Generating Fertility

Principle: Generating Fertility on the Farm

The foundation of the fertility system needs to be based on strategies that emphasize generating fertility from within the life of the farm. When applicable, the following techniques need to be demonstrably utilized to their maximum potential in order for a farm to import allowed fertility materials.

- Livestock integration
- Vegetative cover/ reduction of tillage
- Legumes/nutrient catch crops
- Biodynamic preparations
- Crop rotation

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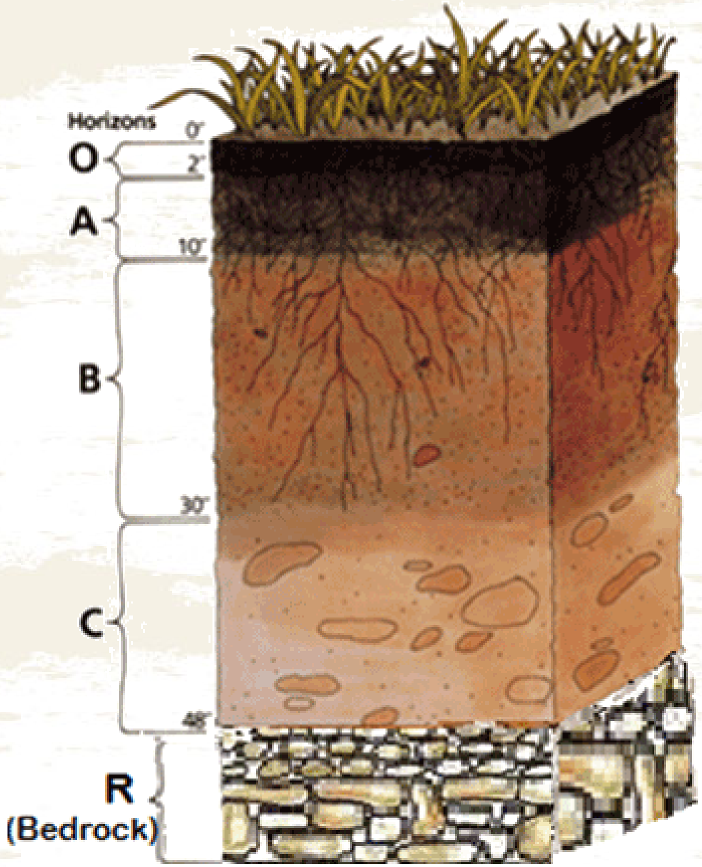
BIODYNAMIC FARMS HAVE HUMUS BASED FERTILITY SYSTEMS THAT AIM TO SEQUESTER CARBON FROM THE ATMOSPHERE BACK INTO THE SOIL

