Quality of Groundwater, Proceedings of an International Symposium, Noordwijkerhout, The Netherlands, 23–27 March 1981, W. van Duijvenbooden, P. Glasbergen and H. van Lelyveld (Eds.), *Studies in Environmental Science*, Volume 17

POLLUTION BY NITRATES OF THE SUBSURFACE WATERS IN HUNGARY

F. CSÁKI and I. ENDRÉDI
Institute for Water Management, Budapest, Hungary

ABSTRACT

Dug wells serve as the source of supply to individual homes and farms in some rural regions of Hungary. Nitrate pollution in these waters has been reported from many areas of the country in the early fifties already.

The water obtained from drilled wells reaching down into confined aquifers and that piped to public water works from karstic springs has shown occasionally signs of deterioration by nitrate pollution in the last decade only. In order to obtain a picture on the extent of pollution due to nitrates, a survey was run in 1979 on all sources of supply to public water works in the country. The results and conclusions of major interest emerging from this survey are described in the present paper.

The area and method of survey, the components determined

The survey covered the entire area of the country and extended to more than 10 000 wells and springs serving as sources of supply to over 1000 public water works. The pollution survey was organized and controlled by the district water authorities. The chemical analyses and bacterial tests were performed by the laboratories of the public-health- and water authorities. No methods of field analysis were applied and no field investigations were made. The fresh analytical- and test data were evaluated invariably by comparing them with the corresponding data of the drilling log, with due consideration also to the rates of pumping. The components surveyed were as follows: Fe^{++}, Mn^{++}, NH_4, NO_2^-, NO_3^-, total hardness, organic content, bacterium count (coliform).

Results, conclusions

The primary sources of nitrate pollution in subsurface waters are as

follows:

- various kinds of effluent disposed of without treatment on filter beds,
- solid and liquid wastes,
- large volumes of manure and
- fertilizers applied at growing rates.

The quantities discharged are:

- fertilizer industry effluent 10.0 million m^3/year
- food industry wastewater 11.0 " "
- intensive stockfarming manure 75.0 " "

Of these effluents only about 60 % are disposed of in a satisfactory manner.

The annual volume of solid manure is 15.3 million m^3/year.The amount of nitrogen fertilizer applied has increased therefold during the past 15 years from 142 768 t/year in 1965 to 567 000 t/year in 1979.

The effluents disposed of on filter beds, or fields by communal sewage treatment plants are important sources of pollution, which fact is characterized best by the proportion of the population connected to public untility water supply and sewerage, further by the figures on water consumption.

	1970	1975	1980
population with piped water	55 %	60 %	73 %
population in sewered area	27 %	33 %	43 %

The water consumption figures for 1950 and 1980, further the figure predicted for 2000 are 200, 720 and 1000 million m^3/year, respectively.

The rapid increase of pollution observed over the past decade is a direct consequence of the figures quoted above.

Round 90 % of the population of Hungary relies on ground water, or bank filtered water withdrawn as ground water, for its domestic water supply. According to origin, the waters pumped can be grouped as:

- bank filtered water 50 %
- artesian (confined ground water) 33 %
- karst water 13 %
- unconfined ground water 4 %

The quality of subsurface waters is impaired mainly by the increasingly severe pollution by nitrates. According to the Hungarian Standard Specifications on drinking water, nitrate contents up to 20 mg/litre are acceptable, while those up to 40 mg/litre are still tolerable.

The survey has revealed 6 to 7 % of the public water works, where the nitrate content can be reduced effectively by adding nitrate-free

water before the distribution network. Owing to adverse conditions (thin, pervious, leaking cover layer, height of the water table), natural protection is poor for round 30 % of the supplies and these are exposed to nitrate pollution (Fig.1). The absence of adequate natural protection presents especially serious difficulties, where ground waters at small depths below the surface are the only available source of supply. Unfortunately, these areas have the most highly developed industries and the highest population densities.

