



Project Summary

Assessment for Future Environmental Problems— Agricultural Residues

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This assessment was undertaken to determine whether agricultural burning constitutes an environmental problem in the United States. Preliminary indications are that agricultural burning is not likely to become a national problem.

The report summarizes available information on location, types, and quantities of residues burned; health effects; nonhealth related concerns; policies, regulations, and smoke management plans affecting agricultural burning; and alternative disposal practices. A qualitative analysis discusses the future of agricultural burning on a regional basis, taking into account factors such as agricultural production potential and demographic changes. A trend analysis computer model is used to examine the potential future emissions of particulates, hydrocarbons, and carbon monoxide from agricultural burning in California and in the Willamette Valley, Oregon.

The report concludes by identifying gaps in information, recommending methods to gather the missing information, and identifying and prioritizing research efforts. An annotated bibliography of over 100 references is provided.

This Project Summary was developed by EPA's Office of Exploratory Research, Washington, DC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

In 1977, the Environmental Protection Agency (EPA) published a report on

agricultural burning entitled "Source Assessment: Agricultural Open Burning, State of the Art." The objective of the report was to "assess the environmental impact of agricultural open burning and to produce a state of the art report summarizing available data on air emissions from this source." Information in the report included a process description of the evolution of emissions from agricultural burning, factors affecting these emissions, geographic distribution of agricultural burning and its emissions, emission estimates and characteristics, and pollution control technology. The current study was able to draw upon some of the information developed in the earlier report in addressing its primary objective of determining whether agricultural burning is a current or a potential national problem, and, if so, identifying research and policy alternatives available to address the problem. However, most of the information required expansions and updating. Furthermore, the current study attempts to assess the potential for environmental problems to a greater extent than did the previous study. The report includes a qualitative trend analysis for the nation based upon literature and personal communications. Also, an attempt was made to develop a quantitative trend analysis. To this end, the FUTURSCAN trend impact analysis model was used to predict the status of the practice in year 2002. The FUTURSCAN analysis was conducted only for California and Oregon, as input data were insufficient for other states. Input data for these two states also were limited. Consequently, the usefulness of the FUTURSCAN results, contained in an appendix to the full report, is limited.

Conclusions

From a review of the available information, some conclusions can be drawn about the practice of agricultural burning, health effects, and the adequacy of the data base available for this study.

Current and Future Status of the Practice

Agricultural burning is an important agronomic practice in certain areas of the nation. Its use is likely to continue, barring discovery of major adverse health impacts associated with exposure to its smoke. Viable alternatives for certain crops or in some areas are limited. Other major factors that could influence the growth or decline of the practice include increases in agricultural production, continued population shifts, and the development of alternative disposal methods.

Agricultural burning is likely to decrease in California and Oregon due to continued efforts to discover and implement viable alternatives and to limited potential for increases in agricultural production. Increased competition for markets is likely to result in a decrease of sugar cane production in Hawaii and, hence, in a decrease in sugar cane burning. In the Southeast region, large acreage available for agricultural production is likely to result in more acres of residues being burned. Population shifts toward the West and Southwest are likely to increase public exposure to the practice and disagreements between farmers and non-farmers. In the West, smoke management programs are in effect. In the Southeast, agricultural burning currently is practiced with much less reliance on smoke management techniques. If total acres burned and populations increase as expected, pressures to reduce emissions and human exposure will likely result in adoption of some form of regulation. As in the West, Southeast states appear to have mechanisms to manage emission control programs.

Health Effects

Little research has been conducted to document health effects from agricultural burning, and the findings from these studies are inconclusive. Therefore, conclusions are limited in scope and reliability.

Common observation indicates that short-term eye and respiratory irritations may occur as a result of exposure to the smoke. Long-term impacts of exposure are unknown; however, the smoke is composed primarily of particulates, car-

bon monoxide, and hydrocarbons. Much of the particulate burden is submicron in size and is easily deposited deep in the lungs. Known and suspected carcinogens and some trace metals have been identified in the smoke emitted from some residues. The presence of these materials suggests a potential for adverse health impacts.

Health effects data in general are insufficient to determine long-term impacts associated with exposure to airborne carcinogens. While agricultural smoke can be a source of materials to which the local population could be exposed, it is only one among many potential sources on a nationwide scale. Research programs are underway to identify health impacts of criteria pollutants and airborne carcinogens, and the identification of agricultural fire smoke as a source of potentially harmful pollutants underscores the need to continue these research efforts. Health effects information specific to agricultural burning should be used to supplement ongoing research.

Information Base

Significant gaps in available information have made it impossible to draw final conclusions about the importance of agricultural burning as a nationwide source of air pollution. Analysis showed that most available and reliable information pertained to agricultural burning in California, Oregon, and Hawaii. However, sources with nationwide information about crops, location, and quantities burned contained numerous inconsistencies.

A more reliable analysis of the importance of agricultural burning as an agronomic practice and a source of air pollution could be completed if a new data base were created or even if the reliability of the existing data bases could be verified. A uniform approach to collecting specific information would provide a data base suitable for developing a clear picture of agricultural burning and other residue disposal methods. The U.S. Department of Agriculture annually conducts a census of agricultural statistics. A section added to this census could provide the desired data base. Alternatively, a nationwide survey of agricultural extension agents or agriculture department officials in county offices could provide a reasonably accurate description of the practice.

Little information was available concerning health and socio-economic effects associated with agricultural burning.

