SNAP CODE: **090700**

SOURCE AACTIVITY TITLE: **OPEN BURNING OF AGRICULTURAL WASTES (EXCEPT STUBBLE BURNING)**

NOSE CODE: **109.04**

NFR CODE: **6 C**

1 ACTIVITIES INCLUDED

This chapter covers the volume reduction, by open burning, of agricultural wastes. It does not include stubble burning, which is covered under SNAP code 100300, or forest fires, which is covered under SNAP code 110300. The open burning of rubber tyres or waste oil on farms has also not been included.

Examples of agricultural wastes that might be burned are crop residues (e.g. cereal crops, peas, beans, soya, sugarbeet, oil seed rape etc.) wood, leaves, animal carcasses, plastics and other general wastes. Straw and wood are often used as the fuel for the open burning of agricultural wastes. Poultry and animal excreta are difficult to burn except under controlled conditions.

2 CONTRIBUTION TO TOTAL EMISSIONS

The open burning of agricultural waste is likely to be widespread, although it will rarely be a significant source of emissions except on a local scale for short time periods.

Table 1: Contribution to total emissions of the CORINAIR90 inventory (*28 countries*)

Source-activity	**SNAP-code**	**Contribution to total emissions [%]**							
		SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	NH_3
Open Burning of Agricultural Wastes	090700	-	0.9	1.8	0.8	5.8	0.3	0.3	-

0 = emissions are reported, but the exact value is below the rounding limit (0.1 per cent)
- = no emissions are reported

3 GENERAL

3.1 Description

The emissions arising from open burning depend on a number of factors. The most important variables are the type of waste burned and the moisture content of the waste. The ambient temperature and wind conditions, and the density/compactness of the pile of waste also affect the combustion conditions and hence the emissions.

3.2 Definitions

3.3 Techniques

The open burning of agricultural waste is carried out on the ground, in pits in the ground, or in open drums or wire mesh containers/baskets.

3.4 Emissions/Controls

One of the main concerns regarding agricultural waste combustion is the emission of smoke/particulates (MAFF 1992). Toxic organic micropollutants, such as polycyclic aromatic hydrocarbons (PAHs) and dioxins are likely to be present in the emissions. In many cases the combustion will be slow and inefficient, and therefore emissions of carbon monoxide (CO) and volatile organic compounds (VOCs) will be more significant than emissions of oxides of nitrogen (NO_X). The burning of plastics is likely to produce particularly toxic emissions, such as dioxins, other chlorinated organic compounds and cyanides.

The application of abatement equipment to open burning is impractical. However, changes in certain agricultural practices can reduce emissions. Waste minimisation and recycling, and the use of other more environmentally acceptable disposal methods, such as composting, reduces the quantity of agricultural waste burned.

The recycling and reuse of plastics, or the use of disposal methods other than burning, is particularly important.

The disposal of animal carcasses by methods other than open burning, such as to a licensed incinerator or landfill site, is likely to cause significantly less pollution.

Methods to improve the oxygen supply to the agricultural waste during combustion, and the burning of dry waste only, will improve the combustion conditions and reduce the emissions.

4 SIMPLER METHODOLOGY

The simpler methodology involves the use of a single emission factor for each pollutant representing the emission per mass of waste burned. This requires a prior knowledge of the weight of agricultural waste produced per hectare of farmland. It is assumed that open burning of agricultural waste (except stubble burning) is mainly practised in arable farming; emissions from open burning for other types of farming are likely to be less significant and are assumed to be negligible.

The dry weight of crop residue arisings for an average hectare of cereal crops has been estimated to be 5 tonnes per hectare (Lee and Atkins 1994). Most of this crop residue is burned as stubble or ploughed into the ground. Using this figure as a guide, it is assumed that the average quantity of agricultural waste disposed of by open burning (except stubble burning) is equivalent to between 0.5% of dry crop residue arisings in UNECE countries. The actual figure for each country will vary depending on farming practices and other available methods of disposal. The average amount of waste burned for arable farmland is therefore estimated to be 25 kg/hectare.

5 DETAILED METHODOLOGY

An improvement of the simpler methodology can be achieved by estimating the weight of waste produced per hectare for different types of farming, and, in the case of arable farming, for different types of crop. This would require a more detailed review of farming practices.

