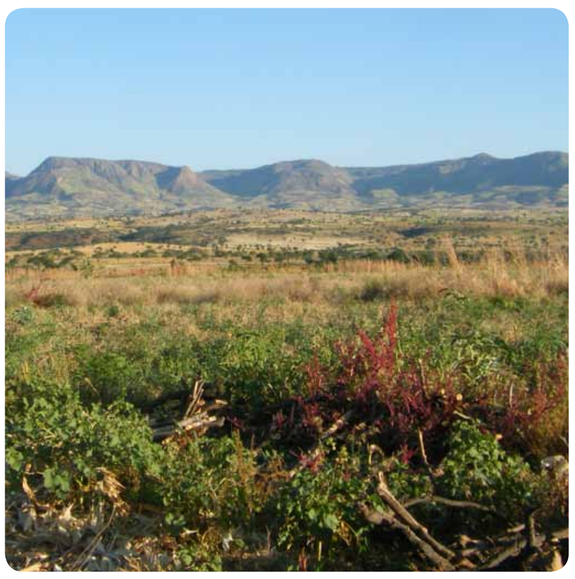
Stonemeal: A better life for farmers & mine workers in Ethiopia

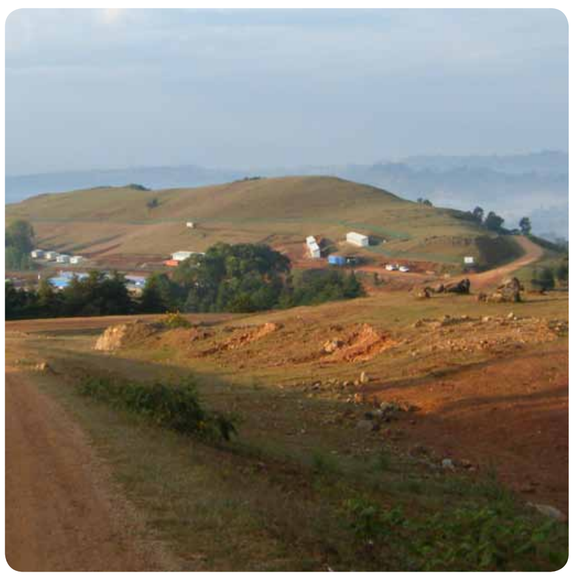
Rema Village

Allthough Rema village is only situated some 220 km north of Ethiopia's capital Addis Ababa, its location in the canyon rich area of Alem Katema and poor boulder rich roads makes the journey around 8 hours by common car. Farmers' access to fertilizers is therefore not economically feasible, and farmers use only some crop residues and cow dung to feed there soils. The practice of feeding cows with crop residues, and selling cow dung as fuel reduces however soils part. Due to this situation and high population density the soils of Rema are biologically (very low organic matter content) and chemically (poor nutrient content) exploited. From 2013 to 2017 MetaMeta and local farmer Mr. Getaw M. Cherinet will start demonstration trials on fertility management using crop residues, cow dung and rock dust to increase soil fertility and production. The rock dust in this area will be developed from basalts, limestone and gypsum, and applied freshly, as well as integrated into composting.



Basalt and gypsum

North of Addis Ababa there is a 600,000 km^2 basaltic rock plateau. Rema village is also part of this plateau. Rivers have however created a canyon rich area with valleys up to 700 meters deep. Typical rock formation in Rema valley are basalt (at the upper parts the mountains); and layers of sand and limestone towards the valley floor. Gypsum occurrences are found at the deepest sections of the valley. The basalts of the plateau have a typical composition of around 50% wt SiO_2, 15% Al_2O_3, 12% Fe_2O_3, 10% Ca and 6% MgO. There is a wide range of trace elements in the basalt, including P_2O_5 and K_2O. Latter ones, however, hardly exceed 1%. There are, however, Rhylotite veins containing over 5 wt% K_2O. Representative basalt samples for this area will be analyzed to assess basalts value as soil improver. Gypsum presences are less complex and can be mined.



Soils

The soils in the area of Gimbi and Yubdo (Welega District) are known for their deep red colour and severe acidity. Actually, all soils in western Ethiopia deal with acidity problems (pH is 5.5 or lower), limiting crop productivity. In order to increase soil pH and improve yields, Ethiopia's government currently runs trials with crushed limestone. Based upon soil requirements, limestone application rates can be up to 38 t ha^{-1}. Economic feasible limestone application is therefore limited to areas in vicinity of limestone deposits. Although there are quite some limestone occurrences in the Gimbi region, they are less voluminous than in the eastern part of the country. This limits the potential of full region coverage. Another disadvantage of limestone is that besides Ca, also CO_2 is released to the atmosphere. To compensate for the CO_2 emissions, as well as to maintain soils Ca:Mg balance, MetaMeta currently explores the economic feasibility to use olivine minerals from road quarry sites in this area for liming purposes. Target crops are coffee, wheat, sorghum, teff and other local vegetables. One of three dunite/olivine/serpentinite hills with green (magnesium rich olivine), partly developed as quarry sites for road construction.

