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Assessment of Bio Farming with Stuble management

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ABSTRACT
The objective of Innovative Bio-Farming, Stubble management and assessment (IbSAs) is to assess impact on different parameter of soil in planting paddy seeds ploughing and non-ploughing with stubble management. The data can be analyzed by using different methods like tabular, chi-square and logit analysis. The planting paddy seeds without ploughing cost effective method which provides farmers to get more crops yields cost effectively. The Stubble management can restore the nutrients of the soil, carbon levels of the soil. It also increases productivity and reduces pollution.

***Keywords* -** Bio- farming, stubble, soil, crop, IOT, yield.

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I. INTRODUCTION

The purpose of Green Revolution aimed for strengthening food grain production in India. By adopting modern farming methods such as high-yielding variety seeds (HYV), fertilizers, pesticides, harvesters and irrigation facilities adopted by farmers. Larger areas of modern agriculture practices results in an increase in agricultural productivity and economic development in the followed decades. With these methods, farmers can harvest large hectares of land in the short period of time. But stubble management is one of the challenges for the farmer. Normally farmers burn the stubble in order to maintain it. Most dangerous consequences of stubble burning is soil infertility, pollution, thermal stability and carbon losses. The most outcome of this is proper stubble management.

Stubble burning pollutes the air with harmful gases like carbon dioxide (CO), carbon monoxide (CO), nitrogen oxides (NO), sulfur oxides (SO), volatile organic compounds (VOC) and methane (CH) but also increases the presence of particulate matters (PM and PM) in air. In addition to the existing industrial and vehicular emissions, anywhere between 20% and 70% of Delhi's haze and air pollution arise due to stubble burning in neighboring states during October and November every year. Scientists observed increase in pollution results melting of Himalayan glaciers.

Stubble burning strips away the essential Nitrogen, Phosphorus, and Potassium (NPK) nutrients and other micronutrients, which affects the soil's organic quality and long-term productivity. Besides that, it reduces the solubility capacity of its upper layers. The process of burning leaves behind ashes which deteriorate its nutrient value and dries it as well. Burning a tremendous amount of stubble at a time results in accelerating heat penetration into the soil, and elevating the soil temperature to about 42 °C. Also, it leads to the loss of thermal instability and moisture. So it results difficult for the succeeding crops to grow. It also damage soil microorganisms present at a depth of 2.5 cm, which are critical for soil fertility. Stubble burning releases approximate 80% of the carbon component as atmospheric carbon dioxide. Although this carbon release is often only slightly more when compared to the residue's natural decomposition, but it is immediate.

For stubble burning, several countries have placed regulations. This practice prohibited in United Kingdom and China. As a part of the Common Agricultural Policy, European Union discourages it. This practice regulated in some north western states in the United States. Australia like country farmers prefer to do stubble burning, it is permitted and recommended for certain circumstances. Despite raising several environmental concerns in the northern Indo-Gangetic Plains of India and state governments placing a ban on it, still stubble burning is practiced at the end of in Kharif and Rabi seasons for different reasons. All the time, climate conditions not favour to farmers in tropical countries like India. During winter, to grow crop farmers get very short intervals to complete the whole process. Sometimes, unforeseen weather conditions, sowing process hampered by rain or extreme cold.

Some crops tends to reduce the fertility of the land. So, it becomes necessary to take the residue out of the soil. Therefore, techniques like stubble burning are practical approach to eliminate the previous crop residue faster and reduce the nitrogen tie-up.

The COVID-19 pandemic has threatened the whole world economically, socially and most importantly health-wise. Because of pollution respiratory conditions are one of the comorbidities that result in COVID-19-related mortality. Deteriorating the air quality can make the COVID-19 pandemic deadlier for those areas affected by stubble burning.

However, there is need of bio farming with stubble management and impact assessment for education to farmers.

I. Bio- Farming with Stubble Management

Pollution and other health hazards prevented by using few alternative practices of stubble burning. But these alternatives are not yet prevalent. The readily available equipment's required for these practices are not available. These methods used twice in a year or 15 days and all other period in the year not useful. It can be completed by hiring private hiring centers which also reluctant to purchase the machinery.

II. In-situ Treatment of Stubble

It is one of the suitable ecosystem conservation techniques. It gets rid of the crop residues by taking care of soil intact nutrients.

III. Happy Seeder

For the in-situ paddy stubble management, it is a tractor-mounted no-till planter. Without preparation of seedbed, rice straw can cut and lifted and directly sow wheat into the soil. Then it deposits much straw residue over the cultivated with earth's needed organic value. The manual process cost is time consuming. Time of same process reduced using machine.

IV. Pusa Bio-Decomposer

Pusa bio-composer is a low-cost microbial bio-enzyme solution for converting crop residue into manure. It takes 15 to 20 days. Within two days after applying the solution, farmers water the fields which will trigger to accelerate residue decomposition. Use of ICU diary should fill it by family, staff.

