
Compost
SYSTEMS
From Carbon to Fertility

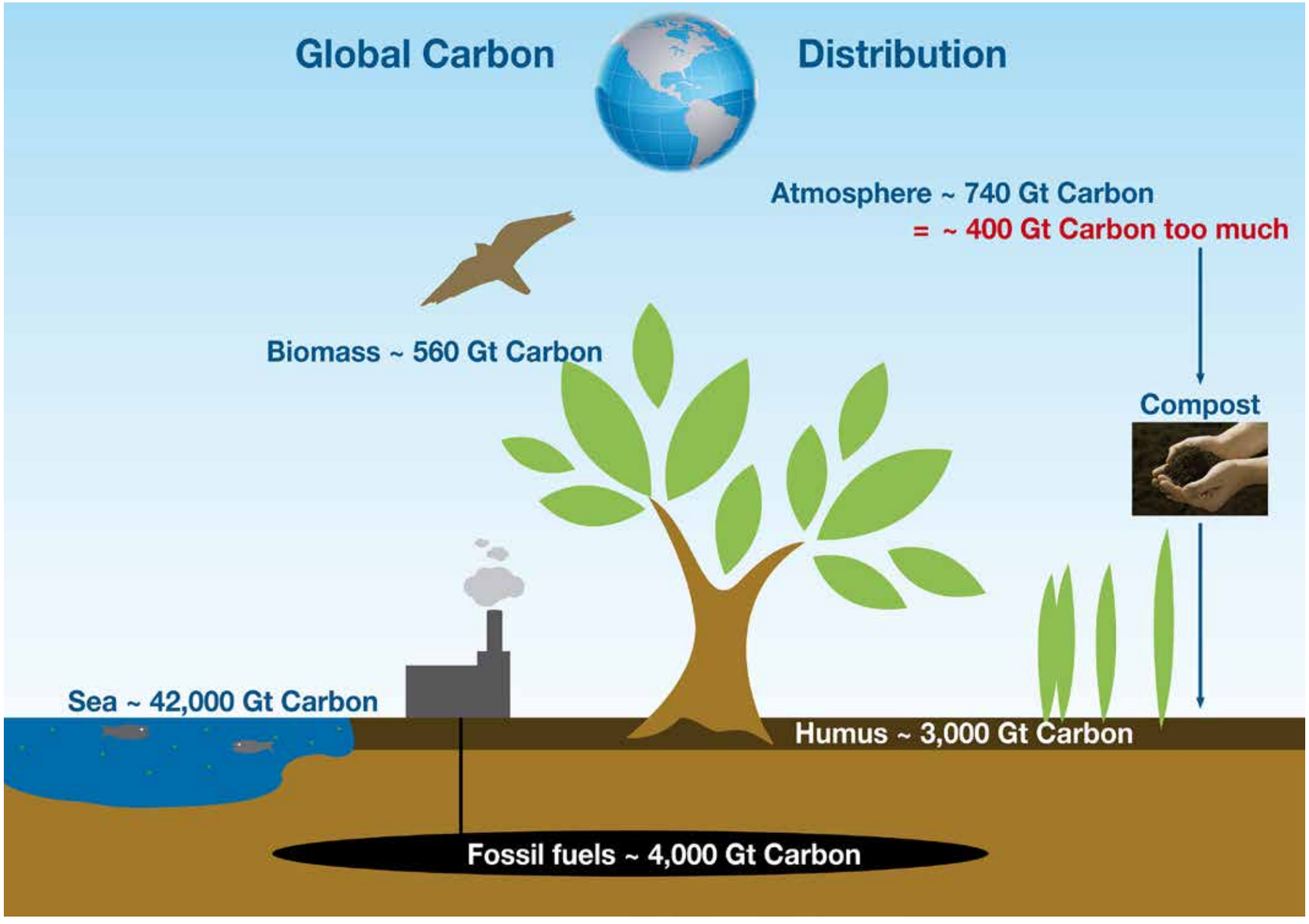


Figure 1: Global Carbon Distribution
Source: Presentation Prof. August Raggam, 2014, Compost Systems Illustration

Carbon farming

Carbon recycling is one of our greatest challenges for the next few decades. Storing Carbon in our soils is solving many problems of our eco system.

Why it will be impossible to reach the goal of <2°C Global Warming without the integration of agriculture!