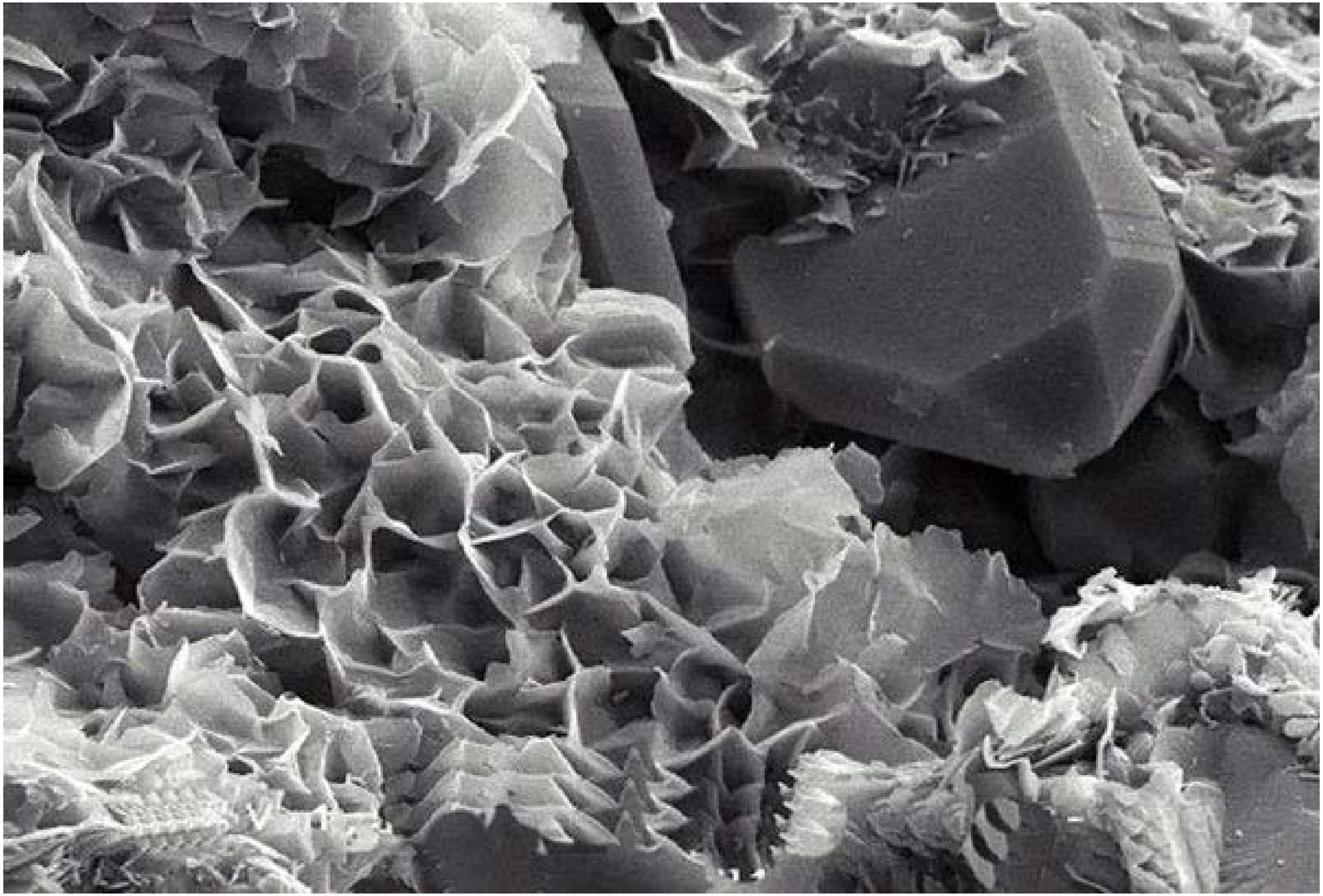
Growing Soil



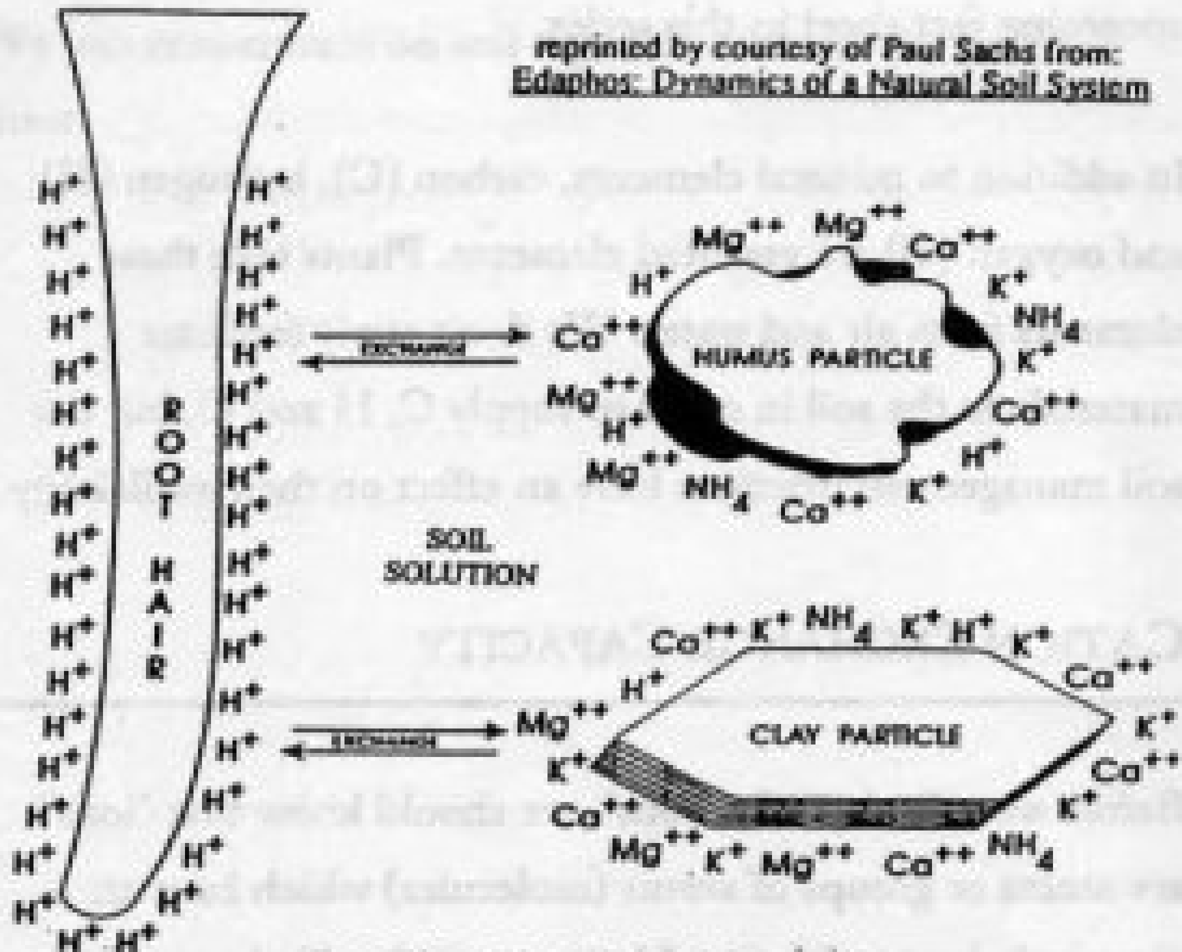
The primary focus of these practices is the development of soil humus, not just the end product but also the biology that leads to its development.

