Agro-waste Generation & Management in Punjab (India): Status Update

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Abstract

The Government of India is promoting bio-energy. Being a developing country, the focus is mainly on agro-residues. Lately, the policy makers have realized that the formulation of pro-bioenergy policies and industrial development strategies is dependent on precise resource assessment of entire spectrum of waste biomass present in the area, including agro-residues. Accordingly, the need for holistic biomass resource assessment has become indispensible to accelerate the growth of bio-power sector in India. Punjab being a leader in agricultural and horticultural production has huge potential of biomass resource availability in the form of crop residues, horticulture waste, vegetable waste, wasteland biomass, animal waste and municipal solid waste (MSW). Paradoxically, Punjab ranks high amongst Indian states practising open burning of biomass. In light of the above, this article attempts to identify major ligno-cellulosic waste biomass types present in Punjab that could act as excellent fodder for bio-power production. Besides, the authors try to draw attention towards rampant open burning of biomass actively practised here and how this bane can be turned to boon through promotion of bio-energy. Due to concerted efforts of Central and State Government the situation seems improving and such results are further motivation for carrying out the re-assessment of the potential biomass resources available in Punjab to not only to catalyse better utilization of biomass resources but also to overcome the challenges posed by mismanagement of such resources. Efforts towards promoting bio-energy in Punjab are gaining momentum, recognizing the vast potential of various biomass resources. However, the prevalence of open burning remains a significant challenge. Through collaborative initiatives between the Central and State

Governments, there's optimism for transforming this detrimental practice into a sustainable bio-power solution, emphasizing the urgent need for thorough biomass resource assessment to drive effective utilization and mitigate resource mismanagement.

Keywords- Waste management,

1. Introduction

Punjab holds 1.5% of India's geographical area yet is considered the "food bowl India" for contributing more than 40% of the wheat and 26% of rice to the central pool. The confluence of five rivers makes Punjab highly fertile and is divided into five agro-climatic zones beneficial for cultivation of a large number of crops, vegetables and fruits[1]. Consequently, agriculture is the main source of income with about 21 % of GSDP being contributed by Agriculture and allied sectors. Total production in 2015-2016 Depicts in figure 1.

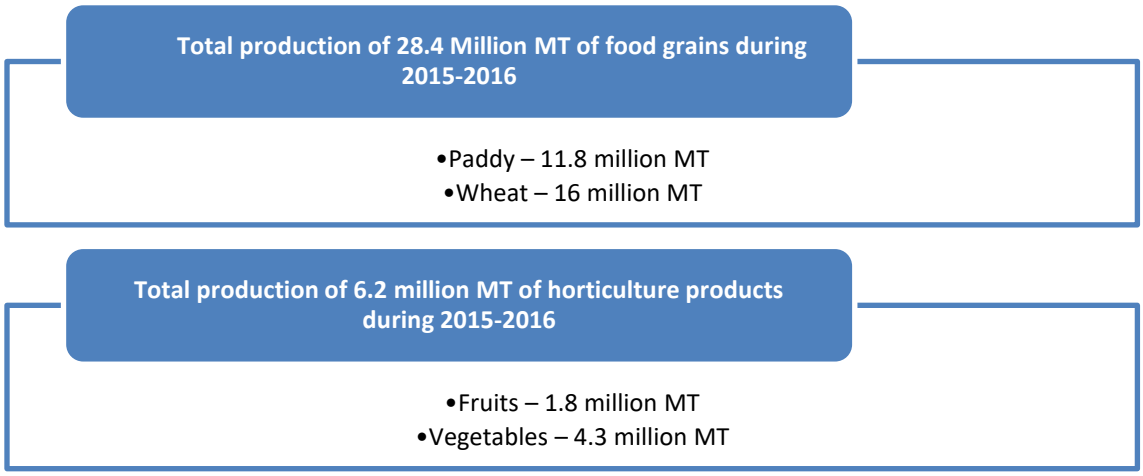

Figure 1- Total production in 2015-2016.

