# Reducing the environmental impact by applying livestock manure on farmland in Taiwan

## ☐ Introduction

Swine and cattle wastes are stipulated to be treated by three-step waste water treatment, then discharge to the surface water body in the past in Taiwan. To reduce the environmental impact of the past practice, the circular agriculture of applying the livestock manure in farmland is evaluated and promoted.

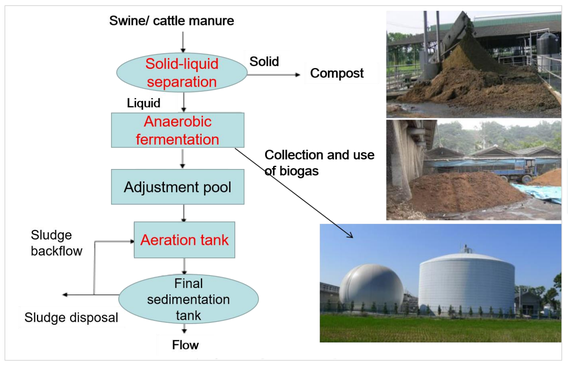


**Figure 1.** The three-step waste treatment of livestock farms in Taiwan.

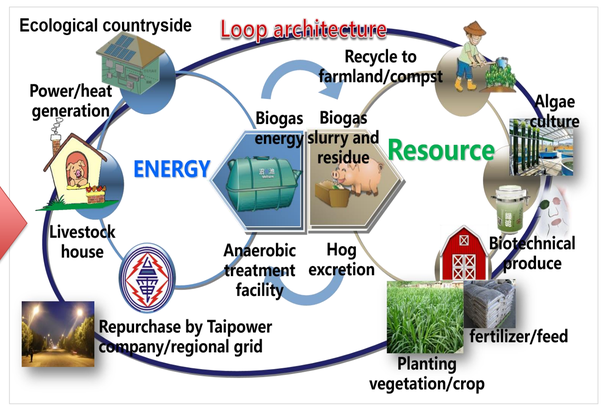


**Figure 2.** Circular agriculture.

## ☐ Evaluation of Manure application on farmland

**1.Nutrient supply:** Although the N efficiency of manure is lower than that of chemical fertilization. It can still supply the nutrient requirement of crop instead of chemical fertilizer.

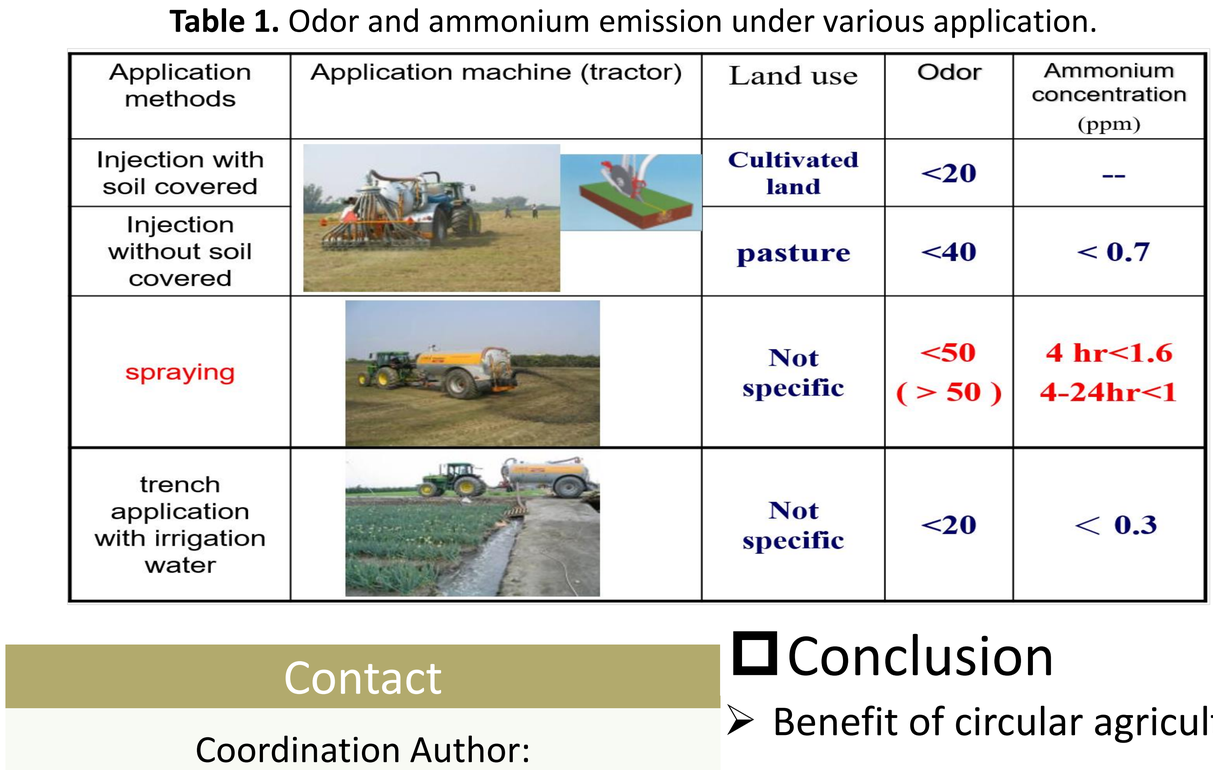


**Figure 3.** Rice yield of field experiment in Wufeng.

**2.Odor emission:** The odor emission is lower the limitation of regulation with various application method except spray method. Spray application site should at a distance > 200 meters from residential area to reduce the impact of odor emission.

