How can soil generation really succeed?

Four Interviews on soil regeneration - short English version

With Gerhard Dumbeck, Sepp Braun, Friedrich Wenz und Paul Mäder

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Introduction

In the context of population growth, nourishment of the world and climate change, people become more and more aware of the soil.

Due to economic growth and climate change, we globally lose more and more fertile soil. Settlements, infrastructure, industry and mines overbuild increasingly large areas. Due to **herbicide-resistant *superweeds***, big agricultural areas fail to produce. Dry land turns to **desert**. Soils **degrade** globally: 16 t/ha of soil are eroded every year [SÖL], nutrients and pollutants are leached out.

Ploughing up grassland, deforestation and draining swamps emits major amounts of **greenhouse gases**. On the other hand, soil contains twice as much carbon as the atmosphere. Photosynthesis binds 20 times as much carbon as all fossil emissions together every year and could compensate theses emissions. Due to respiration and the above-mentioned loss of soil and vegetation today, much more C is emitted than bound by photosynthesis [C-Cycle]. Thus more organic carbon is consumed than grows back. **We exploit global stocks of organic carbon**.

The enormous potential of photosynthesis and soils to bind and store carbon is beyond dispute. How it works, how fast soils may be built up and how much C may be bound is up for a lively debate. For the climate conference 2009 in Copenhagen, organic agriculture promised a big contribution to soil generation and climate protection. Today – based on newer research – representatives are rather disenchanted. After the UN International Year of Soils 2015 and the Paris Agreement 2016, the debate has been reignited and there is movement in practice.

Is there any reliable method to generate soils quickly and safely – or not?
This is what we wanted to find out.

Interviews

Searching for examples where – against the trend – **generation or regeneration of soils** succeeds, we asked four experts in October 2016:

> **How can soil generation really succeed?**

It is fascinating how different the four experts view the process of soil generation.

Gerhard Dumbeck (GD) is a soil scientist. He monitored the recultivation of 12,000 ha brown coal mines for the Rhein-Braun Corporation (formerly RWE) in western and eastern Germany. He underlines the importance of subsoil. Distributing freshly deposited, overly loosened loess with standard machinery, they obtained fatal compaction problems: Due to massive barrier layers, no cultivation was possible. With extensive repairs and purpose-built machinery, a reliable practice could be found.

Rhein-Braun performed many tests and measurements. They found an annual increment of **0.02-0.03 C_{org}** and a **saturation in the humus content of 1.5% C_{org}** applying **conventional farming methods**.

Sepp Braun (SB) optimizes a 7-year wide crop rotation on a **classic organic diary family farm** with **high diversity** near Freising in the north of Munich (D). He **maximizes vegetation**, the thus captured **solar energy** and the **root penetration**; he improves feedstuff and animal health by drying hay, and bedded pack manure by composting it with biochar. He has nearly **reached 5% humus content**. He intends to improve it with **perennial crops** and a continuing **vitalization of subsoil**.

Sepp Braun is a board member of the ***Bioland*** association in Bavaria and was the ambassador for the topic of soil in the German pavilion at the Expo 2015 in Milano. He is tightly linked with research and passes on his knowledge in lectures and courses for practitioners [*Bodenpraktikerkurs*].

Friedrich Wenz (FW) runs his **stockless** farm with undersown crops and diverse, partly even multiple catch cropping within the course of a year. More than 60 years ago, his father Manfred started with intensive maize monocultures. After 15 years, the **humus was completely degraded**. Due to resistances, more and stronger pesticides became necessary. That is why Manfred Wenz co-founded the *Bioland* association and converted his farm to **no-till** cultivation. Since the mid-90s, Friedrich Wenz has run the farm according to **biodynamic** principles. Lost **humus** and more were **regenerated** over the years.

While Sepp Braun relies on **perennial crops** (deep root penetration, agroforestry, permaculture), Friedrich Wenz counts on the **vegetative phase** (before florescence), when plants are growing particularly quickly, on the **acceleration of field composting** and the specific **vitalization** of plants in phases of weakness with preparations from minerals, plants and microorganisms. One could say he engages the **turbo stage** in catch crops and field composting and **avoids damages before they occur** by specific **observation, measurement and vitalization** of soil, plants and microorganisms.

