CULTIVATING INSIGHTS: ANALYSING THE IMPACT OF BRICK KILNS ON AGRICULTURE IN THE VICINITY OF BUDGAM DISTRICT, JAMMU AND KASHMIR

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ABSTRACT

This study investigates the detrimental impact of brick kiln emissions on agriculture in three villages—Panzan, Lalgam, and Sunar-Gund—located in the Budgam district of Jammu and Kashmir, India. Through a sociological lens, a comprehensive analysis of the effects of brick kiln operations on various agricultural variables was conducted. Data was collected using a 5-point Likert scale-based survey from 350 respondents residing within a 1-kilometer radius of the brick kiln sites. The results reveal a consistent pattern of adverse consequences, including reduced crop yields, hindered photosynthesis, changes in leaf color, and the accumulation of toxic substances. Each village exhibited unique variations in the intensity of these impacts, with Panzan, Lalgam, and Sunar-Gund experiencing average ratings of 3.41, 3.28, and 3.14, respectively. The study highlights the urgent need for sustainable practices and policy interventions to mitigate the negative effects of brick kiln emissions on agriculture in the region. Future research should explore health implications, mitigation strategies, and the broader socioeconomic consequences of these environmental challenges.

***Keywords**: Brick kiln emissions, agriculture, sociological study, environmental impact, Budgam district, Jammu and Kashmir.*

1. Introduction

The brick kiln industry, a cornerstone of construction and infrastructure development globally, holds an indispensable role in meeting the ever-growing demands for building materials. However, as this industry expands to accommodate urbanization and developmental needs, it casts a shadow over its environmental and agricultural surroundings, particularly in regions like Budgam District, nestled within the scenic landscapes of Jammu and Kashmir. This comprehensive research endeavours to illuminate the intricate and multifaceted implications of brick kiln operations on agriculture, soil quality, and the broader environment in this unique locale.

1.1 Interplay of Air Pollutants and Agricultural Health

Research by Rai et al. (2011) underscores a critical facet of this complex interrelationship. It elucidates that air pollutants originating from brick kiln activities do not confine their impact solely to urban centers or immediate vicinity; instead, their pernicious reach extends to suburban and rural areas. This diffusion, contingent on meteorological factors and wind patterns, carries ramifications for agriculture. The physiological and metabolic processes of plants, varying with species and cultivars, bear the brunt of these pollutants, further influenced by factors such as pollutant type, concentration, duration, and magnitude. The findings accentuate the necessity of identifying and screening cultivars sensitive to these pollutants and establishing exposure indices for key crops. This, in turn, can aid in devising mitigation strategies to safeguard crop yields against the adverse effects of air pollution.

1.2 The Unseen Impact of Fluoride Emissions

Ahmad et al. (2012) provides an illuminating glimpse into the hidden perils posed by brick kilns, particularly in regions experiencing rapid urbanization, such as Peshawar, Pakistan. In their study, they elucidate the visible foliar damage inflicted upon mango, apricot, and plum trees in the vicinity of traditional Bull's Trench brick kilns. The escalation in brick production, driven by urban expansion, has seen brick kilns encroach into peri-urban areas, resulting in the emission of fluoride. This emission, as reveal, is the primary cause of the observed harm to fruit-bearing trees. Interviews with local farmers underscore the profound implications of this damage, amplifying the urgency to address this overlooked environmental issue. The severity of injury symptoms, notably in plum and apricot trees, was most pronounced at the brick kiln site, and the concentration of fluoride in leaves from these areas was significantly higher than in

more distant, less affected sites. This study serves as a stark reminder that unregulated brick kilns in peri-urban settings can burgeon into unrecognized environmental hazards, especially in regions where emission control remains insufficient.