V. Managing Crop Residues In-Situare Using Agricultural Machine

Rotavator is used for preparation of land which incorporates crop residue in the soil. For land preparation, Zero-till seed drilled and sowing seeds directly in the previous crop's stubble. Baler collects and compress residue into compact bales. Paddy stubble cut by Paddy straw chopper-cum-spreader which spread around the field. Reaper binder harvests paddy stubble and make into bundles.

VI. Ex-situ Management of Crop Residues

Off-site or Ex-situ conservation and treatment of crop residue is effective. It eliminates the leftover crops from the land from its natural habitat. This process is much more eco-friendly compare to stubble burning.

VII. Cost of Return

Cost and Returns of paddy cultivation among adopters and non-adopters of paddy stubble management technology (Rs per Acre) is described in fig 1 to fig 4 . The increase in pollution is high for non-adaptor case of paddy stubble management technology. Cost of paddy cultivation among adopters and non-adopters is given below fig 1 for Seed, Cost of preparatory tillage, Plant protection chemical, Transplanting Cost, Urea, DAP (kg), MOP (kg), Micro-Nutrient(kg), Casual labour payment(hours), Harvesting cost, Transportation cost.

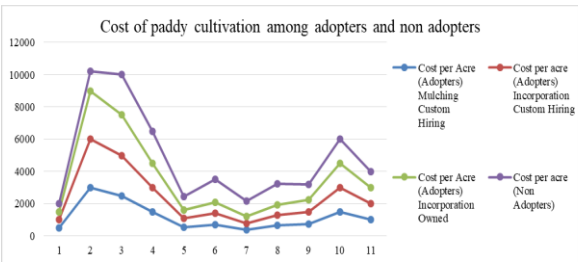

Fig. 1. Cost of paddy cultivation among adopters and non adopters

Total Variable Cost and return over variable cost of paddy cultivation among adopters and non-adopters is given in below fig 2 where 1 referred for Total Variable Cost and 2 referred for return over variable cost.

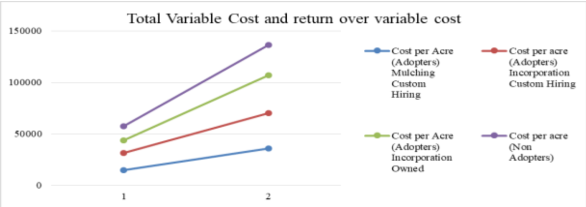

Fig. 2. Total variable cost and return over variable cost of paddy cultivation among adopters and non adopters

Total Cost of stubble management is given in below fig 3 for stubble management adaptor and non-adaptor.

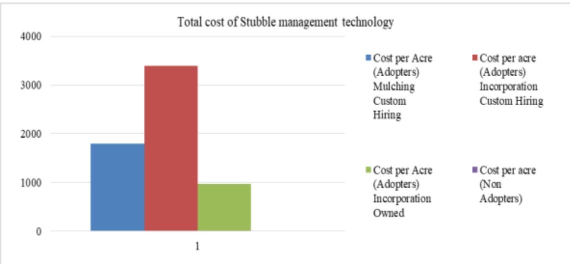

Fig. 3. Total variable cost and return over variable cost of paddy cultivation among adopters and non adopters

Total Cost of stubble management is given in below fig 4 for stubble management adaptor and non adaptor.

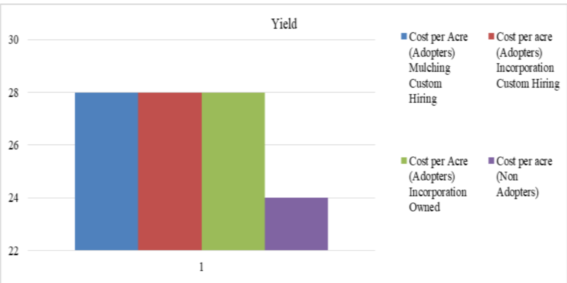

Fig. 4. Total variable cost and return over variable cost of paddy cultivation among adopters and non adopters.

VIII. ADVANTAGES

The advantage with Bio farming with Stubble management is explained below.

1.1 Converting straw to biochar

In the absence of oxygen, Biochar is charcoal generated by the pyrolysis of biomass. It is a green and renewable source of carbon. It includes agricultural and forestry wastes organic material. Energy releases by producing biochar from biomass with almost no sulfur and insignificant amounts of nitrogen. Crop residues are abundantly available which contain high carbon content. Hence, using them to produce biochar helps sequester vast amounts of carbon in a stable form every year. Biochar improves soil quality.

1.2 Alternate use for paddy stubble

Other innovative and commercial applications for crop residue is making paper and packing materials. It can be treated as an alternate fuel source for generating energy in cement, sugar or oil factories. It also can convert it to a pulp for sustainable tableware manufacturing.

1.3 2G Ethanol from agro-waste

There is continuous increasing demand for renewable fuels for replacing fossil-based fuel. Notably, grain crops store only half of the energy capture in the harvestable grain. The significant potential is to extract energy from the crop residues. The objectives of prevention of stubble burning and fossil fuels replacement with a cleaner, renewable alternative achieved by manufacturing second-generation (2G) bio-ethanol from lignocellulosic biomass.

