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General Discussion

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General discussion

J. V. Lake (*Agricultural Research Council Letcombe Laboratory, Wantage, U.K.*). In the opening paper Dr Gasser identified the prime purpose of agriculture as being to provide food. He and Mr Hood agreed that the amounts of N applied as fertilizer in the U.K. increased by a factor of about 20 between 1940 and 1980. On Dr Gasser's basis we should expect some corresponding increase in the total dietary N intake by the population of the U.K. from home-produced food over the same period.

In 1940, the population of the U.K. was about 49×10^6, the daily intake of N in food per person was, say, 6 g and the home-produced fraction of the total intake was, say, 0.4. Corresponding and more reliable approximations for 1980 are 56×10^6, 12 g per day and 0.6. The total annual dietary N intake calculated from these estimates increased less than fourfold over the period of 40 years (table 1).

Table 1

year	fertilizer N applied/kt	total N intake from home-produced food†/kt
1940	60	43
1980	1270	147

† In making these approximations I have tried to err on the low side for 1940 and on the high side for 1980.

As a cross-check on the 1980 food intake figure, the total mass of N discharged into fresh waters and the sea from sewage was 240 kt (Wilkinson & Greene, this symposium); multiplying by 0.6 gives a home produce-derived component of 144 kt, agreeing disconcertingly well with the estimate of intake of 147 kt.

R. Q. Cannell (*Agricultural Research Council Letcombe Laboratory, Wantage, U.K.*). In their papers Dr Wilkinson and Mr Greene and Mr Foster drew considerable attention to the peaks of nitrate at various depths in the deep profiles to which they refer. Can they comment as to whether these peaks relate to changes in fertilizer practice or land use?

W. B. Wilkinson and L. A. Greene. Some well defined peaks occur in the profile (figure 8 of our paper) that we used to illustrate the concentration of nitrate below fertilized arable land. This profile is typical of that observed at a fertilized arable site with grass leys. Young & Gray (1978) give some 60 examples of profiles for a range of land-use situations. An examination of the detailed land-use record and fertilizer application returns for the site in question suggests that the pronounced peaks result from the mineralization of soil organic matter following the ploughing of grass leys 3–4 years old. Marked changes in fertilizer application rates in an arable situation will also give peaks in the profiles but these will be less dramatic than those resulting from a ploughing of grassland. Simple rules governing the N released each year from the soil layers for uptake by infiltrating rain water have been proposed by Young *et al.* (1976). These depend upon present and antecedent field use and fertilizer application. The rules have

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been successfully used by Oakes (1981) in a model to simulate observed profiles on the basis of annual infiltration rate, land-use history and fertilizer application rates, and the pore-water content of the unsaturated rock over the depth of the profile.

References

Oakes, D. B. 1981 Nitrate pollution of groundwater resources – mechanisms and modelling. In *International Institute for Applied Systems Analysis Conference on Management and Control of non-point Nitrate Pollution of Municipal Water Supply Sources*, Laxenburg. (In the press.)

Young, C. P., Hall, E. S. & Oakes, D. B. 1976 *Nitrate in groundwater – studies on the Chalk near Winchester, Hampshire.* (Technical Report no. TR 31, Water Research Centre, 67 pages.)

S. S. D. Foster. A major concern in my paper was the interpretation of the 'nitrate front', as opposed to nitrate peak, which appears to be characteristic of the Chalk unsaturated zone pore-water profiles from beneath *long-standing* arable land in eastern England (figures 3 and 4). *If* the downward movement of nitrate is part of an essentially non-dispersive flow and *if* no significant denitrification is occurring *in situ* (assumptions discussed in some detail in my paper but neither of which have, in my view, as yet been adequately verified), then the form of the profiles ought to relate directly to a history of increasing inputs from the overlying agricultural soils, presumably as an *indirect* result of the major increases in nitrate fertilizer application to arable land during 1955–65. However, a considerable time-lag for the corresponding increase in the rate of leaching losses would apparently need to be invoked.

In some other cases, it would appear that peaks in the unsaturated zone pore-water nitrate profiles can be directly related to changes in land use, such as the ploughing-up of grassland for cultivation (figure 2).

T. Batey. When foresters plough deeply to break up compact soil, trees are subsequently planted in subsoil that has been brought to the surface which is very low in total N. What effect has this inversion of soil on the nitrogen cycle and tree nutrition?

W. O. Binns (*Forestry Commission, Forest Research Station, Alice Holt Lodge, Wrecclesham, Farnham, Surrey, U.K.*). Large forest ploughs may penetrate up to a metre, but the mouldboard produces a smaller ridge than this, the main part of the depth being achieved with a tine. Thus a tree, even though planted on a ridge of subsoil poor in N, rapidly roots through to the sandwich of inverted topsoil and undisturbed topsoil below it.