Humus is a soil colloid. It vastly increases a soils ability to hold onto and release crop nutrients and water.

Soil Colloids



Humus – Clay complex



CATION EXCHANGE

Around the planet we have lost 30-70% of all top soil

Several hundred Billion tons of soil organic matter have been transferred from top soils to the atmosphere or the oceans.

How did humanity destroy up to 70% of the Earth's humus? Tillage. *
* The Carbon Underground- https://www.thecarbonunderground.org

From the GRAIN submission to UNCTAD's 2013 report "Wake Up Before it's too Late":

At least 200 to 300 billion tons of CO_2 have been released to the atmosphere due to the global destruction of soil organic matter. In other words, 25 to 40 percent of the current excess of CO_2 in the atmosphere resulted from the destruction of soils and their organic matter.

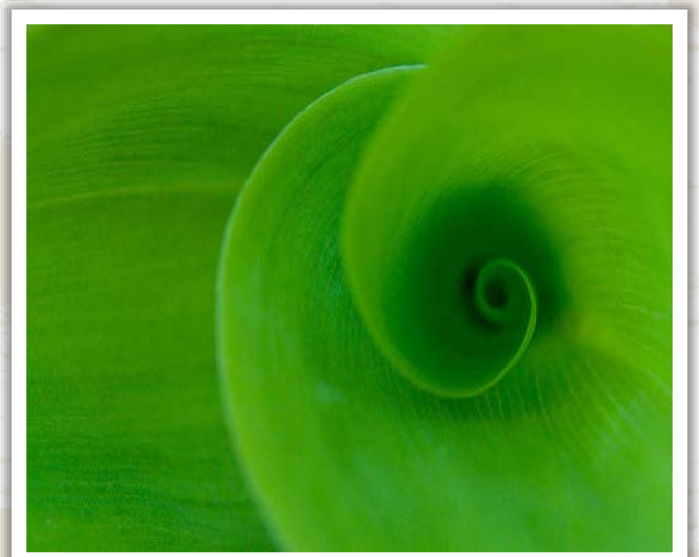
October 2016 NOAA reports that measured CO_2 levels in the Earth's atmosphere reached the highest levels in 3 million years, exceeding 400 ppm, not temporarily but for ever . This happened over a very short period of time (approximately 100 years) with direct relation to global industrialization and the practices that came with it.

IF- we were to stop all contributing industry, the use of all fossil fuels, the current chemical approach to agriculture today there **would still be 400 ppm.**

The interaction of the Earth with the Sun (via photosynthesis) is a process that can pull large amounts of CO2 from the atmosphere, incorporating it into matter, and when managed properly sequester the carbon back into the Earth as Humus. This not only provides one solution to a huge problem it also supports a very efficient and regenerative approach to agriculture that is capable of providing healthy food for many generations to come.

