Design Brief for the Mitigation of Crop-Burning in States Around Delhi

Problem Statement

Crop burning in Punjab, Northern India, is responsible for 50% of Delhi's pollution [1,2]. This harmful practice poses environmental and health risks to local and neighbouring communities (Figure 1) [3]. To tackle this issue, machinery technology was introduced as a non-burning alternative such as PRANA or HARIT [4, 5]. However, small-scale farmers face obstacles in adopting this technology due to unaffordability of the machines and time management [2, 6]. Consequently, this prevalent trend is still ongoing as seen in Figure 2 where we can observe an increase over the year. The specific problem statement focuses on small farmers in adopting sustainable crop residue practices, with Gurdaspur serving as a representative district since it witnesses approximately 324 cases of crop burning annually [7].

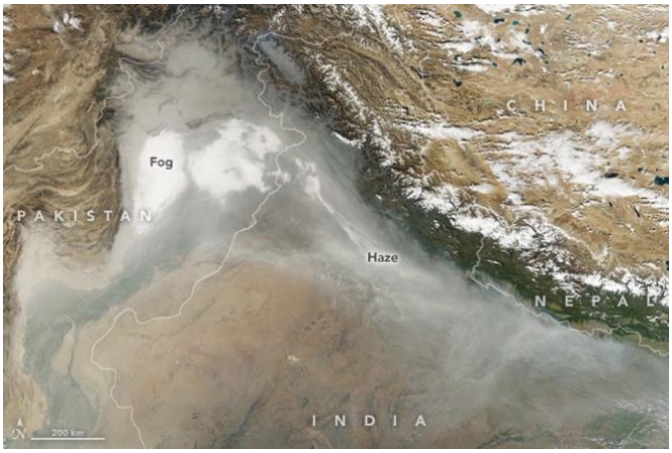

Figure 2 NASA observation of fog and haze in northern India on the 9th November 2017 [8]

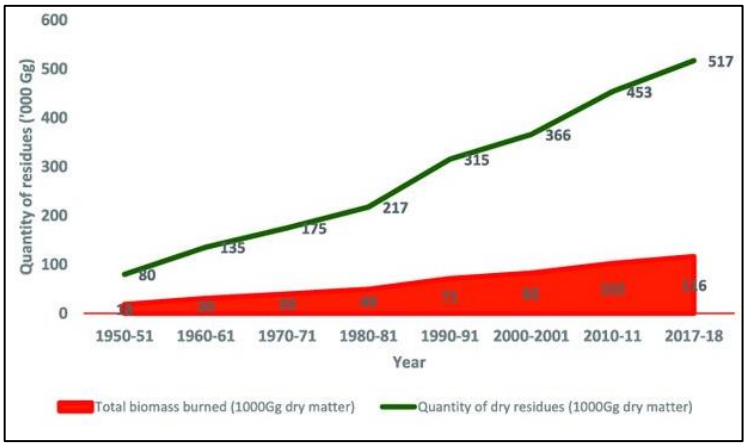

Figure 1 total dry residue generated, and biomass burned in India from 1950-51 to 2017-18 [9]

Key Stakeholders (Figure 3)

Stakeholders of this project consists of small farmers who benefit from close collaboration for an affordable and sustainable solution with agricultural organizations. Government agencies play a regulatory and promotional role, incentivizing farmers through subsidies to encourage sustainability. The synergy between agricultural organizations and government agencies ensures the development and implementation of effective policies, provision of technical expertise, resource allocation, and financial support while ensuring a coordinated approach to combat crop burning.

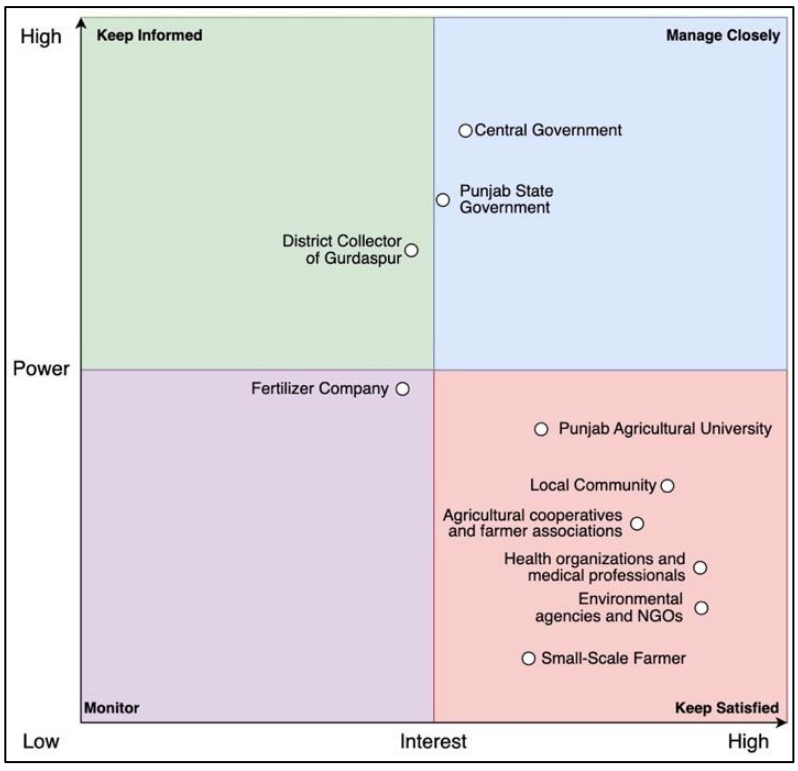

Figure 3 Stakeholder map of the improvement of crop residues management in

Project Objectives and Design criteria

Table 1 Project objectives and their equivalent design criteria.

