	4. Animal Husbandry
4.1.	**Nutrient Budgeting on livestock farms**
NPA Location Finland, Iceland, Northern Ireland, Republic of Ireland, Scotland	**Description and Purpose:** According to the European Commission BEMPs guidelines (2018) Nutrient budgeting is the best practice measure for deciding the nutrient requirement of a farm. It involves balancing of nutrient imports and exports for a farm. A budget requires calculating the macronutrient (N, P, K) and energy intake demand of a livestock unit, recording how much of the nutrient is exported as kg of meat or kg of milk then, considering the land bank area, and shortfall in nutrient that has to be imported as feed concentrate. <u>Nutrient surplus and use efficiency indicators</u> Gross nitrogen or phosphorus balance is calculated as the potential surplus of N or P on agricultural land (kg/ha/year). Nitrogen use efficiency (NUE) is the amount of N imported to the farm system (fertilisers, feed and bedding materials) that is exported from the farm in products (e.g. cereal grain, straw, animal live weight, milk).
	Nutrients Reduction (Effectiveness): According to the Environmental Agency (2008), limiting total N fertilisation and requiring manure N to be calculated at utilisation efficiency relative to artificial N (60%), reduction of 70% and 75% is possible in dairy and pig farms, respectively. Whole-farm nutrient budgets have been used effectively in the USA. Limited results showed voluntary BMP on concentrated animal feeding operations (e.g. feedlots) was more effective (30 – 60% reduction in P accumulation) than mandatory nutrient management plans and buffer strips (5–7% reduction in P accumulation) in reducing nutrient surpluses (Goulding et al., 2008). Farms in Denmark and the Netherlands have been able to achieve decreases in N surplus and increases in NUEN by ca. 30% in a 5-y period and 50% over 10 years.
	Recycling/Recovery: The information is very limited. In general there is not much interest in nutrients recovery from agricultural activities (Drizo, 2019).

	Climate Change Mitigation: Raising animals for food contributes to the production of greenhouse gases implicated in the global warming that is causing climate change. Livestock contribute both directly and indirectly to climate change. Enteric fermentation and manure associated emissions are direct, while production and transport of feed (including the fossil fuels used in manufacturing chemical fertilizers) and land use changes (such as conversion of forest to pasture and crop land) contribute indirectly. It has been shown that about 44% of the emissions generated by livestock are CH_4, which is released during enteric fermentation (eructation in ruminants) and emitted from manure decomposition; 27% are in the form of CO_2 emitted during the production and transport of animal products and feed, and 29% are N_2O attributable to manure and fertilizer (Gerber et al, 2013). According to the FAO Report (2006) the most promising approach for reducing CH_4 emissions from livestock is by improving the productivity and efficiency of livestock production, through better nutrition and genetics. Greater efficiency means that a larger portion of the energy in the animals' feed is directed toward the creation of useful products (milk, meat, and draught power), so that methane emissions per unit product are reduced. More recently, Shields and Orme-Evans (2015) made a comprehensive review of the livestock climate change mitigation practices and their effects on the animal welfare.
	Operation and Maintenance (O & M): The European Commission BEMPs guidelines (2018) provides information on two different online Tools for carrying out a nutrient budget in the UK. For example, PLANET (http://www.planet4farmers.co.uk/) provides field-level record keeping, industry standard recommendations allowing for organic manure nutrients, nutrient application plans, and help with carrying out calculations and producing reports. It can also be used to produce balances and NUE allowing farm standards or benchmarks to be produced. Commercial farms are then scored at 25%, 20%, 15% or 10% above or below the benchmark value for a specific farm system. Benchmarks can be expressed either as kg nutrient/ha or per livestock unit. MANNER (http://www.adas.co.uk/MANNER/tabid/270/default.aspx) is a decision support system that can be used to accurately predict the fertiliser N value of organic manures on a field specific can be used to accurately predict the fertiliser nitrogen value of organic manures on a field specific basis. It also provides estimates of NH3 and NO3 losses, and calculates the amount of applied organic N that remains available to plants, according to application method and timing and organic composition. Best practice measures in soil, grazing management and manure management are to tighten the N loop to maximise retention in the system and minimise losses to air and water.
	Cost: The European Commission (2018) Guide reported that • the cost of undertaking a farm nutrient balance are €200-500 per farm p.a. • Net cost of improving N management is ca. €-1 to +1 per kg N saved. • Default fertiliser costs used in MANNER-NPK to calculate fertiliser replacement value of manures are (converted into EUR at 0.85 EUR/GBP): o EUR 1.06 per kg N o EUR 0.94 per kg P o EUR 0.71 per kg K