

Production of acidic / neutral composts by using large animal mortalities and other agricultural additives to serve circular economy of agro-livestock holdings.

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Management of large animal mortalities

- Are not environment friendly
- Are likely to disperse dangerous diseases to humans and animals
- Do not promote the circular economy of livestock units.



Management of plant raw materials from gardens, parks and tree-lined streets

- Green wastes are discharged unexploited to landfill sites, causing:
 - rapid filling of landfills
 - increase, in fire risk; fires can be also spread from landfills to residential areas
 - burden municipalities with fees, which are related to transportation, to fuels for municipal trucks, routes to and from the landfill sites, machinery and vehicles damages
 - environmental and social



EU Regulation (EC) No 1069/2009 and
Greek law (Government Gazette B/556/02-
03-2016)

- **Category 1**

- Animals suspected of being infected by a Transmissible Spongiform Encephalopathy (TSE) or in which the presence of a TSE has been officially confirmed.

EU Regulation (EC) No 1069/2009 and Greek law (Government Gazette B/556/02- 03-2016)

- **Category 2**

- Includes animal by-products which are not fit for human consumption (dead fishes, animals killed for disease control purposes, dead-in-shell poultry, fetuses, oocytes, embryos and seeds which are not destined for breeding purposes).

EU Regulation (EC) No 1069/2009 and
Greek law (Government Gazette B/556/02-
03-2016)

- **Category 3**

- Includes animal by-products and part of animals which are not fit for human consumption (blood, placenta, wool, feathers, hair, horns, hoof cuts and raw milk originating from live animals that did not show any signs of disease communicable through that product to humans or animals).

Burial

- Various environmental and health hazards such as odor nuisance
- Reduce the quality of life
- Pathogens □ spreading diseases in soil, plants, animals and humans
- The potential leaching of harmful nitrogen and sulfur compounds to ground water
- Attract scavenging animals
- In countries with cold climate □ scavengers are attracted for a long time. Pathogens, which may still be present in the decomposed material, are capable of spreading diseases in animals and humans.
- Sodium pentobarbital □ euthanize animals □ Wildlife and domestic animals may be attracted by the carcass and become intoxicated or die if allowed to feed on it.



Burning in an open fire

- Pollutants produced by carcass burning □ affect the atmosphere, the soils and the waters
- Forbidden method in many countries
- Energy intensive
- Difficult to achieve high temperatures throughout large carcasses. Pathogens, which may still be present in the decomposed material, are capable of



Incineration

- Common method for animals suspected of being infected by a TSE or in which the presence of a TSE has been officially confirmed and other pathogens (anthrax, etc).
- Extremely energy-intensive process especially for the large animal mortalities (e.g. caws).

Greece □ there are not many incinerators. Animal mortalities have to be transported to the areas where incinerators exist. Pathogens, which may still be present in the decomposed material, are capable of spreading diseases in animals and humans



Why composting is a good choice

- Biosecure

- Composting allows immediate year-round disposal of carcasses so that disease is not spread.
- There is no entry of off-farm vehicles that can bring disease onto the farm from other operations, and the high temperatures in the compost pile kill pathogens.
- Properly built compost piles made by euthanized animals will deter pets and wildlife from feeding on carcasses.
- Sodium pentobarbital has been shown to degrade during the composting process (Schwarz, et al., 2013).
- Composting both reduced the volume of the original material by 50 to 60%
- Nutrients with increases of 62, 50, and 46% for N, P, and K, respectively.
- The remains did not have any severely threatening characteristics that would likely cause damage to equipment (Fonstad, et al., 2003).
- Highly pathogenic avian influenza (HPAI), Foot-and-mouth disease (FMD), Porcine epidemic diarrhea (PED), Porcine reproductive and

Why composting is a good choice

- Environmentally sound
 - A properly functioning compost pile gives off little odor and does not harm or affect groundwater. Composting turns a waste into a beneficial fertilizer and soil amendment, resulting in on-farm nutrient recycling.

Why composting is a good choice

- Effective method in managing of massive animal deaths
 - Composting can directly solve the case of massive animal deaths that may occur due to a natural disaster (eg fires, floods, etc.) where public health and the environment are directly threatened



Why composting is a good choice

- Cost effective
 - Composting has low to moderate start up costs and minimal operating costs.

Why composting is a good choice

- Easy to accomplish
 - Composting requires only good management and minimal training. It utilizes readily available organic materials.