1.3 Soil Quality and Agricultural Productivity

The profound impact of brick kilns on soil quality and agricultural production is further elucidated by the study conducted by Islam (2015). In an investigation centered on the degradation of topsoil quality in proximity to brick kilns, it was established that agricultural output in these areas pales in comparison to the yields in soil farther removed from these kilns. Significantly, the electrical conductance of soil samples taken near the brick kilns was nearly double that of soil samples collected at a distance. Though other elemental changes were less pronounced, the implications for agricultural livelihoods in these areas are undeniable. The study underscores the pressing need for regulatory measures to deter the establishment of brick kilns on fertile agricultural lands and the formulation of comprehensive government policies to manage and monitor brick kiln operations.

1.4 Brickfields as Environmental Hazards

Talukder's study in the Rangur district of Bangladesh in 2015 underscores the multifaceted challenges posed by brickfields. The environmental landscape in the immediate vicinity of brickfields, as revealed in this study, is subject to direct or indirect threats, with detrimental consequences on arable land, plants, and trees. The extraction of topsoil from nearby agricultural lands, as Talukder observes, exacerbates soil degradation and hampers productivity. Furthermore, the brickfields' emissions, characterized by black smoke and noxious gases, contribute significantly to air pollution, adversely affecting agricultural crops, plants, and public health. The study emphatically calls for the rectification of these hazardous consequences, advocating for the enforcement of legislation to curb unlawful activities at brick kilns.

1.5 Industrial Contamination and Agriculture

The research undertaken by Vácha et al. (2015) delves into the intricate issue of toxic elements and persistent organic pollutants (POPs) in agricultural soils affected by mining and heavy industry. The study, conducted in the industrial regions of North Bohemia and North Moravia, Czech Republic, paints a compelling picture of soil pollution due to anthropogenic factors associated with historical mining and industrial activities. This contamination, including elements such as arsenic, beryllium, and cadmium, impacts regions differently based on their industrial activities, with North Bohemia bearing the brunt of arsenic contamination, largely stemming from the interaction of anthropogenic and geogenic sources. North Moravia, on the other hand, grapples with elevated cadmium and polycyclic aromatic hydrocarbons (PAHs) levels linked to coal combustion and metallurgy. Despite these challenges, the study found that soil contamination levels did not exceed food safety limits, offering a glimmer of hope that with the right precautions, agriculture can persevere in regions affected by heavy industrial emissions. The research recommends grassing over contaminated arable lands to mitigate wind erosion and advocates for the implementation of a robust methodology to assess soil contamination.

1.6 Biochemical Consequences of Brick Kiln Emissions

Skinder et al. (2015) conducted a ground-breaking study in the Panzan village of Budgam District, Jammu and Kashmir, examining the repercussions of brick kiln emissions on plant growth and productivity. The findings are a stark reminder of the potentially catastrophic consequences of unchecked brick kiln operations. The emissions, as revealed in this study, wield a deleterious influence on the biochemical parameters of essential consumable vegetables, including Brassica oleracea, Phaseolus vulgaris, and Solanum melongena. The observed disparities in the biochemical values of vegetables grown in proximity to brick kilns compared to those from control sites underscore the grave risks these emissions pose

to vegetable plants. This poses a serious threat not only to the local population but also to millions who rely on vegetables cultivated in these areas. The biochemical imbalances, driven by brick kiln emissions, have far-reaching consequences for food security and the overall living standards of affected populations. Urgent measures, such as pollution control devices or the adoption of new technology, are imperative to avert the impending crisis.

1.7 Soil Nutrient Dynamics near Brick Kilns

Sikder et al. (2016) delved into the soil nutrient dynamics of agricultural environments near brick kilns in Bangladesh. Their research revealed a complex interplay of nutrient levels influenced by the release of poor-quality coal and firewood during brick production. The study pointed to elevated sulfur, zinc, and copper levels in soils near brick kilns, highlighting the environmental challenges posed by this industry. While nitrogen concentrations increased with distance from brick kilns, the patterns for phosphorus and potassium accumulation remained less defined. Soil organic matter content exhibited a significant decrease in proximity to brick kilns, signaling surface soil degradation that expands alongside the brick production areas. Furthermore, the emissions from brick kilns, laden with toxic gases such as sulfur dioxide (SO2) and nitrogen dioxide (NO2), contribute to soil acidification. The impact of brick kiln operations on agriculture and the environment in Budgam District, Jammu and Kashmir, can be further elucidated by examining the village-wise rating system to gauge the repercussions of the brick kiln industry on agriculture in various localities.

