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CONSULTATIVE GROUP OF EXPERTS ON NITRATES IN
UNDERGROUND- AND DRINKING-WATER

Report on a WHO Meeting

Copenhagen
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TARGET 20

Control of water pollution

By 1990, all people of the Region should have adequate supplies of safe drinking-water, and by the year 1995 pollution of rivers, lakes and seas should no longer pose a threat to human health.

1. Scope and Purpose

The meeting reviewed the technical findings embodied in reports of missions to the Water Quality Control Laboratory of the Office national de l'eau potable (ONEP), Rabat, Morocco, in 1984, 1985 and 1986 by Mr C.P. Young of Water Research Centre (WRC), Medmenham, United Kingdom, with particular reference to ensuring that the final report fully covered all aspects included in the nitrate subcomponent of the "Improvement of underground and drinking water quality, Morocco" project. In addition, the review was required to ensure compatibility of the nitrate subcomponent with WHO Environmental Health Series No. 1 (Health Hazards from Nitrates in Drinking-Water) and Summary Report ICP/CWS 056(S).

2. Attendance

The meeting was attended by:

Dr H. Abouzaid, Chief, Water Quality Control Laboratory, Office national de l'eau potable (ONEP), Rabat, Morocco;

Mr C.P. Young, Water Research Centre, Environment Division, Medmenham, United Kingdom;

Mr B. Montuelle, Centre national du machinisme agricole, du génie rural, des eaux et des forêts (CEMAGREF), Lyon, France;

Mr E. Giroult, WHO Regional Office for Europe, Copenhagen, Denmark.

3. Review of Nitrate Project

3.1 Following a detailed discussion of reports of three missions to ONEP, Rabat, it was agreed that the final report should include all the technical information incorporated in the previous reports, supplemented by additional data collected since October 1986 (see section 3.2 for details). The format of the final report should be as follows:

- a. Introduction. This should include the objectives of the study and its relationship to the problems of the potential health aspects of nitrate in drinking water and to the possible methods of treatment to remove nitrate. A general statement of the extent of groundwater nitrate problems in Morocco would be included.

The report should make clear that the study has been made from a practical point of view, taking into account the needs of water supply engineers and authorities.

- b. Methods adopted for the study. The chemical, microbiological, radiochemical and hydrogeological techniques selected for the study should be outlined and justified. The selection of pilot areas for field investigations would be discussed and the four areas selected described. WRC will undertake training visits and provide documentation to ONEP.
- c. Results of studies. The data collected during 1984-1987 will be presented, covering chemical, radiochemical, microbiological, hydrogeological and climatological aspects for each of the four study areas, including the use of tracer techniques.

- d. Discussion of results. This and subsequent sections will form the main body of the report. The results of work from 1984-1987 will be discussed in the light of historical data from the four study areas and in comparison with similar studies elsewhere, in order to arrive at a detailed understanding of the sources, movement and fate of nitrate in Moroccan groundwater.
- e. Conclusions and recommendations. Conclusions drawn from section d will be used to draw and justify recommendations aimed specifically at the following areas:
 - (i) Actions to improve water quality at existing sources, including: methodology for assessing the potential threat of nitrate to existing sources other than the four studied in detail; possible engineering solutions to boreholes penetrating quality stratified aquifers; definition of protection zones and the newer concept of "dilution zones" at sites threatened by diffuse source pollution; and actions to be taken at sites threatened by point-source pollution.
 - (ii) Selection of sites for new sources, listing desirable criteria for new sources, and discussing source construction (wells vs. boreholes) and protection zones/dilution zones. Control of nitrate leaching will be included.
 - (iii) Design and implementation of monitoring programmes. Advice on the range of determinants and frequency of measurements under test and operational conditions, the use of cross-correlation computer software and trend programmes in controlling nitrate.

3.2 The final report should incorporate the following additional data:

- (i) Analysis of tracer test at Berrechid, February-April 1987 (data passed to Mr C.P. Young by Dr H. Abouzaid at meeting).
- (ii) Meteorological data during the period of study (1984-1987) and for earlier years, if possible, at the four study sites.
- (iii) Turbidity data at Ain Khadra.
- (iv) Check on pre-1984 quality data, based on computerized records at ONEP.

(ii, iii and iv to be checked by Dr H. Abouzaid and sent to Mr C.P. Young).
- (v) Monthly demand curves by typical crops for nitrate, to illustrate use of multiple fertilizer dressing (Mr C.P. Young).