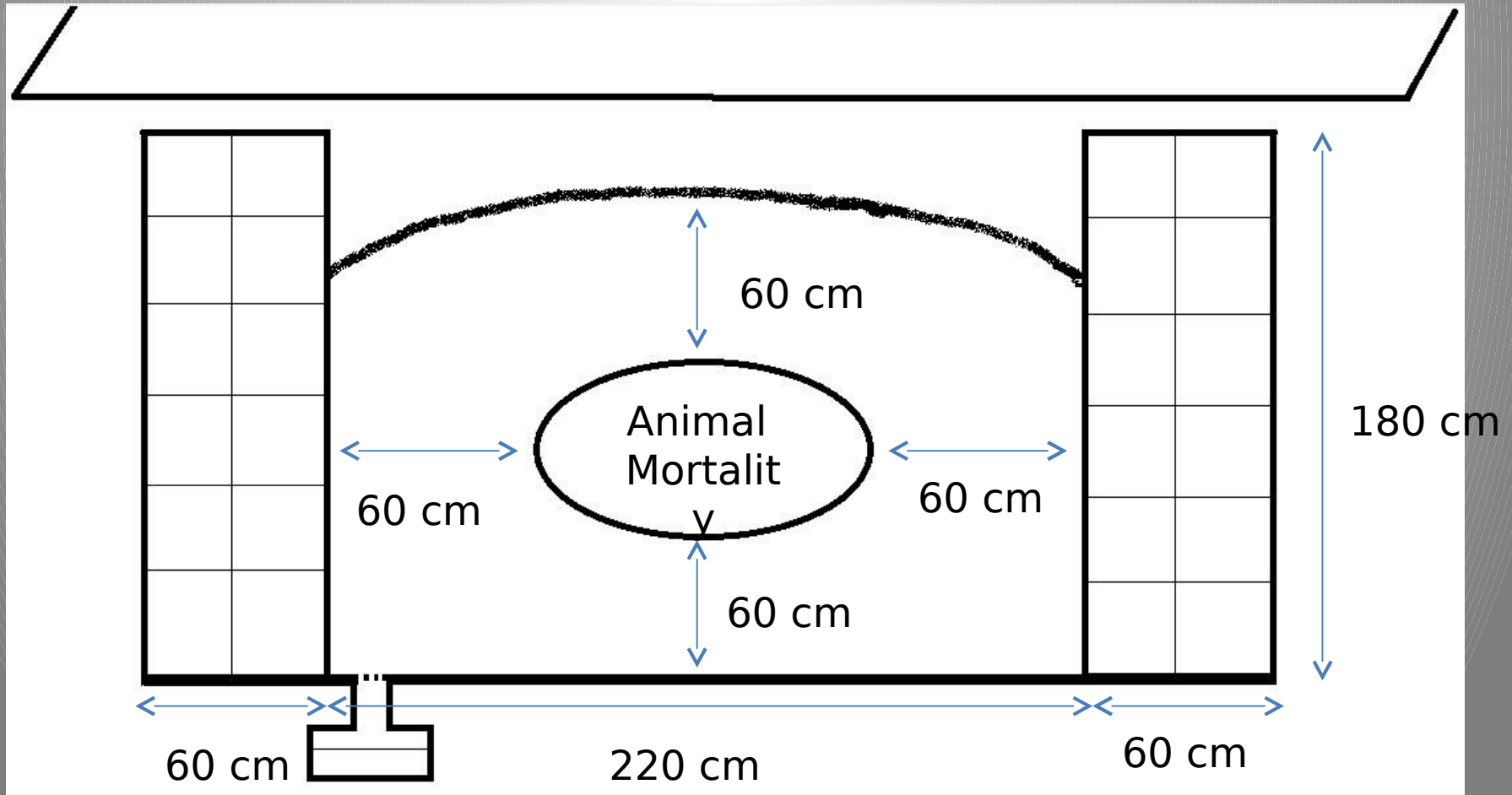
Composting methodology of large animal mortalities by exploiting green wastes

- Large animal mortalities
- Green wastes (lignin-rich plant raw materials) from municipalities
- Agricultural additives (zeolite, sulfur)
- safe and environment friendly product □ to agricultural and forest ecosystems.