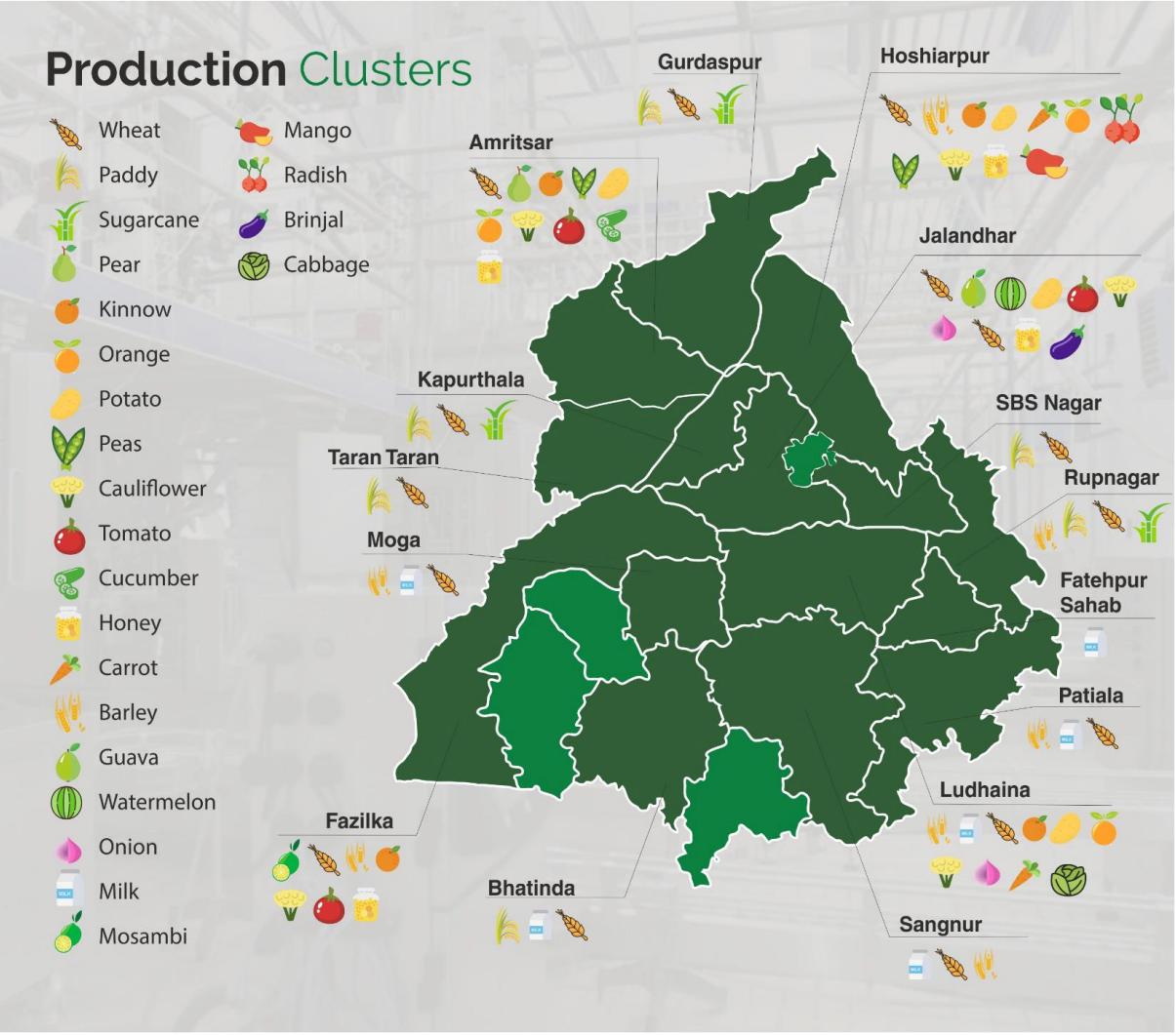

Fig 2: **Major Production Clusters of Agriculture and Allied Sectors in Punjab**

Since the advent of green revolution, Punjab has made an unmatched progress in the agriculture. However, the huge gains in terms of rising food grain production, has not been without their subsequent negative impact on environment & socio-economics in the form of over-all degradation of agro-ecosystem[2-3]. The major challenges before the state are alarming decline in water table, deteriorating soil health, non-judicious use of fertilizers and pesticides, reduction in genetic diversity and crop residue mismanagement[4]. Further, the stagnation in yields and rising cost of inputs is making the situation worse for the farmers, at present and is likely to hit the whole nation, in a longer run. Major Production Clusters depicts in Figure 2

In this article, we have taken up the issues concerning the waste generated during cultivation and processing of different types of plants, such as crops, fruits, vegetables etc., commonly known as lignocellulosic biomass Further, we try to find the scope of bionergy applications of such waste for satisfying the twin needs of waste management with energy production.

