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VRIDDHI from Stubble Management: Waste to Wealth Approach for Sustainable Livelihoods and Empowerment

Published: March 2022

Developed and Designed by Indev Consultancy

https://voisplanet.com

VRIDDHI from Stubble Management: Waste to Wealth Approach for Sustainable Livelihoods and Empowerment

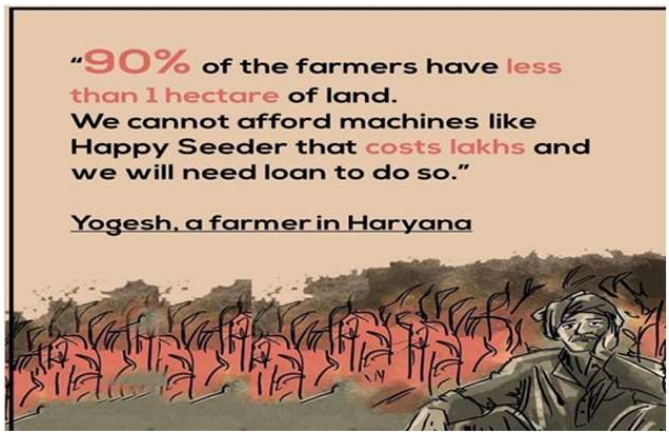
_VO**IS Planet** portal primarily focuses on environmental sustainability covering various aspects: **Low carbon, Renewable energy usage** and **E-waste management.**

It is aimed at aggregating and helping co-create knowledge and information on environmentally responsive behaviours and concurrently pursuing result-oriented social media campaigns to encourage people and specifically the youth, to take proactive actions in promoting sustainable lifestyle and creating a positive impact on the environmental ecosystem in their surroundings

By: _VO**IS Planet**

Executive Summary

In Punjab and Haryana, it is common to burn crop residue1. Stubble emits aerosol particles (coarse particles {PM10}, fine particles {PM2.5} and GHGs. The results are quite evident- aggravated air quality in Delhi and the National Capital Region (NCR) which constitutes a critical environmental challenge (1). Millions of people residing along the Indo-Gangetic plains suffer the burden of stubble burning that has been going on for decades now, which also jeopardizes their health in multiple manners(2). According to a released report by The United Nations in February 2022, globally, pollution caused more deaths than COVID-19. The report mentioned that approximately 9 million premature deaths occurred due to pollution and environmental toxins, which was twice the number of deaths in the first 18 months due to the pandemic. The annual estimate of premature deaths due to pollution, particularly air pollution, was around 7 million (3).The System of Air Quality and Weather Forecasting and Research (SAFAR) under the Ministry of Earth Sciences (MoES) estimated that paddy stubble burning in Punjab and Haryana contributed 40–45 per cent to Delhi's air pollution during peak burning days in 2019 (4).



To address this issue, many initiatives have been taken by the government as well as the private and public sectors and resource conservation technologies such as Happy Seeder and the Super Straw Management System for direct incorporation of seeds are being promoted and made well aware of(1). However, stubble burning still continues in states of Punjab and Haryana. The reason briefly highlights inadequacy of cost-effective alternatives to deal with the issue of this crop residue burning. India has about 82 percent of small and marginal farmers who, due to the lack of resources cannot afford existing Happy Seeder Machinery for stubble disposal.

One such initiative to combat the above problems is PROJECT VRIDDHI. Project Vriddhi prevents crop residue burning, which causes 46% of the pollution in Delhi, India. This climate emergency is tackled using creative solutions by using stubble for: - Mushroom Cultivation (Tabdeel), Handicrafts (Shilpkari), Toilet Establishment (Nirmaan), Biogas (reStove). Project Vriddhi in all its four verticals aims to achieve one primary goal of preventing air pollution

1 We have used stubble burning and crop residue burning synonymously.

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Introduction

Stubble or parali burning is the standard practice of setting the crop residues on fire to remove them from the field for sowing the next crop. In India, it usually begins around the last week of September and peaks in November (post kharif season), coinciding with the withdrawal of southwest monsoon, which aids the spread of smoke to farther lands. Stubble burning is mainly practiced by farmers in the Indo- Gangetic plains of Punjab, Haryana and Uttar Pradesh and is one of the major causes of deteriorating air quality in North India.

Despite being categorized as an offence under the IPC under Section 188 and the Air (Prevention and Control of Pollution) Act, 1981, stubble burning is practiced vastly across the aforementioned states (6).According to a study titled 'Fields on fire: Alternatives to crop residue burning in India,' farmers in northwest India burn around 23 million tonnes of rice straw to clear their field for the sowing of wheat, every year.

Contributing factors to stubble burning

States in the northern parts of India, particularly Punjab, Haryana and Uttar Pradesh are the major contributors to stubble burning, owing to their largest share amongst the crop producers during the kharif season.

States	Rice straw output (Mt)	Rice straw burned (%)
Punjab	18.74	69.49
Haryana	6.8	18.28
U.P	0.67	47.61
Total	26.21	--------

(Source: PIB Government of India Ministry of Environment, Forest and Climate Change and the Tribune, October 2021)

Due to the climate change over the decades, leading to shortening of winters, the time gap between harvesting of paddy and sowing of wheat has reduced, and the farmers owing to lack of time, find it difficult to let the stubble decompose in the soil naturally as delay in sowing of crops leads to considerable losses (7).