In round 40 % of the area of Hungary deep ground waters protected from surface pollution can be developed and these are the source of public water supply. In several areas confined aquifers are known to exist, which are separated from the polluted unconfined ground water by one, or several impervious layers. No evidence is available thus far to indicate that aquifers situated below 50-100 m were contaminated by infiltrating waters.

In the present survey on nitrate pollution NO_3^- concentrations higher than 30 to 40 mg/lit were not detected in wells deeper than 40 to 50 m.

Nitrate pollution was found to be limited to the ground waters in the vicinity of the surface. These waters, which show occasionally high NO_3^- concentrations (above 100 mg/lit) are stored mainly in Quaternary, Tertiary and Mesosoic debris and carbonate aquifer formations in the mountain ranges of North-Hungary, Transdanuvia, in the Mecsek region, further in the potential withdrawal areas of bank-filtered water along the Danube and a number of minor streams (Fig.2).

In Hungary occasional occurrences of pollution due to high NO_3^- concentration in ground waters at small depth could invariably be traced back to human activities. Pollution is caused typically by point sources and is thus an anomaly in the surroundings. Diffuse sources of pollution are so far inferior in their importance. The impacts of large mono-crop farming operations are liable to appear more strongly during the eighties, so that the diffuse sources of pollution will probably pose more serious problems then.

Owing to limitations of space, the particular cases investigated and described in Hungary cannot be included in the present paper. In a number of cases pollution has been traced back positively to the lack of sewerage, or to the proximity of manure, but little information is only available on diffuse pollution caused by fertilizers. Observations under actual, field conditions have been started in 1980 in the area of the Bábolna State Farm.

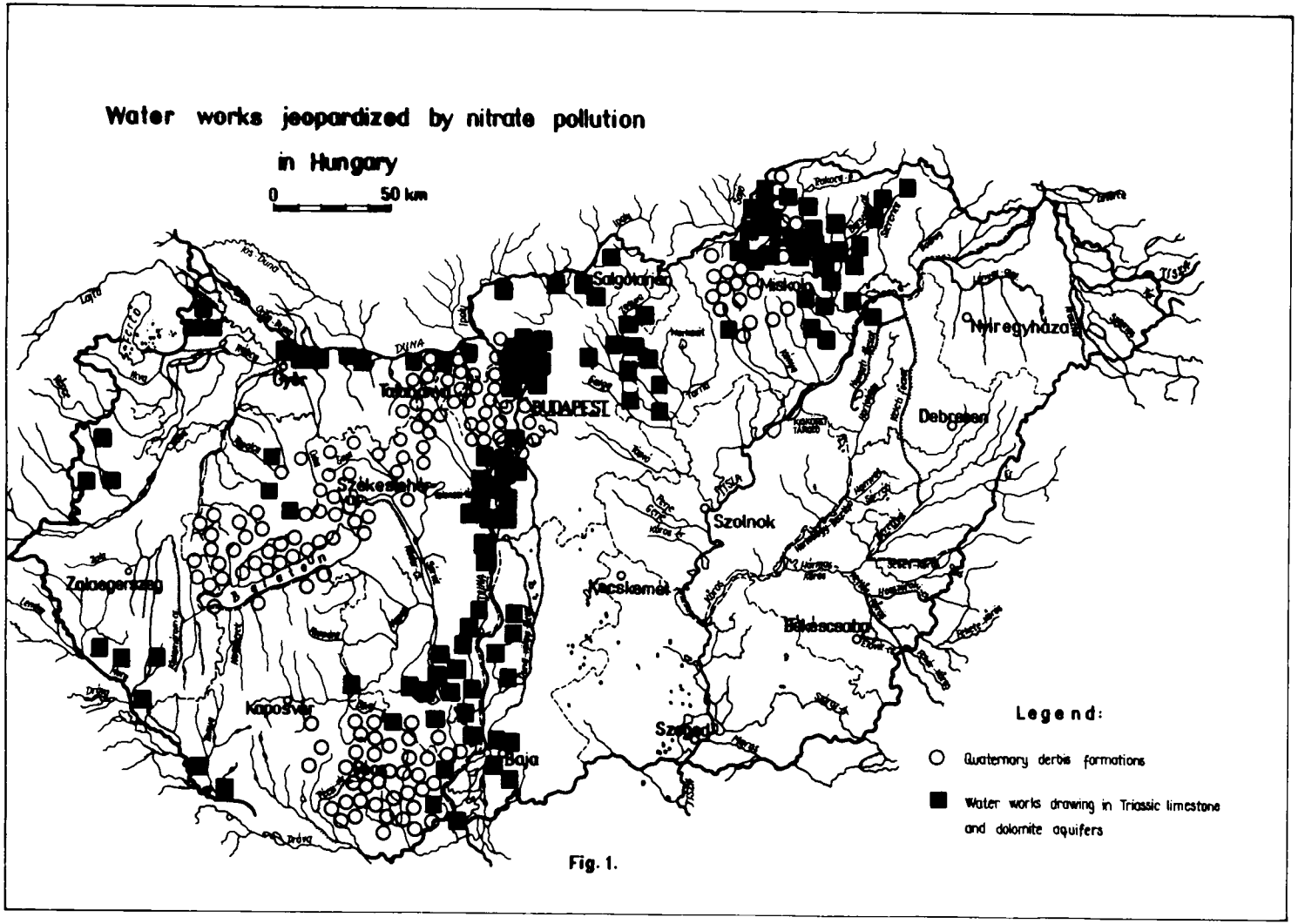
Water works jeopardized by nitrate pollution
in Hungary
0
50 km
BUDAPEST
Salgótarján
Miskolc
Nyíregyháza
Debrecen
Szolnok
Kecskemét
Békéscsaba
Szeged
Baja
Kaposvár
Zalaegerszeg
Győr
Székesfehérvár
Legend:
Quaternary detbis formations
Water works drawing in Triassic limestone and dolomite aquifers

