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Agnihotra Farming: A Sustainable Alternative to Chemical-Dependent Agriculture

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ABSTRACT: Modern agriculture's reliance on chemical fertilizers and pesticides has led to the degradation of soil and the environment. This paper explores Agnihotra farming, an ancient Vedic practice, as a sustainable alternative to conventional agricultural methods. Agnihotra is a fire ceremony that produces ash with potent agricultural benefits, including enhanced soil fertility, crop yield, and natural pest control. For this article "Agnihotra" "Homa" "Agriculture," and "Farming," "Sustainable" have been used as keywords to identify relevant studies. The literature search found a total of 289 articles initially. On applying inclusion-exclusion criteria and removing duplicates, 36 articles were finally selected. The screening process has been presented by PRISMA flow chart in the article. The selected studies were focused on theoretical interpretations of Agnihotra farming based on the use of Agnihotra ash as fertilizer and pesticide. The article analyzes the composition of Agnihotra ash, highlighting its high levels of essential nutrients like nitrogen, phosphorus, and potassium, which contribute to improved plant growth, crop yield and quality significantly. Additionally, the practice promotes environmental sustainability by reducing chemical usage, enhancing biodiversity, and mitigating the harmful impact of modern agricultural practices. The findings suggest that Agnihotra farming offers a holistic approach to agriculture that harmonizes human activity with nature, offering a viable solution to the ongoing challenge of ensuring food security along with addressing the issues of environmental degradation and economic burden on farmers. The use of Agnihotra ash as fertilizer and pesticide requires further scientific exploration.

Keywords: Agnihotra, Farming, Crop Yield, Fertilizer, Agnihotra ash.

INTRODUCTION

Agriculture has traditionally been a practice deeply connected with the natural world, operating in harmony with ecological cycles and allowing the environment to naturally replenish and maintain soil fertility. However, with the rapid increase in the human population, there has been an ever-growing demand for higher agricultural production to meet global food requirements (Wu *et al.*, 2019). In response, the widespread use of chemical fertilizers and pesticides was introduced, leading to significant gains in crop yields (Liu *et al.*, 2015). While these advancements have undeniably contributed to feeding billions, they have also ushered in a host of environmental and health-related issues. The intensive application of these chemicals has resulted in the degradation of soil health, loss of biodiversity, contamination of water resources, and increased exposure to harmful substances for both humans and wildlife (Balkrishna *et al.*, 2021; Babafemi *et al.*, 2022). In recent times, the world community has been looking for sustainable ways of farming that could address ongoing environmental issues and health concerns, along with ensuring food security. Agnihotra-farming is one such method that restores a healthy relationship between humans and nature. Agnihotra farming is a spiritual practice with agricultural benefits. It is a method that uses Agnihotra as an instrument for enhancing crop yield (Gupta and Pathak 2020). Agnihotra has been observed accelerating seed germination, plant growth and fruit formation (Bhatia *et al.*, 2022). Agnihotra farming offers a comprehensive approach to agriculture that harmonizes human activity with nature, offering a viable solution to the ongoing challenge of ensuring food security while addressing the issues of environmental degradation and the economic burden on farmers.

Agnihotra farming focuses on creating a harmonious atmosphere through a fire ceremony. The combustion of Cow dung, Ghee, Rice, etc. in a copper inverted pyramid-shaped vessel during Agnihotra causes the production of volatile compounds, which have medicinal and health-promoting properties, to diffuse into the air (Abhang and Pathade 2017). The energy field, produced

by the chanting of time-specific Vedic mantras at a particular vibrational frequency, promotes positive energy flow by neutralizing the negative influences of microorganisms and other pollutants suspended in the air (Saxena *et al*., 2007; Kumar *et al*., 2022). Chanting is believed to create a specific vibrational frequency, or "Agnihotra" energy field, around the Agnihotra fire. This energy field is thought to harmonize the atmosphere, promote positive energy flow, and neutralize negative influences (Berk and Sharma, 2015). Scientific research suggests that sound vibrations at specific frequencies promote plant growth. These frequencies have a positive impact on overall plant health. Agnihotra ash also shows properties to be utilized as fertilizer and pesticide (Sharma *et al.*, 2012). Utilization of Agnihotra ash as fertilizer and pesticide makes this kind of natural farming as "Zero Budget Agriculture" since all the inputs are produced naturally and domestically. Agnihotra or Yagya farming is in practice at many places worldwide, while Yagya therapy is being explored for the treatment of various diseases like paralysis, cancer, heart issues, diabetes and aggravated vata-borne musculoskeletal pain (Balkrishna *et al.*, 2024a; Balkrishna *et al.*, 2024b; Balkrishna *et al.*, 2024c). Agnihotra farming at a personal level is in practice in many places worldwide. The objective of this study is to explore the composition of Agnihotra ash and its impact on crop yield and productivity. The paper also discusses the effect of Agnihotra on environmental sustainability.