[12]Parali is the leftover or remaining part of the crop after harvesting

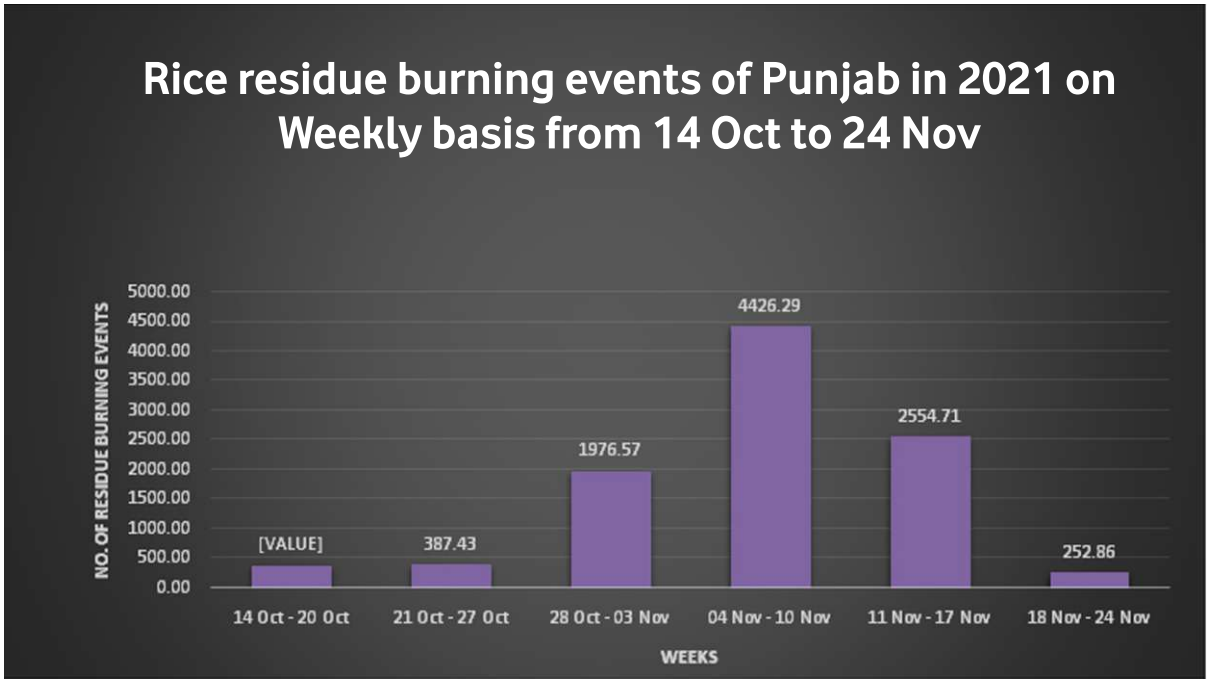
Stubble burning (Source: PIB)

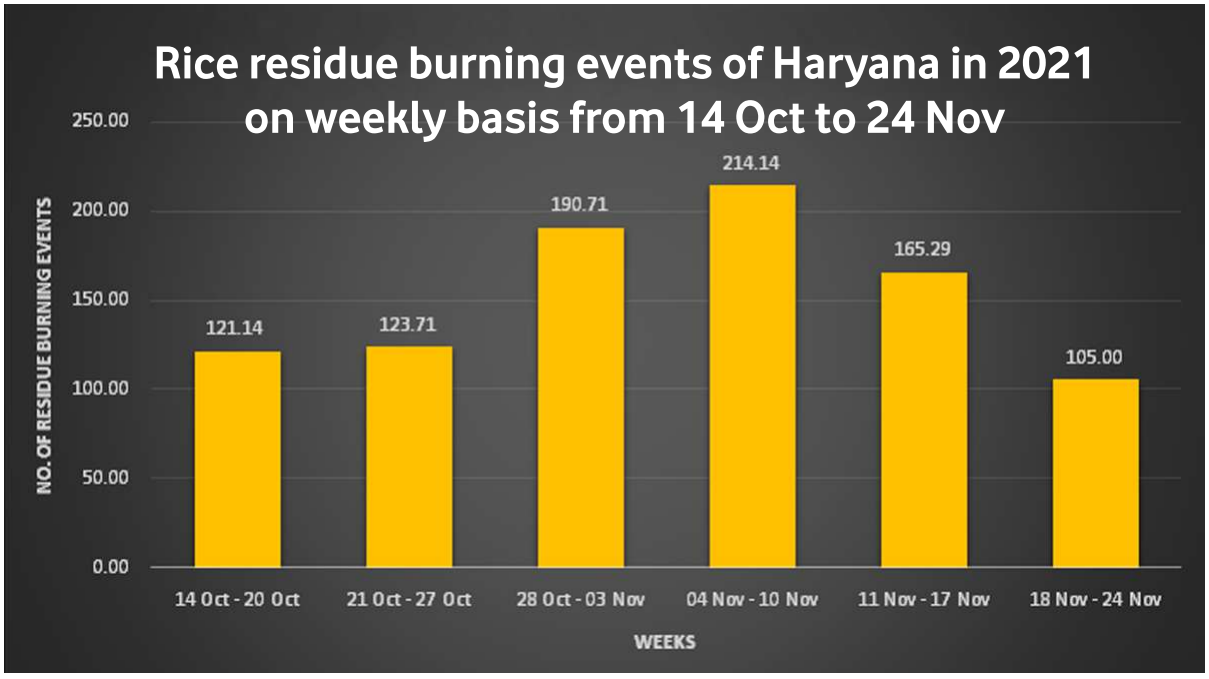
Mechanization in agriculture has also contributed to large scale stubble burning undertaken by the farmers. Mechanized harvesting using combined harvesters extracts only the rice grains leaving behind 6-10 cm paddy stalks in the fields, which generates around 9 tonnes/ ha of crop residue. The practices of using stubble as hay to keep animals, or homes warm, or for cooking have now become outdated. Moreover, the rice straw cannot be used as fodder for animals because it has high silica content. Also, the stubble left in the field is prone to pest attack which may also harm the next crop sown. According to farmers, stubble burning destroys the harmful pests and weeds; moreover, the ash that is left behind is rich in potassium which reduces the acidity of the soil. Burning will save the costs incurred on insecticides thus lowering the total cost of production (7).