In 1997 the world community signed the Kyoto protocol to reduce the emissions of greenhouse gases (GHG) to atmosphere with obligatory targets. Since then, little has happened. The emissions trading system collapsed and the effects of climate change are becoming more and more visible through new temperature records every month. Instead of results, those responsible have delivered excuses as to why the targets have not been reached.
In the frame of COP 21 in Paris in 2015 new and "obligatory" targets have been agreed to limit global warming below 1.5 °C. The fact is that agriculture and "carbon farming" are playing a minor role in the current scheme of carbon reduction. However, without agriculture it will not be possible to counteract the large amounts of surplus CO_2 in our atmosphere.

Different to water and air

Back in the 1970's, when our rivers and lakes were getting poisoned, governments (even without the EU) were quick to pass laws to protect our water resources of lakes and rivers. It was logical to stop the direct disposal of pollutants into our waters by installing wastewater treatment plants to restore the water quality of our rivers. In the same way, at the beginning of the 1980's it was discovered that air pollution affects US ALL. So our industry and traffic were forced to minimize the emission of air pollutants. The sky turned blue again. With even the recognition that water and air are common property, the responsibility became clear and stakeholders acted accordingly.

However, we perceive soil to be the personal property of humans and this attitude does not make the solution very easy. Extremely low prices for agricultural products do not boost the willingness of agriculture to go for sustainable soil management. The fight for economical survival kills any soil sustainability initiative.
No other global industry currently creates less profit per dollar investment than agriculture.

The global carbon balance

A pragmatic view of the numbers already gives a clear perspective of the facts. The magic word is **humus**. The carbon that forms the top layer of this planet, along with other mineral components, trace elements and nitrogen, which we also call fertile land or soil. Specifically, the amount of carbon bound in soil is 3,000 Gigatons. To help you be better able to envisage this: The top soil contains five times more carbon than all plants and living organisms put together. Also all trees on this planet only store 10 % of the carbon in our top soil layer![1]

Status and trend of our soils

Worldwide we are losing about 3,000 m² of fertile land every second through building, erosion, desertification and other means.[2] This is a tendency that receives a rapid boost from today's practice of agriculture.

The dramatic loss of organic matter in our soils is demonstrated in a recent study published in 2015. The chart "Carbon loss" on the next page shows the carbon loss affected by today's methods of agriculture and soil management. So instead of fighting climate change, additional carbon from our soils is emitted into the atmosphere – not the right tendency in view of a potential climate change threat of up to 6 °C.

No better place

In contrast to the carbon in our atmosphere (in the form of CO_2), carbon sequestration in soil as **humus** only brings advantages. Carbon can store up to 8 times its own weight in water. In combination with the colloid structure in the soil, it can even store more water.[3] [4] But not only water is being stored, nutrients are, too. Carbon in the form of **humus** is therefore responsible for protecting our ground water. As the glue of our soil, **humus** also provides protection against erosion.[5]

Urgently required

Soil scientists are rating soil with a carbon content of less than 2 % of organic matter as "IN DANGER". In danger of losing its capability to remain its ecosystem; in danger of becoming a desert. The loss of

[1] Prof. August Raggam, Bauern als Klimaretter, 2014
[2] Save our Soils Internet, 10.12.2015
[3] Annie Francé-Harrar, Die letzte Chance, 1950
[4] Bayerische Landesanstalt für Landwirtschaft Internet, 10.12.2015
[5] Max-Planck-Gesellschaft Internet, 10.12.2015

organic matter has dramatically been driven by the use of chemical fertilizer and chemistry. In the past centuries of agricultural industrialization, the protection of soil has been of low interest and the ecobalance of our soils a matter of ignorance.

8 kg per square meter

To absorb the complete amount of surplus carbon in our atmosphere, the agriculturally used soils around the world would need to absorb 8 kg of carbon per square meter. At first glance, this is just a number. But if this number is taken into proportion by calling it a 20-year-project, the required amount of carbon to sequestrate in our soil would only be 400 g/m²/year.[1] Suddenly a number that seems feasible!

How do we do it?

In contrast to wood or straw, the sequestration of carbon in soil is in the form of digested and stabilized carbon. In this process, the work is done by microorganisms. Carbon in combination with nitrogen is digested by microorganisms to produce **humus.** Unfortunately, our soils do not have the variety of microbial life that they once had. Because of this, the organic raw material going into our soils become spoiled, putrefies and causes problems. So it is our job to fix the digestion system of our soils. Recent studies in the field of soil science have become important, as they show that the combination of **compost** with sustainable soil management created the best and most sustainable results. Only if the soil can recover its natural digestion system, sustainable farming with **humus** or CARBON farming becomes possible.