METHODOLOGY

This comprehensive study aimed to analyze the existing literature on Agnihotra farming. To achieve this objective, a comprehensive search of the literature was conducted in multiple databases, including Science Direct, Google Scholar, Semantic Scholar, Research Gate, Scopus, and Web of Science. The search with relevant keywords "Agnihotra" "Homa" "Agriculture," and "Farming," yielded 289 results. Total articles obtained from searching the databases were pooled together. Duplicates and articles found ineligible to the search criteria were removed. The remaining articles were initially screened by reading the 'title' and after that, the 'abstracts,' and 156 articles were screened further by reading title and abstract, and 104 articles were found ineligible. The remaining 36 articles were screened in the final stage by reading the full text and those not meeting inclusion criteria were excluded. Resulting 36 articles were shortlisted for this review article. The selected articles are focused on theoretical interpretations of Agnihotra farming based on the use of Agnihotra ash as fertilizer and pesticide for cultivation of different crops. The search strategy has been presented through PRISMA flow diagram in Fig. 1.

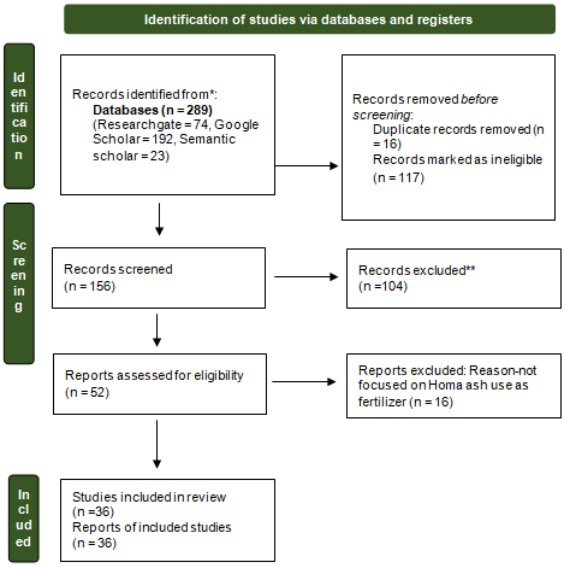

Fig. 1. PRISMA Flow Diagram for Literature Search of this Study.

RESULTS AND DISCUSSION

A. Composition of Agnihotra Ash

Agnihotra ash is a highly porous material. Elemental analysis of Agnihotra ash shows that silicon dioxide (SiO_2) is its major component. The amount of total nitrogen, sodium, total phosphorus, potassium, silica, calcium, chlorides, magnesium, and zinc is higher in comparison to other elements. Table 1 shows a list of ash components present in higher amounts, out of which nitrogen, phosphorus, potassium, calcium, and magnesium are the major nutrients required for plant growth (Abhang *et al.*, 2023).

Table 1: Elements present in higher amounts in the Agnihotra Ash.

Ash Components	Average concentration in ppm
Silica	0.800
Potassium	1.100
Aluminium	0.030
Calcium	0.600
Chlorides	0.560
Magnesium	0.300
Iron	0.030
Volatile matter	0.04
Manganese	0.023
Total Nitrogen	1.500
Total phosphorus	1.010
Sulfur	0.080

Source: (Abhang *et al.*, 2023)

(i) Utility of Agnihotra Ash in Agriculture. There are reports on Agnihotra ash having a fertilizer and pesticide effect, from around the world. In India, Tapovan Homa Farm in Maharashtra and Vedic farming in Uttar Pradesh

have demonstrated the ability of Agnihotra ash to be used as a cost-effective fertilizer and insecticide. Similarly, in other countries like Poland, Australia, and Germany, Agnihotra ash is being successfully used for foliar application, as fertilizer, and for water purification for the cultivation of fruits, vegetables, nuts, grains, pulses, medicinal herbs, and flowers (Berk, 2020; *Homa Farms Around the World, Part 2*, 2023).