Agriculture is a labor intensive sector. Burning parali is not only quick and time saving, but it is also cheap as it saves the labor cost. Due to schemes such as MNREGS, daily wage workers/laborers are getting employment in their own state with better wages. Hence, there is shortage of labor in Punjab. The average percentage of agricultural workers reduced from 62.67% to 35.96% in the year 2018–19 (7).

Small and marginal farmers cannot afford expensive mechanized implements like the rotavator or tractor mounted happy seeders, also they cannot afford new technology and scientific ways of stubble management. Also, Burning stubble in the field reduces the fuel cost of a tractor.

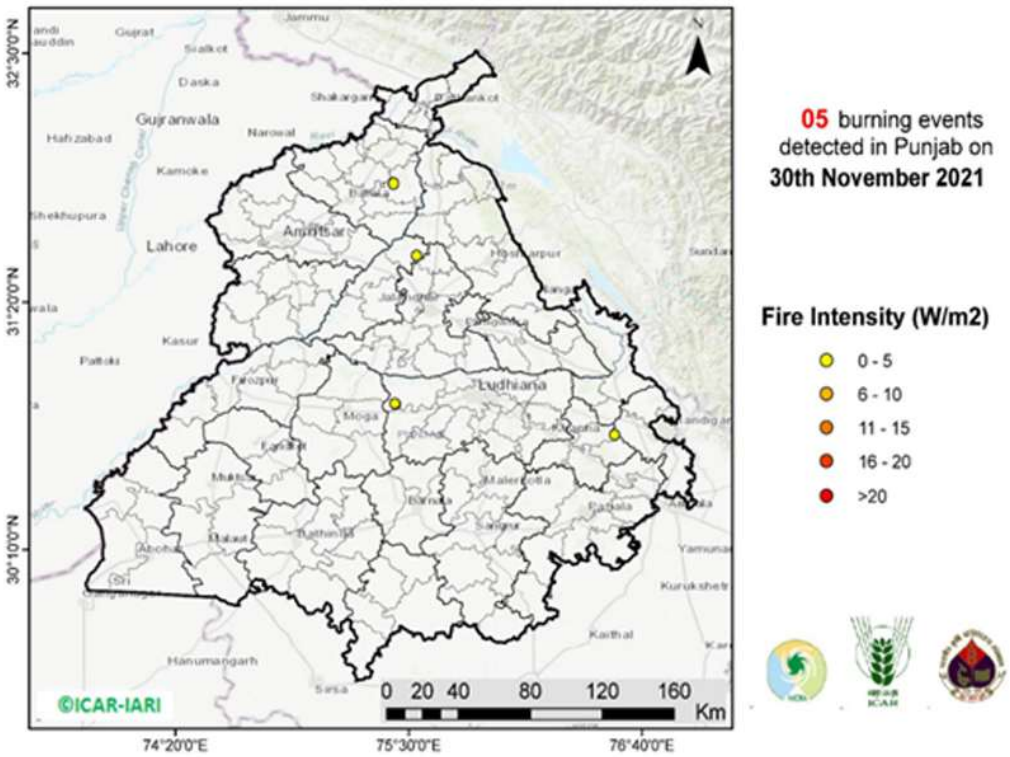
The Punjab Preservation of Subsoil Water Act (2009), has made it mandatory for the farmers to transplant paddy late during the Kharif season to prevent water loss, reducing the time between harvesting paddy and preparing the field for sowing Rabi crop- thus resorting to stubble burning. This has made the time period of stubble burning concurrent with the onset of winters (7).





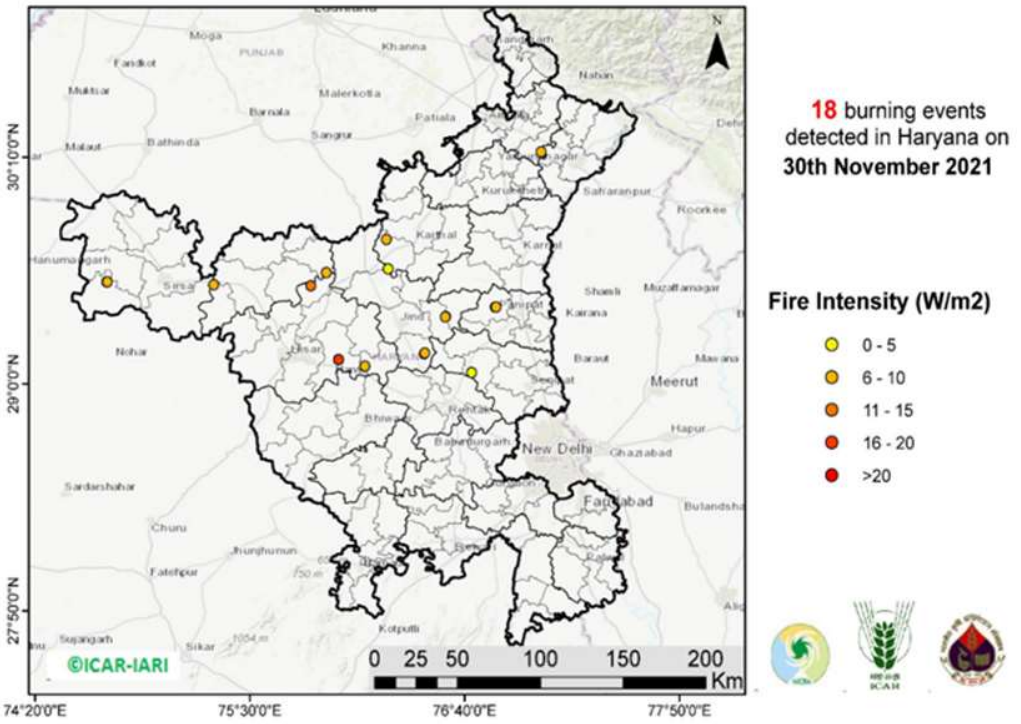
(Source: CREAMS.IARI)