Growing Soil the Macro-Cosm

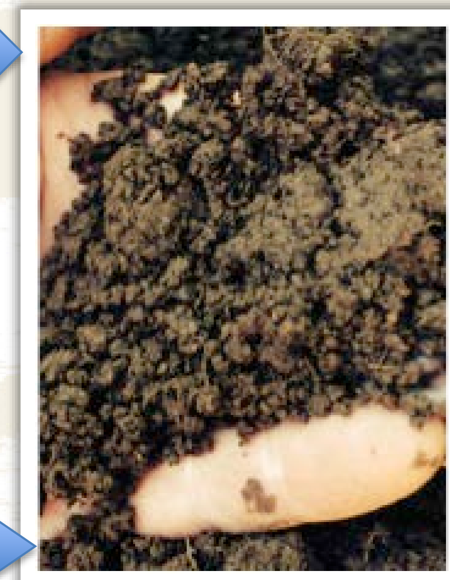
Sunlight/ warmth drives photosynthesis



Photosynthesis sequesters carbon into form as plant life

Plant life feeds herbivores that generate manures that feeds the soil biology and also allows for presence of sod in the system

Plant life generates soil cover and biomass that protects and feeds soil biology



Regenerates as humus

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Principle: Generating On-Farm Fertility

Fertility Practices Addressed By The Demeter Farm Standard Focused On Building Soil Humus

Integrating Livestock

Green Manures

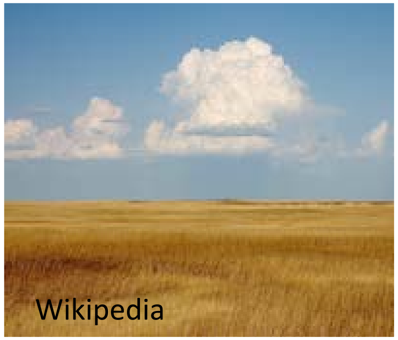
Compost

Crop Rotation Strategies

Biodynamic Preparations

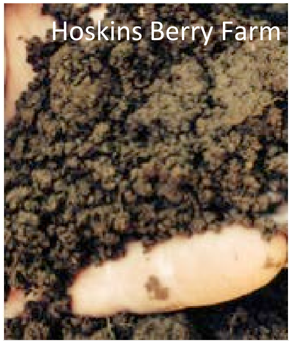
Reduction of tillage/vegetative cover

Fertility Practices: Integration of Livestock
Lessons from the Natural World



Grassland

Ruminant



Humus

The fertility contribution of livestock is not only the manure produced but also the contribution of sod/ pasture into the crop rotation. Sod with grazing animals is one of nature's way of building the organic fraction inherent to a soil. A classic example of this are the grassland plains of North America, the soils of which were built by grasslands and grazing animals such as Bison.

