ragi	390	(Nallathambi Gunaseelan, 1997)
Sugarcane	140	(Karimi Alavijeh and Yaghmaei, 2016)
Wheat	390	(Menardo and Balsari, 2012; Oosterkamp, 2014)

III. RESULTS AND DISCUSSION:

Evaluating the agro-residue production revealed, Overall Karnataka by 6% producing of total production of agro-residue biomass Annually got 9th rank after, Uttar Pradesh, Punjab, West Bengal, Maharashtra, Madhya Pradesh , Rajasthan and Haryana states (Fig 2). So it seems so using agro-residue (biomass) as a source of energy can contribute significant role in economics of Karnataka. Importance of using biomass as a source of biogas highlighted in the other researcher studies. (Karimi et al., 2016) studied on feasibility of different type of renewable energies production, including agro-residues in Iran. (Lehthomaki et al., 2006) investigated feasibility of biogas production through energy crops and agricultural residues.

3.1 Karnataka biomass Production

Yearly biomass production in Belgum, Golbarga, Tomkur, Raichor, Bijapour & Belari taluks with the maximum production are 8.8, 7.3, 6.2, 5.8, 5.8, 5.4 percent respectively (Fig 3). The results revealed each taluk of Karnataka has got significant differences to the other taluks in terms of biomass production, in terms of geographical location, except of Belgum which is located in northeastern of Karnataka, the rest of high potential biomass production taluks located in north, east and center. Knowing the geographical area in high potential production biomass taluks is vital. For instance region or season with an average temperature less than 10° C and in residential area it's not convenient for biogas production **(Chen et al., 2013).** Therefore, the geographical area of biomass production areas play a vital role in further plans and agro-residues management in order to optimal productivity.

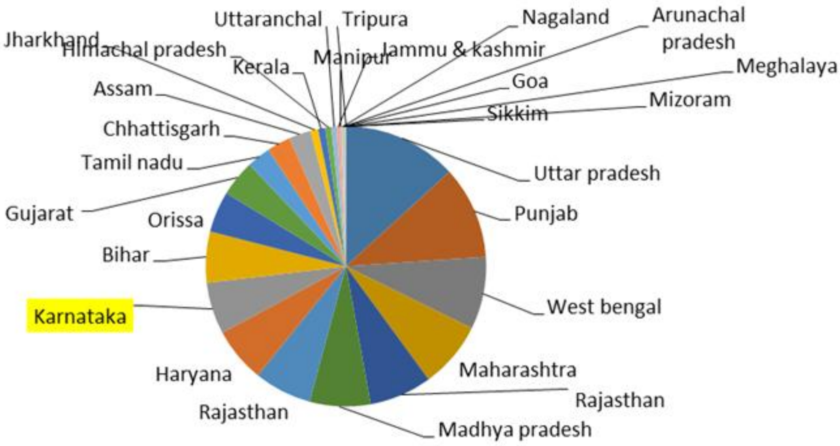

FIG 2: ANNUALLY AGRO-RESIDUE BIOMASS PRODUCTION

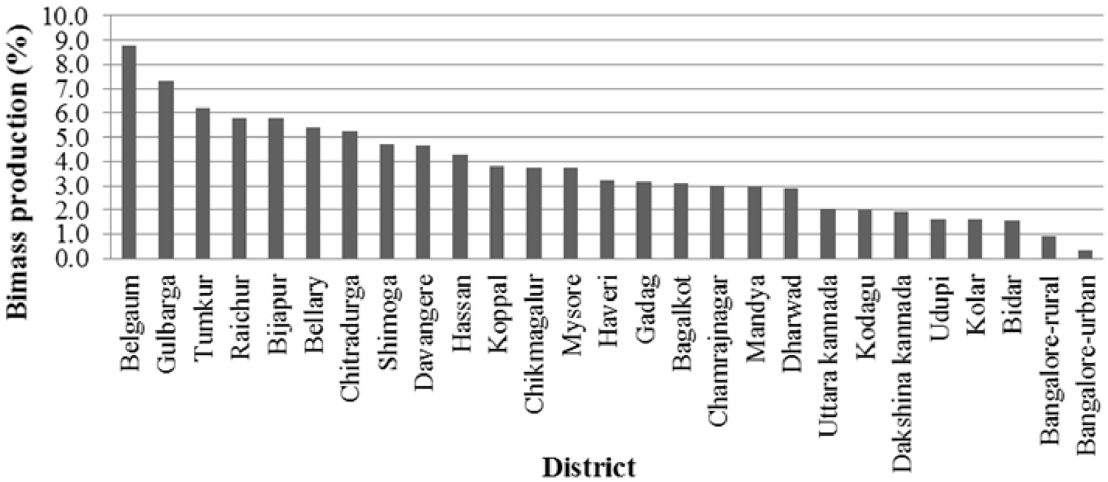

FIG 3: ANNUALLY AGRO-RESIDUE BIOMASS PRODUCTION IN DIFFERENT TALUKS OF KARNATAKA STATE

Study on agricultural production in Karnataka state indicates the main important crops in terms of production of agro-residues biomass by respectively share of 30. 2, 20. 2, 13.2, 11.7, 9.5, 7.4, 4.8, 4.1, 1 percentage belonged to the rice, jowar, cotton, corn, peanut, ragi, sugarcane, bajera and wheat. As it shows in figure 4, biomass production to cultivation area ratio of different major crops significantly is different. For instance this ratio in rice, cotton and corn is more than 1 and in case of sorghum, peanut, bajira, ragi, gram and wheat is less than 1.so the largest area under cultivation does not mean the greatest amount of biomass production and vice versa.in case of rice with low infield produce high yield product.so in terms of producing main product and by-product, rice is important.