RICE RESIDUE BURNING IN PUNJAB



http://geoportal.icar.gov.in:8080/geoexplorer/composer/

RICE RESIDUE BURNING IN HARYANA



The IARI (2021) report showed that out of 23 districts in Punjab, Sangrur, Firozpur and Moga stood among the major districts in stubble burning. On the other hand, out of 22 districts in Haryana, Fatheabad, Kaithal and Karnal were reported to burn the stubble in major amounts (8).

District-wise cumulative number of residues burning events detected in 2020 and 2021
(Period: 15 September – 30 November)

District-wise cumulative number of residues burning events detected in 2020 and 2021 (Period: 15 September–30 November)

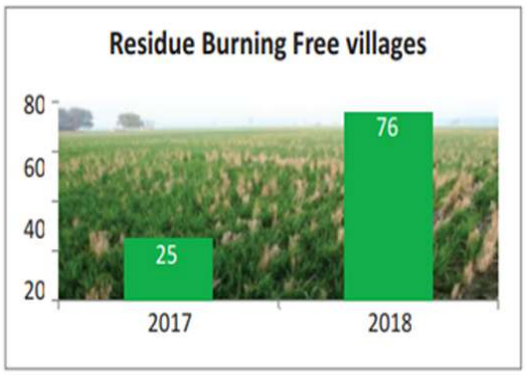
a. **Punjab**

District	15 Sep - 30 Nov	
	2020	2021
Amritsar	3067	2174
Barnala	5342	4326
Bathida	5239	4481
Faridkot	4734	3953
Fatehgarh Sahib	1536	1724
Fazilka	2616	2389
Firozpur	8525	6289
Gurdaspur	2132	1396
Hoshiarpur	388	331
Jalandhar	1951	2548
Kapurthala	1886	1798
Ludhiana	5065	5817
Mansa	3786	3217
Monga	7421	6515
Muktsar	5072	4598
Pathankot	13	6
Patiala	6433	5426
Rupnagar	205	307
Sangrur	11727	9389
Sas Nagar (Mohali)	127	148
SBS Nagar	132	355
Tarn Taran	5605	4117
Total	**83002**	**71304**

b. **Haryana**

District	15 Sep - 30 Nov	
	2020	2021
Ambala	346	308
Bhivani	5	12
Charkhi Dadri	0	0
Faridababd	1	3
Fatehabad	880	1479
Gurgaon	0	0
Hisar	56	245
Jhajjar	6	7
Jind	347	919
Kaithal	840	1157
Karnal	592	955
Kurukshetra	406	538
Mahendragarh	0	0
Mewat	0	0
Palwal	46	115
Panchkula	0	0
Panipat	55	254
Rewari	0	0
Rohtak	50	78
Sirsa	357	551
Sonipat	72	219
Yamunanagar	143	147
Total	**4202**	**6987**

(Source:http://creams.iari.res.in)



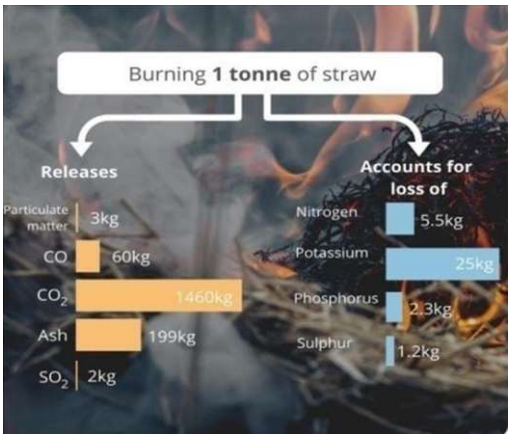
(Source: Ministry of Agriculture and Farmer Welfare)Keeping in view the influence of religious saints in Indian society, KVKs took the help of religious leaders in spreading the message of zero stubble burning which has shown very encouraging results. In 2017, KVKs of Punjab converted 25 villages as Zero Stubble Burning villages whereas in 2018, the number of Zero Stubble Burning villages increased to 76 (9).

(Source: Ministry of Agriculture and Farmer Welfare)

Effects of stubble burning

According to WHO, around 90% of people worldwide breathe polluted air, which leads to 7 million deaths annually.

Pollution: Open burning of parali emits large amounts of noxious pollutants such as methane, carbon dioxide, sulphur dioxide, nitrogen dioxide, particulate matter, carbon monoxide, carcinogenic polycyclic aromatic hydrocarbons etc in the air. According to the FAO report (2018), one ton of stubble burning releases 2 kg SO2, 3 kg particulate matter, 60 kg CO,199 kg ash and high amount of CO2. As evident, it is a major contributor of GHGs. These pollutants may undergo transformation forming a thick blanket of smog and soot.