Experimental studies performed on various crops using Agnihotra ash show its promising potential as a fertilizer and a pesticide. In the case of *Zea mays*, there was a 40% increase in plant growth and crop yield in comparison to control plants when Agnihotra ash was added to the yellow soil. The addition of Agnihotra ash to the yellow soil improved the quality of the soil and nutrient absorption capacity of the plants by enhancing the pore size of the roots (Sharma *et al.*, 2012). The addition of Agnihotra ash to the soil improves soil microflora like nitrate fixers and phosphate solubilizers, which make soil nutrients easily available for plants to absorb (Berde *et al*., 2015). The soil treated with Agnihotra ash-based bio-enhancer Biosol has been found to increase the microbial activity in the soil, leading to the improved content of organic carbon, phosphorus, copper, manganese, iron, zinc, total protein, and oil in Soybean crops (Kumari *et al.,* 2014). Further, the foliar application of Agnihotra ash results in enhanced growth, yield, and quality of fruit of Okra crop, in comparison to plants grown on other organic treatments (Kumar *et al*., 2017). Moreover, Agnihotra treatment has been observed to improve the respiration and germination rate of Rice seeds, even during the adverse season of winter (Devi *et al.*, 2004). Similar, findings have been reported in the case of Chickpea crops as well (Pranay *et al*., 2015). Brinjal crop also shows improved content of ascorbic acid, dry weight, and overall quality of the fruit, on the application of Agnihotra ash (Tripathy and Dutta 2019).

Application of the Agnihotra ash has demonstrated a decrease in the incidences of insect attack and rust in the crop (Pathak and Ram 2020; Kumari *et al.*, 2014). Agnihotra has been observed as a good insect repellent and antifungal agent. The addition of Agnihotra ash reduces the period of vermicomposting and improves the effectiveness of paste for smearing on aerial parts of the fruit trees (Abhang and Pathade 2017). A considerable reduction in disease and pest incidences on Okra plants, including Powdery mildew (19-36%), Alternaria leaf spot (30-57%), and fruit bore (16-38%) have been found after the application of Agnihotra ash (Bhatia *et al*., 2022). Agnihotra ash treatment also significantly reduced early blight disease of potatoes and tomatoes, as well as bacterial blight disease of tomatoes in polyhouses. Additionally, it lowered environmental pathogenic microflora by around 70% (Kadam *et al*., 2020).

Agnihotra Ash and Environmental Sustainability. The widespread use of chemical fertilizers and pesticides in modern agriculture has significantly contributed to environmental degradation. These chemicals, while increasing crop yields, have detrimental effects on soil health, water quality, and biodiversity (Pahalvi *et al.*, 2021). Fertilizers often lead to nutrient runoff, causing eutrophication in water bodies, which depletes oxygen and harms aquatic life (Hashimi and Hashimi 2020). Pesticides, on the other hand, not only contaminate soil and water but also pose risks to non-target species, including beneficial insects and birds, leading to a decline in biodiversity (Ankit *et al.*, 2020). Furthermore, the persistence of these chemicals in the environment can result in long-term ecological imbalances and the accumulation of toxic residues in the food chain, raising concerns about food safety and public health (Sharma and Singhvi 2017). People today suffer from genotoxicity and other health issues like obesity, aggression, insomnia, infertility, cancer, and so on as a result of eating food grown with chemical fertilizers and pesticides by farmers (Biswas and Das 2024; Bahadur *et al*., 2015).

In contrast, Agnihotra, an ancient Vedic practice, offers a sustainable alternative that addresses the negative impacts of chemical-based agriculture. Research suggests that Agnihotra ash can improve soil health by enhancing microbial activity, restoring nutrient balance, and neutralizing the harmful effects of chemical residues (Berk, 2020). Additionally, the smoke produced during Agnihotra has been shown to reduce air pollution by neutralizing toxic pollutants and promoting the formation of beneficial aerosols, which can help mitigate climate change effects by aiding in cloud formation (Berk, 2020; Chaganti, 2020). A significant improvement has been reported in Air Quality Index (AQI) levels and hazardous pollutants like $PM_{2.5}$ and PM_{10} reduced to safe levels after performing Yajna in urban areas (Rastogi *et al.*, 2023). Water purification capability of Agnihotra atmosphere has also been reported (Berk and Sharma 2015; Abhang *et al*., 2023).

Agnihotra ash is utilized to improve the quality (health) of plants and soil. It is used to maintain soil pH, mineral enrichment, moisture retention, and pest control, and also aids in the process of composting (Balkrishna *et al.*, 2021; Pathak and Berk 2015). The practice of composting promotes a clean environment by reducing the use of chemical pesticides and fertilizers. Moreover, Agnihotra farming promotes biodiversity through the practices of crop rotation, intercropping, and pollination-friendly methods (Berk, 2018). Increased biodiversity can lead to improved pest control, pollination, and nutrient cycling (Jones and Snyder, 2018). Thus, Agnihotra farming benefits not only the farm itself but also the surrounding ecosystem and communities (Berk, 2020). Another advantage of using Agnihotra ash in

agriculture is reducing the economic burden caused by the high costs of agrochemicals (Pranay *et al.*, 2015).