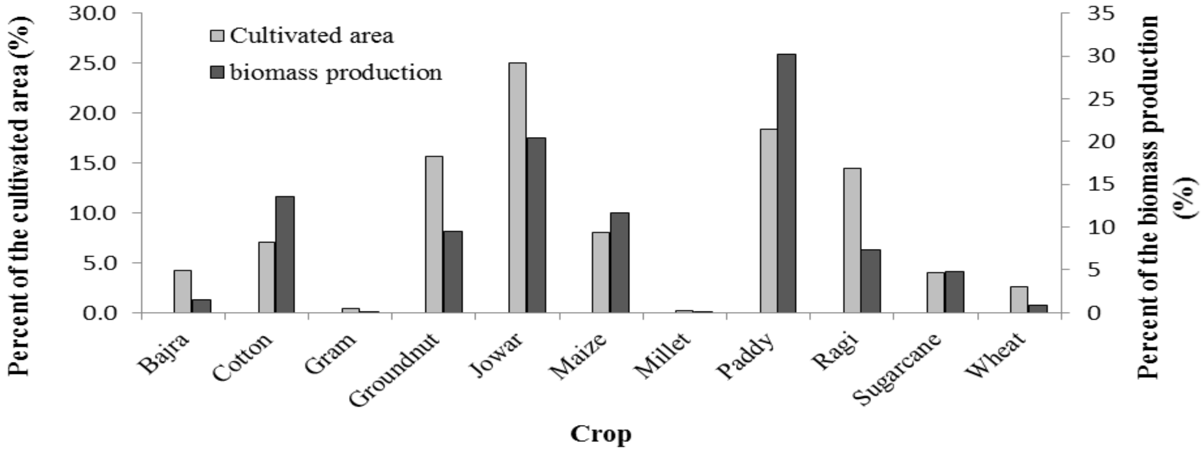

FIGURE 4: CULTIVATED AREA AND BIOMASS PRODUCTION OF MAJOR CROPS IN KARNATAKA

Over all maximum methane extraction in one year it's about **6391403732 m^3** through the rice ,jowar, ragi, peanut , cotton and corn by the respectively production share of 31.9, 29.6, 10.1, 8.4, 8 and 6.7.(table 2). Biogas production feasibility through different sources examined by researchers *(Gamal-El-Din et al., 1986; Isci and Demirer, 2007; Braun et al., 2008; Dinuccio et al., 2010; Anjum et al., 2012; Chen et al., 2013; Kiran et al., 2014).* Different researchers expressed biomass agro-residues would be a suitable source for biogas production *(Lehtomäki, 2006; Parawira et al., 2008; Garcia-Peña et al., 2011; Khalid et al., 2011; Menardo and Balsari, 2012; Durruty et al., 2013; Janke et al., 2015; Sawatdeenarunat et al., 2015; Karimi Alavijeh and Yaghmaei, 2016; Li et al., 2016).* Biomass residues and weeds can be source of biogas production *(Bond and Templeton, 2011).*biogas potential production studied through livestock and slaughterhouse waste in Iran and biogas considered as renewable and sustainable energy***(Afazeli et al., 2014)***.

TABLE 2
METHANE POTENTIAL PRODUCTION THROUGH AGRO-RESIDUES DURING ONE YEAR IN KARNATAKA

Agro-residue	Cultivated area (kha)	Biomass (t/yr)	Methane production (m^3)	%
Bajra	316.1	414000	103334400	2
Cotton	532	3894100	542837540	8
Gram	32.7	33600	7521696	0.1
Groundnut	1179.7	2720500	493512302.5	8.4
Jowar	1882.2	5871400	1681275390	29.6
Maize	603.7	3345000	477532200	6.7
Millet	11.4	9600	2396160	0
Paddy	1379.7	8677300	2287423053	31.9
Ragi	1090.8	2127500	572510250	10.1
Sugarcane	298.2	1367100	164598840	2.3
Wheat	192.5	242500	58461900	0.8
Total	7519	28702600	6391403732	

IV. CONCLUSION

Besides of Limited fusil fuels and energy crisis, extensively non-renewable energy using results to the environmental issues and global warming. So one of the initial actions for the saving our environmental from global warming and related issues is replacing of non-renewable energy to the renewable form of energy. Biomass as a source of renewable energy because of variety of advantages highly suggested by researchers. One of the biomass sources is agricultural residues that left largely unused on the agriculture field and can be consider as a main important sources for renewable energies. Out of biomass, bio-methane/biogas would be produced and its valuable as natural gas or other type of fossil fuel are. Biogas can use to produce electricity or even heating, cooling, pumping, or used as vehicle fuel.

According to the results, agricultural crop residues considered as reliable source for renewable energy production in form of biogas in Karnataka. Results shows 91.6 % of total methane production obtain from rice, jowar, ragi, peanut, cotton, corn residues. Factors such a climate, (temperature above 20 ° C), solar energy and biomass resources have a key role in optimum methane extraction. ***(chen et al ., 2013)*** . According to diversified climate of Karnataka and high production of agro-residue biomass, it seems to biomass as a renewable energy can be considered for supplying some part of demanded energy in Karnataka.

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