(Source: Project Vriddhi)

Delhi has been ranked the most polluted city in the world and stubble burning in Northern India is one of the major reasons for it. Stubble burning across Punjab and Haryana contributes to the winter haze in Delhi and nearby areas (7).

Adverse effect on Health: Burning parali causes severe neurological, cardiovascular and respiratory diseases, COPD, cancer, reduction in visibility, skin rashes etc. It has also been found to affect insulin secretion, thus causing diabetes. Also, prolonged exposure to pollution also increases the mortality rates (10).

Soil Fertility: Stubble burning significantly reduces the fertility of the soil by destroying the essential nutrients present in it.Annually, 5 kg nitrogen, 25 kg potassium, 2.3 kg phosphorus, 1.2 kg sulphur is lost due to the burning of one ton of paddy straw (FAO, 2018).

Moreover, the heat generated due to burning penetrates into the soil, which not only reduces the moisture content but also kills the useful microbes necessary for plant growth. Due to the absence of useful microorganisms, there is growth of 'enemy' pests which can be harmful for the crops (11).

Wealth from stubble

Stubble burning destroys the 'wealth' that can be generated from the stubble. It causes loss of soil fertility, flora and fauna and, loss of biodiversity and threats to animals and birds as well.. India suffers an economic loss of approximately $30 billion annually due to crop residue burning (International Food Policy Research Institute, 2019).The not-so useful stubble can be mixed with cow dung and other natural enzymes to produce high grade organic fertilizers which can further be used personally and sold out commercially, there by bringing in substantial revenue.

Solution to stubble burning

"The first step to curb crop burning is to find uses for the stubble - **Centre for Science and Environment (CSE)**.

Alternatives for stubble management are broadly in-situ management, ex-situ management which includes alternate cropping and processing to biofuels (12).

Project Vriddhi: an initiative of Enactus Hansraj on stubble management

Background:

Enactus is an international not-for-profit organization that is resolute to empower people and improve livelihoods while developing the next generation of value-driven entrepreneurial leaders and social innovators. It provides a forum for over 70,000 young future leaders across 36 countries to create impactful programmes. Enactus students use the positive power of business and innovation to address the social issues affecting the world through diverse and fresh perspectives to create a better, more sustainable world.

(Source: Project Vriddhi)

EnactusHansraj is a not-for-profit student-run organization consisting of dedicated and driven new-gen leaders from one of the most prestigious colleges in the DU circuit. Since its inception in 2012, EnactusHansraj has undertaken several projects namely Ahsaas, Aangaan, Mithaas and Vriddhi, etc. to promote social entrepreneurship among students through inclusive growth, while impacting the lives of underprivileged communities. Their zeal, enthusiasm and vision of working for the community and giving them confidence, livelihood and a sense of belongingness are the perfect example of innovation at its peak.

Motivation for the project:

In 2019, 7 out of 10 most polluted cities in the world were in India. The PM 2.5 levels were 150 times higher than WHO prescribed limits, 46% of it was caused by stubble burning. Nearly 70% farmers face the issue of crop residue management due to attractive alternatives and adequate resources; this leaves them with no other option than to burn the stubble left after harvest. In Northern India alone more than 80% of the stubble produced is burnt, causing severe environmental threats, degradation in air quality, irreversible climate changes and infinite risks to human health.

(Source: Project Vriddhi)

In October 2012, Enactus Hans Raj- a team of 60 passionate students decided to take the issue head on by transforming mindsets, redefining traditional practices, empowering our change makers, battling the evils plaguing the society- an outcome PROJECT VRIDDHI, an initiative conceptualized to curb stubble burning by utilizing it for productive purposes, thus aiming to reduce both indoor as well as outdoor pollution (13). It is currently functioning under 4 diverse verticals—**Tabdeel, Shilpkari, Nirmaan and reStove.**

Tabdeel

(Source: Project Vriddhi)

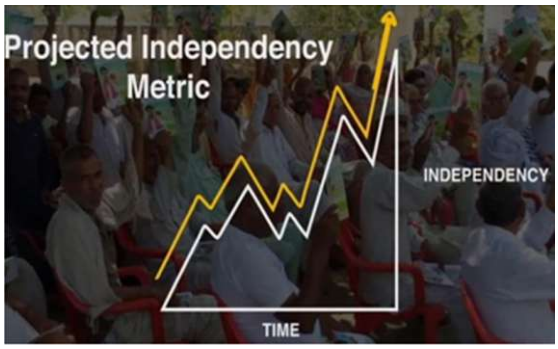
Every year the farmers of Punjab and Haryana burn more than 35 million tonnes (Mt) of stubble due to lack of feasible alternatives. With hardly any money to spare, farmers are left with no choice but to burn stubble to afford even the basic necessities of life. This was the motive behind building Tabdeel, which aims at uplifting the farmers by acquainting them with stubble based organic mushroom cultivation.

Countering the problem of Stubble Burning and Middlemen Exploitation, Tabdeel, the 1st vertical under Project Vriddhi, works for the welfare of farmers by encouraging them to switch to mushroom cultivation.

Stubble can be used as an alternative in mushroom cultivation by acting as the key ingredient in its compost. This not only prevents crop waste from getting burnt but also, results in higher market prices than that of wheat, rice, etc. because of mushrooms exotic status.

For the conversion of stubble to manure, the stubble is taken out of the fields and huts are made out of it. This stubble is then mixed with water for about a month allowing the stubble to absorb the water continuously followed by addition of cow dung to convert it to compost. Mushroom seeds are then added about one week later. The crop starts coming up in a period of 20-25 days.