Where Sepp Braun expects lower yields in the main crop and slow increase of the humus content, **Friedrich Wenz** reports of above-average yields and a humus increase of **1.6 % C_{org} in 4 years**. A participant of his annual *Bodenkurs in Grünen* was able to obtain this **without applying any fertilizer or pesticides** on his **conventional** farm.

Both farmers **do not see any limit on humus generation**. The more vitality of soil and vegetation increases, the less losses occur and the more solar energy may be captured and bound to the soil in living or stable form.

Paul Mäder (PM), an agricultural engineer and leader of the Department of Soil Sciences at the Research Institute of Organic Agriculture FiBL in Frick (CH), is rather careful. In recent studies, the advantages of reduced tillage turned out to be rather a **shift of humus content from the bottom upwards**. Until now, in subsoil and overall, research **could not prove any substantial increase of humus and thus no substantial carbon sequestration**. Organic farming is successful in conserving soil fertility and protecting water and biodiversity, but until now, it may not contribute substantially to humus generation and the reduction of greenhouse gases.

Paul Mäder sees a **limit in humus generation** – an **annual maximum of 0.1-0.2% C_{org}**. Therefore, measuring makes sense only every 3 years. Otherwise, measuring errors and natural variations are too big.

All four experts underline the necessity of **year-round soil cover, light machinery and equipment** and the **avoidance of losses, flaming, compactions, deep soil turning and tilling in wet conditions**.

Soil generation originates from the biological activity of the area and not from external organic matter (stressed during the interview by GD, SB, FW).

The consequent, **systemic perception** and **newer practices** of the two farmers make the difference: the **year-around, dense vegetation, field composting, deeper root penetration, analyses of soil and leaf sap to balance elements and the specific vitalization of soil and plants**.

Key elements for soil generation

Year-round dense vegetation (stressed by FW, SB)

In monocultures, only a fraction of the available solar energy is transformed into sugar and biomass. Undersown crops, catch crops, mixed cropping as well as perennial plants increase the total leaf area and **maximize the bound solar energy**.

A large part of soil organisms depends on the direct supply through living roots.

Liquid Carbon Pathway (according to Christine Jones, stressed by SB, FW)

Plants release up to 70% of photosynthesis products in fluid form into the soil (exsudates). They feed the soil organisms and serve the generation of stable humus compounds via bacteria inside the root fungi **(Mycorrhiza)**. **Glomalin** e.g. surrounds the fine roots of plants and serves as a glue for stable soil aggregates.

The key to humus generation lays in this vast, invisible potential of additional energy, sugar, carbon and biomass, that living plants release in fluid form into the soil.

Avoid losses (FW, SB)

The usual high application rates of fertilizer, compactions, monocultures, long fallows and wrong tillage pose big risks, that humus being in the soil will mineralized and washed out and thus degraded instead of built up. When the wrong degrading microorganisms become prevalent, degradation may occur very quickly and nullify a yearlong build-up.

Lack of humus and a disrupted soil structure decrease the binding capacity of the soil for water and nutrients and cause leaching during the next moderate rainfall – on average, 1.2t/ha of dissolved salts in a year in Germany [Dissertation Christian Hildmann]. Apparently, the losses are much bigger than commonly supposed and a multiple amount of the minerals in fertilizer and yield.

Balance of elements (SB, FW)

Comprehensive literature and practical experience show a **connection between lack of certain chemical elements and specific damage in plants, animals and humans**.
Soil analyses on the principle of base saturation (e.g. according to **Neal Kinsey**) determine every important element and give recommendations for specific adjustment. These **additions of minerals are temporary practices.** Soil life releases minerals from the soil – *active mobilization* [Edwin Scheller], - and rebinds them. Soil generation gradually adjusts the composition of elements.

Balance of microorganisms (FW)

Preparations like horn manure have a long tradition in biodynamic agriculture. Nowadays, **compost tea** and other preparations from minerals, plants and diverse microorganisms are applied for **controlling the decomposition process** when incorporating large amounts of catch crops. This stimulates a quick rotting and rebinding through biological activity instead of anaerobic decay and complete mineralization. This **field composting** takes 2-3 weeks. Afterwards, standard sowing may be performed without any special direct-seed technology.

Vitalization of plants (FW)

In times of **stress** (dryness, lack of nutrients…), **photosynthesis in plants decreases**. Plants no longer supply soil life sufficiently with sugar, and soil life no longer supplies plants sufficiently with water and nutrients. The activity of the whole system decreases substantially. Later, this may cause an infestation with diseases or pests.
Using **leaf-sap analyses,** stress of plants may be recognized early and be treated using **leaf spraying** with **compost tea** or other preparations **in good time before infestation.** Plants respond with a *measurable* resumption of photosynthesis.