**Table 1.** Odor and ammonium emission under various application.

| Application methods | Application machine (tractor) | Land use | Odor | Ammonium concentration (ppm) |
|---|---|---|---|---|
| Injection with soil covered |  | Cultivated land | <20 | -- |
| Injection without soil covered | | pasture | <40 | < 0.7 |
| spraying |  | Not specific | <50 ( > 50 ) | 4 hr<1.6 4-24hr<1 |
| trench application with irrigation water |  | Not specific | <20 | < 0.3 |

**3.Public health:** The spread risk of Zoonoses pathogen is low. However, Crop harvest is suggested two weeks after manure application for public health.

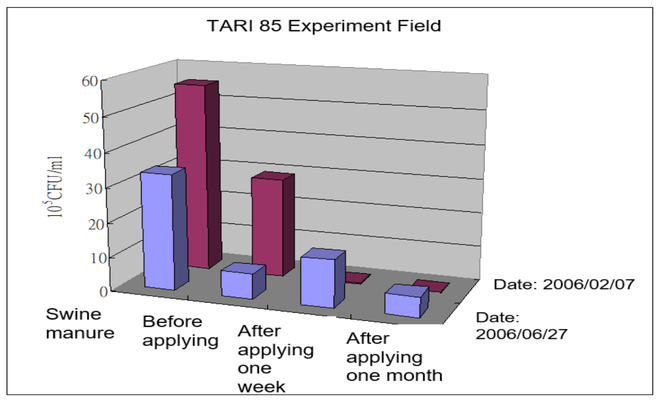


**Figure 4.** Coli detection in field of applying manure.

**4.Reducing the GHGs emission and Increasing the C sequestration:** The practice of manure application on farmland can reduce annual about 1.4 million Mg $CO_2$e/yr emission and increase 22 thousand Mg $CO_2$e soil carbon sequestration/yr instead of conventional practice.

