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Climate change: Solution approaches for practical agriculture:
„With the FRACTIONATED ANALYSIS and And the AKRA-SYSTEM towards success“

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Climate change

Climate change is happening! Different forecast models lead to similar results:

- Precipitation events will become less frequent and more severe (extreme events will increase)
- Winters will become wetter
- Summers will become drier
- The vegetation period starts earlier and ends later

Advantages from this could be that production areas shift (e.g. cultivation of wine). Additionally, a 2nd main crop becomes possible in arable farming, etc. Disadvantages are e.g. the increased spread of diseases and pests, rising temperatures and expected problems concerning water supply.

How can agricultural practices help to make soils fit for climate change?

This question will play an important role if a farm wants to continue to operate economically and ecologically sustainable in the future. Individual and selective measures are not enough. Success will only be achieved with a **systemic** approach involving various specialist disciplines.

Water and soil

Soils can store different amounts of water. How much? This depends very much on the grain size composition (sand/silt/clay), the resulting voids (primary pores), the organic matter content and the soil life (e.g. roots, earthworm tubes).

Water and plants

Plants need a certain amount of water to build **1 kg of dry matter**. This amount is characteristic for each plant species and is called the transpiration coefficient (**TCE**). Relatively "water-efficient" crops are corn and sugar beet. Crops that form pods (e.g. legumes, rapeseed) and crops that form a lot of biomass (e.g. grassland) require a lot of water.

However, the total water requirement of a crop is not sufficient to compare different crops when planning cultivation. Rather, it is a matter of **WHEN** a crop needs water to optimally cover certain stages of development. For example, corn, which requires relatively little water, may still not reach its full potential if there is a lack of water at the time of flowering. In contrast, **winter cereals**, which require more water, can produce good yields if winter precipitation is used.