The addition of ash to the agricultural soil contributes to soil fertility by improving the content of water-soluble phosphate in the soil. The use of Agnihotra ash has been found to increase plant phosphorus solubility and availability (Kratz and Schnug 2007). Being a highly porous material, it also enhances aeration for root respiration and drainage, making soil nutrients readily available to plants (Pathak and Berk 2015). The addition of Agnihotra ash to soil enhances the water-holding capacity of the soil, which helps in the survival of plants during dry periods (Berk, 2020).

Agnihotra-farming helps farmers produce agri-inputs like fertilizer and animal food on their own. So, the farmers practicing Agnihotra-farming do not need to rely on the market for agri-inputs. It protects them against economic crises. Agnihotra-farming emphasizes the cultivation of several varieties of crops and animals, which ensures the security of both food and nutrition. Thus, the obtained crops are not only free of harmful chemical fertilizers and pesticides, but the taste and shelf life of the crop is also improved (Pathak and Ram 2020). Similarly, efficient water use and rainwater harvesting are emphasized by Agnihotra-farming. The spiritual dimension associated with Agnihotra-farming could have a special meaning for farmers, and the consumer community and endorse the mutual dependence of various living beings (Dwivedi and Bajpai 2023) (Fig. 2).

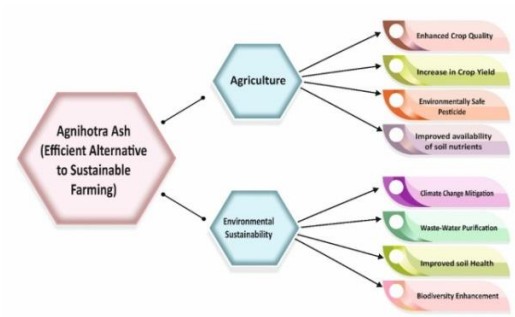

Fig. 2. Agnihotra ash – An Alternative to Sustainable Farming.

Limitations and Solutions. While Agnihotra farming presents a promising sustainable alternative to conventional agricultural practices, it is not without its limitations and challenges. One significant limitation is the lack of extensive scientific validation and empirical evidence supporting its efficacy across diverse agro-climatic conditions. Although various studies have demonstrated the benefits of Agnihotra ash in improving soil health, crop yield, and pest control, these studies are often limited in scope and geographical coverage. The lack of large-scale, multi-location trials raises questions about the consistency and scalability of Agnihotra farming practices, particularly in regions with different soil types, climate conditions, and agricultural demands.

To explore the full potential of Agnihotra ash as fertilizer, there is a need to conduct more experimental studies with Agnihotra ash using different crops. Depending on the materials used and the soil conditions, the composition of Agnihotra ash varies. Therefore, it will take a lot of work to standardize its application and results. Optimization of ash dosage and its application method needs to be explored further as the excessive application can result in disrupted soil pH and affect the nutrient balance and microbial population of the soil. There is no uniformity in the result of the application of Agnihotra ash as fertilizer. The effect of ash varies crop-wise, reflecting upon the different nutritional requirements of various crops. There are possibilities that the Agnihotra ash will not be a suitable fertilizer for some other crops. So, the effect of different kinds of factors on Agnihotra treatment needs to be studied and confirmed scientifically.

Another challenge lies in the integration of Agnihotra farming with modern agricultural practices. The spiritual and ritualistic aspects of Agnihotra, including the precise timing and chanting of Vedic mantras, may not be easily adopted by all farmers, especially in regions where these cultural practices are unfamiliar. This can lead to skepticism and resistance among farming communities, hindering widespread adoption. Moreover, the labor-intensive nature of performing Agnihotra rituals may pose a barrier to large-scale commercial farming operations that rely on efficiency and mechanization. To integrate Agnihotra farming with modern agricultural practices, a combination of simplification, technological innovation, and community collaboration is essential.

