Farmer standing at manure storage (Matjaž Glavan)

Fertilising with farmyard manure (Slovenia)

Gnojenje s hlevskim gnojem

DESCRIPTION

The technology is based on use of livestock manure from dairy cows (excreta and cereals straw) for fertilisation of arable fields with 3-5 year rotation. Manure has a very good effect on soil production capacity and on growth of vegetable crops.

1. The technology is applied in the flatlands of Ljubljana with an average altitude of 350 m.a.s.l. Average annual precipitation is 1400 mm. The area is characterized with often stormy precipitation events and occasional droughts. Silty loam soils in the area are moderately deep to deep with medium soil organic matter. Area has good availability of surface water and groundwater of good drinking quality. The biodiversity of the area is medium without any salinity and flooding problems. Sedentary agriculture with mixed or commercial agriculture is practiced with less than 10% of income coming from off-farm activities. The examined farm household has an average wealth and is fully mechanized/motorized. All farm households have a good access to services and infrastructure. The examinded farm is medium in scale with land patly owned by the land user and partly leased from other private owners.

2. Main characteristic is the use of livestock manure on arable fields and especially for vegetable production. Manure is composed from solid dairy cows excreta and cereals straw (wheat, barley) which is used as bedding for cows. Manure is composted for few months (4-6, depends on storage capacity). It is spread before ploughing and then ploughed into the soil. Spreading of manure is done in autumn or in spring. Knowledge on time of spreading and on handling with machines is needed.

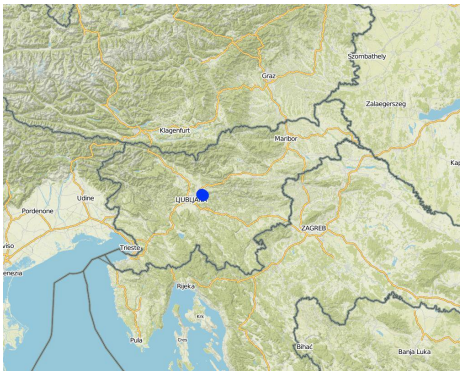
3. Main function is increasing organic matter in the soil and also all major nutrients (nitrogen, phosphorus, potassium, magnesium, calcium etc.). This leads to better (1) productivity due to nutrients slow release, (2) better water holding capacity and (3) decreased soil compaction threat.

4. Major inputs needed to establish are: livestock (animals), stable adapted to the manure collection, use of straw bedding, storage facility (if possible covered with roof), manure spreader, and loading equipment. Major inputs to maintain are: keeping of the livestock herd and maintenance of the machines.

5. The benefits are: (1) increase in soil organic matter, (2) increase soil water holding capacity, (3) to maintain soil productivity, (4) increase in yields quantity and quality.

6. Land users like: (1) lower cost for mineral fertilisers, (2) impact on soil fertility, (3) it's a traditional method.
Land users dislike: (1) time-consuming - labour hours invested, (2) storage capacity takes space, (3) costs of transport.

LOCATION



Location: Municipality of Dol pri Ljubljani, Slovenia

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 14.63797, 46.09285
- 14.63651, 46.09029
- 14.63849, 46.09133
- 14.65132, 46.08351
- 14.65132, 46.08351

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

In a permanently protected area?:

Date of implementation: more than 50 years ago (traditional)

Type of introduction
- [ ] through land users' innovation
- [x] as part of a traditional system (> 50 years)
- [ ] during experiments/ research
- [ ] through projects/ external interventions

Spreading manure over cropland (Matjaž Glavan)

Close up of spreding manure (Matjaž Glavan)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [ ] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [x] create beneficial economic impact
- [ ] create beneficial social impact

Land use

Cropland

- Annual cropping: cereals - barley, cereals - maize, cereals - wheat (winter), root/tuber crops - potatoes, root/tuber crops - sugar beet, vegetables - other

Number of growing seasons per year: 1

Water supply

- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

Purpose related to land degradation

- [x] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

physical soil deterioration - Pc: compaction, Pk: slaking and crusting

biological degradation - Bq: quantity/ biomass decline, Bl: loss of soil life

SLM group

- integrated crop-livestock management
- integrated soil fertility management

SLM measures

agronomic measures - A2: Organic matter/ soil fertility

structural measures - S11: Others

management measures - M7: Others

TECHNICAL DRAWING

Technical specifications

The infographic presents main parts of the technology from livestock originated manure, stored and composted and finally applied over fields. After that manure is incorporated in to the soil with purpose of improving the productivity of soils and for better crop and vegetable yields.