2. Resource Assessment and Management

Punjab has two main harvesting seasons: Kharif (May to September) and Rabi (November to April). During November, the farmers usually harvest rice and sow wheat. After crop harvesting, the leftover plant residue is burnt to clear fields for the next crop. This practise is knowing as stubble/ straw burning.

Straw burning is a relatively new phenomenon which became popular with introduction of combine harvesters in 1980s. Earlier, the farmers harvested and ploughed fields manually and incorporated the debris back into the soil while with the mechanized harvesting burning became common because machine leaves stalks of almost one-foot tall in the field. Subsequently, burning became the quickest and cheapest way of paddy straw management. Reports say that around 15 MT of paddy straw is generated in Punjab every year and on an average, almost 7–8 MT of it is set on fire. Recently, The Down to Earth magazine published by CSE, New Delhi reported the similar trend in wheat straw management[5-6]. The study titled Fields on fire: crop intensification is the culprit (31 May 2017, Down to Earth) reveals that despite the fact that India faces a fodder shortage of 22 % and wheat crop residue is the preferred for it yet farmers are increasingly opting to burn it ,too, due to intensive cropping patterns. The result could be seen as another agro-residue (Table 1) burning season during April- May .

Table 1: Residue generated, residue surplus and burnt in Major States (in MT)

S.N.	States	Residue generation	Residue surplus	Residue burned
1	Andhra Pradesh	43.89	6.96	2.73
2	Bihar	25.29	5.08	3.19
3	Chhattisgarh	11.25	2.12	0.83
4	Gujarat	28.73	8.90	3.81
5	Haryana	27.83	11.22	9.08
6	Karnataka	33.94	8.98	5.66
7	Madhya Pradesh	33.18	10.22	6.91
8	Maharashtra	46.45	14.67	7.42
9	Orissa	20.07	3.68	1.34
10	**Punjab**	**50.75**	**24.83**	**19.65**
11	Rajasthan	29.32	8.52	1.78
12	Tamil Nadu	19.93	7.05	4.08

13	Uttar Pradesh	59.97	13.53	11.92
14	West Bengal	35.93	4.29	4.96

(Source: National Policy for Management of Crop Residues)

A study titled **Socioeconomic and Environmental Implications of Agricultural Residue Burning A Case Study of Punjab, India** (2015) by Pramod Kumar et. al [13]has discussed the issue in detail and even elaborated the state of agro-residue burning district-wise . According to this study, the farmers seldom incorporate rice and wheat stubble in the soil. Wheat stubble is used as fodder for animals, but the usage of rice stubble as fodder for animals is not much. The paper mills procured rice-straw at a rate of Rs. 200–300 t −1. The wheat straw was generally sold after making chaff. The price of chaff varied between Rs. 2,500 and 3,700 ha−1. Amongst, districts Amritsar shows high alternate use of paddy straw is where 18.2 % is used as animal fodder, 19.6 % is sold in the market and 9.4 % is given to poor. On the other hand, in Gurdaspur 20.6 % of the rice residue is provided to and 12.9 % is used as fodder while the rest is burnt. Similarly, in Patiala 11.7 % of the rice straw is used as fodder, 5.9 % is sold in the market and the rest 81.5 % is burnt. However, in Bhatinda district of Punjab paddy straw is not put to any alternate use but totally burnt. In Ferozepore, 18.8 % of the paddy straw is provided to poor, 8.8 % is incorporated in the soil while the remaining 68.1 % is burnt. Ferozepore is the only district where the paddy is incorporated in the soil to improve the soil quality. The wheat straw is widely used as fodder for animals only in 7 districts of Punjab[7-10].

3. **Challenges in Agro-waste Management**

In this section, we will discuss the impact of various factors affecting the efficient lignocellulosic biomass management in the state and possible solution to it.

