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EUROPEAN COMMISSION INITIATIVE ON THE CIRCULAR ECONOMY

THE NEED TO INCLUDE AGRICULTURE

The European Commission has launched an initiative that "aims at promoting the transition to the circular economy through a comprehensive, coherent approach that fully reflects interactions and interdependence along the whole value chain".

Agriculture is a clear example of a sector that could readily operate to circular principles. At present, however, it is linear in its structure. It uses unnecessarily high levels of inputs, a large proportion of which are not converted into edible products but instead result in wasteful and environmentally damaging outputs.

Rather than using high external inputs, circular agriculture strives to obtain inputs such as nutrients from within its world. It works with the grain of nature. It ensures that its wastes are recycled into productive agricultural use rather than being allowed to escape and pollute the environment. It recognises the ethical imperative of farming to the highest standards of animal welfare.

EU agriculture's inefficient use of nutrients

EU agriculture consumes 16.5 million tonnes of synthetic fertiliser per year. The bulk of this -11 million tonnes - is nitrogen.[i] Much of this nitrogen is not absorbed by crops. This is both wasteful of a valuable resource and a major source of pollution.

The *European Nitrogen Assessment* (ENA) points out that nitrogen (N) recovery (kg N taken up by a crop per kg applied N) varies from 30–60% across Europe, indicating that 40–70% of the N fertiliser applied is lost to the atmosphere or the hydrosphere.[ii]

The concentrate feed given to industrial livestock has high levels of nitrogen. However, livestock only assimilate half or less of the nitrogen in their feed; half or more is excreted in their manure. The ENA points out that only 10–50% of reactive nitrogen (N_r) in feed is retained in liveweight and 5%–40% in the edible weight.

The ENA states that accounting for the full chain from fertiliser application to N_r in edible produce, overall nitrogen use efficiency in animal production for the EU-27 is around 15–17%.
The ENA concludes that "for this reason, the full chain of animal protein production generates much more losses to the environment than plant protein production".

The nitrogen that is not absorbed by feed crops and then by the animals pollutes the environment. The ENA identifies five key threats associated with excess N_r in the

environment: damage to water quality, air quality (and hence human health, in particular respiratory problems and cancers), soil quality (acidification of agricultural soils and loss of soil biodiversity), the greenhouse balance and ecosystems and biodiversity.

In the EU 2.6 million tonnes of phosphate are used annually in synthetic fertilisers.[iii] As with nitrogen, a proportion of phosphorus is lost to the environment through erosion, leaching and run-off resulting in pollution of drinking water and eutrophication of surface waters.[iv]

Inputting large quantities of a resource and then allowing most of it to escape from the agricultural sector and cause great damage is the very epitome of a non-circular system. Moreover, the manufacture of synthetic fertilisers uses considerable amounts of fossil fuel which results in sizeable CO_2 emissions.[v] We need to move to genuine nutrient cycling in which a much greater proportion of nutrients is created from within farming and much more of the nutrients are incorporated into edible products rather than leaking into the wider environment.

The proportion of fertilisers introduced into EU farming from outwith agriculture could be decreased by reducing the need for external inputs and increasing the volume of nutrients created by biological processes that can be stimulated by good farming practices such as agroecology. These include the use of:

- compost, green manure and animal manure provided that the latter is applied in quantities that can be utilised by the land
- legumes which 'fix' atmospheric N into biologically available forms of reactive nitrogen
- local/domestic agro-biodiversity, well adapted to local climatic conditions that favour soil formation, hardy and requiring fewer or no external inputs.

The loss of nutrients to the environment can be reduced by precision application and by building soil organic matter. This enhances soil's capacity for water absorption and retention thereby minimising the loss of nutrients through run-off and leaching. Good soil quality also reduces soil's vulnerability to erosion. A circular approach to agriculture will take steps to avoid erosion which leads to the loss from the system of a core resource.

EU agriculture's damaging approach to dealing with insects and plant pathogens
Another area where EU agriculture relies on external inputs rather than drawing on its internal resources is pest control. Chemical pesticides and herbicides are used to control insects, plant pathogens and weeds even though these chemicals cause great damage to the environment and biodiversity including soil biodiversity.

A proper circular approach can be found in *Integrated Pest Management* which primarily relies on nature's own processes to control pests (with pesticide use being a last resort). These include allowing the natural enemies of pest species to thrive (whereas pesticides tend to kill pests' predators), the use of resistant varieties and the development of healthy soil as this promotes strong healthy crops which are better able to withstand disease and pest attack. In addition, conditions can be made unfavourable for specific pest insects or crop diseases.

Intensive agriculture's tendency to undermine the natural resources on which it depends can be clearly seen in the huge decline in bee populations largely due to the use of pesticides, monocultures and the loss of wildflowers. A 2015 IUCN (International Union for Conservation of Nature) study found that 9.2% of European wild bee species are threatened with extinction, while 5.2% are considered likely to be threatened in the near future.[vi]

Commenting on the report, the European Commission states "large-scale loss and degradation of bee habitats is one of the main threats to their survival. This is mostly caused

by intensive agriculture and changing farming practices, such as a concentration on silage production at the expense of hay-cropping, and the extensive use of insecticides and fertilisers".[vii] A circular system would not destroy the core resources on which its well-being and ability to function productively in the future depends.

Rotations, raising ruminants on pastures, integrated crop-livestock systems and agro-forestry are genuinely circular approaches to agriculture

In these systems resources are found and developed within agriculture. Moreover, wastes, rather than being ejected as pollutants, are utilised to build fertility.