With visits to 18 villages, 40+ sessions, sensitization of more than 600 farmers, Tabdeel formed its FPO to improve the bargaining power and avail various government schemes making it a sustainable organization, trying to negate any dependency on external individuals.



The mushroom industry in India is highly untapped and is growing at an average growth rate of 4.3% per annum. Moreover, every 100kg of stubble can be used as manure to produce as much as 70kg of mushroom, thus presenting ample income earning opportunities for the farmers. The project is successfully running in Harsanakalan (Sonipat, Haryana), with the help of Ayurvet Foundation and JBRN Trust. More than 30+ sessions have been conducted to create awareness that mushroom cultivation can be an alternative to stubble burning; thus impacting more than 650 farmers.

Initially there werejust 10 farmers who were trained with the help of HAIC and PAU, but now more than 160 farmers are involved in the project. They have collectivized the farmers into farmer producing organization- Harsanakalan FPO, which has helped the farmers in getting the benefits of collective bargaining and monetary grants by the government.

Currently the farmers are producing 500,000kg of mushroom which is sold to leading retailers like **Banjosh** and **Golden Crown** through a B2B model. This has yielded total revenue of USD 586,755, thus increasing the income of the farmers by as much as 30%. 15% of the total profits of each farmer are e-directed to the FPO to ensure sustainability in the long run while 5% is maintained as an Enactus Hans Raj's reserve to ensure financial stability. To ensure price stability in the long run, they have entered into a 9 month price contract periodically so that the mushrooms are sold at a competitive price of Rs 75 per kg. They have devised a projected independency metric, a feedback analysis mechanism to monitor results of the farmers with the aim to make them independent. 13 farmers have become independent by 2020 which is 49% of the total base, ensuring that the farmers are moving towards self-reliance. They have scaled up their operations as much as 74% in Gurdaspur, Punjab. There has been an expansion of 48% in operations by entering new markets and states. With over 165 farmers on board, Tabdeel has now become completely autonomous.

Mushroom cultivation from stubble (Source: Project vriddhi)

Shilpkari

Farmers are not the only community that can be benefited out of stubble. Rising urbanization and the disappearance of the Indian handicraft industry has threatened around 6.8 million artisans. In June 2019, Project VRIDDHI gave birth to Shilpkari, which aims to revive the handicrafts industry through skilled women entrepreneurs. Stubble is converted into PULP SHEETS, which in turn is used to develop marketable handicrafts like lamps and paper-bags. They have collaborated with Kriya Labs (14), an IIT Delhi based startup which provides technical assistance and SEVA BHARTI NGO for community development and training workshops. The USP of the handicrafts lies in the fact that their products are not just an output of waste materials but are also eco-friendly, cost effective and a close substitute for single use plastics. It currently works in a B2B model.

They have further collaborated with leading market players like Fab India, Kriti Creations and Greenock to establish systematic market linkages and to ensure continuous scalability in sales. The revenue is earned through a commission based system which directly goes into the hands of women entrepreneurs. So far, many women entrepreneurs have been impacted with the help of Sewa Bharti NGO, who have helped in the community development and training workshops. The objective is threefold-

- curb pollution due to stubble burning
- uplift marginalized women by making them self-reliant
- Relive the Indian Handicrafts industry.

Products made from stubble (source: Project Vriddhi)

More than 90+ women entrepreneurs annually earn an average of Rs 21000 each, giving them a sense of financial security and self-sustenance. The total revenue generated in Shilpkari is around USD 24,333. They plan to roll out two more products- stationery items and tableware, which is expected to bring USD 17,500 additional annual revenue.

About ninety tons of stubble from Harsanakalan village is converted into pulp and later into thick paper sheets. These sheets are then transported to Sewa Bharti NGO in RajouriGarden , Delhi, where women are trained to make products like coffee mugs, lampshades, hats etc. products range from around Rs 100-300 (14).Shilpkari intends to provide a helping hand to the declining Indian Handicraft market, while reducing the need for single use plastic.

Nirmaan

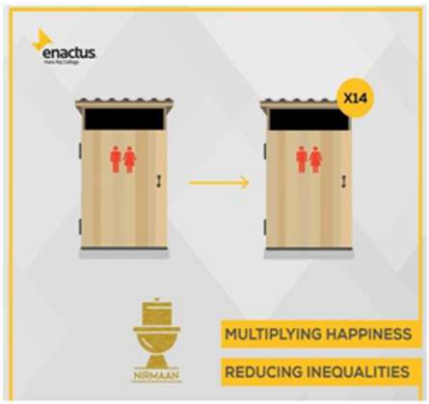
Products made from stubble (source: Project Vriddhi)

More than 30% of rural households in India do not have access to toilets. Ironically, even the ones with access to toilets do not use it by virtue of their functionality and unwillingness to change their habits. This gave birth to Nirmaan, where the wonder element stubble is compressed into stubble boards under high pressure to construct durable and cost effective toilets. One such single establishment puts 800kg of stubble into productive use avoiding it from being burnt.

The stubble boards serve as suitable alternatives to conventional brick and mortar structures. They are highly durable with proper drainage mechanisms and termite resistance.

They have collaborated with Ecoboard, Pune. The project is running successfully in many districts of Haryana like Sonipat, Nuh etc. leading the people to a healthier lifestyle. They established their first washroom facility in October 2019. They are working with the local government bodies to accelerate the process.

