5.3. Appropriate solid manure storage

NPA Location
Finland, Iceland, Northern Ireland, Republic of Ireland, Scotland

Description and Purpose: Manure is usually managed as dry solid manure or liquid slurries, stored in especially designed Storage Facilities or Structures. Liquid manure and wastewaters are sent to detention ponds or lagoons for settling out the solids fraction and reducing the volume through evaporation (5.1.). Lagoons also serve as a temporary storage facility for land application. However, the quantities of manure generated on the confined animal operations often exceed local crop needs and areas available for application, posing considerable challenges in P management (e.g. Sharpley et al, 1994; Sims et al, 2005; Doody et al, 2012; Doody et al, 2013; Teenstra et al, 2014). This is particularly the case in the USA, Canada and other temperate regions of the world where manure spreading winder ban had been introduced for a period of 6 months (December 15th to April 1st). In addition, in many areas manure has been stored in open pits that can still cause significant P pollution at each precipitation event (Teenstra et al, 2014). According to EC (2018) anaerobic digestion or separation of animal excreta prior to storage is best practice for farms with liquid slurry systems. Best practice is to compost or batch store the solid fractions arising from all manure management systems, especially farm yard manure and poultry litter. As a general recommendation, the manure storage facility must be located in well-drained area and the surface water should not enter it. An appropriate effective buffer strip must be constructed between the manure storage facility and the watercourse (EC, 2018). Siting manure heaps away from drains reduces the risk that preferential flow of effluent through the soil might transport N, P and fecal indicator organisms (FIOs) to field drains. Similarly, an adequate separation distance between the heap and a watercourse reduces the risk that any effluent from the heap might run over the soil surface directly into the watercourse (Haygarth, 2011).

Nutrients Reduction (Effectiveness): Small.
Nitrogen: A small reduction in nitrate leaching is estimated on the fields in the USA to which the option was applied. This assumes that 20% of manure heaps are at risk (i.e. over a drain, etc), and only 2% of total N is leached. Averaged over the farm area, this corresponds to a very small reduction in nitrate leaching losses per unit area.
Phosphorus: Cuttle et al. (2007) estimated that option implementation would result in a small reduction in the manure component of the baseline P loss.

Recycling/Recovery: None.

Climate Change Mitigation: Manure storage units contain little oxygen, promoting production of the greenhouse gas (GHG) methane. Methane is estimated to be 86 times more powerful than CO_2 (over 20 years) in contributing to climate change. Recent research has shown that covering and flaring methane from most storage units would reduce GHG emissions by 62% at a cost of \$13 Mg $CO_2e{-1}$, which is within the range currently paid in carbon markets (ACSESS, 2016).

Operation and Maintenance (O & M):
General recommendations/rules are presented in Table 1:
Table 1: Best practice measures for solid manure management according to Newell-Price et al. (2011)

Adopt batch storage of manure	Store 'fresh' solid manure in separate batches for at least 90 days before land spreading
Compost solid manure	turn the solid manure at least twice in the first seven days of composting to facilitate aeration and the development of high temperatures
Site solid manure field heaps away from watercourses/field drains	where solid manure is stored in a field heap it should not be sited within 10m of a watercourse or (effective) field drain
Store solid manure heaps on an impermeable base and collect leachate	Manure heaps are sited on an impermeable base, with leachate collection facilities.
Cover and protect solid manure stores from rain	Solid manure field heaps are covered (e.g. with heavy duty polythene sheeting) in a similar manner to a silage clamp.

Cost: Handling manure has many costs connected with it, including equipment purchase and maintenance, the opportunity cost of the time it takes to apply manure to fields, and the liability if something goes wrong and there is a spill. Additional costs may be incurred where the land base is limited and additional land must be rented, or in situations where manure agreements must be established. The Eurostats provide thorough information on the manure storage statistics (https://ec.europa.eu/eurostat/statistics-explained/index.php/Archive:Agriculture_-_manure_storage_statistics). Manure value and economics is also explained by LPELC (2019b).