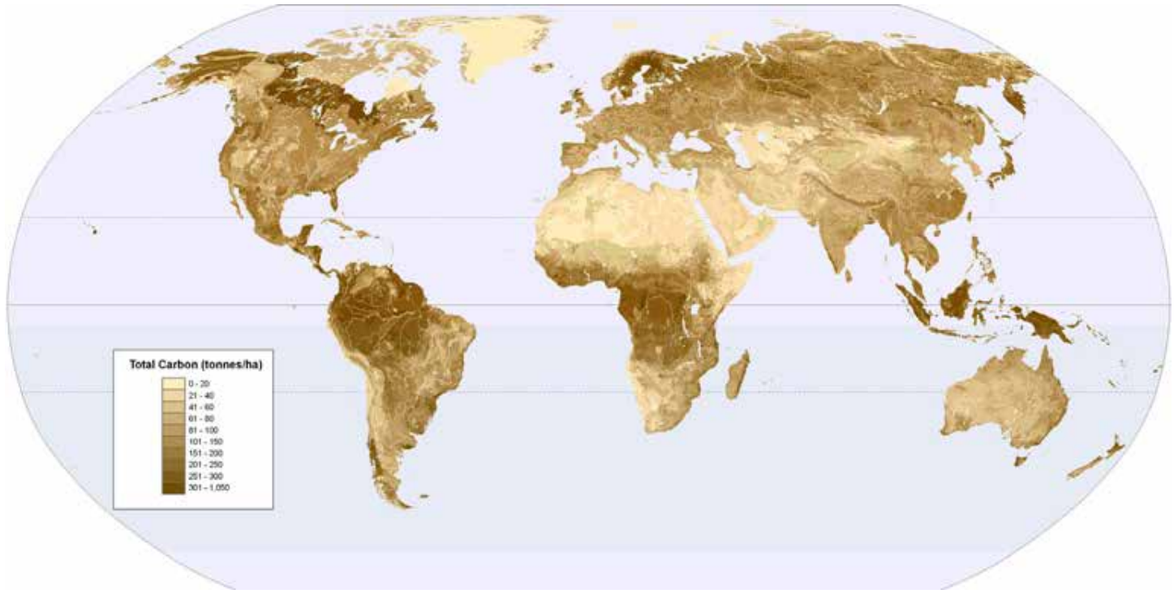


Figure 2: Carbon content in our soils worldwide in t/ha
Source: European Commission Internet, 10.12.2015

Carbon loss through "modern" agriculture in agricultural soil

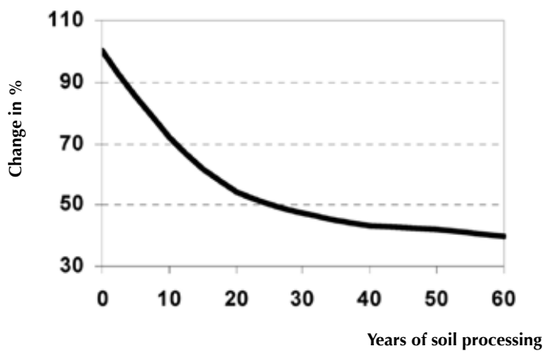


Figure 3: Reduction of the carbon content in soils
Source: Sustainability Internet, 10.12.2015

[1] Prof. August Raggam, Bauern als Klimaretter, 2014

Why chemical fertilizer cannot be the alternative

Without doubt, Agriculture can be successful even without soil. The shelves in supermarkets are full of products that have been grown on glass or rock wool. The majority of our food however still originates from traditional agricultural production. There, with the targeted use of N/P/K fertilisers the yield is yet kept high. However, nitrogen is gained from air with a high use of energy resp. oil. Phosphorus and potassium are taken from mines. If these nutrients were not washed out of our soils every year, all agricultural land would be terribly overfertilized. But instead of keeping nutrients in our life cycle, we secure them from mines. However, the mining resources are only secured for a few centuries according to experts. In addition, not every natural phosphorus or potassium reserve is suitable for the production of chemical fertiliser. Experts calculate, that within the next 50 years the deposits will come to an end.[6] [7] In the same time, the world population will be grown to approx. 10 billion people.