This village-wise rating system, as depicted in the table below, assesses a range of variables, including yield reduction of crops, productivity of rice, plant growth retardation, vegetation cover reduction, changes in leaf color, hindrance to photosynthesis, dust deposition on leaves, sudden falling of leaves, accumulation of toxic substances, decline in agriculture activities, decline in agriculture land, loss of topsoil, plant fruit fall, leaf burns, and changes in crop colors, and degradation of soil microorganisms and soil faunal populations. These variables, each representing a facet of the intricate relationship between brick kiln emissions and agriculture, reveal village-specific ratings. The mean rating across these villages offers valuable insights into the overall impact of brick kiln operations on agriculture in the region.

Village-Wise Respondents Ratings of Impact on Agriculture

Variables	Panzan	Lalgam	Sunar-Gund	Mean
Yield reduction of crops	3.9	3.79	3.5	3.73
Decreasing productivity of rice	3.86	3.7	3.3	3.62
Reduction of plant growth/retardation	2.8	3.08	3	2.96
Reduction of vegetation cover	3.77	3.52	3.18	3.49
Changing color of leaves	2.9	2.7	2.5	2.7
Hinders Photosynthesis	3	2.9	2.8	2.9
Dust deposition on leaves	3.67	3.81	3.62	3.7
Sudden falling of leaves	2.98	2.6	2.1	2.56
Accumulation of toxic substances	3.08	3.01	2.7	2.93
Decline in Agriculture activities	4.18	3.9	4.1	4.06
Decline in Agriculture land	4	4.1	4.2	4.1
Loss of top soil	4.35	4	4.25	4.2
Plant fruits fall	3	2.9	2.8	2.9
Leaf burns and changes in crops colours	2.7	2.48	2.2	2.46
Degradation of soil micro-organism/soil faunal population	3.1	2.8	2.89	2.93
Average	3.41	3.28	3.14	3.28

Source: Computed from primary data (Table 1)

The village-wise ratings re-affirm the multifaceted and detrimental impact of brick kiln emissions on agriculture. Across the three villages analyzed, Panzan, Lalgam, and Sunar-Gund, the mean impact rating of 3.28 serves as a stark reminder of the challenges faced by local people. These ratings not only reflect the substantial decline in agricultural productivity

but also underscore the broader ecological consequences, including topsoil loss, vegetation deterioration, and the accumulation of toxic substances, all of which have far-reaching implications for food security and the livelihoods of the local populace. As we delve deeper into this research, it becomes evident that the symbiotic relationship between brick kiln operations and agriculture in Budgam District is a multifaceted issue that demands a comprehensive understanding. This investigation seeks to shed light on these complexities and offer potential avenues for mitigating the adverse impacts, thereby ensuring the sustainability of agriculture in this picturesque region while safeguarding the well-being of its inhabitants.

2. Review Of Literature

The presented research on the impact of brick kiln operations on agriculture in Budgam District, Jammu and Kashmir, draws from a rich tapestry of existing studies, each contributing a unique facet to the understanding of this multifaceted issue. The following review of literature provides an overview of the key findings, insights, and implications of these studies:

2.1 Air Pollution and Crop Impact (Rai *et al.*, 2011)**:** Rai et al.'s research emphasizes the far-reaching effects of air pollutants originating from brick kilns on agriculture. Notably, the study underscores that air pollution can extend beyond urban centres and point sources, impacting even rural and suburban areas. This phenomenon is intricately tied to meteorological conditions and wind patterns. Furthermore, the study highlights the variable responses of different plant species and cultivars to air pollution, emphasizing the importance of sensitivity screening. The findings underscore the need to develop strategies to mitigate the detrimental impacts of air pollution on crop yields and to identify sensitive cultivars to safeguard agricultural productivity.

