

# Structural change in the Agro-Food System towards relocation of food & feed production and consumption as a lever to mitigate nitrogen environmental losses

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International trade of agricultural commodities is an increasing factor of nitrogen (N) losses from agricultural soils, including nitrous oxide (N<sub>2</sub>O) emission. Although the budget of GHG emission by waterway transport is negligible, such trade leads to an unbalanced N cycle in agricultural systems with uncoupling between crop and livestock farming, and between food and feed production and consumption. In this situation, recycled animal manures are inefficiently applied to croplands thus enhancing losses of reactive N to the environment as well as increasing the demand of synthetic N inputs. We have assessed the magnitude of long distance trade compared with internal N flows in agriculture, for the cases of France and Spain, two countries differing in their overall balance of agricultural trade. In both countries regional specialisation has been assessed from Eurostat data at NUTS3 level (i.e. French departments and Spanish provinces). FAO data were also used since they provide insight into international exchanges. For France, the availability of data on inter-regional trade (the Sitram database) allowed a more detailed analysis of trade of major agricultural commodities between departments. The maps we draw reveal that the specialization and the decoupling of livestock and crops production lead to intensive exchanges of agricultural products. Indeed the net food and feed trade to Spain amounts 100% of the national production and net export of cereals from France represents 30% of the national production. Based on simplified model of the agro-food-system, we derived an alternative “Bio-Local-Demitarian” scenario involving a more healthy diet, more local connections between food production and consumption, and between crop and livestock farming. Comparison of the N cycle for the current situation of selected French and Spanish regions with that of the “Bio-Local-Demitarian” scenario highlights the implication of the structure of the agro-food system in the N cycle efficiency. This suggests that the relocation of production and consumption of food and feed might have a significant abating effect on N losses as well as on the GHG budget compared to technical improvements of agricultural practices in the current structure of the agro-food system.