Washroom made from Eco board processed from stubble(Source: Project Vriddhi)



(Source: Project Vriddhi)

government bodies to accelerate the process. The cost of a single washroom under Nirmaan is around Rs 40,000 which is financed through the reserve generated by the activities of Enactus Hans Raj and other verticals of Project Vriddhi. The revenue is earned through a subscription based daily pass and a one-time use basis. In merely 8 Washroom made from Eco board processed from stubble(Source: Project Vriddhi) months of operation for daily pass users paying a fee of Rs 3 per day and a fee of Rs 2 per use, it accounted to revenue of Rs 60,500 for the entrepreneurs. They have collaborated with pan India organizations such as SULABH to establish an extensive network of washrooms. They have constructed 14 washroom facilities by July 2021. The total revenue generated is USD 3,120. 8 more washroom facilities are being set up including 4 'women only washrooms'.(Source: Project Vriddhi)Open defecation in rural India presents a puzzle: even with people having access to toilets, open defecation still persists. The first Nirmaan washrooms were established in Arthala, Ghaziabad, impacting more than 100 families and showing them a way towards a healthier and better lifestyle.

reStove

Indoor air pollution claims four million lives every year. In India alone, each year one million people die due to the severe health detriment caused by toxic smoke as a result of cooking indoors with open fire and by burning solid fuels. 77% of the households in rural India use firewood as the primary source of energy for cooking and cannot afford expensive LPG for the operation of gas stoves. Lack of awareness and accessibility to LPG cylinders has forced the rural households to use firewood. A recent vertical of Project Vriddhi in partnership with Enactus Munich is reStove, which aims to replace the traditional cook stoves used in rural homes with state of the art stubble to Bio Gas system (reStove). The bio gas plant utilizes agro waste; this will not only provide another alternative to stubble burning but will also reduce indoor pollution. The money will be charged on installment basis. This vertical will generate USD 1500 per entrepreneur annually. In addition to this an extra annual income can be generated by providing maintenance services. 10 biogas plants have been set up so far.

Project reStove is the first ever stubble to biogas conversion plant installed by Project Vriddhi at Vaidik farms. The plant marked the beginning of a new journey for Project Vriddhi as the expanse of their horizon and endeavors to tackle the devastating problem of indoor air pollution by bringing state of the art technology to the rural segments of India. Under the joint venture, the biogas plant will be made using barrels and IBCs, instead of the conventional fixed dome structure thereby increasing the cost efficiency of the model.In the near future the vertical will be diversified into BIO-ENERGY PELLETS made from COMPRESSED AGRO-WASTE.

Covid impact

Covid 19 called for reassessment of their business models to adapt to the new normal. To ensure post-harvest operations in Tabdeel, the FPO applied for subsidy on cold storage facilities under the Indian government's economic stimulus package. The women entrepreneurs shifted the production process from an assembly end to end to end operation scheme to ensure social distancing.

In NIRMAAN they installed hand sanitizing stations outside the washrooms. The total number of orders witnessed a fall of 20% in 2020; however, they rose to 42% in 2021.

Achievements

With more than 60,720 working hours they have uplifted more than 281 entrepreneurs and impacted more than 982 lives directly and 59,732 lives indirectly. With a revenue growth of 43.3% in 2020, Project VRIDDHI generated total revenue of 38.2 million and a total profit of 22 million in 2020. It has shown a growth rate of 67% in 2021, and has generated USD 614,208. They have created 62.8M media impressions.

With the increasing demands for mushroom, the total numbers of sheds have grown by 50% in 2021 and are expected to increase by 67% in 2022. The number of entrepreneurs has also grown from 75% to 86% by 2021. In 2 and half years of operation they have prevented 941 tonnes of agro-waste from being burnt, stopped 1,374,000 kg of CO2emissions and most importantly prevented 1,87,266 kg of ash from being left behind.

Currently they have established 12 projects successfully across 22+ villages, 10 cities fulfilling 14 SDGs, ultimately impacting 35 differently able, 50 marginalized women, 70 drug addicts, 150+ families, 800 farmers and 900+ children. They have interacted and brainstormed with ENACTUS MUNICH, FLEMING, and GHANA. They have added a global perspective to the common cause of combating change.

The efforts of Project VRIDDHI in taking a stride towards a cleaner and greener planet have been appreciated by many. The enthusiasm of the students and the potential of the project, not only has the power to change the world but also to inspire millions around.

Innovation quotient

With the aim to mitigate the ill effects of climate change, providing farmers lucrative alternatives to stubble burning, helping women from rural and marginalized families become financially independent, achieving open defecation free communities and reducing indoor and outdoor air pollution, the team of EnactusHanraj came up with an innovative and sustainable Project called VRIDDHI.

There are four verticals in Project Vriddhi namely, Tabdeel, Shilpkari,Nirmaan and Restove. Their first vertical Tabdeel, aims to eliminate crop residue burning by creating awareness and encouraging the farmers to grow mushroom using stubble as manure. This will not only give an economic value to their crop residue thus discouraging them to burn parali but will also reduce pollution. Their second vertical is Shilpkari, which aims to revive the declining handicrafts industry, provide financial security to women from lower income families and reduce the use of single plastic. Stubble is converted into pulp sheets, which is then used to create marketable handicrafts like lamps, coffee mugs, paper-bags, hats etc.

In their third vertical Nirmaan they have set up cost effective toilets with the aim to create open defecation free communities especially in the rural areas. In this stubble is compressed into stubble boards under high pressure to construct durable and cost effective toilets which are suitable alternative to the conventional brick and mortar structures.