It is the same industry claiming that feeding the world population will not be possible without chemistry, whilst at the same time relying on a finite source. Even GMO's (Genetically Modified Organism) cannot change this fact. It is even the opposite: Microbial activity in the soil is responsible for the digestion and breakdown of chemicals involved in GMO's farming.[8] Due to monocultures of soybeans and corn the soils are partially in such bad condition, that the ability of microorganisms to clean the soil is hardly present, so the chemicals accumulate in the soil. Later they are washed out with the next rainfall and finally they end up in our ground water and are consumed by humans and animals! Recently, NGO's have drawn attention on glyphosate being found in the precious amber nectar "beer".

Wrong turn

Therefore it is hard to understand why agriculture is still receiving support for emitting carbon to the atmosphere. Instead of encouraging agriculture to sequestrate carbon to soil, subsidies are based on the replacement of wood instead of oil. Agricultural support is still based on production volume and monoculture. It does not support the things that store CO_2, but those that replace carbon from oil. It would be important to reduce the carbon emissions, but not to replace those from oil by those from soil. Based on calculations and facts it will not be possible to limit the global warming to < 2 °C, if agriculture is not considered in the grand scheme of things, along with all its consequences!

Which things does compost improve?

Right from the beginning it must be said that not all compost is the same. Due to a lack of quality criteria, which sometimes only consider heavy metal contents or foreign particles or colour, the microbial quality of the product is given little or no attention in order to make it of a high quality as standard. But this is exactly the criterion that is required for evaluating the quality of soil's digestion process. The organic raw materials must be broken down to then being stabilized into a new matrix, our **humus**. In the digestion process of composting, raw materials are combined in the ideal proportion, moisture and oxygen are secured and optimal conditions are kept, in order to prevent any losses. In its highly concentrated form, this soil improver is used to enrich our soils with carbon. Several billions of microorganisms can be found in a hand full of compost, which then create a sustainable life in the soil. In combination with green manure or harvest residues, the digestion capability of the soil is further improved by compost to enrich soil with even more carbon.

What else does compost do for our soils?

Microbiology in soil is playing a big role in fighting diseases. In particular, the application of compost in soil can prevent the spreading of pathogens. For example, consider the recent discussion about pathogens being resistant to antibiotics. When breeding animals, antibiotics are used as feed, not as medicine for infected animals. This causes a strategic breeding of pathogens that are resistant to antibiotics. Doctors worldwide are warning that our health systems would be thrown back for hundreds of years, if antibiotics get useless. However, these resistant pathogens are not only found in our meat, but also in the manure of animals. [9] By spreading manure to agricultural lands without any treatment, these pathogens are transported to fields and consequently back to our food (Bad news for Vegans)!

With a proper composting process, the infection cycle is broken: The fully controlled sanitization at temperatures of more than 60 °C kills pathogens. [10] Also by processing manure in order to produce compost, the environmental conditions are changed, so that pathogens do not have the ability to grow. Today, compost is even used in liquid form as compost tea to use its positive effects against diseases. It also contains many positive substances to support the health and natural growth of plants. So starting to compare the effort of sustainable **humus** management in relation to benefits of animals, human and environment, the question on affordability has just been answered.

GM corn, glyphosat, biogas and monoculture

Biogas is a heavily discussed development within the past decades. The basic idea to use the surplus production of agriculture as energy is not the discussion point. However, the development should not cause any damages to our environment. In the whole discussion on renewable energy, the soil has been forgotten. The anaerobic digestion is an efficient way to produce a water-soluble N/P/K fertilizer from manure or crops. So the soil is not seen as a living organism, but as a media for hydro-culture. As long

[6] Cordell, Drangert, White, Story of phosphorus: Global food security and food for thought, 2009
[7] Leibnitz Gemeinschaft Internet, Wenn Phosphor knapp wird, 10.12.2015
[8] Bayerisches Landesamt für Umwelt, Pflanzenschutzmittel in der Umwelt, 2008
[9] WHO Internet, 10.12.2015
[10] Lebensministerium, Stand der Technik der Kompostierung, 2002