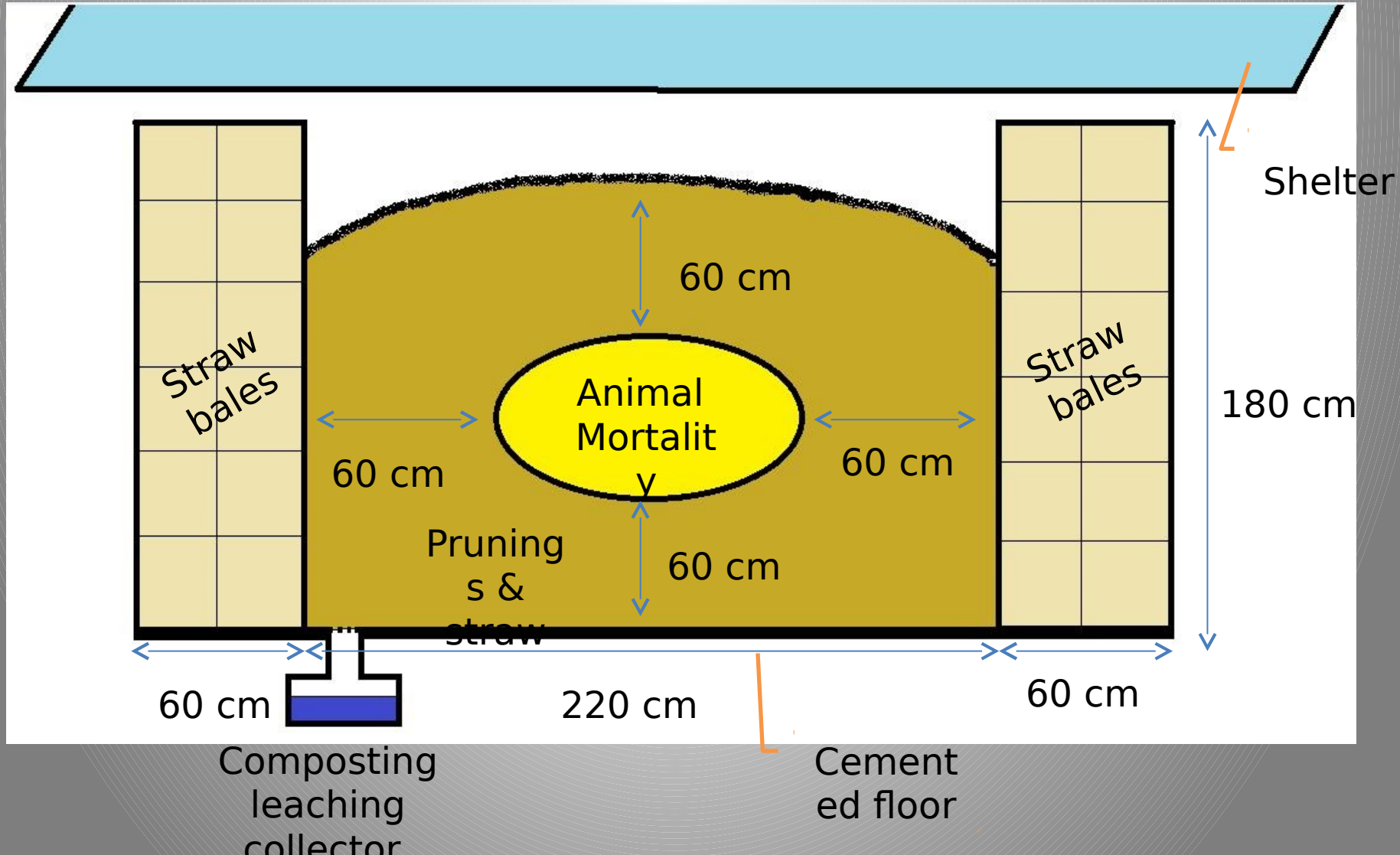
The aim of this study is to:

- Composting as a safe and effective method in managing large animal mortalities.
- Emphasizing composting as the most environmentally sound method against burial, incineration etc.
- Minimize the nitric nitrogen ($\text{NO}_3\text{-N}$) leaching .
- Produce an acidic / neutral compost for the needs of the acidophilus plant species.
- Developing a composting method as the best way to manage plant raw materials with high lignin content (gardens, parks and tree-lined streets, forest by-products, agro-industrial residues, etc.).
- Contribution of composting to the circular economy of a farming and livestock holding.
- Adaptation of the composting process to the conditions of the Mediterranean climate.

