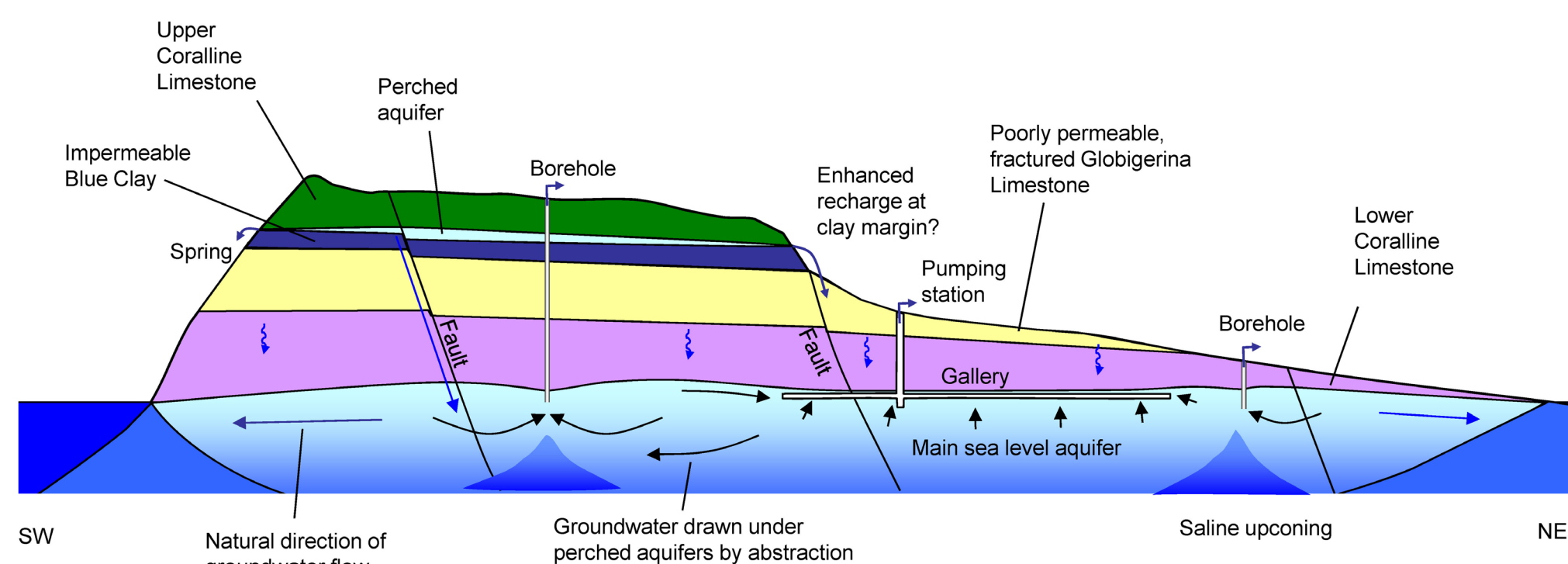


Impacts of nitrate on the water resources of Malta

Marianne Stuart

Setting

- High density of population (1250 persons/km²) and livestock (300 head/km²).
- Heavy dependence on groundwater for public supply and agriculture.
- Complex landuse with multiple cropping and small landholdings.
- Semi-arid Mediterranean climate with low and variable infiltration (<200 mm/year).
- Two aquifers, 'perched' and 'mean sea level' (MSL) separated by impermeable clay.
- Water level in MSL aquifer depressed to 5 m above sea level by abstraction.