Fig. 1.

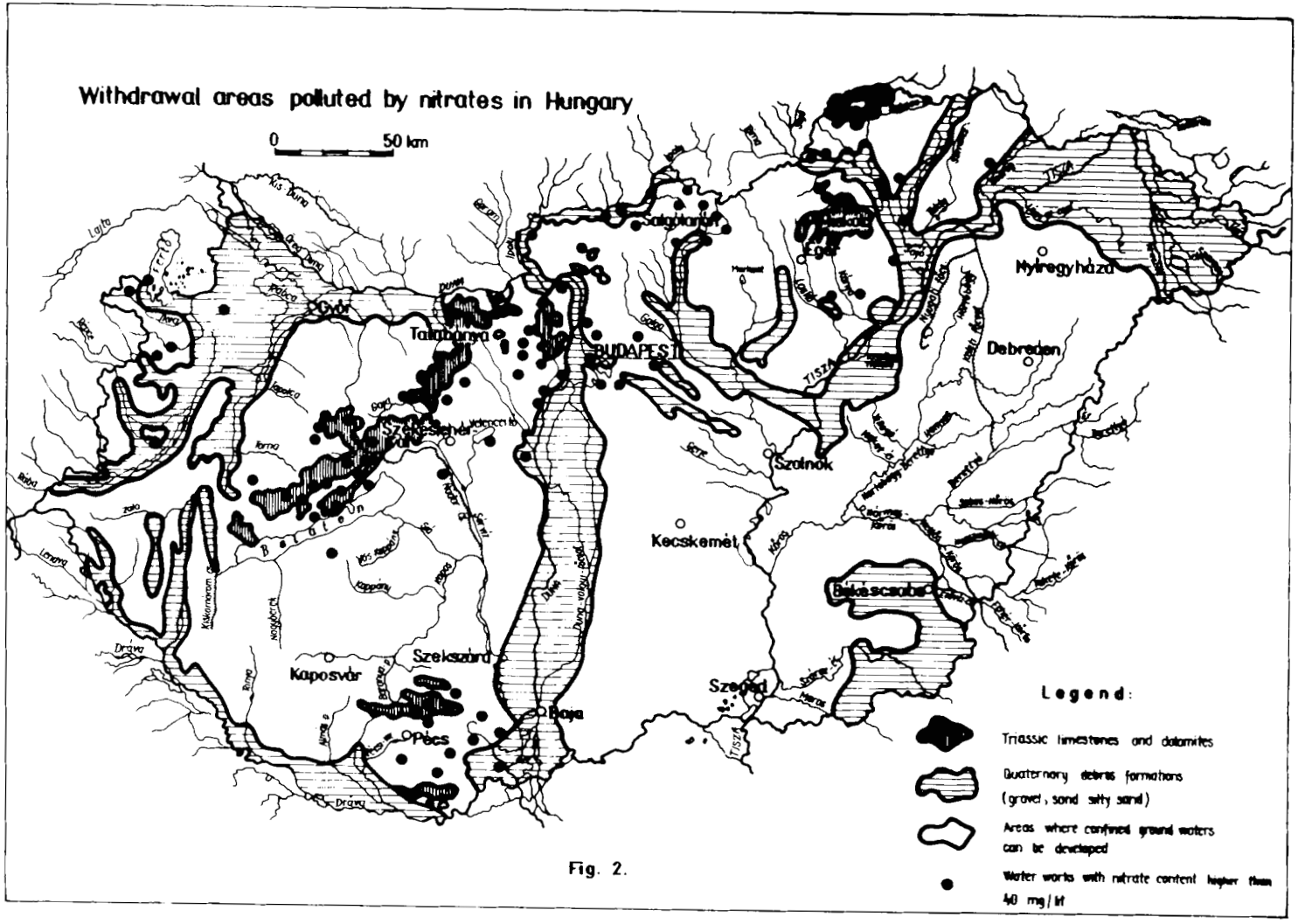
Withdrawal areas polluted by nitrates in Hungary
0
50 km
Győr
Tatabánya
BUDAPEST
Salgótarján
Nyíregyháza
Debrecen
Szolnok
Kecskemét
Békéscsaba
Szeged
Szekszárd
Kaposvár
Pécs
Baja
Legend:
Triassic limestones and dolomites
Quaternary debris formations (gravel, sand silty sand)
Areas where confined ground waters can be developed
Water works with nitrate content higher than 40 mg/lit

Fig. 2.

The impact and spreading of polluting substances in the soil are not understood sufficiently and further research is needed on these problems.

Recommendations for minimizing and preventing nitrate pollution to sources of public water supply

- No improvement in, and protection of, the quality of water in private wells is anticipated. The development of public water works and distribution systems presents the only viable alternative.
- Protection is possible in the case of water works drawing on ground waters in the vicinity of the surface, provided that the withdrawal area is properly sited. Exclusion of communal pollution is difficult, or impossible, but the pollution due to agricultural activities can be limited.
- Industrial, or agricultural activities must be discontinued, or limited, if these present point- or diffuse pollution to the source of supply.
- Sewerage and sewage treatment must be provided with top priority in communities, where the effluents are disposed of within the community area, or drained therefrom in a manner to jeopardize the water supplies.
- Surface drainage must be provided in all potential intake areas.
- Internal- and external protective belts must be established around the withdrawal areas of water works, and protection must be extended to the connected hydrogeological intake area, i.e., the area of the depression caused by pumping. In these areas restrictions must be imposed on industrial and agricultural activities.

The programme outlined before should be realized over the next 15 years. Any abatement of pollution and perceptible improvement of the situation can be expected after this period only.