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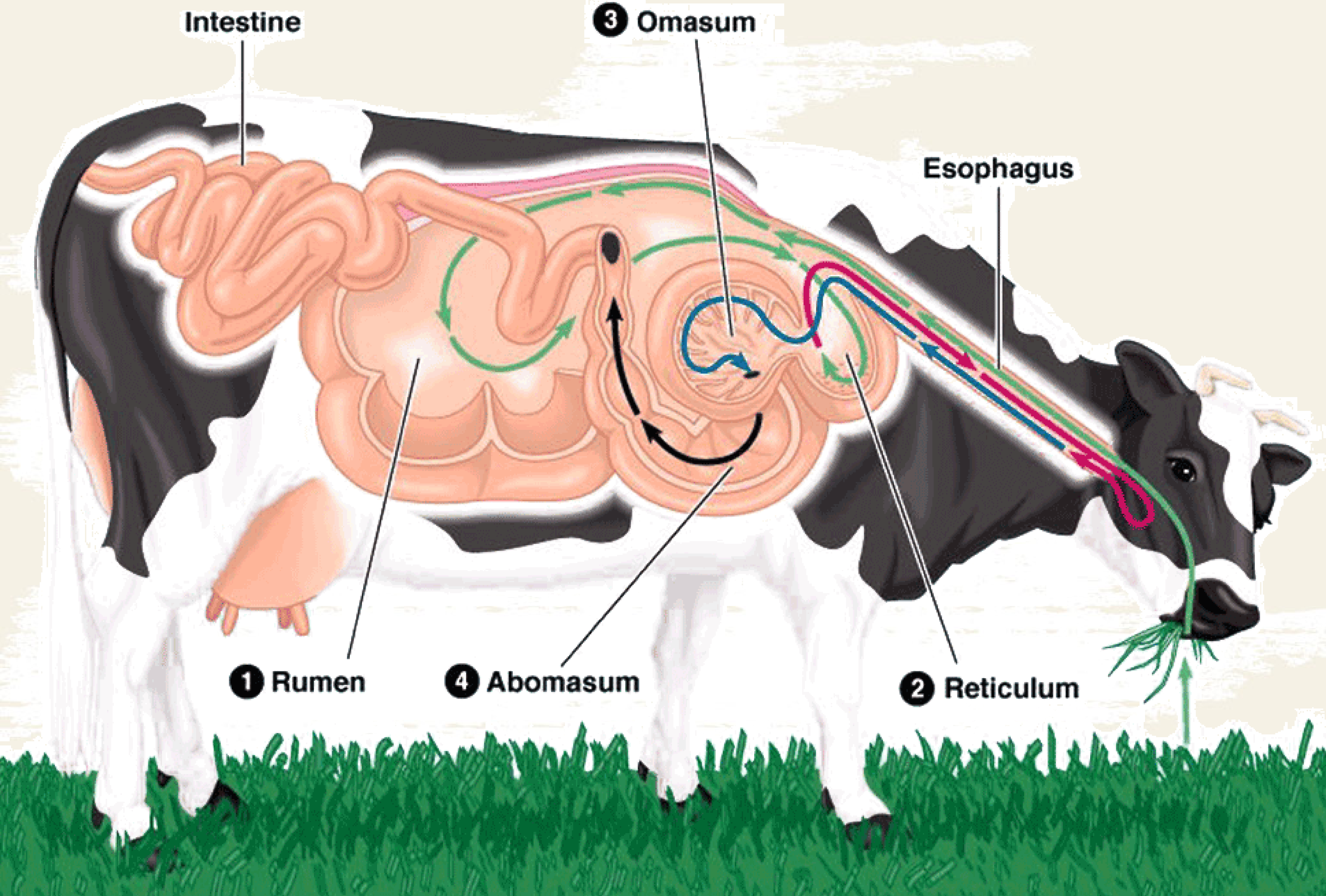
The Beauty of Rumination



Fertility Practices: Integrating Livestock

Integrate farm animals back into a living farm landscape

Rather than confining them in CAFO's

Integration Of Livestock

Not having livestock on the farm and having livestock on the farm that are not managed fully to the Demeter Standard requires approved exemptions.

From Demeter International Standard Appendix 7 Exemptions
http://www.demeter.net/certification/standards/production

5) No animals carried by the enterprise: *exemption possible for "market gardens" and "perennial crops". We apply this exemption on a case by case basis*
5a) Cooperation between farms: *exemption to allow a crop farm to formally work with a neighboring livestock farm as one unit.*
#15) Guest animals: *exemption to allow animals not fully meeting Demeter Standard, for US attention to contamination from wormers, antibiotics etc. needed*

In situations when there are animals not certified to the Demeter Standard on a farm how these animals are managed needs to be considered. Attention must be paid to humane handling of the animals while they reside on the farm. Also attention must be paid to avoiding contamination of production land with residue of materials such as veterinary treatments and wormers.

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RESEARCH EDITORIAL

http://www.jswconline.org/content/71/2/156.full.pdf+html

doi:10.2489/jswc.71.2.156

Journal of Soil And Water Conservation

The role of ruminants in reducing agriculture's carbon footprint in North America

W.R. Teague, S. Apfelbaum, R. Lal, U.P. Kreuter, J. Rowntree, C.A. Davies, R. Conser, M. Rasmussen, J. Hatfield, T. Wang, F. Wang, and P. Byck