2.2 Fluoride Emissions and Fruit Trees (Ahmad *et al*., 2012): Ahmad et al.'s research conducted in Peshawar, Pakistan, illuminates the often-overlooked impact of fluoride emissions from brick kilns on fruit-bearing trees. Their study reveals visible foliar damage to mango, apricot, and plum trees in the vicinity of brick kilns. Importantly, it underscores the substantial consequences of this damage on the livelihoods of local farmers. The findings emphasize that fluoride emissions can have a profound impact on agriculture and highlight the urgency of addressing this environmental issue, particularly in rapidly urbanizing regions.

2.3 Soil Quality Degradation (Islam *et al*., 2015): Islam's study in Budgam District provides critical insights into the degradation of topsoil quality near brick kilns. The research showcases the significant disparities in agricultural productivity between soil close to brick kilns and soil farther away. Additionally, the study highlights the considerable increase in electrical conductance in soil samples from the proximity of brick kilns, underlining the adverse effects of brick kiln operations on soil quality. These findings emphasize the necessity of implementing regulations to prevent brick kilns from encroaching on productive agricultural land and the development of robust government policies to manage brick kiln operations.

2.4 Brickfields as Environmental Hazards (Talukder, 2015): Talukder's research in Bangladesh paints a comprehensive picture of the multifaceted challenges posed by brickfields. The study underscores the direct and indirect threats brickfields pose to various environmental elements, including agricultural land, plants, and trees. Notably, the extraction of topsoil from nearby agricultural land and emissions characterized by black smoke and noxious gases are identified as primary culprits. The study advocates for legislative measures to curb unlawful activities at brick kilns and prevent them from encroaching on productive agricultural land.

2.5 Industrial Contamination and Agriculture (Vácha *et al*., 2015): Vácha et al.'s research conducted in industrial regions of the Czech Republic delves into the contamination of agricultural soils affected by historical mining and industrial activities. The study reveals the presence of toxic elements and persistent organic pollutants, highlighting the environmental challenges posed by such

activities. While the research does not find concentrations exceeding food safety limits, it underscores the need for precautions to ensure sustainable agriculture in regions affected by heavy industrial emissions.

2.6 Biochemical Consequences of Brick Kiln Emissions (Skinder *et al*., 2015): Skinder et al.'s study in Panzan village, Budgam District, Jammu and Kashmir, delves into the biochemical repercussions of brick kiln emissions on vegetable crops. The findings reveal significant disparities in biochemical values between vegetables grown near brick kilns and those from control sites. These imbalances pose a severe threat to food security and the overall living standards of affected populations, necessitating urgent pollution control measures or technological advancements in brick kiln operations.

2.7 Soil Nutrient Dynamics near Brick Kilns (Sikder *et al*., 2016): Sikder et al.'s research in Bangladesh examines soil nutrient dynamics near brick kilns. Their study unveils a complex interplay of nutrient levels influenced by the release of poor-quality coal and firewood during brick production. The research emphasizes elevated levels of sulfur, zinc, and copper in soils near brick kilns, underlining the environmental challenges posed by this industry. The findings underscore the need for careful soil management and highlight the potential for using fly ash as a soil amendment while minimizing harmful effects.

2.8 Impact of Gaseous Pollutants on Wheat (Adrees *et al*., 2016**)**: Adrees et al.'s field experiment in Faisalabad, Pakistan, assesses the impact of gaseous pollutants emitted from brick kilns on wheat growth. The study finds that exposure to pollutants reduces plant growth, yield, and quality while increasing physical injury and metal concentrations in grains. This research underscores the significant influence of brick kiln emissions on agriculture and calls for further investigations into the effects on other crops.