Water cycle

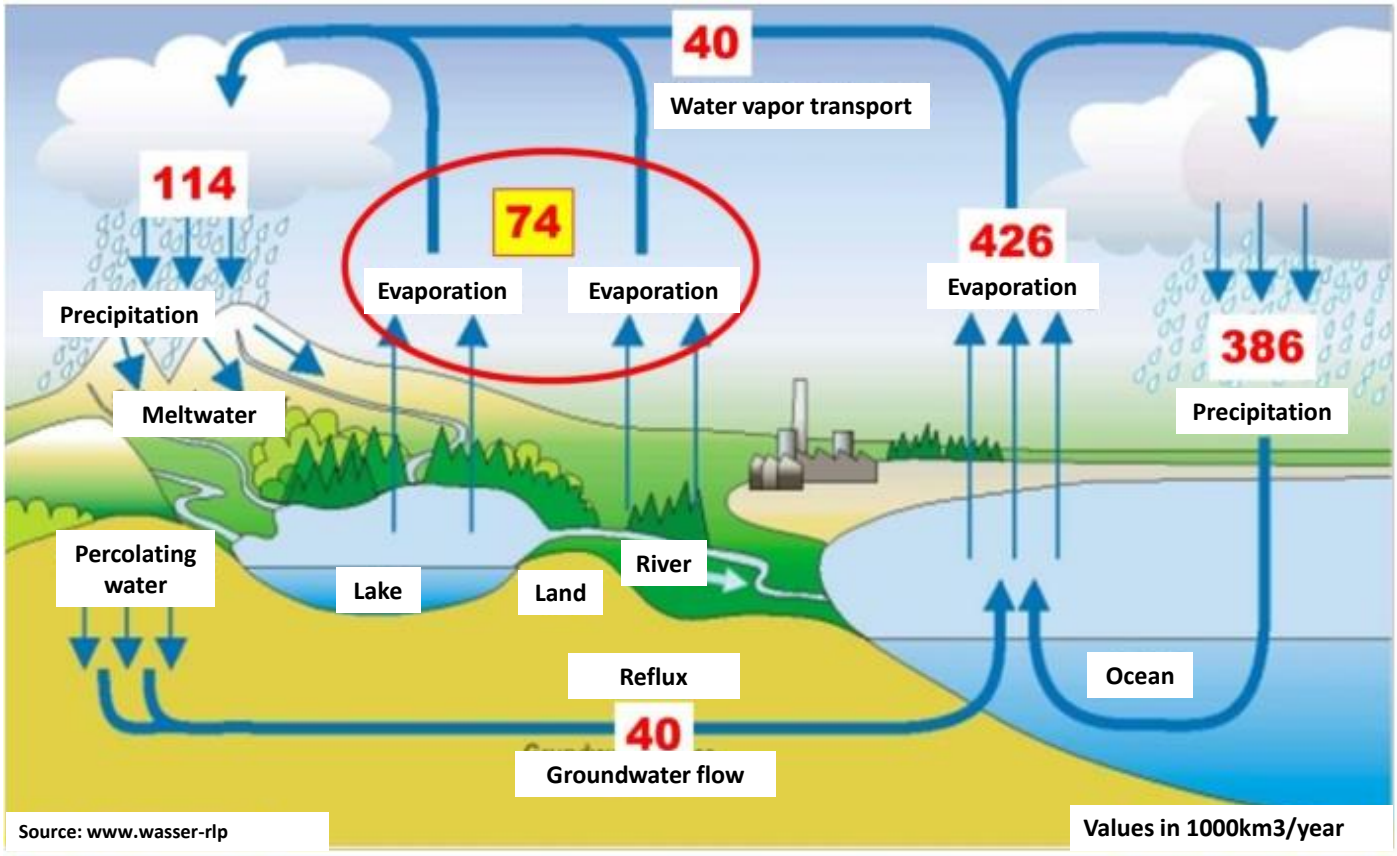

Figure: Global water cycle

The main part of evaporation takes place over the oceans where most of the water also rains back down over the oceans. A relatively small part reaches the inland areas. It is striking that the precipitation sum in the interior areas corresponds to a multiple of the water vapor transport from the oceans. This is only possible when **soils** absorb rainwater, plants evaporate it, clouds are formed, and the water is in turn rained off as precipitation in the corresponding region!

A raindrop must be contained within a certain region and be circulated at least 5 times before leaving the region via the major river systems!

Extreme weather events are becoming more frequent in the foreseeable future. The skill of successful farmers will lie in aligning **plant cultivation** and **soil management** measures in such a way that precipitation events (including extreme rainfalls) do not affect soil fertility in a negative way (e.g. through erosion) but instead the precipitation should penetrate and be **stored** in the soil. Such adapted soils also make a valuable contribution not only to the production of **agricultural** products but especially to the maintenance of the **regional climate**. The following measures are recommended for this purpose:

- green cover (catch crops, green manures)
- biological activity
- stable aggregates (AKRA DGC)
- increase of the root penetration depth
- increase of humus content
- supply of mineral substances (AKRA Kombi)
- sufficient calcium supply for stable Ca-humates (AKRA DGC)
- ……..

Soil testing as a valuable tool

Farmers have to cope with ever greater challenges. They work with the "rigors" of nature, produce food and play a crucial role in maintaining **soil functions** that benefit society as a whole (e.g. groundwater protection, passive flood protection, filtering, buffering and transformation functions, biological diversity).

Farmers thus make a decisive contribution to the continued existence of humankind!

To cope with this great responsibility, farmers must be **highly trained** and, above all, have the tools of the trade to meet the **current challenges**. One of these tools is soil testing.

The analysis method propagated by the **official side** is the **CAL extract**. The use of this method has remained **unchanged** for almost **50 years**. A method that was not accurate even when it was introduced in 1969 and only represents isolated "**total contents**" of P and K. The consideration of absolute contents has long been "**overruled**" in the field of soil science. It is generally accepted that material ratios are more important than absolute element contents. A question that may arise is the following: Why are results from science and research ignored, especially in this highly sensitive field of soil science?

Results from research and development have increased exponentially in the last 50 years due to modern methods, one can “zoom in” to the smallest atomic components! Only in the field of agricultural soil science and consulting one is stuck with the simple magnifying glass... One could get the impression that **innovations** are **consciously** avoided in this field. The term consciously is used here because keeping scientific results away from implementation for the last 50 years exhibits a certain amount of (conscious) effort.

A method that provides scientifically sound data/analysis results for the current challenges is the **fractionated analysis method**. This method was developed by Prof. Husz and is based on the **Russian-Hungarian** soil science. The **fractionated analysis** is **standardized** in the Austrian Standards Institute (ÖNORM 2122-1) and **accredited** by the Ministry, its inherent scientific nature is beyond question. Moreover, it is not a static method but is subject to continuous review and supplementation (see e.g. concerning the 5 phosphorus fractions)!