Subject to receipt of new data, the final version of the report should be completed by the end of May 1987, for transmission to participants in June.

(vi) Following the review of reports by Mr B. Montuelle, the following aspects should receive more attention in the final report:

- the use of boron as an indicator of pollution by domestic wastewater;
- elaboration of section on indicators of faecal pollution and nitrogen-transforming bacteria;
- philosophy of deciding frequency of monitoring surveys;
- improved maps showing geology, hydrogeology, climate, etc.

3.3 The final outcome of the nitrate project should be disseminated as widely as possible. In this context the Expert Group supported the proposed seminar in Rabat in November/December 1987.

4. Consideration of WHO Documents: Environmental Health No. 1 (Health Hazards from Nitrates in Drinking Water) and Summary Report ICP/CWS 056(S)

4.1 Environmental Health No. 1. The participants had no points of serious disagreement with the document, but the following comments were made in the light of both general knowledge and points arising specifically from the Moroccan study.

Section 9.1. Conclusions

1. No comments.
2. The Moroccan study provides evidence of some increasing trends, but in many cases the data do not provide clear evidence because of high inter- and intra-annual variations in nitrate concentrations.
3. No comments.
4. The Moroccan study did not generate any information on this aspect.
5. A limit of 11.3 mg N/l; 50 mg NO₃/l has been adopted in Morocco.
6. As a general comment, the Group found the wording to be confusing.
7. In the same way, the Moroccan study group recognized at the outset that nitrate removal presented serious technical and financial problems. Therefore, the Group directed its study specifically towards seeking preventive rather than curative solutions to the problem.

General conclusions which have arisen from the Moroccan study are as follows:

1. A correlation between nitrate and other quality parameters was not apparent, due to substantial variations between and at individual sources of groundwater supply.

2. Similar nitrate concentrations in groundwater may arise from both point and diffuse sources of nitrate pollution.

3. Evidence was found which suggests that there may be opportunities, in certain circumstances, to control nitrate levels by simple, economical, local measures to protect sources, rather than by treatment of water after abstraction.

4. The use of nitrogen isotope ratio measurements (δN^{15}) appears to provide a useful tool for distinguishing sources of nitrate in groundwater. Such measurements were not envisaged to form part of a routine control function, but they are valuable when studying on new problems or surveying new areas.

Section 9.2 Recommendations

1. A nitrate limit of 11.3 mg/l has been adopted in Morocco. In the opinion of the Consultative Group, the recommendation should include mention of the desirability of breast feeding. A local solution to high levels of nitrate in water may be to blend this water with that from low-nitrates sources to achieve a satisfactory overall standard.

2. The first sentence is a conclusion, not a recommendation.

3. No comment.

4. No comment.

5. and 6. The Consultative Group felt that there is confusion between point sources, which may be amenable to control, and diffuse sources, which are more difficult to control. It is suggested that the two sections be reworded to:

5. "Special attention from direct discharges and other point sources and sewage treatment plant effluent."

6. "Efforts agricultural practices and other diffuse (or non-point) sources". The Consultative Group recognized, however, that for countries where food production does not satisfy the requirements of the population, there may be a need to take into account the balance of interests between food production and water resource quality protection.

7. No comment.

8. No comment.

9. The Moroccan experience supports this view.

10. No comment.

11. The Consultative Group would like to emphasize that effort may be better applied to improving the sanitary disposal of sewage wastes in such areas, since that is very commonly the source of the nitrates in shallow wells.

12. Agreed as absolutely essential.

13. No comment.

General recommendations

1. First priority should always be given to developing source protection, rather than to applying post-abstraction treatment.

2. Summary document ICP/CWS 056(S).

Conclusions and recommendations

1. Supported.

2. Supported.

3. The Consultative Group considered that it would be valuable if the list could include details of capital and running costs for the various installations.

4. Ion-exchange and reverse osmosis plants have apparently been omitted from the threefold classification. Cheap, reliable, simple processes are needed.

5. No comment.

6. No comment.

7. Agreed.

8. No comment.

9. No comment.

10. Agreed.

11. No comment.

12. International coordination of research is needed. As a specific point, the Consultative Group suggested that because of the apparent usefulness of nitrogen isotopic techniques in defining nitrate sources, lists of laboratories willing and capable of undertaking such analyses should be compiled and circulated by WHO or IAEA. It is doubtful whether N^{15} measurement facilities would be economically feasible to set up in each country/region, but sufficient work should be guaranteed to make a centralized facility viable, which would also ensure comparability of results.