2.9 Selling Soil for Brick Making (Biswas, 2018): Biswas's research in Bangladesh explores the drivers and impacts of selling soil for brick making. The study reveals that soil degradation poses a significant threat to sustainable agriculture, with brick production contributing to soil loss due to the country's reliance on clay-rich soil. The short-term financial gain from selling soil also acts as a powerful motivator for farmers facing financial crises. The research emphasizes the need for sustainable soil management practices to mitigate the detrimental effects of soil removal for brick production.

2.10 Environmental and Agricultural Consequences (Sarwar *et al*., 2019): Sarwar et al.'s study underscores the substantial negative impacts of rapid growth in industries like brick kilns. The emissions from brick kilns, laden with harmful gases and particulate matter, contribute to air pollution, posing risks to agriculture, horticulture, and forestry. The research emphasizes the destruction of agricultural and farming production, long-term environmental effects such as ozone depletion and smog, and the decline in soil fertility. The study advocates for the enforcement of regulations to prevent brick kilns from encroaching on wooded areas, educational institutions, and agricultural land.

2.11 Utilizing Fly Ash in Agriculture (Kumar and Kumar, 2020): Kumar and Kumar's investigation explores the potential use of fly ash in agriculture. The research finds that lower doses of fly ash can be beneficial for crops, providing macro- and micro-nutrients while serving as an eco-friendly disposal option for excess fly ash. However, the study emphasizes the need for careful utilization to minimize harmful effects, particularly regarding heavy metals and radionuclides.

In sum, the body of literature reviewed here underscores the intricate relationship between brick kiln operations and agriculture in Budgam District, Jammu and Kashmir. These studies collectively reveal a complex web of challenges, encompassing air pollution, soil degradation, vegetation deterioration, and the direct impact on crop productivity. They highlight the critical need for environmental regulations, technological advancements, and sustainable soil management practices to mitigate the adverse effects of brick kiln operations, thereby ensuring the sustainability of agriculture and safeguarding the well-being of local communities.

3. Research Methodology

Research Design

Research design is a critical component of the research process, providing a conceptual plan to investigate the relationship between dependent and independent variables. In the present study, a descriptive research design has been employed. This design focuses on characterizing specific individuals, groups, or situations, enabling an analysis of various perspectives on issues such as the impact of brick kiln industries on socio-economic conditions, health, agriculture, and the environment.

Sampling

Sampling is a pivotal aspect of research, ensuring the selection of a reliable and appropriate sample. To investigate the impact of brick kiln industries in Budgam district, a purposive sampling technique was employed. Three villages in proximity to brick kiln industrial clusters in Budgam district—Panzan, Sunar-Gund, and Lalgam—were purposively selected for the study.

The sampling procedure involved selecting 350 respondents from these three villages using a simple random sampling method. Respondents were chosen based on their residence within a 1-kilometer radius of the brick kiln industrial manufacturing sites in the district. The sampling details are presented in Table 2.

Sampling Chart

(Village Names)	Total number of households within 1 km radius	Population	Sample size	Percentage %
Panzan	473	1720	172	10%
Lalgam	213	940	94	10%
Sunar-Gund	180	840	84	10%
Total	866	3500	350	10%

(Primary Source Table 2.)

To ensure the reliability of data collection, a pilot study was conducted in the research area, involving 60 respondents from the industrial sites in Panzan, Lalgam, and Sunar-Gund. The pilot study validated the effectiveness of the structured interview schedule. Modifications were made to align the interview schedule with the research objectives.

The primary data collection tool employed was a structured interview schedule, designed to gather comprehensive information regarding the impact of the brick kiln industry. The schedule included a set of well-crafted questions covering various aspects, such as socio-economic characteristics, environmental conditions, agriculture, health, and community development. In addition to structured interviews, observation techniques were utilized. These techniques involved first-hand observations and direct interactions with the study area, providing deeper insights into ground realities. The combination of interviews and observations aimed to collect reliable and consistent data.

Fieldwork was conducted. Secondary data from research papers, journals, surveys, books, pollution control board offices, newspapers, and census reports supplemented primary data, enhancing the comprehensiveness and depth of the research findings.

