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Stubble Burning Problem in Punjab Region

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Abstract-Burning the leftover stubble from the harvest of grains like wheat and rice is known as stubble burning. One of the problems that contribute to environmental pollution and are becoming increasingly prevalent in the nation is the burning of stubble. Burning stubble releases particulate and gaseous pollutants into the atmosphere that have a detrimental impact on both human health and the environment. This is one of the main causes of air pollution worldwide. Even though it ranks third after industrial and vehicle emissions, it is still a substantial source of air pollution in many regions of the world. The major aim of this paper is to look deeply into the problem of stubble burning in Punjab, analyse the trend of stubble burning events in different cities of Punjab with the help of data taken from Punjab remote sensing centre and provide effective measures that can provide alternatives of stubble burning to farmers and will help to combat pollution generated due to stubble pollution. The duopoly of two crops (wheat and rice) in Punjab in a rotating pattern is a root cause of stubble burning. As most of farmers in Punjab region are dependent on agricultural practices so they find it less costly and easy to burn the stubble after cultivation rather than treating it in an effective way. An extensive awareness programme is the need of hour from government to enlighten the farmers on the environmental and economic benefits of using alternative approaches of stubble burning. The pollutants released from stubble burning pose a threat to health which can lead to death. Also, a stubble burning is also providing extra thrust to global warming and climate change. This paper will examine the air quality during stubble burning period with the help of Air quality Index. It will help to provide alternative approaches to stubble burning that are environment friendly that can help India to fulfil sustainable development goals adopted in 2015. There are many technological solutions of managing stubble generated from crops that will provide a greener environment and also help in generating higher yield like Happy seeder. The government should have to provide incentive to farmers so that they can shift towards these technological measures. Also, Punjab should have to take a break on this crop rotating of wheat and paddy and shift towards cultivation of other crops.

Keywords-Climate change stubble burning

I. INTRODUCTION

The rotational rice-wheat cropping method is widely used in the Indo-Gangetic Plain (IGP). The IGP is a significant area in South Asia that is blessed with fertile farmland and a varied ecosystem. Geographically, it takes up around 20% of the entire land area of Nepal, Bangladesh, Pakistan, and India. In India, it makes up roughly 40% of the total population and takes up about 20% of the country's total land area. 41% of India's yearly food production, primarily grains, comes from this region. About 12 million of the 66 million hectares of Indo-Gangetic Plains are used for the wheat-rice (Crop Rotation) farming system. The rice-wheat cropping method uses an estimated 9.6 million hectares of land each year in India [1].

In India specially in the state of Punjab and Haryana that leads to crop duopoly (wheat and rice) and exacerbate the practices of stubble burning. Farmer in Punjab are responsible for majority of cereals production in the country (mainly wheat and paddy). The time window between harvesting paddy crops and planting the wheat crop is just 15 to 20 days. Any disruptions in this time window will leads to crop failure. So, farmers directly burnt the paddy straw as it is less costly and less time consuming. Burning crop residues or stubbles is crime under "Section 188 of IPC" [2] and under the "Air Pollution control Act of 1981" [3].

A study estimates that stubble burning released 150 million tonnes of carbon dioxide (CO_2), 10 million tonnes of carbon monoxide (CO), 0.25 million tonnes oxides of sulphur,1.28 million tonnes of particulate matter,0.07 million tonnes of black carbon.[4] All these Greenhouse gases (GHGs) are directly contributed in environmental pollution, melting of glaciers and global warming. It is a significant source of gaseous pollutants such as, carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur oxides (SO_x), and methane (CH_4) as well as particulate matters causing serious damage to human health and the environment.

3.4 Mt of CO, 0.1 Mt of NO_x, 91 Mt of CO_2, 0.6 Mt of CH_4, and 1.2 Mt of PM (particulate matter) were reported to be released into the atmosphere by burning 63 Mt of crop stubble.[5] India's predicament is particularly dire because of the extensive rice-wheat rotation system that produces a lot of stubble. According to estimates, India produces 352 Mt of stubble annually, of which stubble from rice and wheat contributes 22 and 34%, respectively. Immediately following harvest, about 84 Mt (23.86%) of the stubble is burned on the field each year. Due to the fact that it occurs during the peak burning season (October to November), the terrible haze seen over India during the winter has been connected to stubble burning. During this time most of Indian cities, especially in north western and northern part of India experiences harsh pollution often reaching the severe levels of Air Quality Index (AQI).

