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Multiplying Forest Garden Systems with biochar based organic fertilization for high carbon accumulation, improved water storage, nutrient cycling, and increased food diversity and farm productivity

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On abandoned, erosion prone terraces in the middle hills of Nepal, 86 participating farmer families planted >25,000 mixed trees in 2015/16. Since it was convincingly demonstrated by more than 20 field trials in this region that this was the most plant-growth promoting method, all trees were planted with farmer-made organic biochar-based fertilizer. Planting pits were mulched with rice straw and were pipe irrigated from newly established water retention ponds during the 7 months of the dry season. A peer control system of farmer triads ensured an efficient maintenance of the plantations. Tree survival rate was above 80% after one year compared to below 50% on average for countrywide forestation projects over the last 30 years. In between the young Cinnamon, Moringa, Mulberry, Lemon, Michelia, Paulownia, nut and other trees, other secondary crops were cultivated such as ginger, turmeric, black beans, onions, lentils, all with organic biochar-based fertilizer and mulching.
The objective of this forest garden project was to establish robust social-agronomic systems that can be multiplied from village to village for increasing soil fertility, protecting abandoned terraces from erosion, replenishing natural water resources, generating a stable income with climate-smart agriculture, as well as capturing and sequestering atmospheric carbon.
The initial financing of the set-up of the forest garden systems (tree nursery, plantation, preparation of organic biochar based fertilizer, mulching materials, building of irrigation pits and pipe irrigation system, and general maintenance) was covered by carbon credits paid in advance by the international community in the form of a monthly carbon compensation subscription. All planted trees are GIS inventoried and the yearly biomass carbon uptake will be calculated as an average value of the first ten years of tree growth. The 25,000 mixed trees accumulated the equivalent of 350 t CO_2 per year (10 years total C-accumulation divided by 10 years). Besides covering the set-up costs, farmers received and continue to receive carbon payments for each survived tree during the first three years. Based on a voluntary carbon credit price of 35 USD per t CO_2, the annual income of the farmers increase by 6 to 13% depending on their poverty level. After this initial period of three years, the income from tree crops (fruits, nuts, medicine, essential oil, silk, perfume, honey, timber, animal fodder) exceeds by far the (catalyzer) carbon credits (average crop income for the 25,000 trees including secondary mixed cropping > 150,000 USD).
The trees will accumulate carbon for 15 to 75 years depending on the tree species. While trunk wood will be used for construction timber and thus continue to sequester carbon for probably 50 years. While part of the wood will be used for cooking, at least 50% of the tree biomass will be pyrolyzed to biochar to produce organic biochar-based fertilizers and for using the pyrolysis heat for the production of essential oil, pasteurization and fruit or tea leaves drying.
Compared to the barren terraces, sparsely covered with grasses and prone to erosion, the forest garden system with organic biochar-based fertilizer, continuous soil cover, mulching, leaf litter fall, root growth and root exudates, rotating cover crops and animal pasture, soil organic carbon (SOC) is expected to increase annually. Therefore, for each participating farmer at least one land spot is GIS marked for soil organic carbon analysis to be executed every five years and to calculate and certify soil organic carbon increases for additional or bonus carbon credits.
In our presentation we will show and document the establishment of the forest garden systems, and discuss the link between local carbon sequestration and global carbon markets, the carbon calculation and certification procedures, and the challenge for multiplying such systems inter-regional and internationally.