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An Over View to Agricultural Waste Burning*

M.M.Lal

Ex. Deputy Director, In-Charge Environmental Monitoring Division
Industrial Toxicology Research Centre, Lucknow

Introduction

Open-field burning of plant material has been a long-standing traditional agricultural practice by farmers and foresters. The reasons are highly variable. Most often it is an efficient method to reduce and/or dispose of vegetative debris from an agricultural operation necessary for disease control, pest control, crop propagation, and/or crop rotation. Some common reasons of agricultural burning include:

1. Field burning of large areas of crop residue after harvest to reduce excess plant material;
2. To control crop diseases, weeds or pests, or to maintain crop yields;
3. Disposing of piles of agricultural debris such as orchard trees, limbs, or haystacks; and
4. Clearing vegetation out of irrigation ditches and canals.

Although by burning of plant materials the farmers have particular benefits in terms of cost and time to agricultural and forest operations such as disease and weed control, it has larger, far-reaching negative impacts, which often are overlooked or considered and accepted as minimal. Significant examples of the negative impacts are the degradation of regional air quality by smoke particles and the loss of organic materials necessary for soil enhancement.

Agricultural burning is not a device or chamber designed to achieve combustion. When farmers burn their agricultural lands, the products of combustion are emitted directly into the open air. Heavy smoke, consisting of Particulate Matter, from these fires clouds the skies. This smoke is a mixture of airborne particles of various sizes and composition, including soot, ashes, and dust. The very smallest particles can be inhaled deeply into the lungs where they can be absorbed into the bloodstream and remain lodged for extended periods of time. It is these fine particles that are most damaging to our health, particularly to people with breathing problems and asthmatic conditions.

Paddy growers burn wheat stubble that remains in the fields after wheat harvesting. Burning reduces the amount of pesticides that must be applied to control insects, nematodes, and weeds, but at the same time the smoke from agricultural burning contains various air pollutants, including particulate matter (PM), nitrogen dioxide (NO_2), CO, and a series of semi-volatile and volatile organic compounds. Inhalation of these air pollutants could result in respiratory symptoms. Thus agricultural burning can be a significant health issue especially to people with pre-existing respiratory diseases such as asthma or emphysema.

Emissions from Agricultural Burning

Burning of agricultural materials releases a variety of products into the atmosphere. The combustion process is well documented as one of combining oxygen with carbon materials producing carbon monoxide, carbon dioxide and water plus a wide variety of volatile chemicals. These chemicals are dispersible into the atmosphere, depending on the material being burned. Besides fully combusted materials, the smoke plume also contains particulates of partially combusted materials such as soot, which becomes airborne and is transported downwind. Also, some unburned residues usually remain at the site of the fire as ashes to be returned to the soil or blown away. Thus, the smoke plume is a variety of particulates and gases that move vertically and downwind in the transportation and dispersion process.

Thus the on-site burning impact is to remove a large portion of the organic material being burned while denying the soil an opportunity to enhance its organic matter and incorporate important chemicals such as nitrogen and phosphorous, while the off-site impacts can be health related if there are populations downwind with sensitivity to the smoke constituents and in general the air quality of regional haze degrades.

Particulate Emissions from Agricultural Burning (Problem Statement)

Problem about particulate emissions from agricultural burning has a growing environmental concern about the quality of air we breathe. We know that one of the primary pollutants of concern is particulate matter.

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Particulate termed PM-10 and PM-2.5 are of primary concern to us. These emissions have been deemed to have significant potential impact on the health and well being of humans and animals. These particulates can pass through human's nasal air filtering system and it is difficult for the body to dislodge them from the respiratory tract.

Understanding how these emissions are generated, transported, and controlled is of primary interest to us. With ever increasing regulatory stringency in relation to the character and quantity of emissions, agricultural burning needs reliable emission factors by which we can better understand the amount of particulate emission generated by burning processes. Without this understanding, reduction of emissions would have limited success. However, the quantity and composition of any particular agricultural burning may not be easy to measure and document. These depend on such variables as the organic material quantity, composition, moisture content and wind and fire characteristics. The proportions that become combusted or suspended as soot or ashes depend on many of these parameters and are highly variable, making it difficult to predict them.