II. METHODOLOGY

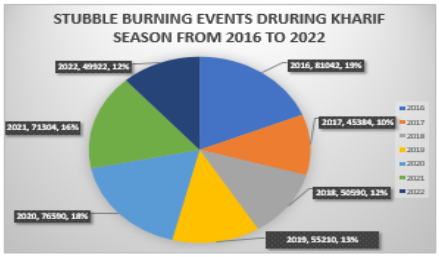
Punjab remote sensing centre has devised a "Crop Residue Burning (CRB) [6] Information and Management System" that provides stubble burning data yearly and district wise of Punjab. In this paper data has been used from Punjab remote sensing CRB system to analyse the extent of Stubble burning in Punjab region and analyse the trend of stubble burning from 2018 to 2022 in Punjab. Air quality index is used for reporting the air quality. The air quality of a region can be categorized in terms of a parameter termed as the air quality index or AQI, which is a range of categorical measurements of the pollution level which helps in interpreting the quality of air in a region on a scale of 0-500. It can be a useful to determine the quality of air around stubble burning areas and examine the harmful effects generated from the polluted air. In paper, Air quality index (AQI) data has been obtained from Punjab Pollution Control Board

III. DISCUSSION AND RESULTS

1. Extent of Stubble Burning in Punjab-
Stubble Burning Cases During Kharif Season

From figure 1 (a), we can see that there are thousands of cases of stubble burning every year during kharif season (September to November). The year 2016 has maximum number of fire events i.e.,

81,042 and the year 2022 has least number of fire events i.e., 49,922. The year 2020 and 2021 shows remarkable increase in fire events due to covid pandemic where it is difficult to manage the stubble efficiently. We can conclude that the efforts have been made to reduce stubble burning events year by year but still the numbers of cases are very large and more efforts has to be done to reduce these numbers.



(Figure 1: Stubble burning events during Kharif season from 2016 to 2022)

(* - The data used for graphs in this section has been obtained from Punjab remote sensing centre, CRB system, Ludhiana) [6] (Note: Here Kharif and Rabi Seasons are mentioned According to their harvesting timings i.e., Kharif season: September to November and Rabi season: April-May)

Trend of Stubble Burning of Last 5 Years During Kharif Season (September to November) District Wise-

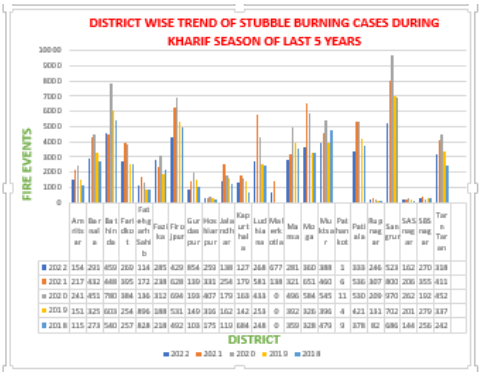


Fig 2: Fire events during Kharif season of last five years in various districts of Punjab

Figure 2 shows Sangrur has maximum number of stubble burning cases in last 5 years followed by Bhatinda, Firozpur and Moga districts whereas Pathankot district has least number of cases. Amritsar, Barnala, Faridkot, Fatehgarh Sahib, Kapurthala, Moga, TarnTaran districts shows slight increase in stubble burning cases from 2018 whereas Firozpur, Gurdaspur, Mansa, Muktsar, Patiala and Sangrur districts show negative trend in stubble burning cases.

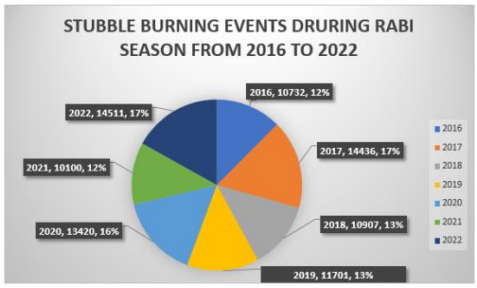


Figure 3: Stubble burning cases from 2016 to 2022 during harvesting of Rabi crops

Figure 3 shows that stubble burning cases has been increased from year 2016 during Rabi season. In 2022, there are 14511 cases of stubble burning as compared to 10732 in 2016 as decomposition of rice straw is more difficult than wheat straw so there are a smaller number of cases of stubble burning during harvest of rabi crops in April and May, as wheat straw can be easily managed.