Author: Matjaž Glavan

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **28 hectares**)
- Currency used for cost calculation: **EUR (€)**
- Exchange rate (to USD): 1 USD = 0.89 EUR (€)
- Average wage cost of hired labour per day: 50 EUR

Most important factors affecting the costs

Labour is the most important. It is followed by livestock herd. However, herd costs are covered with milk production.

Establishment activities

1. construction of the storage facility for capacity of 6 month (Timing/ frequency: all year around)
2. Purchase of machinery for manure loading (Timing/ frequency: all year around)
3. Purchase of machinery for manure transport (Timing/ frequency: all year around)

Establishment inputs and costs (per 28 hectares)

Specify input	Unit	Quantity	Costs per Unit (EUR (€))	Total costs per input (EUR (€))	% of costs borne by land users
Equipment					
Storage facililty for 6 month capacity	pcs	1.0	10000.0	10000.0	100.0
Machine for loading manure	pcs	1.0	10000.0	10000.0	100.0
Machine for transport of manure	pcs	1.0	15000.0	15000.0	100.0
Total costs for establishment of the Technology				**35'000.0**	
Total costs for establishment of the Technology in USD				*39'325.84*	

Maintenance activities

1. Labour with daily manure handling (Timing/ frequency: all year around)
2. Labour with transport to the fields (Timing/ frequency: all year around)
3. Maintanance of machines (Timing/ frequency: all year around)

Maintenance inputs and costs (per 28 hectares)

Specify input	Unit	Quantity	Costs per Unit (EUR (€))	Total costs per input (EUR (€))	% of costs borne by land users

Labour					
Manure handling every day	EUR/hour	182.5	6.25	1140.63	100.0
Transport to the fields	EUR/hour	30.0	6.25	187.5	100.0
Equipment					
Maintanance of machines	EUR/hour	8.0	6.25	50.0	100.0
Total costs for maintenance of the Technology				**1'378.13**	
Total costs for maintenance of the Technology in USD				*1'548.46*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone
- [ ] humid
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 1352.0
Averegae rainfall period (1991-2000).
Majority of rain in autumn, followed by summer, spring and winter.
Name of the meteorological station: Ljubljana - Bežigrad
Strong summer tunder storms and showers. Local precipitation.

Slope
- [x] flat (0-2%)
- [x] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms
- [ ] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] footslopes
- [x] valley floors

Altitude
- [ ] 0-100 m a.s.l.
- [x] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

Technology is applied in
- [ ] convex situations
- [ ] concave situations
- [x] not relevant

Soil depth
- [ ] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [x] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [x] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [ ] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [x] medium (1-3%)
- [ ] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [x] 5-50 m
- [ ] > 50 m

Availability of surface water
- [ ] excess
- [x] good
- [ ] medium
- [ ] poor/ none

Water quality (untreated)
- [x] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

Species diversity
- [ ] high
- [x] medium
- [ ] low

Habitat diversity
- [ ] high
- [x] medium
- [ ] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [x] less than 10% of all income
- [ ] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [ ] manual work
- [ ] animal traction
- [x] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [x] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [ ] women
- [x] men

Age
- [ ] children
- [ ] youth
- [x] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [x] 5-15 ha
- [x] 15-50 ha

Scale
- [ ] small-scale
- [x] medium-scale
- [ ] large-scale

Land ownership
- [x] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [x] individual, titled

Land use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [x] leased
- [x] individual

Water use rights
- [ ] open access (unorganized)