Abstract: Owing to the methane (CH_4) produced by rumen fermentation, ruminants are a source of greenhouse gas (GHG) and are perceived as a problem. We propose that with appropriate regenerative crop and grazing management, ruminants not only reduce overall GHG emissions, but also facilitate provision of essential ecosystem services, increase soil carbon (C) sequestration, and reduce environmental damage. We tested our hypothesis by examining biophysical impacts and the magnitude of all GHG emissions from key agricultural production activities, including comparisons of arable- and pastoral-based agroecosystems. Our assessment shows that globally, GHG emissions from domestic ruminants represent 11.6% (1.58 Gt C y^{-1}) of total anthropogenic emissions, while cropping and soil-associated emissions contribute 13.7% (1.86 Gt C y^{-1}). The primary source is soil erosion (1 Gt C y^{-1}), which in the United States alone is estimated at 1.72 Gt of soil y^{-1}. Permanent cover of forage plants is highly effective in reducing soil erosion, and ruminants consuming only grazed forages under appropriate management result in more C sequestration than emissions. Incorporating forages and ruminants into regeneratively managed agroecosystems can elevate soil organic C, improve soil ecological function by minimizing the damage of tillage and inorganic fertilizers and biocides, and enhance biodiversity and wildlife habitat. We conclude that to ensure long-term sustainability and ecological resilience of agroecosystems, agricultural production should be guided by policies and regenerative management protocols that include ruminant grazing. Collectively, conservation agriculture supports ecologically healthy, resilient agroecosystems and simultaneously mitigates large quantities of anthropogenic GHG emissions.

Key words: carbon sequestration—conservation agriculture—ecosystem services—greenhouse gases—regenerative ecosystem management—soil erosion

Fertility Practices: Maintaining Vegetative Cover/ Reduction of Tillage

Covered soil is key to improving the effectiveness of the ecosystem processes.

Fertility Practices: Maintaining Vegetative Cover/ Reduction of Tillage

Demeter Standard: Bare tillage year round is prohibited. Land base needs to maintain adequate green cover. The primary objective of Demeter Biodynamic soil fertility management is the development of soil humus. Excessive tillage is contrary to this goal.

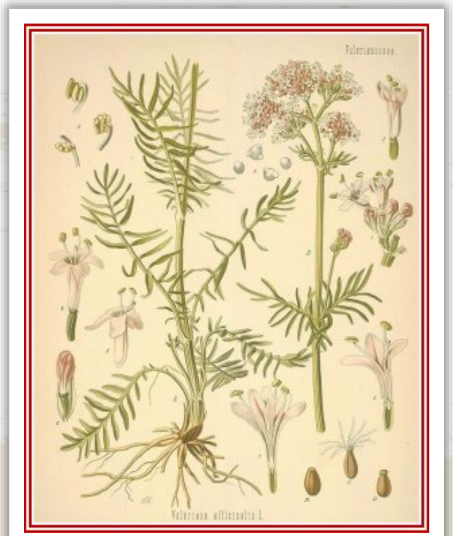
Resources:

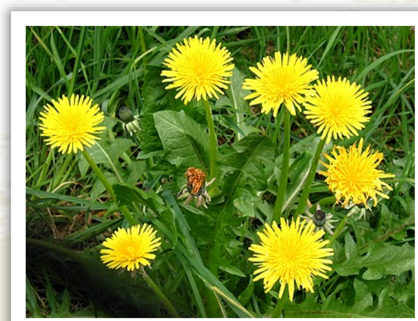
- http://rodaleinstitute.org/our-work/organic-no-till/
- http://www.savoryinstitute.com
- https://www.thecarbonunderground.org

Fertility Practices: Green Manures & Crop Covers

Green manuring and cover cropping needs to be implemented before fertility inputs can be imported from the outside.

The Biodynamic Preparations (500 – 508)





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Fertility Practices: Crop Rotation

In annual crop rotations a given harvested commodity cannot be planted in the same field for more than 2 years in succession. Close attention needs to be paid to the nutrient export associated with each harvested commodity. The crop should not return to a given field until there has been adequate time to return exported nutrients to the soil in a manner consistent with these standards.

As noted above sod & vegetative cover in the overall rotation plays a vital role.

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Fertility Practices: Applied Fertility Grazing Animals

In situations where fertility is applied only by grazing animals compliance with the Demeter applied fertility requirements can be based on compliance with the Demeter stocking rate requirements for the animals involved applied over the entire acreage of the crop rotation.

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Appendix F: CALCULATION OF STOCKING RATES

The stocking rate takes into account the development and maintenance of soil fertility. The maximum amount of nitrogen and phosphorus that may be supplied by way of the fertilization used may not exceed the amount that would be produced by those animals that the farm could support from its own fodder production. Manure Units - measurements of fertility potential - are used to determine stocking rates for the various animal types. One manure unit is equivalent to 176 lbs of N and 154 lbs of P205.