This plant protection recognizes and **resolves the causes** for substantially decreases in the activity of plants and soil. With increasing build-up of soil, these practices become less and less necessary. There is no symptom treatment. Pathogens, weeds and pests are indicators of a disrupted ecosystem and infest only weakened organisms.

Holistic approach (SB)

In our mind set, we need to **move away from combat to cooperation**, symbioses and partnership. We have to do everything that we can for the well-being of plants and animals. Health, activity and yield will follow. *What needs does wheat have? How does it want to grow, as a chief of a community with many other plants, animals and microorganisms?*

In agricultural policy and research, a complete rethinking is necessary. In living systems, **cooperation – as opposed to competition - is essential.** The same needs are to be applied to agricultural practice and research: **Holistic thinking, overcoming compartmentalization and exchange with practitioners at eye level**.

International

In practice as well as in international research on *Regenerative Agriculture,* there are many upcoming new and promising approaches and movements, hundreds of documents, examples and initiatives [e.g. regenerationinternational.org and in the context of the climate agreement Paris 2016 [4p1000.org].
Partly – like in the interviews – the focus is on acres, partly on grassland, trees, water or climate: an enormous diversity in understanding, forming and using productive ecosystems. They claim to simultaneously improve soil, vegetation, water, biodiversity, productivity and climate continuously and to increase vitality of soil, plants, animals and humans [Regenerative Ag Definition 2/23/17.pdf].
The same objectives as in organic agriculture with a breath of fresh air.

Also the **FAO** demands in its study *The future of food and agriculture* 2016 (stresses by HvK):

*Needed are innovative systems that protect and **enhance** the natural resource base, while **increasing productivity**.*
*Needed is a transformative process towards **'holistic' approaches**, such as **agroecology, agro-forestry**, climate-smart agriculture and conservation agriculture, which also build upon indigenous and traditional knowledge.*

Conclusion

Knowledge about how soil regeneration can succeed is available. It exists in a in a small but growing literature and in the experience of pioneers and initiatives around globe.
We only need to put it into action:

Simultaneously and continuously, improve soil, vegetation, water cycles, biodiversity, productivity and climate and increase the vitality of soil, plants, animals and humans.

Specifically: Incorporate a lot of solar energy into the system by year-around dense vegetation and use it for yield, soil generation and biodiversity.

Escape the economic treadmill:
Replace expensive external inputs with intensified life processes.

Additional emphasis should be placed on perennial plants, and on avoidable losses, subsoil, dynamics of humus, nutrients and root penetration, new measuring methods and overall vitalization and regeneration.

Regardless of the problem in the foreground - soil protection, biodiversity, productivity, food security or climate change - **at the heart of the solution are always diverse, highly productive agro-ecosystems**. They always incorporate more energy, air, water and minerals in their living processes, provide nutrition and living space for soil life, plants and animals, deliver long-term yields and directly contribute to the regeneration of local water cycles and the climate by water retention, evaporation, balance of temperature and avoidance of emissions.

As a framework for these solutions, a fair access to land, knowledge and other resources is needed – an equally important issue.

Time for an implementation project

Soil generation – How can it be achieved, proven and broadly implemented?

- **Inventory taking** – What is available?
  Collect, summarize and compare approaches, examples, definitions, documents and proofs
  Cross-link actors
- **Further development** - What is missing?
  Monitoring and implementation concept, further trials, terminologies, tools
  Inventory of diverse (agro-)ecosystems and their resource balance
- **Broad implementation** – How we can promote this?
  Practitioners have already started this process. Australia and Austria e.g. are ahead.
  Civil society, science, economy and politics are on the ball.
- **Who is on board?**

Links

This short version – with active links www.flexinfo.ch/Regeneration/SoilGeneration_4interviews_short.pdf

Short version in German www.flexinfo.ch/Regeneration/Bodenaufbau_4Interviews_kurz.pdf

More information in German with links to English documents:

Complete interviews www.flexinfo.ch/Regeneration/Bodenaufbau_4Interviews.pdf

Definition *Regenerative Landwirtschaft* www.flexinfo.ch/Regeneration/Definition_RL.pdf

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