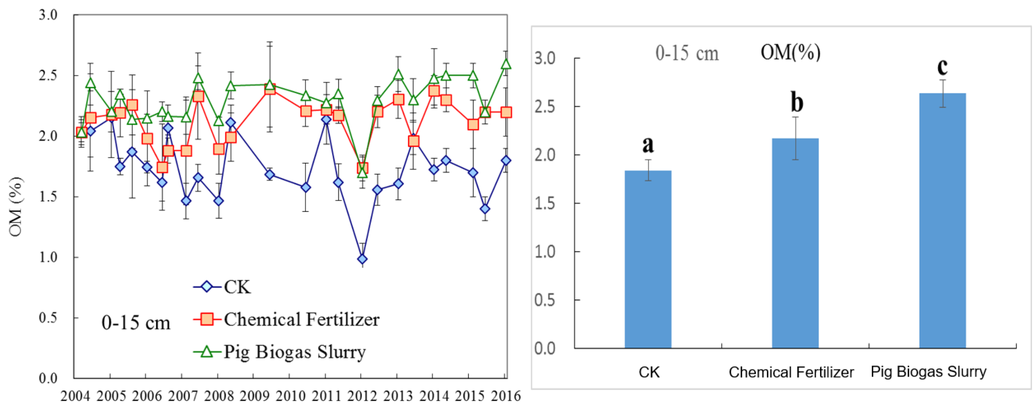


**Figure 5.** SOM under long term application of manure.

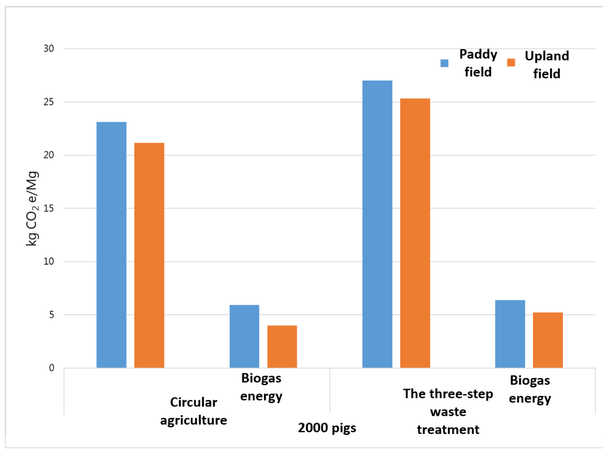


**Figure 6**. Carbon emission comparison of different livestock manure water treatment.

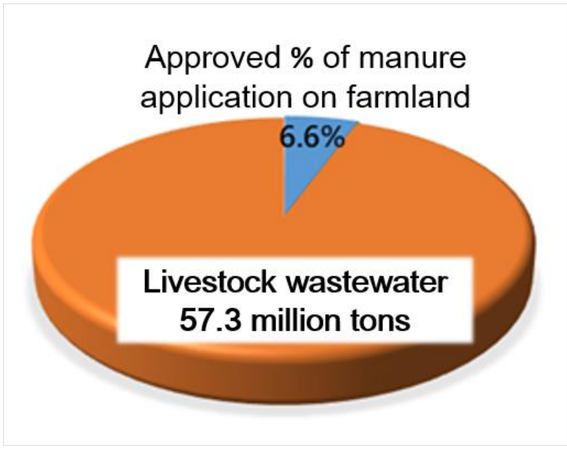


**Figure 7**. Reuse amount of livestock wastewater on farmland in Taiwan.

**5.Heavy metal accumulation:** Cu and Zn is accumulated gradually in soil in many cases. Readjust the heavy metal standard of feeding or using chelated minerals is necessary.

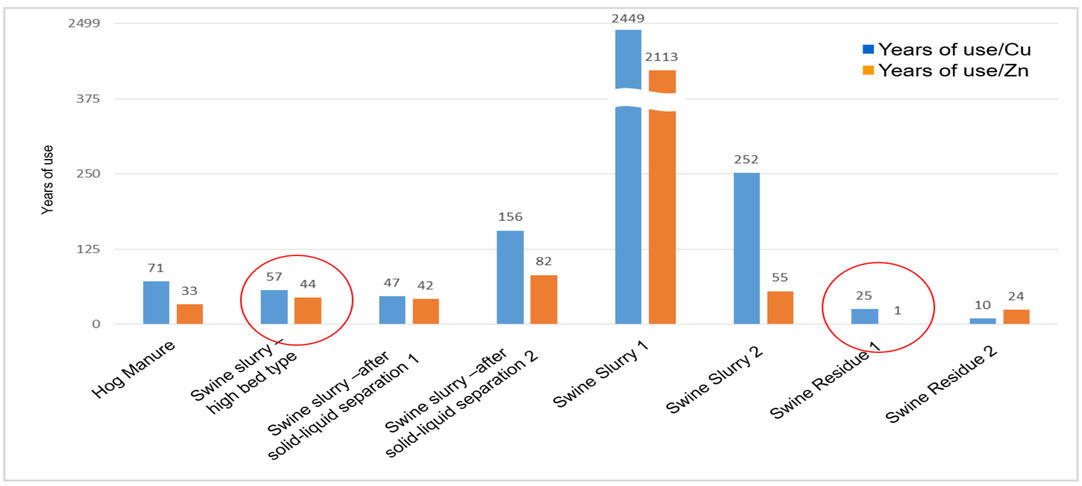


**Figure 8.** Duration to allow for manure application based on soil accumulation of heavy metals reaching the environmental monitoring norm.

## ☐ Conclusion

- Benefit of circular agriculture.

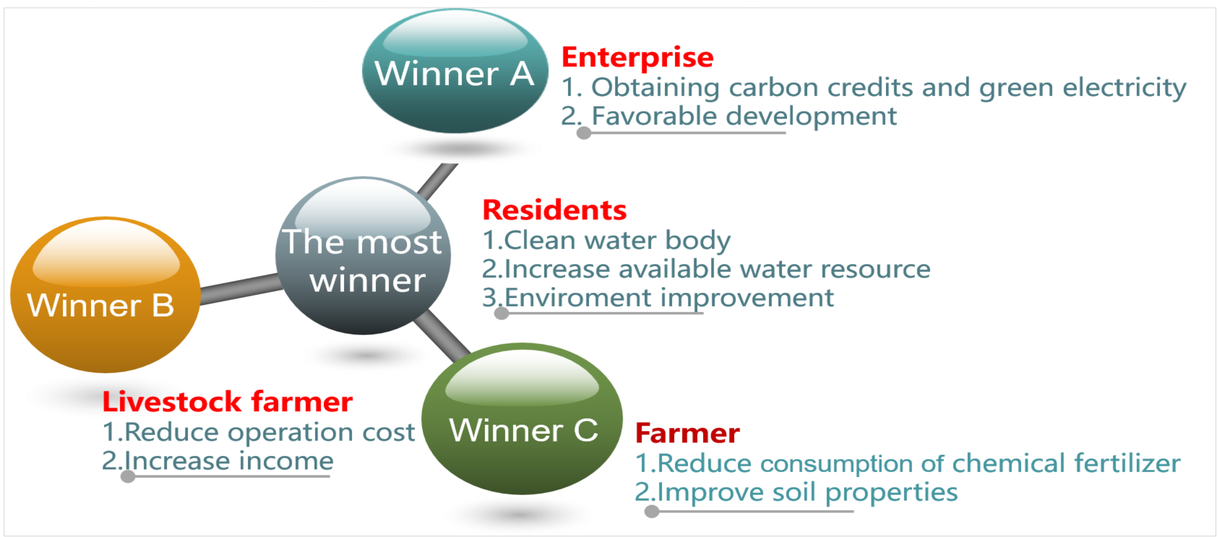


**Figure 9.** Benefit of circular agriculture.


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