Research on Agnihotra farming methods is hindered by limited research funding also (Biswas and Das 2024). At present, Agnihotra farming is limited to personal-level farming only, for wider acceptability it requires scientific validity and policy support from the Government. Agnihotra farming requires to be integrated with modern-sustainable farming practices like the use of Agnihotra ash as fertilizer in combination with soil retreating carbon farming practices as reduced tillage, cover cropping, and compost application. Engagement of Agricultural specialists in this area of research would further increase the chances of incorporation of Agnihotra ash into agricultural operations. Moreover, additional studies must be conducted and reported on Agnihotra ash as a fertilizer and pesticide for various crops.

There are also gaps in the understanding of the long-term impacts of Agnihotra farming on soil health, biodiversity, and overall ecosystem services. While initial studies indicate positive effects, more research is needed to explore the long-term sustainability of these practices, particularly in comparison to other organic and regenerative farming methods. Additionally, the potential interactions between Agnihotra ash and existing soil nutrients, as well as its impact on non-target

organisms, are areas that require further investigation. Addressing these gaps through rigorous scientific research and field trials is essential to validate Agnihotra farming as a viable and scalable solution for sustainable agriculture.

The present research contributes significantly to the field of sustainable agriculture by demonstrating the unique benefits of Agnihotra ash as a natural fertilizer and pesticide, which aligns with but also extends the findings of recent studies in sustainable farming practices. While previous research, such as Kumari *et al.* (2014), focused on enhancing microbial activity and nutrient cycling in crops like soybean, this study shows a broader application across different crops, including *Zea mays* and Okra, where a 40% increase in yield and enhanced pest control were observed. In comparison to works like Kratz and Schnug (2007); Devi *et al.* (2004), which explored the benefits of bio-enhancers and organic inputs in improving phosphorus solubility and germination rates, the present research advances these findings by illustrating that Agnihotra ash not only boosts soil nutrient availability but also mitigates adverse seasonal effects, such as in rice crops. Moreover, this research highlights the environmental sustainability of Agnihotra farming, reducing the reliance on chemical inputs while improving crop yield, which builds upon previous sustainable practices but adds a spiritual and ritualistic dimension that further differentiates it from other organic methods.

This study further addresses the limitations of Agnihotra farming and proposes scientifically grounded solutions. Unlike previous studies that primarily focused on the benefits of Agnihotra ash as a fertilizer and pesticide, this review critically examines the gaps in current research, such as the variability in the composition of Agnihotra ash depending on soil conditions and materials used in the ritual. The inconsistency in outcomes across different agro-climatic regions has also been highlighted, calling for more extensive and geographically diverse trials to validate its scalability and efficacy.

Thus, the major contribution of this study lies in its validation of Agnihotra farming as a scalable and effective alternative to chemical-based agriculture, presenting a comprehensive solution that improves both crop productivity and environmental health, which can be adopted globally across various agricultural systems

CONCLUSIONS

Agnihotra farming represents a promising and innovative approach to sustainable agriculture, offering a comprehensive solution to many of the challenges posed by conventional farming practices. The utilization of Agnihotra ash as a natural fertilizer and pesticide has demonstrated significant benefits in enhancing soil health, improving crop yields, and reducing pest incidences, as evidenced by various studies. Furthermore, the practice's alignment with environmental sustainability principles—such as promoting biodiversity, enhancing soil microbial activity, and reducing the ecological footprint of farming—positions it as a viable alternative to chemical-based agriculture.

However, for Agnihotra farming to be widely adopted and integrated into mainstream agricultural practices, further scientific validation and empirical research are necessary. Addressing the existing limitations, such as the variability in Agnihotra ash composition and the need for standardization of its application, will be crucial for its scalability and consistency across different farming contexts. Additionally, bridging the gap between traditional practices and modern agricultural technologies through policy support, education, and community engagement will be essential in promoting the widespread adoption of Agnihotra farming as a sustainable and economically viable agricultural practice for the future.

FUTURE SCOPE

The prospects of Agnihotra farming look promising. It presents a solution to contemporary agricultural and environmental issues. In the era of threatened food security and environmental degradation, Agnihotra farming offers a holistic solution. The future of Agnihotra farming depends on bridging the gap between tradition and scientific validation. This farming method promotes the use of natural fertilizers like compost, by enhancing the crop and biomass yield. Agnihotra ash acts as an insect repellant, prevents diseases, and improves soil fertility and a protective atmosphere is created by the ritual of Agnihotra. In terms of cost, Agnihotra farming methods are economical, as very low-cost inputs are required to perform the ritual. There is high demand in the market and a good return price for the crop produced by Agnihotra farming. To make Agnihotra farming be adopted at a large scale, it must be promoted through comprehensive policy frameworks and educational programs.

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Conflict of Interest. None.

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