Panzan Village

The village reported a substantial reduction in crop yields due to the presence of nearby brick kilns, with an average rating of 3.9 on a 5-point Likert scale. This signifies that crop yields are moderately impacted by the brick kiln emissions. Rice productivity in Panzan is adversely affected, with an average rating of 3.86 on a 5-point Likert scale. This suggests that rice cultivation faces challenges in maintaining its productivity in proximity to brick kiln emissions. Respondents indicated a reduction in plant growth or retardation, with an average rating of 2.8 on a 5-point Likert scale. This implies that the emissions from brick kilns moderately impede the growth of agricultural plants in the area. There is a notable reduction in vegetation cover with an average rating of 3.77 on a 5-point Likert scale. This implies that the presence of brick kilns contributes to a moderate decrease in the extent of green cover in this area.

Leaf color changes are reported with an average rating of 2.9 on a 5-point Likert scale. This suggests that brick kiln emissions may moderately affect the pigmentation and health of leaves on plants. Photosynthesis, a critical

process for plant growth, is moderately hindered as indicated by an average rating of 3 on a 5-point Likert scale. This underscores the adverse but moderate impact of brick kiln emissions on the physiological functions of plants. The deposition of dust on leaves is a prevalent issue with an average rating of 3.67 on a 5-point Likert scale. This can moderately clog leaf stomata and reduce the efficiency of photosynthesis. The abrupt falling of leaves is reported in with an average rating of 2.98 on a 5-point Likert scale. This suggests that brick kiln emissions may moderately lead to premature leaf drop, which can harm plant health.

Toxic substance accumulation is observed in with an average rating of 3.08 on a 5-point Likert scale. This indicates that the emissions from brick kilns moderately introduce harmful substances into the agricultural environment. A decline in overall agricultural activities is reported, with an average rating of 4.18 on a 5-point Likert scale. This signifies a broad and moderately severe impact on the agricultural sector in this village. A decrease in available agricultural land is noted with an average rating of 4 on a 5-point Likert scale. This implies that brick kiln operations moderately encroach upon or render portions of agricultural land unusable. The loss of topsoil is a significant concern with an average rating of 4.35 on a 5-point Likert scale. This is a critical issue as topsoil is essential for nutrient retention and plant growth.

The falling of fruits from plants is observed with an average rating of 3 on a 5-point Likert scale. This suggests that brick kiln emissions may moderately impact fruit development and retention. Leaf burns and alterations in crop colours are reported in with an average rating of 2.7 on a 5-point Likert scale. This highlights the aesthetic and moderate physiological impact on crops. The degradation of soil micro-organisms and faunal populations is documented with an average rating of 3.1 on a 5-point Likert scale. This indicates that brick kiln emissions moderately disrupt soil ecosystems.

Lalgam Village

The village reported a substantial reduction in crop yields due to the presence of nearby brick kilns, with an average rating of 3.79 on a 5-point Likert scale. This signifies that crop yields are moderately impacted by the brick kiln emissions. Rice productivity is adversely affected, with an average rating of 3.7 on a 5-point Likert scale. This suggests that rice cultivation faces challenges in maintaining its productivity in proximity to brick kiln emissions. Respondents in indicated a reduction in plant growth or retardation, with an average rating of 3.08 on a 5-point Likert scale. This implies that the emissions from brick kilns moderately impede the growth of agricultural plants in the area.

There is a notable reduction in vegetation cover with an average rating of 3.52 on a 5-point Likert scale. This implies that the presence of brick kilns contributes to a moderate decrease in the extent of green cover in this area. Leaf color changes are reported with an average rating of 2.7 on a 5-point Likert scale. This suggests that brick kiln emissions may moderately affect the pigmentation and health of leaves on plants. Photosynthesis, a critical process for plant growth, is moderately hindered as indicated by an average rating of 2.9 on a 5-point Likert scale. This underscores the adverse but moderate impact of brick kiln emissions on the physiological functions of plants.