The stocking rate is calculated utilizing Livestock Units (LU) and the corresponding annual production of Manure Units (MU), associated with various animals. One LU excretes .7 MU annually. The maximum stocking rate may not exceed 0.8 Livestock Units/ Acre (.56 manure units/acre) if feed is imported. This is the equivalent of 100-lbs/ acre of applied N and 87-lb/ acre applied P_2O_5. Note that this stocking rate might not be possible in all climates. The maximum allowed may need to be reduced if conditions require it in order to maintain the health of the farm.

Stocking Rate: Animal type	LU/animal	Acres/animal	Animals/acre
Breeding bulls	1.2	1.50	.66
Cows	1	1.25	.80
Cattle over 2 years old	1	1.25	.80
Cattle 1-2 years old	0.7	.87	1.14
Calves	0.3	.38	2.60
Sheep and goats up to 1 year old	0.02	.03	40.0
Sheep and goats over 1 year old	0.1	.13	8.0
Horses under 3 years old and young horses	0.7	.87	1.14
Horses, 3 years and older ponies and small breeds	1.1	1.42	.7
Pigs for meat production (45-110 lb.)	0.06	.08	13.0
Pigs for meat production over 110 lb.	0.16	.20	5.0
Breeding boars	0.3	.39	2.6
Breeding sows (including piglets to 45 lb.)	0.55	.67	1.5
Breeding sows without piglets	0.3	.38	2.6
Piglets	0.02	.03	40.0
Laying hens (without replacement stock)	0.0071	.009	112.6

Fertility Practices: Applied & Imported Fertility

The Principle

The maximum amount of nitrogen and phosphorous that may be applied by way of fertilizers used, averaged over the crop rotation, may not exceed the amount that would be produced by those animals which the farm could support by its own forage production. Direct relation to stocking rates and the related manure units generated

Applied Fertility= fertility applied over the total acreage of the farm whether imported or farm generated.

Maximum 100 lbs. N/acre and 87 lbs. P205/acre applied to the total acreage in the crop rotation.

Imported Fertility= fertility imported from outside the farming system

Maximum 36 lb N/ acre and 31 lb P205 / acre N and P imported/ applied to total acreage in the crop rotation. Exemption for higher amounts in cases with clear documented need.

Imported Fertility Calculation

- Imported fertility (36 lbs N, 31 lbs P) averaged over the total acreage being cultivated. Acreage that does not apply is acreage that is permanently set aside as biodiversity reserve such as wild areas, permanent insectories etc. Acreage that is in the rotation but fallow in a given year does apply as does pasture being grazed or hayed.

Example:

300 acre farm with 100 acres in its crop rotation in a given year imports 50 tons of approved cow manure for compost and 30 gallons of approved fish.

a) Cow manure analysis 1-1-1

100,000 lbs x 1% N(.01) = 1000 lbs N imported

100,000 lbs x 1% P(.01) = 1000 lbs P imported

b) Liquid fish analysis 5-1-1

1 gallon = 8 lbs. 50 gallons = 400 lbs

400 lbs x 5% N(.05)= 20 lbs N imported

400 lbs x 1% N(.01)= 4 lbs N imported

c) Imported Nitrogen = 1,020 lbs (1000 lbs manure, 20 lbs fish). 1020 lbs divided by 100 acres = 10.2 lbs N/A imported. Compliant with Standard.

d) Imported Phosphorous= 1,004 lbs (1000 lbs manure, 4 lbs fish). 1,004 lbs d divided by 100 acres= 10.05 lbs P/A imported. Compliant with Standard.

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Applied Fertility Calculation

Applied fertility (100 lbs N, 87 lbs P) averaged over the total acreage being cultivated. Acreage that does not apply is acreage that is permanently set aside as biodiversity reserve such as wild areas, permanent insectories etc. Acreage that is in the rotation but fallow in a given year does apply as does pasture being grazed or hayed.

Example: Applied Fertility Calculation

300 acre farm with 100 acres in its crop rotation importing fertility calculated as above and also supporting 30 cows on farm.

a) The imported cattle manure (dry matter basis) and fish as imported above= 10.2 lbs N/ acre and 10.5 lbs P / acre.

b) 30 cows = 30 Livestock Units (LU) (see appendix F of Demeter Farm Standard). 1 LU = .7 Manure Units (MU). 1 MU = 176 lb N and 154 lb P.

