4.3. Silage Runoff Management

Summary: Wilting of the forage crop decreases the moisture content of the forage and on that way the silage effluent extraction and prevents dry matter loss from the silage. The collection of the silage effluent into closed container prevents nutrient runoff to the surface and ground water and the effluent can be used as fertilizer on the field. Silage stacking should be at least 10 m away from watercourse.

Operation and Applicability: The silage effluents can be mixed to slurry and applied on the field as fertilizers. The collection and storage solutions can be adapted to the each farm system.

Efficiency: The practice has no negative environmental effects when all the effluents are collected and recycled in the farm and the runoff to the waterways is prevented.

The Silage Effluents Are a Point Source of Nutrients:

- About 30 % of the silage effluent runoffs ends up to the waterways.
- 90 % of the silage effluent is extracted during the first storing month from high moisture forage
- The dry matter loss from the silage via the effluent is 10–110 g DM/kg DM.
- pH ≈ 3,5–5 -> corrosive for metals and solubilize rock phosphates from the soil
- High nitrogen content: 2750–4905 mg TN/l, mainly in ammonium form
- The mineral content (K, Ca, P and Mg) of the silage effluent is higher than in the fresh forage -> lowers mineral content in the silage = nutrient loss
- High BOD-value 33 800–170 000 mg/l and COD 16 410–80 960 mg/l -> deplete DO causing fish-kills and eutrophication
- Silage effluent contains organic and amino acids

The Benefits in the Silage Effluent management:

- The nutrient runoff to the environment and to the ground waters is prevented.
- The nutrient outlet is collected and returned back to the farm's nutrient recycle.
- Built collection system will last for years if corrosion is avoided.

The Moisture Content of the Forage Crop Affects on the Volume of Silage Effluent:

- Freshly collected grass – high moisture content <45 % DM and high effluent extraction
- Wilted grass – low moisture content 45–80 % DM and minor effluent extraction
- Haylage ≈60 % DM and dried hay >83 % DM – no effluent extraction
- Wilting decreases the forage moisture content and the loss of dry matter from the forage.
- The transport of the wilted and lighter forage saves fuel costs.

Costs of the Practice: Depending on the silage storage system: groundwork, pipeline laying and cesspit tank installation. The value of the effluent is evaluated to be 2,23 €/m3 and the handling of it costs 1,15 €/1000 l.

Ability for climate chance mitigation: The designed collection of the silage effluents into the covered and solid containers decreases the risk for nutrient runoff due to the uncertain effects of the climate change.

Potential for nutrient recovery: The nutrients of the silage effluent are used as fertilizers in the crop production and returned back to the farm's nutrient recycle.

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Evidence of Success: Example of Silage Effluent Collection

Based on EU's nitrate directive the silage effluents must be collected to protect the environment.
At the moment it seems like that the silage effluent collection is well organized from the solid silage storing systems like silos. In the one part of Western Finland, it is evaluated that on fifth of the silage harvest is stored on the field stacks and none of them has a silage effluent collection. The good practices are needed for these cases and implied to the practice.

- **The Effluent Release During the Storing varies between 0,05–0,25 m^3/tn:**

- Fresh grass (78–83 % MC) produces 180–260 liters effluent per ton (≈0,15 m^3/tn)
- Wilted grass -> 0,05 m^3 effluent from ton of forage
- Plan the size of the effluent storage based on the effluent volume from the stacked silage
- For example: 3 m^3 /100 tn 70 % MC forage

The Silage Effluent Collection Systems:

- The silage bales containing effluents can be unwrapped on solid-soled ground with effluent collection system or absorbed into saw dust and mixed to the solid manure for the field application.
- The bales should be moved to a central location where effluent can be collected and managed accordingly.
- The silage effluent can be piped from the solid silage storages into the slurry storage. This must be build at the same time with the actual silage storage system. INTEGRITY
- Closed cesspit tank can be build next to the silage stack, silo or courtyard.
- The volume of the cesspit tank must be measured either for the silage effluents or also for drainage water depending on the collection area. Inessential drainage water collection and spreading on the field can be avoided with pipe blogging after when the silage stops to extract effluents with 3–4 weeks.
- The silage stack should piled on solid-soled ground and coved with at least 0,5 mm plastic which helps to collect effluents. The collection piping can be put under the stack and the effluents piped to the underground cesspit tank.
- Silage stacking must be made at least 10 m away from watercourse! In Canadian recommendations separation distances from surface water should be 61 m. Also dug and drilled wells should be protected.
- Use of constructed wetlands and vegetated infiltration areas for treating dilute silage effluent is need to be charted and innovated.
- Barley straw to effluent absorption

MORE INFORMATION:
https://helda.helsinki.fi/bitstream/handle/10138/153900/SYKEra_8_2015.pdf?sequence=1
https://www.sciencedirect.com/science/article/pii/S0301479714001923

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