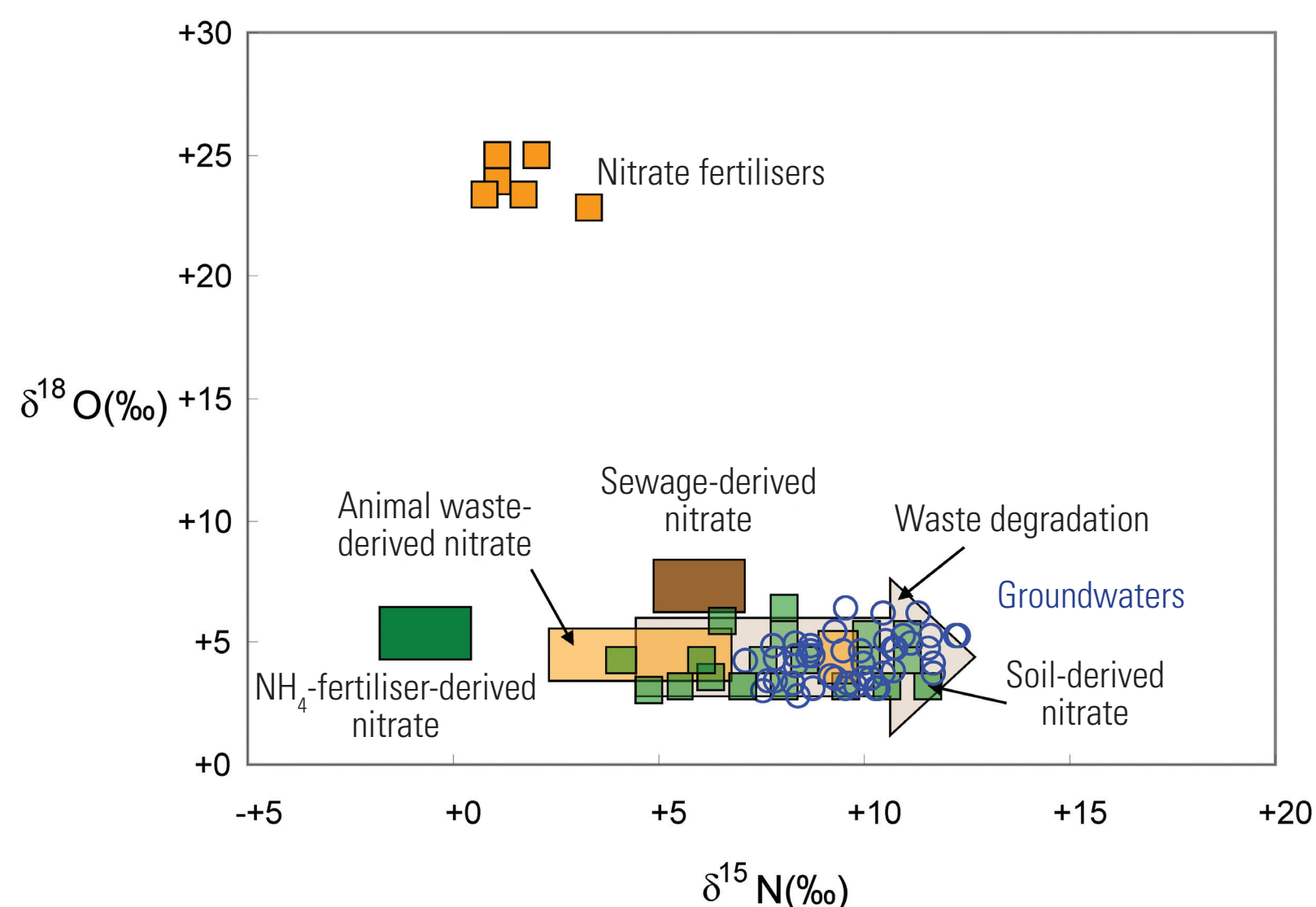


Nitrate sources

These could potentially be:

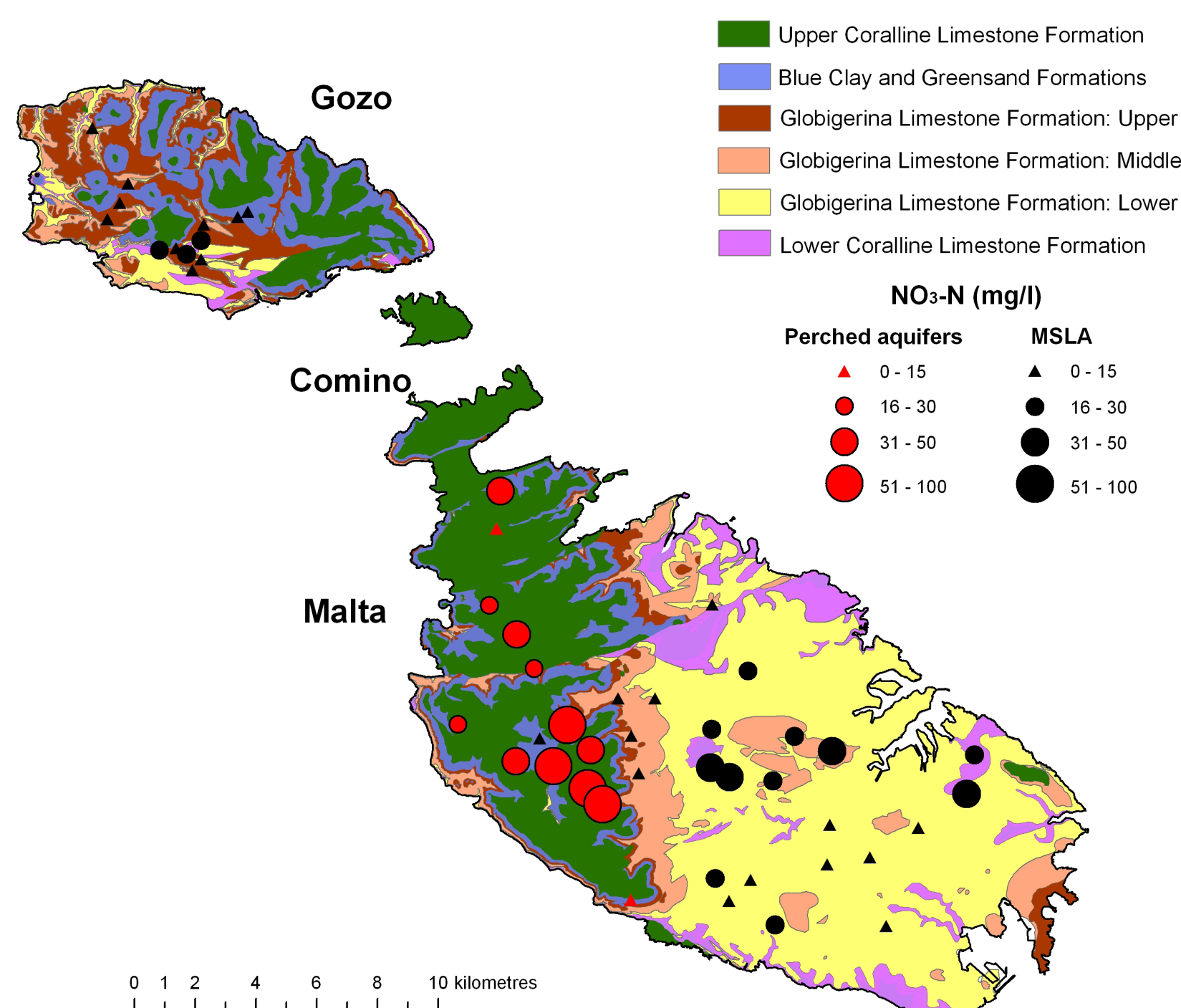
- Leaking sewers and septic tanks.
- Synthetic fertilisers and manure used in agriculture.
- Animal waste stores.
- Irrigation with treated sewage effluent.
- Soil leaching.

Evidence from nitrate stable isotopes ($\delta^{18}\text{O}$ and $\delta^{15}\text{N}$) confirms that the predominant source of nitrate in groundwater is not derived directly from fertilisers or sewage. Soil leaching is the most likely major source with animal waste stores also possibly contributing.



