

**'ATMOSPHERIC POLLUTION AND ITS IMPLICATIONS IN THE
EASTERN TRANSVAAL HIGHVELD'**

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1. BACKGROUND

This report reflects the current knowledge regarding atmospheric pollution and its effects on inhabitants and the environment of the Eastern Transvaal Highveld (ETH) and adjacent regions.

It is based on information obtained from research that was initiated by the CSIR (contracted by Department of Constitutional Development and Planning) and ESKOM (1979–1983) and followed by a co-operative effort (1984–1987) that had been directed and managed by a Steering Committee under the auspices of the National Programme for Weather, Climate and Atmosphere Research. Several organizations participated in this effort, including the CSIR, universities, Atomic Energy Corporation, SASOL, ESKOM as well as research institutions of various government departments. Financial support for the co-operative research effort has been provided mainly by the Departments of National Health and Population Development, Environment Affairs, Water Affairs, CSIR and ESKOM.

2. AIM OF THIS REPORT

This report has been prepared to provide a state-of-the-art publication that will inform and be of use to the scientific community, the authorities involved with the control and abatement of atmospheric pollution and for all those anxious to see that the ETH and adjacent environments are not despoiled by man's activities.

3. FINDINGS

3.1 Atmospheric pollution climate

The ETH atmosphere is highly unfavourable for dispersion of atmospheric pollutants. Indeed, the ETH has an atmospheric pollution climate among the most adverse anywhere in the hemisphere, let alone in South Africa. This fact needs to be accepted and taken into account in future atmospheric pollution management strategies for the region.

3.2 Emissions and sources of atmospheric pollutants

Substantial amounts of pollutants are released into the ETH atmosphere. Inventories of overall emissions (tons per annum) in the ETH for 1984 has been as follows:

Particulates	374 692
Sulphur dioxide	1 038 556
Nitrogen oxides	355 246
Carbon monoxide	339 574
Hydrocarbons	276 503

Most of the pollution results from power stations but substantial contributions also arise from various smaller industries, smouldering discard coal dumps, domestic combustion and motor vehicles.

3.3 Progress in control

Controls are applied at most of the sources within the ETH area. Significant progress has already been made in improving the situation, but the atmospheric pollution problem has, for practical reasons, not as yet been fully addressed.

3.4 Ambient atmospheric pollution levels

Ambient atmospheric levels of pollutants such as sulphur dioxide, ozone and sulphate aerosols (as measured at near-ground level) generally comply with local ambient air quality standards. It should, however, be pointed out that

- relatively high concentrations of sulphur dioxide pollution may be experienced with certain airflow types and pose possible environmental problems
- increases in sulphur dioxide concentrations can be expected when the new power station units at Tutuka, Kendal and Majuba are commissioned between now and 1999

- exceedances of levels at which adverse effects from sulphur dioxide and ozone on sensitive species of plants may be expected do occur periodically
- conditions in the atmosphere over the ETH are favourable for the formation of pollutants such as ozone and PAN (peroxyacyl nitrates) which exhibit phytotoxic properties. Likewise, sulphate and nitrate aerosols occur and are the precursors of 'acid rain'.

3.5 Deposition of atmospheric pollutants

Reason for concern exists about pollutants which are accumulated in the upper layers of the atmosphere over the ETH resulting from high-level emissions from power station stacks. Some of this trapped pollution is deposited by wet processes ('acid rain') and dry processes (dry deposition) and may eventually cause detrimental effects in the ETH environment. Areas which in particular appear to be at risk are the eastern portion of the Vaal dam catchment and the forests along the escarpment.

3.6 Visibility

Visibility degradation resulting from aerosols and other pollutant species produced via photochemical reactions may be a problem in many areas within the ETH.

3.7 Export of atmospheric pollution

Evidence suggests that an export of ETH atmospheric pollution takes place to adjacent regions such as the Orange Free State and Natal. It is, however, not as yet clear to what extent neighbouring countries such as Swaziland and Lesotho may be affected in this regard.

3.8 Environmental impacts of atmospheric pollution

Conditions in the ETH are currently sub-acute, i.e. the atmospheric pollution levels are unlikely to cause effects that are readily observable. Any effects on natural systems are likely to be masked partially by those of other environmental stresses such as drought. Incomplete understanding of the processes of pollution damage adds to the problem of understanding environmental impacts of atmospheric pollution.

Sufficient reason for concern for potential effects on the ETH environment does, however, exist in the presently observed levels of atmospheric pollution. Ambient levels of pollution are at least episodically sufficient to cause some kind of damage to human health as well as to artificial and natural resources. Moreover, rates of atmospheric pollutant deposition are clearly enhanced through much of the region and rainfall acidity is markedly increased.