By analyzing **137 individual parameters** per sample, many "gears" of soil fertility are recorded and evaluated in their concentration and in relation to other relevant parameters. Since each soil is unique, the analysis results are also unique. In case of deviations from the optimal ranges, recommendations are worked out in order to "lubricate" the gears of soil fertility in their entirety and to bring them back to full yield capacity (typical for the site).
It is **not** about the derivation of **fertilization measures** but of measures to **structurally influence** the **dynamic processes** in the soil, which optimize the soil fertility in a sustainable manner!

For the **implementation** of the measures, a **partner** who also puts the holistic consideration of the system in the focus is necessary. It is important to consider that soil fertility is not only about the supply of nitrogen, phosphorus and potassium!

AKRA fertilization system for implementation

Complementing field findings from the soil profile, the **fractionated analysis** provides the scientific basis for deriving measures to make **soil fit for climate change**. The recommended measures are not isolated and punctual interventions, but rather take into account the soil system and its interdependencies.
In the **AKRA fertilization system**, as in the **fractionated analysis**, the **holistic consideration** of soil fertility (=yield capacity) is in the focus! The measures derived from the fractionated analysis require certain products or product combinations, which can be specifically composed and mixed by **KARNER Fertilizer Production**.

Measures to fortify the acid buffering capacity

If a measure to strengthen the acid buffer system and optimize the ratios of Ca, Mg and K is recommended for amelioration, some basic principles must be taken into account for implementation:

Not every LIME is identical!

In trade, a whole group of naturally occurring limes and by-products arising from industrial processes, some of which are not lime at all from a chemical point of view, are referred to as "**LIME**". Basically, it should be noted that each product has its own main application! Conversely, **not every product is suitable for every purpose!**

Figure: Various "limes" placed on the market

So which LIME is "right "? Which one fits best for the recommended measure?

Limestone that is mined has its origin in a catastrophic event that took place many **millions** of years ago. Meteorite impacts, volcanic activity and earthquakes caused **mass extinctions** in which 75 to 95% of all marine and terrestrial life was extinguished. Dead animals, plants, and microorganisms have sunk to the seafloor, forming calcareous mud and thick **sediments** over thousands of years. The composition of the sediments has been locally altered by input of sands, clays, and organic matter. Due to tectonic events, **pressure** and **temperature**, the sediments were deformed and finally came to the surface as **mountain ridges**. This means, however, that each LIME has its own history of formation and thus quite individual properties.

A variant of pure calcium carbonates are the **dolomites**, sedimentary rocks with 5 to 45% magnesium content. A special feature is the **DOLOMITE**, which is part of the **AKRA DGC mixtures**. For the formation of such a high-quality dolomite, conditions must prevail that occur only on a **small local scale** and relatively **rarely**. About 250 million years ago (during the **Triassic** period), a magnesium-enriched salt solution seeped through the calcareous mud on the sea floor, displacing calcium. In the process, the theoretically highest magnesium content was reached (Ca to Mg = 1 to 1!). The sediment was tectonically compressed, the dolomite grains thus have a size of 0.04 to 0.05 mm. The combination of these properties is **unique** in the entire world and provides the product with very specific reaction mechanisms!

Amelioration with DGC

The products listed for amelioration from the fractional analysis - **dolomite**, **gypsum** and **calcium carbonate** - refer to the products of the **KARNER Fertilizer Production** company and to their specific composition, formation and complementary mode of action. In addition, the individual products are mixed depending on the results of the tests. The **AKRA DGC** is a very finely ground product with a very high degree of conversion. This gives **planning security**!

If other products with different composition are applied, it may happen that the predicted changes fail to materialize and the situation may deteriorate!