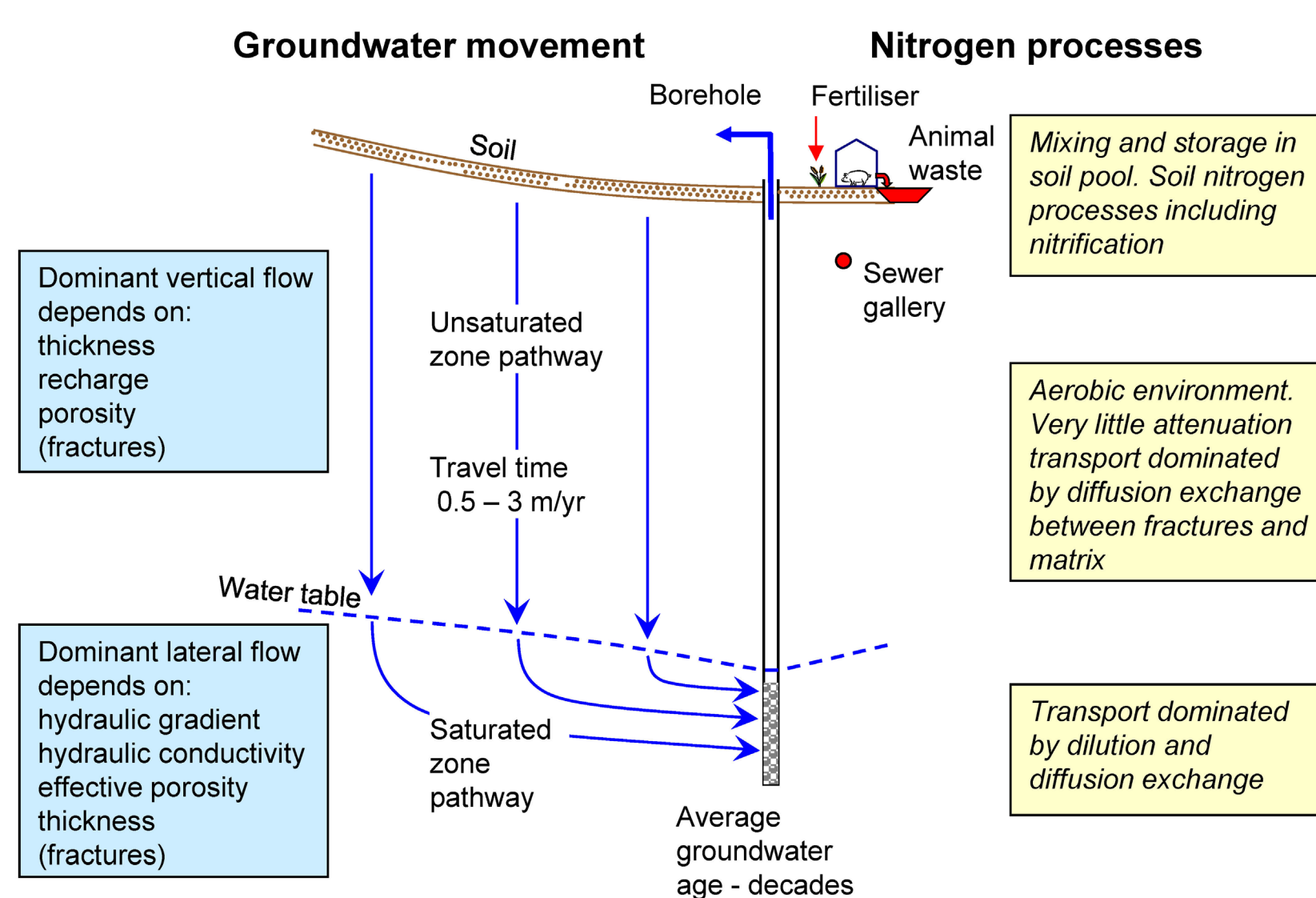
Groundwater nitrate concentrations

- Median nitrate in perched aquifers is 37 mg/L (NO₃-N) and has risen significantly over past 20 years.
- Median nitrate in MSL aquifers is 14 mg/L (NO₃-N) with slow increase.
- 11.3 mg/L limit under European Nitrate, Water Framework and Groundwater directives.



Timescales of groundwater flow

- Perched aquifers have limited thickness and short residence times.
- In the MSL aquifer the unsaturated thickness is great (up to 100 m), and in the saturated zone transmissivity is low and water residence time may be decades.
- Storage of nitrate in the unsaturated zone and slow downwards movement can give rise to the popularly-termed nitrate 'time bomb', as has been observed in the UK.



Policy implications

Malta has a Code of Good Agricultural Practice which incorporates Action Programme under the Nitrates Directive. They have already put in place controls on animal waste storage. Further actions should include:

- Overall reduction in livestock numbers, alternative uses for manure or reducing area where manure applications are permitted.
- Controls to manage inorganic nitrate.
- Diffuse sources and small-scale landholdings make further controls difficult to implement effectively.

- Long timescales mean that improvements from action programmes may take decades to be seen and nitrate may persist or even continue to rise in the medium term.
- Major change in nitrate management policy with implications for allocation of resources to support farm management was required.
- Reduced uncertainty and better targetting of resources to address WFD objectives.

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Groundwater Science Programme