Comparison of Stubble Burning Cases During Rabi Season (April-May) and Kharif Seasons (September-November)-

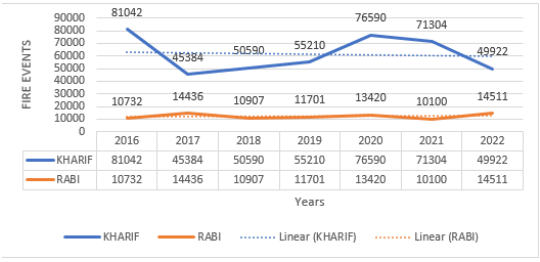


Fig 4: Stubble burning cases during harvesting of Kharif and Rabi crops from 2016 to 2022

As there is a small-time window between sowing of wheat after harvesting of rice so farmers used to burn the stubble of rice as it is difficult to decompose the stubble of rice. So, there is large gap between the number of stubbles burning cases during harvesting of kharif crops and rabi crops. The stubble burning cases during harvesting of rabi crops are just 13 % of that of cases during

harvesting of kharif crops. So, the air quality during winters season (October to December) is more severe than in summer (April-May) due to extensive burning of stubble of rice. From figure 4, we can say that there is slightly downward trend in stubble burning cases from 2016 to 2022, but it has to be more downward to tackle this problem which needs a proper scientific management plan. On the other there is a little upward trend in stubble burning cases during harvesting of rabi crops from 2016 to 2022 which shows that stubble burning cases during these months are unnoticed. Although these numbers are just 13% of kharif season but stubble during rabi season should also be managed efficiently.

Trend of Stubble Burning District Wise of Last 5 Years During Rabi Season (April-May)-

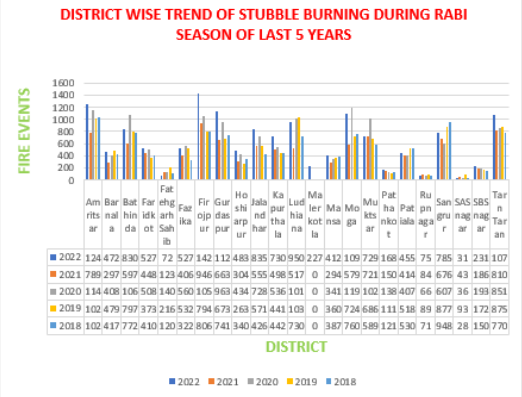


Figure 5: District wise trend of stubble burning of year 2022 during harvesting of rabi crops

From figure 5, we can conclude that stubble burning cases has been increased from 2018 during harvesting of rabi crops. Firozpur, Amritsar, Ludhiana, Moga districts has the greatest number of cases. In majority of districts the trend is upward which shows stubble burning cases have been increasing over the years. Only Fatehgarh sahib and Sangrur shows downward trend means these districts has a smaller number of cases in 2022 as compared to 2018.Pathankot, Fatehgarh sahib, Rupnagar, SAS Nagar districts has least number of stubbles burning events during harvesting of rabi crops.

Comparison of Stubble Burning Events During Rabi(April-May) and Kharif Season(September to November) in 2022 District Wise –

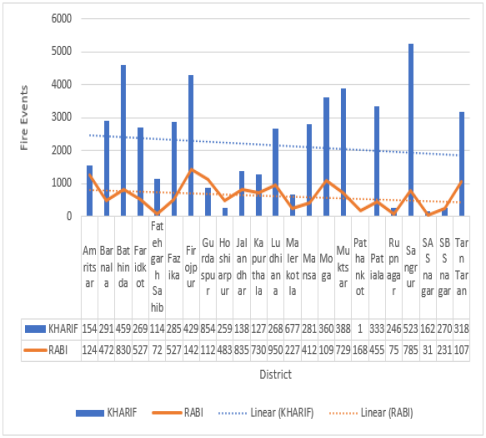


Figure 6: Comparison of fire events during Rabi and Kharif season in 2022 district wise

From figure 6 it is clear that stubble burning events during harvesting of kharif crops are much more than during harvesting of rabi crops in all the districts except Pathankot where there are 168 cases of stubble burning in rabi season in comparison to only 1 in kharif season and in Hoshiarpur too. 13 districts out of 23 have more than 1500 cases of stubble burning in the year 2022 during harvesting of kharif crops. Firozpur, Ludhiana, Moga, Sangrur, Tarn Taran has high peaks on both kharif season and rabi season which shows these districts should be strictly monitored and stubble managements plans should be strictly implemented in these districts.