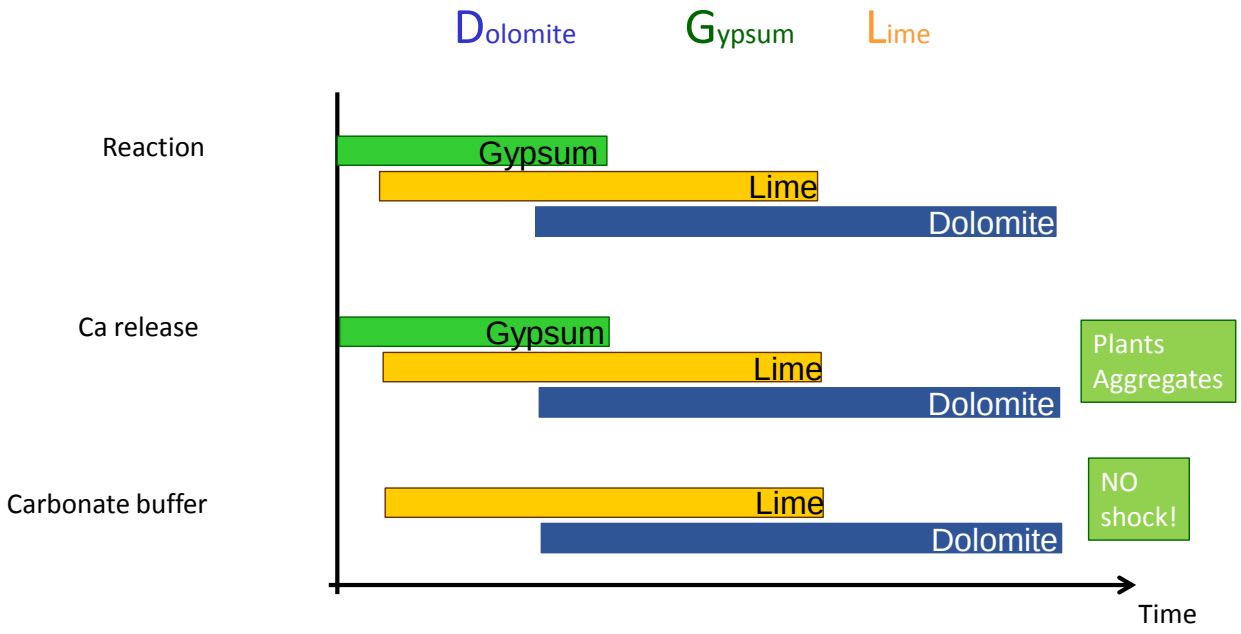

Figure: Gradual effect of the AKRA DGC

A small part of **AKRA DGC** acts immediately. After a certain period of time the calcium carbonate comes into effect, and a delayed reaction of dolomite begins. This guarantees that there is no **shock effect** (especially important in sensitive soil systems!) and that **calcium and magnesium** are continuously supplied for **plant nutrition** and maintenance of the **stability** of the aggregates! Acid in the soil is continuously neutralized via the carbonates without overloading the system.

ATTENTION: Calcareous soils can also show calcium deficiency!

Frequently, calcareous soils show calcium deficiency symptoms in certain crops (e.g. rapeseed, legumes) and a limited stability of the aggregates (erosion, silting). This is due to the fact that in **calcareous soils** the flow **equilibria** are extremely **stable** and mobilization is only possible under ideal conditions. Under very wet or very dry conditions, Ca replenishment is inadequate, and problems may occur.

Therfore, the supply of AKRA DGC is also useful on calcareous soils!

Climate change and the AKRA fertilizer system

The AKRA fertilizer system consists of various components, which complement each other and only bring the predicted success when entirely applied (implemented).

Scientific data from fractionated analysis and field findings form the basis for deriving measures that make **soils fit for climate change**. The implementation must be carried out as a SYSTEM, not through isolated measures! The **AKRA fertilizer system** perfectly closes the gap between science and practice.
The following table exemplarily shows the effect of different system components:

AKRA DGC	✓ neutralizes acid (promotes soil life) ✓ supplies Ca for plant nutrition (vital plants) ✓ provides Ca for aggregate stability (**infiltration capacity**, reduces **erosion** and **crusting**, increases **bearing capac**ity) ✓ supplies Ca for humus build-up (Ca humates, important for **water holding capacity** of organic matter)
AKRA Kombi	✓ increases sorption and **water holding capacity** (20 times own weight) ✓ supplies **nutrients in equilibrium** ✓ mobilizes nutrients (e.g., phosphorus)
AKRA Blatt & AKRA Plus 9	✓ supplies plants aboveground during stressful situations ✓ enables root growth in dry/wet conditions (**build-up of humus! water retention capacity**)
AKRA MSB	✓ strengthens plants, increases and promotes activity of **microorganisms**
AKRA N Bakterien	✓ contribute to save the use of 40 to 80% commercial nitrogen
AKRA Saatgutbehandlung	✓ protects the grain without the use of poison and facilitates initial and early development
AKRA Stroh R.+P+K	✓ straw management (straw decomposition without nitrogen, reduction of inection foci – blackleg, **erosion control**)

Fractionated analysis + AKRA (fertilizer) system = Soil fertility