A study conducted by IARI showed that in 2008-09, crop residue burning released 149.24 MT of carbon dioxide (CO2), over 9 MT of carbon monoxide (CO), 0.25 MT of oxides of sulphur (SOX), 1.28 MT of particulate matter and 0.07 MT of black carbon. Besides, soil health is also affected badly by removal of 1.43 million tonnes of nutrients from the topsoil layer.

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According to some scientist, the financial burden of agro-residue burning to Punjab farmers is about Rs 800-2,000 crore annually in terms of nutritional loss and Rs 500-1,500 crore in the terms of government subsidies on fertilisers. In a similar effort, the Institute for Social and Economic Change, Bengaluru, has estimated that people in rural Punjab spend Rs 7.6 crore annually on treatment of diseases caused by stubble burning.

In another study, rising temperatures reduce global wheat production – published in 'Nature Climate Change' shows that global wheat production is estimated to fall by 6% for each degree

Celsius rise in temperature. It further warns that, South Asia, including India, could be amongst the worst hit if remedial actions are not taken on time[11].

Biomass Resource assessment and proper management is in focus of the Government to evade the problems related to open burning of biomass, especially, paddy straw .The Ministry of Agriculture & Farmers Welfare, Government of India has formulated the "National Policy for Management of Crop Residues (NPMCR), 2014" to rein the rampant burning of crop residues practised by various states across India. The policy focuses on adoption of technical measures including diversified use of crop residue, capacity building and training to ensure better management of the waste[12].

On the other hand, grave impact of biomass burning on human health are also in news, such as rising rates of Asthma in healthy individuals (3 May, 2015, The Times of India) and higher incidences of respiratory and lung diseases in children from rural areas(11 May, 2015, The Tribune) . Further, alarmed by the grim situation, World Health Organization(WHO) has recommended its member countries to take urgent actions for emission reduction as it is the cause behind more than seven million premature deaths annually (October 27, 2015, The Times of India) . In the interest of the health of humans, animals and the environment, it needs a solution.

Result and Discussion

Reports say that India would need to import around 60 percent of its energy requirement in near future and this will increase import bill of the country. Therefore, provisions for conversion of waste to energy can be a sustainable option in the current scenario. With this perspective, Indian Railways has recently started promoting blending mandates for biodiesel in railways to reduce both cost of fuel and emission, is a welcome step.

Another possible solution to it can be obtained through Green Climate Funds (GCF) under Paris Agreement on Climate Change as the GCF board is invites high quality funding proposals to address climate change. Such Projects could provide the necessary funds required by the farmers to meet the cost of removing the crop residue instead of by burning it.

National Green Tribunal (NGT) has clearly directed Punjab Government to devise action plan to prevent agro-residue burning in at least one district in the state.

Rapid technical advancements has led to production of machines that harvest crop residue and convert it into bundles mechanically for transportation and sale to thermal power plants or to manure manufacturers, yet their high cost, even after subsidy, keeps it out of reach of small, marginal and medium farmers constituting around 95% of the cultivators in Punjab. To address this issue, utilization of waste for bio-power production was proposed. Presently, operational and

planned projects could cumulatively use only 0.94 MT of paddy straw out of 19-20 MT paddy straw generated annually in Punjab.

The Central Electricity Regulatory Commission (CERC), under the Ministry of Power, has notified favourable tariffs to biomass-based power plants. This opportunity can help Punjab simultaneously produce power and to effectively manage the waste.

Thus, we can conclude that various efforts are being undertaken for huge volumes of lignocellulosic waste produced in the state. However, lack of efficient utilization mechanism for the bye products , thus generated, is the major problem along with paucity of funds. The authors strongly feel that there is a good scope for further strengthening **waste to energy** production and applications in the state.

The authors have observed that there is many more different types of residues that can be used in bioenergy applications other than the agro-residues. Such residues are from vegetable, fruits, wasteland sectors. They can be used through gasification for decentralized power generation or even forwarded to biorefinery for **Fischer-Tropsch synthesis and the water-gas shift** reaction as they can convert the mixture of such wastes into transport fuel, such as CNG to diesel, methanol and aviation jet fuel. It can be also used for production of dimethyl ether that can replace

Conclusion

In conclusion, it can be said that there is a dire need to re-assess the potential biomass resources available in Punjab to not only to catalyse better utilization of biomass resources but also to overcome the challenges posed by mismanagement of such resources.

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