Project Objectives	Design criteria
Enhancing existing technologies to ensure their applicability at a small scale.	60% adoption of alternative method in small farms and decrease of 40% of burning cases in in Gurdaspur district [7,10].
Design an affordable sustainable crop residue management solution tailored to the needs of small farmers in Gurdaspur district.	Collaboration and partnerships established with agricultural organizations, environmental agencies, NGOs, and government entities.
Establish a self-sustainable solution that minimizes ongoing expenses and external resource dependencies.	Encourage farmers to capitalize on their crop residue, turning it into a profitable resource.
Reduce air pollution levels significantly by mitigating crop burning and its associated environmental and health risks.	Preventing 300 metric tons of CO_2 equivalent from entering the atmosphere [9]. Decrease of the amount of black carbon produced by 15% [11].

Risks and Constraints

Table 2 Risks and constraints related to the objectives set.

	Risks	Constraints
Social	Rejection due to cultural norms and traditional practices.	Lack of awareness about the benefits and proper technique to utilise crop residues.
Political	Inadequate policy framework and inconsistent enforcement.	Discouragement of famers to consider this technology due to insufficient funding from NGOs.
Economic	The affordability and long term viability of the technology.	Farmers with limited resources may consider this as a financial burden considering initial investment maintenance costs.
Commercial viability	Market demand and poor supply chain.	lack of storage facilities, processing unites and transportation network will pause a problem while introducing this new technology.

Bibliography:

1. Goswami U. More to Delhi's pollution than crop burning. The Economic Times [Internet]. 2020 Oct 27; Available from: https://economictimes.indiatimes.com/news/politics-and-nation/more-to-delhis-pollution-than-crop-burning/articleshow/78891537.cms?from=mdr

2. Ellis-Petersen H. Delhi's smog blamed on crop fires – but farmers say they have little choice [Internet]. the Guardian. The Guardian; 2019. Available from: https://www.theguardian.com/world/2019/nov/08/indian-farmers-have-no-choice-but-to-burn-stubble-and-break-the-law

3. Tallis H, Polasky S, Shyamsunday P, Springer N, Ahuja V, Cummins J, et al. The Evergreen Revolution: Six Ways to Empower India's No-Burn Agricultural Future. South Asia: University of Minnesota; The Nature Conservancy; 2017.

4. Promoting Regenerative And No-burn Agriculture (PRANA) to Tackle Climate Change in Northwest India [Internet]. The Nature Conservancy. 2021. Available from: https://www.nature.org/en-us/about-us/where-we-work/india/our-priorities/prana/

5. Harnessing the power of Agricultural Residues through Innovative Technologies (HARIT) [Internet]. The Nature Conservancy India. 2021 [cited 2023 Jun 5]. Available from: https://www.tncindia.in/what-we-do/our-priorities/food-and-water/harit/

6. Dutta A, Patra A, Hazra KK, Nath CP, Kumar N, Rakshit A. A state of the art review in crop residue burning in India: Previous knowledge, present circumstances and future strategies. Environmental Challenges. 2022 Aug;8:100581.

7. Tarn Taran, Amritsar, Gurdaspur account for 60 per cent of stubble burning cases in Punjab. The Economic Times [Internet]. 2022 Oct 24 [cited 2023 Jun 5]; Available from: https://economictimes.indiatimes.com/news/india/tarn-taran-amritsar-gurdaspur-account-for-60-per-cent-of-stubble-burning-cases-in-punjab/articleshow/95059943.cms

8. NASA. A combination of fires, urban pollution, and bad weather caused a remarkable build-up of haze over northern India and Pakistan [Internet]. Earth observatory. 2017 [cited 2023 Jun 5]. Available from: https://earthobservatory.nasa.gov/images/91240/haze-blankets-northern-india

9. Economic Survey 2019-2020, Agricultural Statistics at a glance 2018. Crop statistics of India [Internet]. Available from: https://www.researchgate.net/publication/348792081_Nexus_Between_Crop_Residue_Burning_Bioeconomy_and_Sustainable_Development_Goals_Over_North-Western_India

10. TNN. Close to 850 straw burning cases across state, most from Gurdaspur district. The Times of India [Internet]. 2022 May 2 [cited 2023 Jun 5]; Available from: https://timesofindia.indiatimes.com/city/chandigarh/close-to-850-straw-burning-cases-across-state-most-from-gurdaspur-district/articleshow/91244364.cms

11. Kumar BM, Aravindakshan S. Carbon footprints of the Indian AFOLU (Agriculture, Forestry, and Other Land Use) sector: a review. Carbon Footprints. 2022;1:7.