Modern intensive agriculture tends to use monocultures, growing the same crop season after season. With rotation, however, a crop that removes certain nutrients from the soil is followed by a dissimilar crop that may replenish those nutrients or utilise different nutrients.

In rotational systems at least one cycle of the rotation will usually involve legumes as these are able to fix atmospheric nitrogen thereby reducing or avoiding the need for synthetic fertilisers. Nitrogen may also be replenished and soil quality strengthened by the use of green manure. This involves leaving crops, often specifically grown for this purpose, to decay on the surface or ploughing them into the soil. Crop rotation can also help build soil structure by alternating deep-rooted and shallow-rooted plants.

Rotational systems can also reduce the use of pesticides. Crop rotation impedes the build-up of pathogens and pests that often occurs when one species is continuously cropped.

Crops rotations can also incorporate animals in an integrated crop-livestock system. One rotational cycle may grow crops such as turnips for feeding cattle. Crop residues are used as animal feed or may be left on the field to protect soils from erosion and build soil organic matter. The animals' manure, rather than being a pollutant, fertilises the land.

Raising ruminants on pastures is truly resource-efficient as they convert grass into meat and milk and use land that is generally not suitable for other forms of food production. The animals' waste, which in industrial livestock production is a pollutant, develops soil quality. In addition, semi-natural grasslands support biodiversity and store carbon. However, many EU pastures have been intensified; 17% of the EU's synthetic fertilisers are used on grassland.[viii] The poor state of biodiversity in many EU grasslands is seen from the dramatic decline in grassland butterflies of almost 50% between 1990 and 2011.[ix] One of the main drivers of the decline in grassland butterflies is agricultural intensification which leads to uniform, almost sterile grasslands that are detrimental for biodiversity.[x]

An important touchstone for circular livestock systems is that they convert inedible material, such as grass, crop residues and food waste, into food that we can eat. In addition, the animals should be kept at relatively low densities so that they produce manure in a quantity that can be absorbed on near-by fields.

In linear systems, however, livestock are fed human-edible cereals that they convert very inefficiently into meat and milk. Moreover, they are stocked at high densities and so produce much more manure than can be properly used in neighbouring fields; this excess manure becomes a pollutant. Bajželj et al (2015) identify grazing on pasture, the use of crop residues and processing co-products as efficient forms of feed. They say that "together these support about 30% of current livestock production; the remaining 70% has to be seen as a very inefficient use of land to produce food".[xi]

In agroforestry multifunctional trees are incorporated into agricultural systems. Nitrogen-fixing trees can build up soil health and increase crop production. The roots of the trees can

slow down soil erosion. Thanks to the trees, birds return to feed off insects thereby reducing the use of chemical pesticides.

Research has studied silvopastoral systems for cattle that, alongside pasture also provide shrubs (preferably leguminous) and trees with edible leaves and shoots. Such systems do not need synthetic fertilisers, produce more biomass than conventional pasture and hence result in increased meat and milk production.[xii]

Facilitating the transition to circular agriculture

Common Agricultural Policy

The CAP should play a leading part in steering the EU to a circular approach to agriculture. CAP payments should not be available for farmers who use more than a specified proportion of (i) synthetic fertilisers and (ii) pesticides and herbicides. In order to minimise the challenges posed by this change, the permitted proportion of these inputs could start at a relatively high level and be reduced in steps over a period of time.

Increased support should be given to farmers who adopt circular practices such as rotations; short food supply chains; the building of soil quality through the use of legumes, fallow periods, green manure and animal manure; and *Integrated Pest Management* with chemicals used only as a last resort.

Taxation

Industrial agriculture, with its heavy use of synthetic fertilisers, agro-chemicals and monocultures, produces a range of costly 'negative externalities' including pollution of water and air, soil degradation, erosion of biodiversity and poor animal welfare. These negative externalities represent a market failure as the costs associated with them are borne by third parties or society as a whole and are not included in the prices paid by consumers.

Taxation measures could be used to enable the negative externalities of livestock production to be included in prices. Taxes could be levied on the sale of synthetic fertilisers, pesticides and herbicides at a rate commensurate with the environmental damage caused by these products. For example, the *European Nitrogen Assessment* estimates the environmental damage related to N_r effects from EU agriculture to be €20–€150 billion per year. Alternatively, a tax could be placed on surplus nitrogen and phosphate in excess of a farm's approved nutrient budget.

A circular approach could be promoted by allowing a percentage of farmers' taxable income to be tax-free when they employ specified practices such as rotations and drawing on nature's own resources to create nutrients (e.g. use of legumes and green manure).

Consumers could be encouraged to support circular agriculture by placing a lower or nil rate of VAT on food that has been produced in this way and, in the case of animal products, to high welfare standards.

Public information and education

The EU should develop programmes to increase public awareness of the environmental and animal welfare benefits of moving to a circular agriculture. The EU should encourage the provision of information to consumers on the farming methods used through comprehensive labelling of food products. This will encourage consumers to support a move to circular agriculture when shopping for food.

Public procurement

Public sector bodies should, when buying food, use their buying power to augment the market for food produced in accordance with circular principles and to high nutritional, environmental and animal welfare standards.

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[i] Industry facts and figures 2015. Fertilizers Europe

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[vi] IUCN and European Commission, 2015. European red list of bees

[vii] European Commission press release, 19 March 2015. European bees: new report shows nearly one in ten wild bee species face extinction

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[x] *Ibid*

[xi] Bajželj B, Clark M, Garnett T, Marteau T, Richards K, Smith P and Vasiljevic M, 2015 Synergies between healthy and sustainable diets. Brief for Global Sustainable Development Report

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