Despite the efforts of the Government to provide free LPG cylinders to lower the usage of firewood for cooking, it still remains a major cause of indoor pollution taking lives of millions of people due to the release of toxic gases and smoke. The fourth vertical of Project Vriddhi is reStove, which aims to replace the traditional cooking stoves with state of the art stubble to Bio Gas system, the first of this kind initiative.

Challenge

With more than 200 Mt of stubble produced annually, it is not possible for the farmers to manage the crop residue single handedly. Besides the central, state and local government, the private players and stakeholders have to play a proactive role to curb the nuance of stubble burning. The first step to solving any problem requires a clear understanding of the root cause of the problem.

The rising prices of petrol/diesel for transportation and other purposes is a major problem moreover there is ambiguity as to who will bear this cost- the farmers or the organizations involved in managing crop residue?

Moreover, the state governments do not provide any financial assistance to the farmers using crop residue management machines to compensate for the increase in operational cost of these machines vis-à-vis the rising fuel prices (15), which discourage the use of these machines in the next season.

The pretreatment of crop residue is a costly affair (8) requiring expertise and installation of expensive machines. The organizations working in crop residue management are mostly government owned or PSUs like ONGC, HPCL etc. The involvement of private players is very less.

Moreover there is emission of nitrous oxide due to decomposition of nitrogenous fertilizers.

Methane emission from rice fields is also a serious concern (3). Although the PUSA decomposer is an ecofriendly, economically feasible and time-saving solution to crop residue burning, still its adoption is not wide spread. In 2020, it was used only across five villages in Punjab covering an area of merely 200 hectares (PIB 2021). More awareness and training programs needs to be conducted to demonstrate its potential, only then it can be brought into wide scale use (15).

Delay in handling over the crop residue management machines to the farmers (by the government) before the commencement of the residue burning season is another reason for rise in farm fires. The CHC model is not very popular moreover there are misconceptions regarding the use and impact of options such as the Happy Seeder. The use of these crop residue management machines in a few high-burn districts such as Amritsar, Patiala, and Ludhiana has not scaled up significantly and is far from the ideal requirement (10).

There is lack of an adequate base of biomass end-users; moreover the present end-users are purchasing residue from areas outside the district they are located in. The existence of limited number of end-users creates a monopsony market structure thus giving way to price manipulation. The cost of biomass supplies delivered is very high whereas the demand for biomass is very low which makes it economically unattractive for entrepreneurs in the supply chain (10).

Although the ex situ options hold a great promise to curb the crop residue burning issue, they are inadequately addressed because there is no comprehensive ex-situ policy covering issues such as capacity utilization, sufficient balers, storage infrastructure, supply chain linkages, and skilled labor force to aggregate, store, and efficiently supply the crop residue generated.

Partners and collaborations

Project VRIDDHI has collaborated with leading organizations such as NABARD, ENACTUS MUNICH, JBNR: Educational & Ag-tech Charitable Fund, SEVA BHARTI (Delhi), Golden Crown, KRIYA LABS,

DELHI Government, AJAY KUMAR GARG ENGINEERING COLLEGE, PAU, Ministry of New and Renewable Energy (Government of India), Haryana Agro Industries Corporation Ltd, AYURVET Research Foundation, ECO BOARD (15).

Way forward

Although the National Green Tribunal banned crop burning way back in 2015 and also imposed penalties on the farmers burning stubble as environment compensation, the practice is still prevalent in Northern India which clearly shows the inability of the government agencies to curb this practice, negligent attitude of the farmers towards environment conservation and also the non-availability of attractive and affordable alternatives (7).

We need to focus on alternative and permanent long term solutions as merely imposing fine will not work in our socio-economic conditions to curb stubble burning. The government should increase monetary incentives and ensure the affordability and easy availability of machines for in situ waste management, especially to thesmall and marginal farmers. It would be unfair to penalize the farmers without providing them feasible solutions. More effort is needed for ex-situ management, both on the government and private front. Farmers should be educated about the side effects of stubble burning. A holistic approach is required to address crop residue burning, which includes a multi-disciplinary and multi-agency setting involving technical agencies, minimum support prices (16) for alternative crops along with infrastructure support, cold storage facilities, market-based economic tools, supporting agricultural and environmental policies, and awareness and capacity building for farmers. Chhattisgarh Model of setting up 'gauthans', where all the unused stubble is collected through paralidaan and converted into organic fertilizer by mixing with cow dung and other natural enzymes can prove effective in curbing stubble burning.

Abbreviations

IPC: Indian Penal Code

MNREGS: Mahatma Gandhi national rural employment guarantee act

WHO: World Health Organization

FAO: Food and Agriculture Organization

GHG: Greenhouse gases

CREAMS: Consortium for Research on Agroecosystem Monitoring and Modeling from Space

IARI: Indian Agriculture Research Institute

ICAR: Indian Council of Agriculture Research

SO2: Sulphur dioxide

CO: Carbon Monoxide

CO2: Carbon dioxide

COPD: Chronic Obstructive Pulmonary disease

KVKs: Krishi Vigyan Kendras

CSE: Centre for Science and Environment

NABARD: National Bank for Agriculture and Rural Development

Mt: Million tones

JBNR: Jwala Bai Nathu Ram trust

FPO: Farmer Producer Organization

B2B: Business to Business

SDGs: Sustainable Development Goals

ONGC: Oil and Natural Gas Corporation Limited

HPCL: Hindustan Petroleum Corporation Limited

PIB: Press Information Bureau

CHC: Community Health Centres

HAIC: Haryana Agro Industries Corporation Limited

PAU: Punjab Agriculture University

IBCs: Intermediate Bulk Container

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