2. Air Quality of Punjab During Stubble Burning Period*

Air Quality Parameters (PM10, PM2.5, SO2, CO, Nox) Concentration During Stubble Burning Period From 2018 to 2022-

(*-The data used for making graphs and tables in this section have been obtained from Punjab Pollution control board [7] and Centre pollution control board [8])

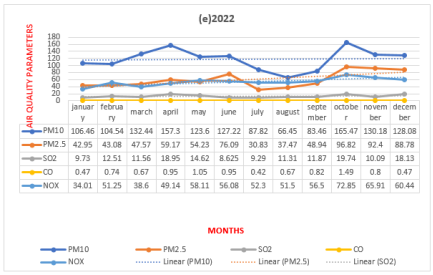


Fig 7: Monthly variation in pollutant concentration for Punjab of year (a)2018 (b)2019 (c)2020 (d)2021 (e)2022

(PM1o, PM2.5, SO2, NOX measured in µg/m3 and CO in mg/m3.)

(Data Source: Punjab pollution control board [7] for the year 2018,2019,2020,2021 and Centre pollution control board [8] for the year 2022. Station name: Golden temple, Amritsar -PPCB) From figure 7, it is clearly visible that the concentration of pollutants during stubble burning season is drastically increased in these years. The trendline of all the pollutants clearly shows that the concentration of pollutants is increase in the months of November and December.

Pm10 levels during April-May is above 100µg/m3 during harvesting of rabi crops and above 150 µg/m3 during October -November when rice stubble is burned which clearly shows the impact of stubble burning in increasing environment pollution. In all the graphs mentioned in figure 10 there is a peak of all the pollutants during October -November that shows how air quality gradually changes into poor quality.

Particularly in year 2022 of (e) graphs, we can see that the concentration of Pm10 during April-May is 157.3 µg/m3 and 123.6 µg/m3 respectively as compared to 106.46 µg/m3 and 104.54 µg/m3 during January-February. It shows the concentration of Pm10 in air is increased during harvest of rabi crops due to stubble burning. Similarly, PM2.5 is 59.17 µg/m3 and 54.23 µg/m3 which is higher than preceding months. Also, the concentration of SO2, Co, NO x is 18.95 µg/m3,0.95 mg/m3,49.14 µg/m3 in April 2022 and 14.62 µg/m3,1.05 mg/m3 and 58.11 µg/m3 in May 2023. So, the concentration of all the pollutants is higher than the preceding months in rabi season.

During harvesting of kharif crops (October - November) the concentration of Pm10 is rapidly increased to 165.47 µg/m3 and 130.18 µg/m3 as compared to 66.45 µg/m3 and 83.46 µg/m3 in August and September. Similarly, PM2.5 is 96.82µg/m3 and 92.04 µg/m3 which is double of preceding months. Also, the concentration of SO2, Co, NO x is 19.74 µg/m3,1.49 mg/m3,72.85 µg/m3 in October 2022 and 10.9 µg/m3,0.08 mg/m3 and 65.91 µg/m3 in November 2022.

Comparison of AQI of Punjab During Stubble Burning Season (April-May and October-November) and Monsoon Season (July -August)

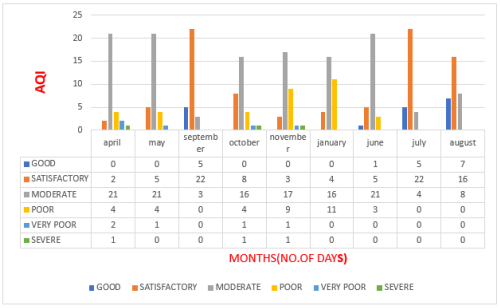


Figure 8 Comparison of AQI of Punjab during stubble burning season (April-May and October-November) and monsoon season (July -August)

From the figure 8, it is clearly seen that during monsoon season in Punjab the average AQI shows

satisfactory (51-100) whereas during stubble burning period average AQI is moderate (101-200). This shows stubble burning has negative impact on air quality. July, august and September has the greatest number of satisfactory air quality I.e., 22,16 and 22 days respectively. On the other hand, stubble burning months has satisfactory air quality less than 10 days throughout the month. Monsoon season has no poor, very poor and severe air quality days whereas stubble burning has nearly 1 or 2 days of very poor and severe air quality and nearly 4-9 days of poor air quality. Thus, we can say that Air is more polluted during stubble burning months as compare to other months.