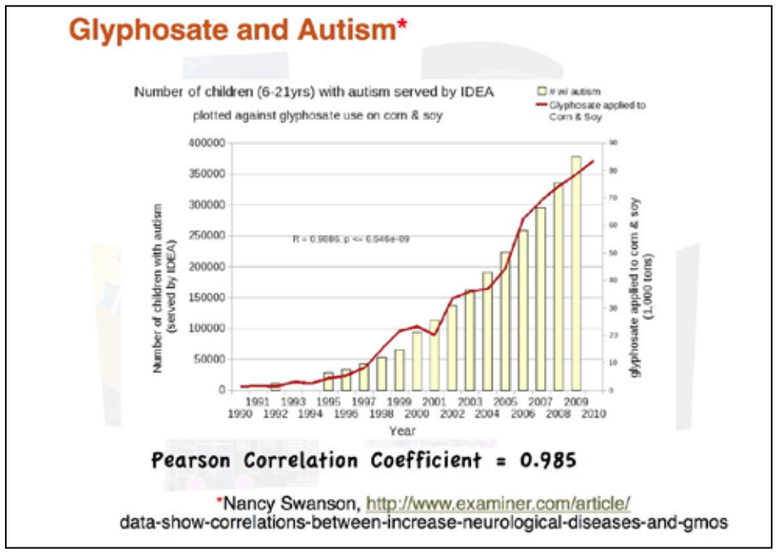
as the soil has enough organic matter and **humus**, the system works as the soil compensates for a long time. However, it is just a question mark of time!

The use of GM corn for energy production has little or no influence on humans in terms of health. However, glyphosate is used as a weed control, which is only digested and broken down in the soil, if there is enough microbial life in the soil in quantity and variety.[11] This exactly is not secured, if every gram of carbon (the food for these microorganisms) is used for energy production (Biogas, incineration). The consequence is that glyphosate in the soil is not degraded but accumulates and finally ends up in our groundwater. So if the consequence of sustainable agriculture to produce energy is the ruin of our fertile soils, we should rethink the concept once again.

Also the fact that due to our bee deaths the use of Neo Nicotine was forbidden in many countries[12], showed that the monoculture of corn had to be replaced with a balanced crop rotation thanks to the problem of the European corn borer. This had the knock-on effect that suddenly glyphosate accumulated in the soil can also be absorbed by other crops and gets into the food cycle. The WHO has considered glyphosate to be “likely carcinogenic” and Monsanto has been under heavy attack since its release in the 1970’s.[13] [14] Studies used for its registration were found to be faked, acting people were sentenced in court.[15] In other studies a direct correlation between Glyphosate and Autism was detected.
While the industry is discussing, whether and how glyphosate affects humans and animals, a lot of weeds are developing resistances to glyphosate. According to “what does not kill you, makes you stronger” the weeds are becoming resistant like pathogens to antibiotics. It is not a matter of discussion, that glyphosate and other pesticides are degraded in the soil only by microorganisms.[16] [17] So here, a healthy and active microbial fauna in the soil is the foundation for any responsible agriculture.

What it is that counts
It is a fact, that the European Union only farms a minor part of this world´s agricultural land. Thus the change of European agriculture to sustainable methods of farming can only be seen as a demonstration model for global agriculture. In the same model as in industrial production and mobility, it will be China and India deciding whether the target of limiting global warming to < 1.5 °C is achievable or not. While in the industrial and mobility sector the developing countries are creating new methods of pressurizing Western countries, the change of agricultural production also means a drastic change for wealth development and therefore evokes a very high level of interest beyond climate change. Facing dangerously high rates from rural depopulation into hopelessly crowded cities, it becomes a question of survival for small communities. Hopelessness drives thousands of Indian Farmers commit suicide every year. More than half of India’s population depends on agriculture, most of them operate rain field crops.[18] If monsoon is absent, it is the guilt of climate change. But even if it comes, it is the soil's carbon **(HUMUS)** protecting against erosion and enables the soil to store water.

Conclusion
Agriculture will face a dramatic change in the coming years. It is necessary for agriculture to be integrated in the scheme and structure of GHG emission reduction. No other business or industry (besides the oil and coal industry) has more potential for influence on our climate. Agricultural support funds - but also climate protection schemes - have to be evaluated and newly adapted to agriculture. Programs of sustainability, not the blind production of crops, need to be supported.
The sustainable farming of our soils will be one of the final decision makers as to whether we can limit the global warming to < 1.5 °C. Without massive actions of the agricultural industry and the support of the whole society, it will not be possible to reach the climate targets. Additionally there is the fact that the dependence on a massive fertilizer industry that can only supply more chemical fertilizers in bags for a limited period of time. The protection of groundwater and drinking water, erosion and desertification together with eco-social aspects of developing countries are additional aspects we should consider in the eco-balance. These will all form part of the final question mark as to whether the 9.6 billion people that there will be by 2050 will perceive this planet as worth living on.



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[14] Samsel, Seneff, Glyphosate, pathways to modern diseases, 2015
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