- 30 LU x .7 = 21 MU
- 21 MU x 176 lb N= 3,696 lbs N applied by 30 cows. Divided by 100 acres= 36.96 lbs N/ acre applied.
- 21 MU x 154 lb = 3,234 lbs P applied by 30 cows. Divided by 100 acres= 32.34 lbs P / acre applied.

c) Total applied fertility =

- Nitrogen : 10.2 lbs / acre (imported manure) + 36.96 lbs / acre (30 cow units on farm) = 47.16 lbs N/ acre applied
- Phosphorous: 10.5 lbs / acre (imported manure)+ 32.34 lbs P / acre (30 cow units on farm)= 42.84 lbs/ acre
- Both in compliance with the Demeter Farm Standard requirement of 100 lbs N/ acre and 87 lbs P/ acre.

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In situations such as intensive grazing strategies where significant amounts of raw manure and urine are deposited on a land base, effort must be made to help the soil assimilate the manure in a living way before a crop to be certified can be planted or harvested.

Fertility Practices: Applied & Imported Fertility Cooperation Between Local Farm

In cases where no Biodynamic farm is sufficiently close by, co-operation can be organized between the certified Biodynamic farm and an organic farm. In either case there must be a formal agreement.

Before co-operation with an organic farm is permitted, the following conditions must be fulfilled:

1. The co-operating partner farm must feed the animals with 100% organic fodder,
2. The co-operating partner farm must be converted entirely to organic production.
3. An exemption must be requested and approved
4. Farmyard manure has to be prepared on the farm where it originates (ideally in the stable, or at least six weeks before application).
5. The distance of transportation must be kept at a minimum and will be considered as part of the exemption process


Biodynamic Compost
Farm generated fertility materials, such as livestock manures, are one of a farmers most valuable fertilizers. Care must be taken not to lose the inherent fertility present in these materials during storage and the composting process.

Biodynamic Compost

Attention is paid to avoidance of contamination of both the pile itself and the surrounding environment.

Fertility Practices: Fertility Materials Requiring Special Attention

Fertility materials needing special consideration
The use of plant wastes such as lawn clippings, leaves, green chop, or compost from municipal sources.

Permitted forms of potassium salts can not have a chloride content of more than 3%**.**

Meals from potential GMO crops are to be used as production aids it must be verified that such materials are non- GMO at the time of application.

The addition of minerals can significantly affect mineral balances in the soil such as cation ratios. The importation of any minerals should be based on a documented need.

Chilean Nitrate not permitted as it is with NOP

Potting soils need to contain 25% Biodynamic compost or be inoculated with the BD compost preparations 502-7.

Use of rock wool and sterilization of potting soil

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Appendix C: Permitted and Restricted Fertilizers and Soil Conditioners

In principle, the enterprise is to aim for self-sufficiency in its manures and fertilizers. Importation of the brought in fertilizers listed in 1. to 4. below may only be as demand dictates. The use of brought in materials requires particular care with respect to their effects on the quality of Demeter products. The Biodynamic preparations are to be used if possible. Brought in materials are to be declared in the annual certification procedure. In some cases the results of a residue test are to be supplied (e.g. for compost from green material).

1. **Fertilizers and Soil Conditioners brought in from Demeter or Organic certified sources:**
    - - Compost
    - - Stable manure, semi liquid manures from animals (even after biogas extraction)
    - - Liquid manures from plants
    - - Organic wastes (harvest residues etc.)
    - - Straw
2. **Fertilizers and Soil Conditioners brought in from non-certified sources:**
    - **- Manures as far as possible prepared at the place of origin (no liquid or semi liquid manures of conventional origin).**
    - **- Straw and other plant materials.**
    - **- Processing by-products (fertilisers made from pure horn, bone meal or meat-bone meal, where possible from organic or Biodynamic certified stock*, hair and feather, and other similar products) as an addition to the farmyard manure.**
    - **- Fish, composted or fermented with the preparations. Testing for heavy metals maybe required. Factory fishmeal or fish wastes from fish farming are excluded.**
    - **- Seaweed products**
    - **- Fresh wood products: saw dust, bark, and wood wastes (as long as**

- **- Lime fertiliser, slow release types to be used in principle (dolomite, calcium carbonate,
seashells, lime from the iron and steel industry*, calcified seaweed - only from dead marine deposits or fossil forms on land). Fast release: quicklime* for disinfection purpose only**

3.1. Only if the results of soil testing prove the need, and after agreement has been reached with the respective organisation may the following materials be used:

- - Natural phosphate rock, low in heavy metals
- - Ground basic slag