3. Root Causes of Stubble or Residue Burning in Punjab Region

Lack of a Gap Between two Successive Crops

The time of sowing is the fundamental and most significant agronomic practise in agriculture. The second fortnight of May is the ideal time to plant paddy, and the second fortnight of June to the latest possible date in July is the time to transplant. The crop matures in November. Ironically, the first two weeks of November are the dates for seeding the following wheat crop, giving farmers no opportunity to handle their rice straw properly.

Lack of Understanding About Managing Stubble

Despite the fact that farmers believe burning is the simplest way to get rid of crop leftover, the Indian government is making an effort to reach out to them and educate them.

Mechanical Harvesters

Rice is the most significant grain crop and is grown in vast quantities, therefore using human labour for harvesting is expansive. As a result, mechanical harvesters were developed, with the combine harvester being a key component. Due to the fact that it is not intended to cut the plant to the soil's surface and assimilate it, a sizable amount of straw remains in the field itself.

Lack of Responsibility

Despite being aware of residue management and its effects on the environment, some people still urgently burn stubbles in the field, prompting politicians to establish new rules and legislation to stop these careless actions by a small number of farmers.

Lack of Labour and Avoiding Paying Labour Costs

As intensive agriculture has grown, a steady decline in the use of human labour over time and an increase in the use of mechanical power have been observed. As a result, Punjab's contribution of agricultural workers and other workers has fallen from 62.67 percent to 35.96 percent between 1970 and 2013. These days, labour wages have skyrocketed. Farmers just burn their residue to reduce these costs.[9]

4. Technologies and Management Practices Used to Reduce Stubble Burning

Effective Methods Although numerous strategies have been developed for managing rice stubbles, burning stubble is still the most effective option. Therefore, all of these methods must be applied at the same time, and new, creative methods are urgently needed to replace stubble-burning in an efficient manner.

1.Pusa Decomposer

The Division of Microbiology at ICAR-IARI, New Delhi, has created an efficient microbial remedy for accelerating the decomposition of paddy straw called Pusa Decomposer. The PUSA decomposers come in the form of capsules that are created by extracting fungal strains that aid in the paddy straw's unusually quick decomposition. The fungus contributes to the production of the vital enzymes needed for the breakdown process. To ensure quick bio-decomposition of agricultural stubble, it entails creating a liquid formulation utilising decomposer capsule and fermenting it over the course of 8–10 days.[10] The liquid formulation is then sprayed on fields with crop stubble. The farmers can blend 4 pills, jaggery, and chickpea flour to create a 25-litre liquid mixture.[11] One hectare of land can be covered using the combination.

Figure 9 :Pusa decomposer capsule

Benefits

- The decomposer increases the soil's fertility and productivity since the stubble acts as compost and manure for crops, reducing the need for future fertiliser applications.
- In addition to harming the environment, burning stubble causes the soil to lose its richness and eliminates the beneficial bacteria and fungus that exist there.
- It is a realistic method to stop stubble burning that is also effective, affordable, practicable, and practical.
- It is a green technology that benefits the environment.

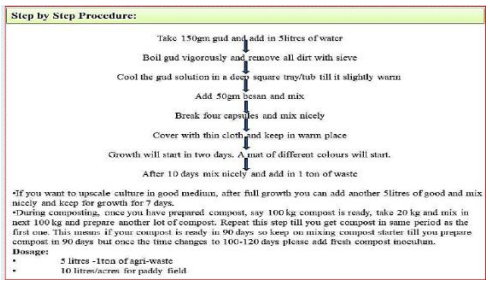


Figure 10: Indian Agriculture Research Institute

Issues

- Under usual circumstances, shredded and watered paddy straw, which is mixed with soil, takes at least 45 days to decompose.
- It does not give enough time for farmers to prepare fields for the wheat crop on time.

In Punjab alone, ICAR-IARI in collaboration with company are getting ready to spray >6000 acres with Pusa Decomposer in 2021, and 25,000 farmers have been chosen to take part. Ten Companies have been granted licences to use the technology, and all of them are eager to assist farmers in reducing straw burning by mass producing and disseminating the Pusa Decomposer product. By using it, the soil is enriched with organic carbon (OC), nutrients, and its biological and physical qualities are also enhanced. In contrast, burning paddy straw destroys healthy microorganisms and also pollutes the air. In light of this, using machinery in conjunction with the Pusa Decomposer is a long-term, sustainable approach for managing paddy straw.