The deposition of dust on leaves is a prevalent issue with an average rating of 3.81 on a 5-point Likert scale. This can moderately clog leaf stomata and reduce the efficiency of photosynthesis. The abrupt falling of leaves is reported with an average rating of 2.6 on a 5-point Likert scale. This suggests that brick kiln emissions may moderately lead to premature leaf drop, which can harm plant health. Toxic substance accumulation is observed with an average rating of 3.01 on a 5-point Likert scale. This indicates that the emissions from brick kilns moderately introduce harmful substances into the agricultural environment.

A decline in overall agricultural activities is reported with an average rating of 3.9 on a 5-point Likert scale. This signifies a broad and moderately severe impact on the agricultural sector in this village. A decrease in available agricultural land is noted with an average rating of 4.1 on a 5-point Likert scale. This implies that brick kiln operations moderately encroach upon or render portions of

agricultural land unusable. The loss of topsoil is a significant concern with an average rating of 4 on a 5-point Likert scale. This is a critical issue as topsoil is essential for nutrient retention and plant growth.

The falling of fruits from plants is observed with an average rating of 2.9 on a 5-point Likert scale. This suggests that brick kiln emissions may moderately impact fruit development and retention. Leaf burns and alterations in crop colors are reported with an average rating of 2.48 on a 5-point Likert scale. This highlights the aesthetic and moderate physiological impact on crops. The degradation of soil microorganisms and faunal populations is documented in Lalgam, with an average rating of 2.8 on a 5-point Likert scale. This indicates that brick kiln emissions moderately disrupt soil ecosystems.

Sunar-Gund Village

This village experiences a significant reduction in crop yields due to the presence of nearby brick kilns, with an average rating of 3.5 on a 5-point Likert scale. Rice productivity is adversely affected in Sunar-Gund, with an average rating of 3.3 on a 5-point Likert scale. This suggests that rice cultivation faces challenges in maintaining its productivity in proximity to brick kiln emissions. Plant growth retardation is observed with an average rating of 3 on a 5-point Likert scale. This indicates that the emissions from brick kilns moderately impede the growth of agricultural plants.

There is a notable reduction in vegetation cover with an average rating of 3.18 on a 5-point Likert scale. This implies that the presence of brick kilns moderately contributes to a decrease in the extent of green cover in this area. Leaf color changes are reported with an average rating of 2.5 on a 5-point Likert scale. This suggests that brick kiln emissions may moderately affect the pigmentation and health of leaves on plants. Photosynthesis, a critical process for plant growth, is hindered as indicated by an average rating of 2.8 on a 5-point Likert scale. This underscores the adverse and moderate impact of brick kiln emissions on the physiological functions of plants.

The deposition of dust on leaves is a prevalent issue with an average rating of 3.62 on a 5-point Likert scale. This can clog leaf stomata and moderately reduce the efficiency of photosynthesis. The abrupt falling of leaves is reported with an average rating of 2.1 on a 5-point Likert scale. This suggests that brick kiln emissions may moderately lead to premature leaf drop, which can harm plant health. Toxic substance accumulation is observed with an average rating of 2.7 on a 5-point Likert scale. This indicates that the emissions from brick kilns introduce moderately harmful substances into the agricultural environment.

A decline in overall agricultural activities is reported with an average rating of 4.1 on a 5-point Likert scale. This signifies a broad and severe impact on the agricultural sector in this village.A decrease in available agricultural land is noted with an average rating of 4.2 on a 5-point Likert scale. This implies that brick kiln operations moderately. The loss of topsoil is a significant concern with an average rating of 4.25 on a 5-point Likert scale. This is a critical issue as topsoil is essential for nutrient retention and plant growth. The falling of fruits from plants is observed with an average rating of 2.8 on a 5-point Likert scale. This suggests that brick kiln emissions may moderately impact fruit development and retention.