1.4 Changing crop pattern

Changing the crop cultivation pattern is the effective alternative. Excellent substitutes for paddy, wheat are non-water-intensive Vegetables, Fruits, or other low-residue crops. Also genetically modified crop varieties are beneficial to farmers. Shorter-duration paddy varieties such as Pusa PR-126 and Basmati-1509, have approximate 120–125 days seed-to-seed maturity.

IX. ASSESSMENT OF IMPACT ON ENVIRONMENT

Impact of bio faming with stubble management accessed on environment is accessed using IoT system. IoT based stubble monitoring applications provides a large-scale solution to monitor wheat, rice and other growing areas on map and analyse stubble burning patterns in whole region. Also assessment in terms of pollution, productivity and soil parameters can be monitored. IbSAs is pursuing extensive research to employ IOT based solutions for risk mitigation associated with crop residue burning and generate statistics for government bodies. This initiative also benefits the crop stubble mobilization process and reduces the risk of environmental damage. IbSAs has real time satellite imaginary geospatial framework and various remote sensing indices generated for analysing environmental impact of crop residue (stubble) burning. AI-ML model based system help analyze the Rice, Wheat and other crop system which helps farmers. It also to monitors the crop residue burning activity carries in fields. Crop sowing patterns and crop stages of the villages can able to monitor using this system.

Active fire mapping complemented by various other remote sensing indices, such as the burning area index (BAI) and Normalized burning ratio (NBR), provided by the VIIRS (Visible Infrared Imaging Radiometer Suite) data tool from NASA which derived from thermal and shortwave infrared bands. It analyses both current and historical identification of stubble burning. The historical information, when integrated with sowing patterns, crop stages, and weather seasonality parameters takes a tailored precision farming approach to contribute to designing the likelihood model that forecasts the stubble-burning areas. IbSAs monitors poisonous gases and particles, carbon monoxide, nitrogen dioxide, and particulate matter in the atmosphere and calculated a pollution index for the region.

IbSAs platform monitors IOT data and analyses statistics at different levels of administrative boundaries to enable intelligent, data-driven decision-making. It would be empower the concerned entities to undertake sustainable mitigation measures while supporting farmers to boost their revenue and preserve their agricultural productivity and land fertility, too.

Likewise, enterprises procuring crop stubble for other uses, as mentioned above, can use IbSAs platform to monitor crop stage and connect with farmers directly during the harvest period.

Normalized Difference Vegetation Index (NDVI), Perception, PM10, Carbon monoxide, Nitrogen dioxide, Soil Moisture can be monitored on dashboard.

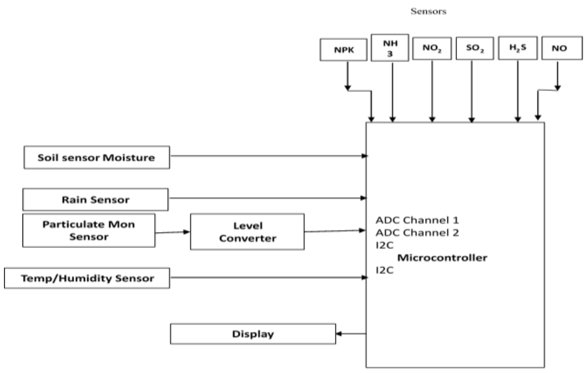

Fig. 5. Block diagram for monitoring the soil conditions

The microcontroller is interfaced with different sensors for monitoring the soil parameters such as NPK, NH3, NO2, SO2, H2S and NO. Atmospheric conditions are monitored by using sensors like moisture, rain fall, temperature, and humidity. The microcontroller read data from the different sensors and display the values on the LCD display in regular intervals of time. Based on the display parameters on the display farmer can understand the soil and atmospheric conditions to decide which crop are better for the farming. Following figure 6 shows soil content monitoring and reporting dashboard which is helpful for farmers.

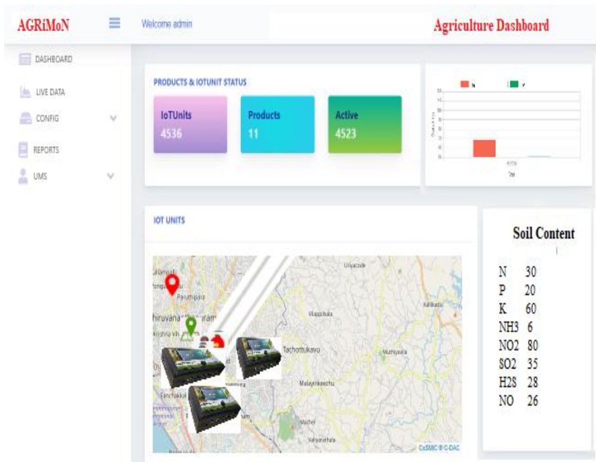

Fig. 5. Soil moniting dashboard

X. CONCLUSION

Bio farming based on stubble management increases productivity, reduce pollution. Also, IOT based assessment gives impact on production and assessment. Stubble management promotes recycling of nutrition which can be sensed using sensor. It results soil organic carbon and microbial biomass improvement.

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