2. Happy Seeder and Super Seeder

A Happy Seeder is a no-till planter that is pulled by a tractor and sows (plants) seeds straight in rows without first preparing the seedbed. Super seeder is upgraded version of happy seeder. It has a three-point linkage connection and is driven by the tractor's PTO (Power-take off). It has a straw-managing cutter and a zero-till drill that enable new crops to be sown in the leftovers of previous crops. The straw management rotor is equipped with straight blades of the flail type that are used to chop the stubbles that come into touch with the sowing tine. It spreads mulch made of the leftovers from the previous crop over the field that was sowed. Happy seeder and Super Seeder are a proposed solution for stubble management after harvesting of the paddy crops.[12]


Figure 11: Happy Seeder


Figure 12: Super Seeder

Benefits

- Increases soil filtration and reduces evaporation, which protect soil moisture.
- It improves the soil's microclimate by controlling its temperature and helping to prevent heat and radiation extremes.
- It defends the structure of the soil.
- It doesn't stop the natural drainage systems.
- Minimise soil erosion.

Issues

- Even though the government offers subsidies ranging from 50% to 80%, many farmers are hesitant to utilise happy seeder.
- Some farmers claim that happy seeder is ineffective at managing stubbles and leave behind a lot of debris that is not ploughed back into the field. resulting in a difficulty with germination and seeding for the wheat crop.
- When harvesting paddy, a SUPER SMS (Super Straw Management System), which chops and spreads the residue evenly on the field, is required for the happy seeder to perform its job well that increases further cost.

3. Other Management Practices for Stubble Burning

Use of Rice Residues as Animal Feed

Rice leftovers can be fed to animals as food. Due to the high silica concentration of the rice residue, this procedure is not particularly common among Punjabi farmers. However, about 40% of the wheat straw made in this state is used as dry hay for livestock. However, the Punjab State Council for Science & Technology PSCST at PAU (Punjab Agricultural University), Ludhiana, has started a pilot project to promote the use of rice residue as animal feed. PAU conducted tests on the spontaneous fermentation of paddy straw for use as protein-enriched livestock feed. The health and milk output of the cattle fed with this diet improved.

Rice residue for Electricity Generation

The first plant in India to use biomass, a renewable energy source, as a fuel is the thermal plant at Jalkheri, District Fatehgarh Sahib. For the purpose of producing energy, this plant can use rice husk, used wood chips, and the straw from a variety of plants, including paddy, wheat, and others. The project reduces the release of smoke and other pollutants brought on by garbage burning while also giving thousands of farmers additional revenue from the sale of agricultural waste.

Rice Residues for Mushroom Cultivation

Paddy straw is also being used for the cultivation of mushrooms such as Agaricus bisporus, Volvariella volvacea, and Pleurotus spp. One kg of paddy straw yields 300, 120–150 and 600 g of these mushrooms, respectively.

Utilization of Rice Residue as a Cow Bedding Material

Farmers in the state have been advised to use paddy straw as bedding material for crossbred cows during the winter. Studies on the use of rice residue as bedding material have been conducted by the Department of Livestock Production and Management, Guru AngadDev Veterinary and Animal Sciences University. The animals' comfort, udder health, and leg health are all improved by the paddy straw bedding, which also leads to an improvement in milk quality and production. It enables animals to maintain appropriate rates of body heat loss while still keeping them warm. Additionally, it offers a safe, sanitary, dry, pleasant, and non-slip environment, reducing the risk of accidents.

Rice Residues Can be Utilisedto Produce Biogas and Bio-Oil

Biogas is produced from agricultural waste. The primary source of lignocellulose, which is necessary for the creation of biogas, is agricultural crop leftovers, such as rice straw. Rice straw can also be used for making bio-oil. A high-density liquid called bio-oil is made from agricultural biomass using a process called fast pyrolysis. Similar to petroleum-based products, bio-oil may be stored, pumped, and transported. It can also be burned directly for heat and power purposes in boilers, gas turbines, and slow and medium speed diesel engines.

Bio-Char

The PAU in Ludhiana has developed a new method for turning stubble into "biochar," which will

significantly reduce environmental pollution and improve soil fertility.