Also the off-site impacts on health and air quality degradation are not readily known and are difficult to estimate. The variation in human sensitivity to combustion products makes this aspect particularly difficult to assess and manage. General air quality and regional haze depend highly on atmospheric conditions such as wind and pressure patterns, precipitation, and interaction with radiation.

Health Effects due To Smoke Exposure

If you are healthy, you are usually not at a major risk from short-term exposures to smoke. Still, it is a good idea to avoid breathing smoke if you can help it. The biggest health threat from smoke comes from fine particles. These microscopic particles can get into your eyes and respiratory system, where they can cause health problems. The health problems may be of burning eyes, runny nose, coughing, wheezing, and decreased breathing ability in persons having asthma, emphysema and bronchitis. In some cases, healthy adults and children are also at risk.

Fine particles can also aggravate chronic heart and lung diseases. Even these particles are linked to premature deaths of people with these conditions. Research has linked particulate matter exposure to serious respiratory health effects among the elderly and those with heart and lung diseases.

Approach to Assessment of Pollution due to Agricultural Burning

A multidisciplinary approach has to be used to differentiate the quantities of PM-10 and PM-2.5 being emitted from agricultural burning and to use that information to formulate reliable emission factors. Methods and procedures should be developed and employed to investigate the generation, transport, and deposition of particulate emissions from the burning source. The assessment programme can be highlighted as follows:

1. Reliable particulate emission factors should be developed for both PM-10 and PM-2.5 for different types of agricultural burning;
2. Reliable, repeatable methods should be developed to measure and evaluate size of particulates emitted from agricultural burning.
3. A database should be created to support scientifically sound decisions concerning the generation, transportation, and deposition of particulates from agricultural burning;
4. Some control technologies should be applied or developed where needed to reduce PM-10 and PM-2.5 particulate emissions; and
5. Conditions that create PM-10 and PM-2.5 occurrences should be predictable (e.g., weather, humidity, burning material etc.).

Control / Management of Agricultural Burning

Open burning is directly related to the growth and harvesting of crops. Burning should be done taking some precautions as follows:

1. Emission of smoke should not be allowed to pass onto or across a public road or landing strip such that no hazard is created by impairment of visibility;
2. The material to be burned must be as dry as possible; and

3. The wind direction at the site of agricultural burning must be such that the smoke would generally be carried away from areas of human habitation.

The following experimental designing may be helpful in the management of agricultural burning:

1. Develop viable alternatives to agricultural burning;
2. Develop burning strategies that reduce emissions and downwind impacts;
3. Develop capability to predict composition and quantities of emissions from agricultural burning; and
4. Identify and minimize burning components that significantly impact downwind inhabitants.

Reasonable tasks directed toward accomplishing these goals should include a specialized research capability to perform agricultural burning experiments and careful analysis of each application of agricultural burning for its need and impact on agricultural production operations, followed by: 1) seeking alternatives to burning; 2) development and testing of a variety of burning techniques that minimize emissions and downwind impacts; and 3) developing close coordination with the medical profession to evaluate components and concentrations of burning emissions that cause the maximum impairment on impacted people.

Conclusion

Agricultural burning can produce a large amount of smoke in a short amount of time. To reduce impacts, some information is required to be known before burning can be conducted. This is:

- Type of agricultural materials;
- Amount of agricultural materials to be burned; and
- Time of burning when air quality and meteorological conditions are most suitable for reducing potential impacts.

Additionally some research programmes should be initiated to achieve an understanding such that burning can be minimal and in specialized cases only. Further, through alternative practices and careful management, burning should be utilized for those agricultural and forester operations for which there are no other logical, mechanical or biological options. Utilizing burning as the most economical of several options should not be an acceptable criterion for general applications. Efforts should be made to find out method and technologies aimed at optimum efficiency in reducing particulates emitted into the atmosphere at minimum cost.