The initial literature search produced reports concerning energy production from burning or agricultural residues; however, little of this information could be obtained or analyzed under the scope of the present study.

FUTURSCAN

Insufficient historical data and the difficulty in determining the technical relationship between events and their impacts limit the usefulness of the results. Also, the results give little information that is not already apparent from a careful study of the input data and event parameters. Furthermore, the probabilities of events vary among states and the impacts of events vary among crops and states. Thus, it is only feasible, at best, to use a futures model of agricultural burning for small geographic areas, such as the Willamette Valley in Oregon. These results are not applicable to other parts of the country for several reasons, including the absence of an event concerning increased agricultural production. That particular parameter was not considered for this study because increased production in the two study areas (California and Oregon) is questionable.

Recommendations

Agricultural burning is primarily an air pollution problem. The Clean Air Act defines air pollution problems that befit federal action, and it describes appropriate actions that the federal government should take with respect to air pollution problems. The act specifies protection of public health as EPA's top priority with regard to air programs. Thus, EPA's top research priorities should include filling data gaps relating to health effects associated with agricultural burning. Secondary priority should be given to research that would assist EPA or the states in developing appropriate regulatory responses. Such research priorities are further suggested by the gaps that exist in the health effects information.

The following are research recommendations listed in order of priority:

1. Improve data base concerning health impacts of agricultural burning. To accomplish this, the federal government should support air pollutant risk assessments, according to the steps itemized below:
 - conduct smoke assays and determine specific hazardous compounds in smoke for crops the

residues of which typically are burned in the largest quantities or in areas appearing to have the highest probability for human exposure to smoke;

- for use in estimating ambient air concentrations and population exposures, develop air pollution dispersion models applicable to agricultural burning area sources;
- conduct source characterization studies for crops selected as described above. These studies should contribute to the development of a uniform national data base for all crops burned. The studies could be undertaken as part of the annual census conducted by the U.S. Department of Agriculture, or they could consist of surveys of agricultural extension agents and local agricultural department officials. The studies should provide information, including the location of sources (given in latitudinal and longitudinal coordinates), areas of specific types of crops grown and harvested per source, tons per acre of residue generated, annual burn periods, and descriptions of physical characteristics of agricultural burning sources, including burning technique, fuel heating value, heat loss, moisture content of residue, flame height, temperature and wind speed, and fire propagation rate;
- conduct toxicological, or, where feasible, epidemiological studies to verify suspected short-term impacts of intrusions (e.g., eye and respiratory irritation), and to develop risk factors (if not already developed with regard to other sources of the same pollutant) for hazardous components of agricultural burning smoke. Synergistic effects also should be investigated; and
- use risk factors, pollutant dispersion, and population exposure (population information should be available) models to determine annual health effect incidence and maximum lifetime risk for specific hazardous compounds in smoke for crops selected as described above.

2. Actively encourage the development and implementation of smoke man-

agement techniques. Smoke management techniques appear to be the best available techniques for limiting emissions where agricultural residues are burned. These techniques have been implemented successfully in California, Hawaii, Oregon, and Washington and could be adapted for use elsewhere, especially in the Southeast.

To promote smoke management techniques, the federal government should direct efforts toward:

a. Development of a guidance document for state air pollution control and agriculture department personnel explaining smoke management techniques. Specifically, these reports should contain the following types of information:

- description of smoke management techniques and alternative methods (both tried and untried);
- description of regions and crops where methods are used or may be appropriate for use;
- critical factors that affect the feasibility of implementation or transferability to other areas;
- instruction for adapting techniques to accommodate local or regional needs;
- the kinds of impacts the methods have on emissions, safety, cost to the farmer, agronomic and other benefits, other environmental and economic factors, and smoke plume characteristics;
- critical factors that affect the above impacts;
- instructions for developing a smoke management plan and incorporating the plan into the state's body of regulations; and
- contacts for further information.

b. Development of a guideline document to introduce smoke management techniques to farmers, including information listed above that would assist farmers in implementing the techniques.

c. Implementation of outreach programs to farmers to explain and encourage the use of smoke

management techniques. Workshops, provided through agricultural extension agencies and using guideline documents described above should be provided to farmers.

3. Support research into alternative methods of residue disposal. Research already is underway in certain areas. One particularly promising alternative is the substitution of meadow foam grass for ryegrass in Oregon. Further market assessments and breeding experiments are necessary to establish the value of meadow foam and increase its agronomic suitability to Oregon soils. Further research is also needed in Oregon and elsewhere into alternative disease, pest, and weed control; research efforts in these areas have been slow due to high costs and the long-term nature of the experiments.

Energy production from residues in California has already been successful. Further research is required to determine the energy-producing value of other promising residues, particularly those from prunings, rice, and field crops.

Whole cane stalk cleaners have shown promise in Louisiana; however, more study is needed to demonstrate their value under field conditions and for different conditions of cane stalk.

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The complete report, entitled "Assessment for Future Environmental Problems—Agricultural Residues," (Order No. PB 84-161 371; Cost: \$17.50, subject to change) will be available only from:

*National Technical Information Service
5285 Port Royal Road
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*The EPA Project Officer can be contacted at:
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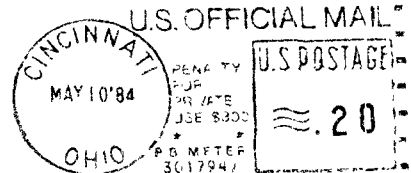
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