Human health and quality of life

Exposed children of school going age displayed increased frequencies of certain respiratory symptoms such as coughing and wheezing (statistically significant amongst girls only) and certain respiratory illnesses, i.e. asthma in boys and chest colds in girls. These findings were, however, not supported by lung function tests which revealed no significant differences between exposed and unexposed children. It would therefore appear, in the absence of clear evidence, that control measures have succeeded in maintaining the atmospheric pollution levels below the thresholds of risk to human health.

It seems that the impact of present atmospheric pollution levels on public perception of the quality of life and of amenity values can be significant. This aspect needs evaluation if decision makers are to take properly informed action on atmospheric pollution control.

Buildings and other structures

Several of the economic sectors, i.e. construction, agriculture, farming, power generation and distribution, telecommunication systems, transport and mining, are potentially at risk to atmospheric pollution in the ETH. It can be expected, based on atmospheric pollution, climatic and corrosion data from the closeby Vaal Triangle and Pretoria areas, that buildings and other structures, roofing and side-cladding as well as galvanised iron and steel fencing used on farms will be affected negatively by atmospheric pollution in the ETH. For example, copper lines passing close to smouldering discard coal dumps have already been seriously affected due to corrosion caused by sulphur dioxide emitted by these dumps.

Soils

Acidification resulting from acid deposition ('acid rain') will be modest on agricultural

soils and of little consequence where liming is practised. However, there is some likelihood that the strongly acid soils of the ETH, where not under cultivation, maybe significantly affected by current levels of deposition of atmospheric pollutants.

In the case of forest soils an analysis of soil properties indicate that the majority of such soils will at least be moderately sensitive to the effects of deposition of atmospheric pollutants.

Surface waters

Sulphate concentrations of streams in the ETH have been notably affected by deposition of atmospheric pollutants. The economic significance of this has not been quantified, but the cost of water treatment may yet be affected. Upland streams, in particular those in the vicinity of Sabie and Tzaneen, are potentially at risk of acidification, but the real consequences of such potential affects cannot be predicted at present.

Agricultural crops

There is as yet no clear evidence of direct effects of atmospheric pollution on agricultural crops in the ETH region. The size of the regional agricultural community, however, demands that the current research work on crop plants should be continued and expanded. There is, for example, evidence from experience elsewhere that some degree of impact should be anticipated at the levels of atmospheric pollution recorded for the ETH; these could be negative as well as positive.

Forests

In the pine plantations of the ETH, symptoms of foliar damage apparently consistent with atmospheric pollution effects and not ascribable to pests and pathogens, were diagnosed only recently. A close evaluation of the situation regarding forests is needed urgently.

Managing and ameliorating atmospheric pollution impacts on forests will be more difficult, with less opportunity for adjustment, than in agricultural crops, where atmospheric pollution effects may often be overshadowed by agricultural practices.

Natural terrestrial ecosystems

Very little is presently known about the physiology and ecology of the wide diversity of natural

plant species occurring in the ETH and much less of their likely responses to atmospheric pollution. Atmospheric pollution impacts could potentially cause substantial modification to community composition and ecosystem functioning, could change the course of evolution within species, and cause a loss of biological diversity.

4. FUTURE STEPS AND NEEDS

The current tall-stack policy of atmospheric pollution control has apparently been successful in avoiding unacceptably high ambient atmospheric pollution concentrations at ground-level. This has, however, been achieved at the cost of pollution accumulating in an elevated layer over the ETH. Some of this pollution is subsequently deposited by wet and dry processes with possible deleterious environmental consequences in and beyond the region in question. It seems that the present policy may have to be revised and supplemented with more stringent controls in future in order to safeguard the ETH and adjacent regions from detrimental medium- and long-term effects on the environment. Considerable costs will, however, be involved in the implementation of more stringent controls. These costs will have to be carefully weighed against those which are expected or predicted to result from detrimental affects to the ETH environment. It is also likely that the needs for industrial development will preclude the option of full atmospheric pollution control. Knowledge must, therefore, be used to adapt agricultural, forest, and conservation management practices so as to minimise the impact of atmospheric pollution.

Every justification exists for the present policy of caution in controlling atmospheric pollution. The caution is wise, should not be relaxed and may need to be increased. New industries, particularly those that will involve large-scale combustion of coal, should be established in the ETH only if adequate control is applied to particulate and gaseous emissions. Furthermore, it appears necessary that the design of industrial plants to be erected in the regions adjacent to the ETH should make provision for the retrofitting of equipment to control particulate and gaseous emissions.

Continued well-planned and co-ordinated research is imperative in developing a sound basis for understanding the complex processes determining the behaviour, fate and impacts of atmospheric pollutants in the ETH and adjacent regions in order ultimately to allow

- planning and implementation of effective control measures, and
- adaptation of conservation management practices that will minimize the impact of atmospheric pollution in these regions.