Arsi Negelle

Arsi Negelle woreda includes part of the Lake Abyatta Shall National Park. Villages in this park are among the food aid zones of Ethiopia. Over the last years, households in this area have only been able to be self-sufficient during three or four months, receiving additional food-packages in the remaining months. Although farmers use 100-150 kg fertilizer (DAP and urea) per hectare, yields never exceed 3.5 t ha^{-1}. These maximal yields were only realized during rain fall seasons with some 500 mm precipitation. The described situation gives the idea of yield constraints caused by on the one hand limited soil moisture and on the other hand the soils incapability to pass the applied nutrients to the crops. In order to tackle both problems we are assessing the availability of the zeolite minerals in the vicinity of this area. Zeolite both increases soil moisture capacity by its micro-pore structure, as well as CEC, which increases fertilizer use efficiency. Both mechanisms allow to improve farmers yields, as well as protecting their groundwater quality and surface water quality of nearby lakes.

Further more, the use of waterhyacinth (Eichhornia crassipes) as slow release fertilizer is studied. This plant covers now some hundred of hectares, decreasing oxygen levels, fish population, and limiting fishermen's access to the lakes.

Zeolite

Zeolite is widely found in the Rift valley of Ethiopia. Several million tonnes of high-grade zeolite deposits (mordenite and clinoptilolite) are found in rift valley sediments near Nazret and Boru, west of Nazret. Due to its micro-porous structure it can retain a lot of water, and increases the amount of water available to plants. In addition, the negative charged SiO_4 molecules allow a large CEC, with particular affinity for NH_4^+. Currently, the Ethiopian government assesses its potential with the Finnish government. MetaMeta explores its potential for sandy soil remediation and areas with high fertilizer use statistics.

Background

Crop (cereal) yields of Ethiopian farmers averaged 1.7 t/ha over the year 2010. This is slightly higher than neighbouring Kenya and Uganda (both 1.6 t/ha), and it even triples the yields of neighbours Sudan, Eritrea and Somalia (0.4-0.5 t/ha). The higher average yields are for some extent the result of better rainfall (compared to Sudan and Eritrea), but can be further explained by higher fertilizer use.

Countries with higher yields have commonly higher fertilizer use statistics: Ethiopia (17.7 kg ha^{-1}), Kenya (32.4 kg ha^{-1}) and Uganda (2.1 kg ha^{-1}); while the countries with low yields used only sparse fertilizer: Sudan (7.9 kg ha^{-1}), Eritrea (2.8 kg ha^{-1}) and Somalia (n.a.). Compared to international cereal yields and fertilizer use standards, it can however be concluded that there is still large potential to improve.

Some international figures for fertilizer use and cereal yields are: United States (110 kg ha^{-1}; 7.0 t ha^{-1}), France (148 kg ha^{-1}; 7.1 t ha^{-1}) and China (504 kg ha^{-1}; 5.5 t ha^{-1}). In order to improve fertilizer availability, Ethiopia's government signed a 2 billion USD agreement last May to develop five urea and three DAP fertilizer plants within its territory. This will certainly reduce costs and time compared to import processes through Djibouti port. Also, current road construction efforts will assist in the timely distribution of the fertilizer to each corner of the country.

While the fertilizer supply network is professionalized in the coming decade(s), farmers' fertilizer demand remains at the lower site. The main reason is that use of the costly fertilizer not automatically results in higher yields and profits. Yield response is limited on large part of nation's arable land by soil acidity (pH < 5.5), poor soil structure with low organic matter and nutrient contents and limited water availability during the growth season.

Ethiopia's government recognizes these problems and developed several programs and projects to explore remedies. For treating soil acidity in Western Ethiopia it runs trials with limestone application and its long term CRGE vision mentions "application of compost for improved fertility and increased carbon retention" as a way forward.

MetaMeta wants to contribute to Ethiopia's efforts to get Ethiopia's soils more fertile and productive again. Therefore we assess the potential of local fertilizer sources (rock formations) and organic matter streams for soil restoration and fertilization. The boxes provide a brief overview on the demonstration trials, which will be conducted from 2013 till 2017.

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