6 RELEVANT ACTIVITY STATISTICS

For the simpler methodology the national area of arable farmland is required. If a more detailed methodology is required then the breakdown of the national area of farmland into different types of farming (including the breakdown of arable farming into areas of different crops) would be needed.

7 POINT SOURCE CRITERIA

This activity should be considered as an area source.

8 EMISSION FACTORS, QUALITY CODES AND REFERENCES

There is no information available on emissions from the open burning of agricultural waste by methods other than stubble burning. It has been assumed that emission factors for the open burning of agricultural waste will be similar to stubble burning and forest fires, for which some research has been carried out. Emission factors have been derived for dioxins, PAHs, VOCs and ammonia.

Table2: Typical Emission Factors for Dioxins and PAHs

Pollutant	Emission Factor g/tonne waste burned	Quality Code	Reference
Dioxins	10 µg I-TEQ/tonne	D	Bremmer et al. 1994 Thomas and Spiro 1994
PAHs	100 g/tonne	D	Ramdahl 1983 Wild & Jones 1995
VOCs	2 kg/tonne	D	Passant 1993 Lee and Atkins 1994
NH_3 NH_4	1.9 kg/tonne 0.5 kg/tonne	D D	Lee and Atkins 1994

In addition Bailey et al. (1993) give a range of emission factors for aldehyde emissions from stubble burning as 0.03-0.47 kg/tonne (expressed as formaldehyde). Mariani et al. (1992) measured PAHs, PCBs and dioxins in the stack from an incinerator burning biomass (eg olive residues, wood chips), and also detected Cd, Pb, Hg, Cu in the incinerator ashes.

9 SPECIES PROFILES

The dioxin profile for individual isomers is only reported in a few of the relevant reports. It is dominated by the tetra and octa chlorinated dioxins and furans.

Similarly, emissions data is rarely reported for individual PAH compounds. Wild and Jones reported emissions of 6 PAHs from stubble burning; pyrene and benz(a)anthracene/chrysene were detected in the largest quantities.

VOC emissions from straw and stubble burning have not been characterised (Rudd 1995), and this is likely to be the same for other agricultural burning methods.

10 UNCERTAINTY ESTIMATES

There are little data on emissions from the open burning of agricultural waste (not including stubble burning). However, stubble burning is likely to involve similar combustion conditions to the open burning of agricultural waste, and therefore similar emission factors can be applied. As for many reports on emissions of PAHs and dioxins, significant uncertainty is caused by the fact that 'total' PAHs or 'total' dioxins in emissions from stubble burning are generally reported, whereas it is likely that only a limited number of compounds were measured.

Although information on the area of farmland is likely to be reliable, the estimation of the weight of waste arising per hectare of farmland is very uncertain.

11 WEAKEST ASPECTS/PRIORITY AREAS FOR IMPROVEMENT IN CURRENT METHODOLOGY

No reliable information is available on the quantity of agricultural waste that is disposed by open burning (not including stubble burning) and its estimation is the main area for improvement in the current methodology.

In addition, no data is available on emission factors for pollutants other than dioxins, PAHs VOCs and ammonia.

12 SPATIAL DISAGGREGATION CRITERIA FOR AREA SOURCES

Spatial disaggregation requires the knowledge of the location of the farms that will carry out a significant amount of open burning of agricultural waste (other than stubble burning). These are likely to be arable farms as opposed to farms with mainly livestock. Spatial disaggregation might be possible if the detailed methodology were developed as this would involve the estimation of emissions from different types of farm.

13 TEMPORAL DISAGGREGATION CRITERIA

Temporal disaggregation requires the knowledge of current agricultural practices. It is likely that more burning will take place at the time of harvesting.

14 ADDITIONAL COMMENTS

15 SUPPLEMENTARY DOCUMENTS

16 VERIFICATION PROCEDURES

A detailed study of agricultural burning practices should be carried out so that the methodology can be verified. In addition, a measurement programme for the emissions from the burning of the most common agricultural wastes is required.

17 REFERENCES

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20 POINT OF ENQUIRY

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