- 50-100 ha
- 100-500 ha
- 500-1,000 ha
- 1,000-10,000 ha
- > 10,000 ha

- communal (organized)
- leased
- ✓ individual

Access to services and infrastructure

health	poor	✓ good
education	poor	✓ good
technical assistance	poor	✓ good
employment (e.g. off-farm)	poor	✓ good
markets	poor	✓ good
energy	poor	✓ good
roads and transport	poor	✓ good
drinking water and sanitation	poor	✓ good
financial services	poor	✓ good
None	poor	✓ good

IMPACTS

Socio-economic impacts

Crop production	decreased	✓ increased
crop quality	decreased	✓ increased
fodder production	decreased	✓ increased
fodder quality	decreased	✓ increased
product diversity	decreased	✓ increased

Organic manure is crucial in vegetable production. The examinded farm would already have stopped the livestock production but then he would lack manure as crucial component for the vegetable production. Few years ago the land user only produced raw milk but as market demand for vegetable increased he started with this type of production.

land management	hindered	✓ simplified
expenses on agricultural inputs	increased	✓ decreased
farm income	decreased	✓ increased
diversity of income sources	decreased	✓ increased

Organic manure is crucial in vegetable production. Few years ago the examined land user only produced raw milk but as the market demand for vegetable increased he started with this type of production too..

workload	increased	✓ decreased

Socio-cultural impacts

Ecological impacts

soil moisture	decreased	✓ increased
soil accumulation	decreased	✓ increased
soil crusting/ sealing	increased	✓ reduced
soil compaction	increased	✓ reduced
nutrient cycling/ recharge	decreased	✓ increased
soil organic matter/ below ground C	decreased	✓ increased
beneficial species (predators, earthworms, pollinators)	decreased	✓ increased
drought impacts	increased	✓ decreased

Farmer observed that soils with regular application of manure have better ability to retain soil moisture, reducing impacts of drought.

Off-site impacts

groundwater/ river pollution	increased	✓ reduced

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	✓ very positive
Long-term returns	very negative	✓ very positive

Benefits compared with maintenance costs

Short-term returns	very negative	✓ very positive
Long-term returns	very negative	✓ very positive

CLIMATE CHANGE

Gradual climate change

seasonal temperature increase	not well at all	✓	very well	Season: summer
seasonal temperature increase	not well at all	✓	very well	Season: autumn
seasonal rainfall decrease	not well at all		very well	Season: summer Answer: not known

Climate-related extremes (disasters)

local rainstorm	not well at all		very well	Answer: not known
local thunderstorm	not well at all		very well	Answer: not known
local hailstorm	not well at all		very well	Answer: not known
heatwave	not well at all	✓	very well	
cold wave	not well at all		very well	Answer: not known
extreme winter conditions	not well at all		very well	Answer: not known
drought	not well at all	✓	very well	

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- ☐ single cases/ experimental
- ☐ 1-10%
- ☐ 11-50%
- ☑ > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- ☐ 0-10%
- ☐ 11-50%
- ☐ 51-90%
- ☑ 91-100%

Has the Technology been modified recently to adapt to changing conditions?

- ☐ Yes
- ☑ No

To which changing conditions?

- ☐ climatic change/ extremes
- ☐ changing markets
- ☐ labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Strengths: Mitigates drought. Use of mineral fertilisers is decreased. If fields are fertilised with organic livestock manure, the impact of spring drought on plant growth is minimal.
- Opportunities: Livestock manure is a basic fertiliser for vegetable production. Customers are asking farmer what he is using for fertilisation. They trust more to the product if it is fertilised with organic manure produced at the farm.

Strengths: compiler's or other key resource person's view

- Strengths: increased levels of organic content.
- Slow release of nutrients.
- Better water holding capacity, especially in early spring.

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- Weakness: Costs of labour They are investing in to mechanisation of the process.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- Weaknesses: More labour work. Investing in machines with larger capacity
- Risk: uncontroled release of nutrients into groundwater They have to put lower quantity of more manure at one spreading. If they have vegetable production they can add two or three times in a year.

REFERENCES

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Resource persons
Matjaz Glavan - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2824/

Linked SLM data
n.a.

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