According to Dr. RK Gupta, a senior soil chemist in the PAU Department of Soil Sciences, burning rice and wheat stubble results in nutrient loss and air pollution due to smoke.

"For the past three years, we have been working on this project, and the experiments we have run have been successful. "We discovered that turning stubble into "biochar" rather than burning it can assist to reduce environmental pollution by 70%", "Dr. Gupta added. "After three years of fruitful experimentation, we will urge the PAU's KVK to produce biochar and inform farmers about it," they said.[14]

IV. CONCLUSION

Duopoly of two crops (Wheat and Rice) in Punjab after the Green Revolution and a very short time window of 15-20 days between harvesting of paddy and sowing of wheat resulted in the generation of significant quantity of stubbles in Punjab. It may be concluded from this report that although stubble burning cases has been reduced from 2016 levels in 2022 during harvesting of kharif crops but still the number of stubble burning cases are very high touching nearly 50,000 in 2022.On the other hand stubble burning cases have been increased during harvesting of rabi crops from 2016 levels. Although stubble burning happens majorly in the month of October and November but management practices should be used also during harvesting of rabi crops in the month of April and May. There are 8 times more stubble burning cases in November and October month of year in comparison to April and May month.

According to the data presented in this research on the AQI and Concentration of several air quality indices for the years 2018 to 2022, stubble burning is a significant factor in Punjab's poor air quality, particularly during the burning of rice stubbles in the months of October and November.

The pollutants from a stubble burning pose a grave risk to agriculture productivity including injury to leaves, damage to grains, acid rain, chlorosis or bifacial chlorosis, proliferation of the insect aphids etc. has a detrimental influence on agriculture productivity and must be properly addressed. These pollutants from stubble burning increases emission of GHGs, PM, VOCs, NOx, CO, SO2 that adversely affected the environment and contributes towards global warming which results in environment pollution and lose of biodiversity. Therefore, comprehensive policies must be put in place immediately to stop this problem at its source.

Technology like the Pusa decomposer has the potential to lessen this problem, but because there is only a small window of time about 15-20 days between rice harvest and crop sowing, it is not particularly efficient at managing stubble because it takes more than 25 days for agricultural waste to decompose. On the other hand, Happy seeder and Super seeder are quite good in managing stubbles, but most farmers are hesitant to employ them due to their expensive cost. So, government has to provide high incentives to farmers e for efficient management of stubbles.

Instead of being burned, these stubbles can be used to boost farmers' income. These can be utilised for the production of biofuel and biooil, bio compost, charcoal, electricity, cow bedding, animal feed, and the growth of mushrooms. The majority of Punjabi farmers don't know about these abundant options; thus, they view burning as their best option. Therefore, there is a need for awareness campaigns to inform farmers about the range of economically viable options and the overall effects of burning stubble.

The activity of stubble burning is still carried out in many districts of Punjab despite the numerous schemes, such as stubble burry, CRM and strict policies put in place by the central government and Punjab government. Patriotic compliance with these policies requires effective follow-up with timely and continuous monitoring at all locations to reduce the problem of stubble burning in Punjab region.

V. RECOMMENDATIONS

A well-planned strategy was required to address the issue of stubble burning. Although there are strict laws and penalties in place by the government to address this issue, this practise is still occurring in Punjab, Haryana, and Uttar Pradesh In addition, the government must launch a comprehensive awareness campaign to earn the support of farmers. Government incentives to farmers could aid in reducing the issue of stubble burning.

It is important to regularly monitor the burning of stubble and the contaminants that are generated when stubbles are burned. To combat pollution from burning of stubble, numerous institutions must work together. The national leaders and decision makers should do effective communication with various stakeholders to implement a national plan for curbing this problem. The pollutants produced by burning stubble have various characteristics. Utilizing contemporary methods, effective periodic monitoring of contaminants emitted by stubble burning is necessary. Government agencies should use effective enforcement and follow-up to guarantee intended compliance.

Stubbles can be used as a fraction of the raw material in many different industries like biomass, powerplants, paper and pulp etc... The government must compel these industries so that farmers can sell their crop residue there and make more revenue. Since most stations are located in metropolitan areas, it is necessary to expand the National Air Monitoring Programme (NAMP) in order to assess where stubble burning occurs in most rural areas. Every citizen has to show patriotic compliance with the policies made by government and has to come together for successful execution of programs to reduce this stubble burning menace in future.

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