Leaf burns and alterations in crop colors are reported with an average rating of 2.2 on a 5-point Likert scale. This highlights the aesthetic and moderate physiological impact on crops. The degradation of soil microorganisms and faunal populations is documented with an average rating of 2.89 on a 5-point Likert scale. This indicates that brick kiln emissions moderately disrupt soil ecosystems. These ratings reflect the perceptions and experiences of respondents in Sunar-Gund Village regarding the impact of brick kiln industries on various aspects of agriculture and the environment.

Discussion

The findings of this study reveal a significant and nuanced impact of brick kiln emissions on agriculture in three distinct villages: Panzan, Lalgam, and Sunar-Gund, all located within the Budgam district of Jammu and Kashmir. These impacts were assessed across various parameters, and the ratings, gathered through a sociological study using a 5-point Likert scale, shed light on the varying degrees of influence that brick kilns exert on agricultural practices

in these villages.Across all three villages, a notable reduction in crop yields and the productivity of rice was observed. However, Lalgam exhibited the highest reduction in both categories, followed by Sunar-Gund and Panzan. This finding highlights the vulnerability of rice cultivation to the emissions from nearby brick kilns, particularly in Lalgam. Plant Growth and Vegetation: The growth of agricultural plants and the extent of vegetation cover were adversely affected in all three villages. Sunar-Gund faced the most significant plant growth retardation, while Panzan experienced the most significant reduction in vegetation cover. These results underscore the negative consequences of brick kiln emissions on the overall greenery and health of agricultural plants.

Photosynthesis, a vital process for plant growth, was hindered in all three villages. Panzan reported the highest hindrance, followed by Lalgam and Sunar-Gund. Additionally, changes in leaf color, dust deposition on leaves, and the sudden falling of leaves were observed. Again, Panzan demonstrated the highest degree of these issues. These findings suggest that brick kiln emissions can affect not only the physiological functions of plants but also their visual health.

Accumulation of toxic substances was reported in all villages, with Panzan exhibiting the highest accumulation. This implies that emissions introduce harmful elements into the agricultural environment. Moreover, the degradation of soil microorganisms and faunal populations was documented in all villages, with Sunar-Gund experiencing the most significant disruption. This highlights the broader ecological impact of brick kiln emissions on soil health. Declines in overall agricultural activities and available agricultural land were reported in all three villages. Lalgam faced the most significant decline in agricultural activities, while Sunar-Gund had the most substantial loss of agricultural land. This indicates that brick kiln operations can not only deter agricultural activities but also encroach upon or render portions of land unusable. Loss of topsoil was a significant concern across all villages, with Sunar-Gund showing the most severe loss. Since top-soil is essential for nutrient retention and plant growth, this poses a grave threat to agricultural sustainability. Additionally, the falling of fruits from plants was observed in all villages, emphasizing the potential impact on fruit development and retention.

Conclusion

In conclusion, this study underscores the diverse and substantial impacts of brick kiln emissions on agriculture in the villages of Panzan, Lalgam, and Sunar-Gund within the Budgam district of Jammu and Kashmir. The findings reveal that these emissions adversely affect crop yields, rice productivity, plant growth, vegetation cover, photosynthesis, leaf health, soil health, agricultural activities, land availability, and topsoil retention. Moreover, they can contribute to the premature falling of fruits from plants. While the severity of these impacts varies across the three villages, the common thread is the detrimental influence of brick kiln emissions on agriculture. Lalgam consistently exhibited the highest degree of impact, followed by Sunar-Gund and Panzan. These findings underline the pressing need for regulatory measures and sustainable practices within the brick kiln industry to mitigate these adverse effects. Additionally, it emphasizes the importance of local context in understanding and addressing the multifaceted challenges posed by brick kilns to agricultural communities.

Efforts should be made to raise awareness among policymakers, industry stakeholders, and local communities about the ecological and socioeconomic consequences of brick kiln emissions. Strategies for cleaner production, emission control, and reclamation of affected agricultural land should be explored. Furthermore, the engagement of these affected communities in decision-making processes and the promotion of sustainable alternatives can contribute to more resilient and thriving agricultural practices in these regions.

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