Construction



Construction - Compost pile



Compost Piles

- No1 □ 1 sheep mortality + prunings & straw
- No2 □ 1 sheep mortality + prunings & straw + Zeolite (5%, during construction)
- No3 □ 1 sheep mortality + prunings & straw + Zeolite (5%, during maturity phase)

Composting

- Primary composting phase □ anaerobic microorganisms work in the carcass to degrade it □ releasing fluids and odorous gases such as H_2S and NH_4 □ diffuse into the bulking agent where aerobic microorganisms degrade these materials to odor-free CO_2 and H_2O .
- The aerobic process produces considerable heat, causing the temperature of the compost pile to rise.
- The heat kills common viruses and bacteria that may be present in the carcass.
- By the end of the primary stage of composting, some large bones and hair may still be present but no soft tissues.
- The temperature will rise to 70-75°C.
- At the maturity phase (4th-6th month) □ skull parts, teeth will be visible □ soft and easily crumbled by hand.

Acidic / neutral composts

- At the end of composting
- 2 different amounts of sulfur

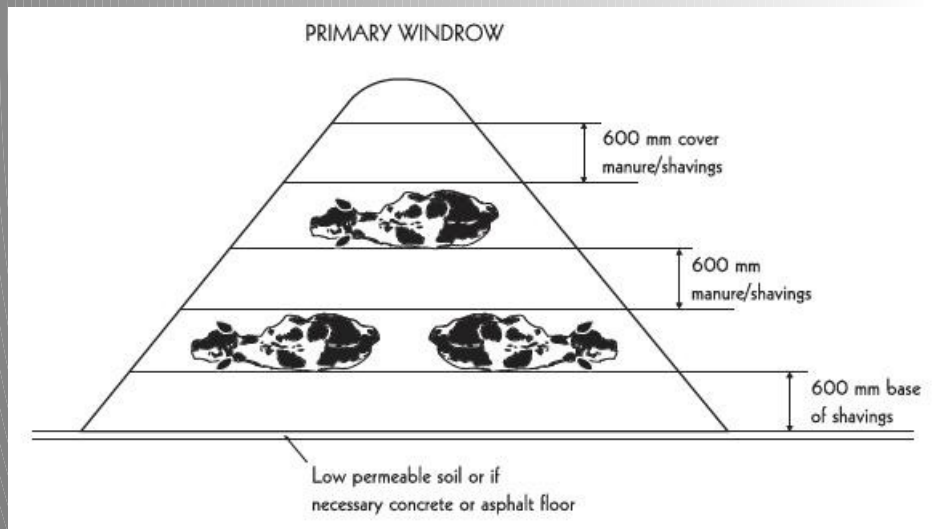
Final Composts

- Alkaline Composts
- Acidic / Neutral Composts

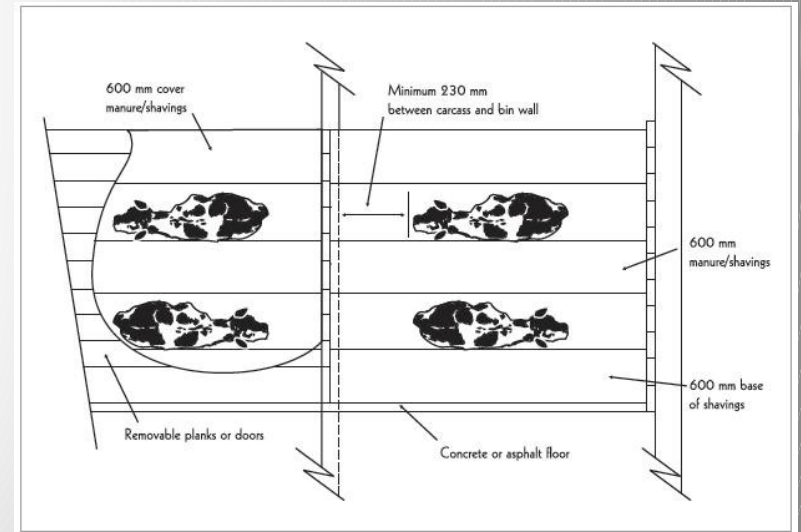
Greenhouse pot experiment

- *Lactuca sativa* (var. romana)
- Alkaline soil
- Composts, soil, leached water and plant tissues analysis

Composting practices Alberta - Canada



Composting windrow built in layers



Composting bins built in layers

Composting practices USA



Wooden bin used for poultry

Wire bin mini-composter



Composting practices USA



Enveloping a carcass with wood chips



Compost pile opened 4 months later

Composting practices Michigan - USA



Cow carcass placed in the center of the compost pile foundation

Covering the carcass and shaping the new pile



Composting practices New Jersey - USA



North Atlantic Right Whale bone remains following
composting

Paleontological Research Institute Ithaca, New York (USA)



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Thank you!

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