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Reviving Seed Sharing for Biodiversity Conservation Food Security and Ground Water Recharge

Lorenz Bachmann[1], Tahiratou Alassane[2], Helga Fink[2], Komlan Kpongbegna[2], Günther Rapp[2]

[1]Agecol Association, Germany
[2]ProSEHA-GIZ, GIRE Water Ressource, Benin

Abstract

Ground water protection and recharge is a major concern in West Africa, since water demand is likely to double in next thirty years with the growing population. Climate projections indicate that West Africa will be subjected to increased variability combined with a decline in rainfall. The GIZ Water Program ProSEHA investigated how ground water recharge can be improved alongside improvements of food security.

ProSEHA decided to test the improvement of rice production by increasing rice biodiversity and by encouraging site specific cultivation of old traditional rice varieties. ProSEHA collected a total of 25 varieties with different local names and the farmer-led testing and genetic tests validated 15 well distinguished varieties. Among these varieties were some with very good abilities to grow in deeper water and varieties with very low water needs for upland cultivation. Due to this wider adoption range, farmers were able to cultivate a larger proportion of their traditional watersheds. This increase in production area, helped that less land in the watershed banks remains idle, and thus prone to erosion, and consequently water recharge is enhanced.

167 farmer-managed rice testing plots were evaluated. In the first year the plots were very small (<100 sqm) and increased over time as more seeds become available to plot sizes of up to 1 ha. All farmers tested various old varieties against a modern variety (mainly IR841). Farmers were invited to rate the relative performance of cultivars by observation and in addition precise yield measurements were taken. The trials were done without chemical fertilisers or other chemical plant protection measures.

The 4-year results showed local varieties performed at least equal (22%) or even better (52%) than modern varieties. Average yield for local rice varieties was 2,35 t ha^{-1} against 1,94 t ha^{-1} for modern varieties (+21%). Farmer observation revealed that the local varieties offer a broader variation in crop cycle length, flooding and drought and pest resistance. Information and seed were diffused by annual seed sharing fares. The encouraging results led to an increase in participating farmers from less than 20 in 2016 to 538 in 2019.

Keywords: Water recharge, seed exchange, food security, biodiversity, watershed management

Contact Address: Lorenz Bachmann, Agrecol Association, Breiteweg 1, 35415 Pohlheim, Germany, e-mail: l.bachmann@gmx.de

Background

The protection of ground water is a fundamental necessity for mankind on this planet. Human beings need water for drinking every day, equally all animals and all plants need clean sweet water daily. With the current African population increasing by about 3% annually, the human demand for drinking water alone will double in thirty-year intervals.[1] Equally, the future is influenced by global warming, that in turn will affect rainfall and temperature. Current climate projections indicate that West Africa will be subjected to increased variability combined with a reduction in rainfall.[2] In the context of protecting water resources, reduced rainfall poses a major threat to ground water recharge. This problem creates a vicious circle that is likely to worsen in the near future. The GIZ Water Program ProSEHA investigated how ground water recharge can be improved alongside improvements of food security.

Methodology

Rice cultivation near riverbeds is very common in Benin. Due to past agricultural intensification strategies, in many areas only 1-2 modern rice varieties are cultivated today. ProSEHA attempted to search for new innovative approaches for combining farm productivity with ground water protection. In this context ProSEHA decided to conserve the still existing agricultural biodiversity by reviving an old farmers practice, “seed exchange”. The project searched for old traditional rice varieties in 8 villages in Atakora department in the north west of Benin.

A total of 25 rice varieties with different local names were made available to farmers through seed fairs and joint variety testing. During the farmer-led testing 15 genetically well-distinguished varieties could be validated.

In between 2016 to 2019, a total of 167 farmer-managed rice testing plots were evaluated. In the first year the plots were very small (<100 sqm) and increased over time to plot sizes of up to 1 ha as more seeds become available. All farmers tested various old varieties against a modern variety (mainly IR841). Farmers were invited to rate the relative performance of cultivars by observation; and in addition, precise yield measurements were taken. For the purpose of improved groundwater protection, the project encouraged rice trials without chemical fertilizers and without herbicides. Special attention was given to varieties with low water demand.

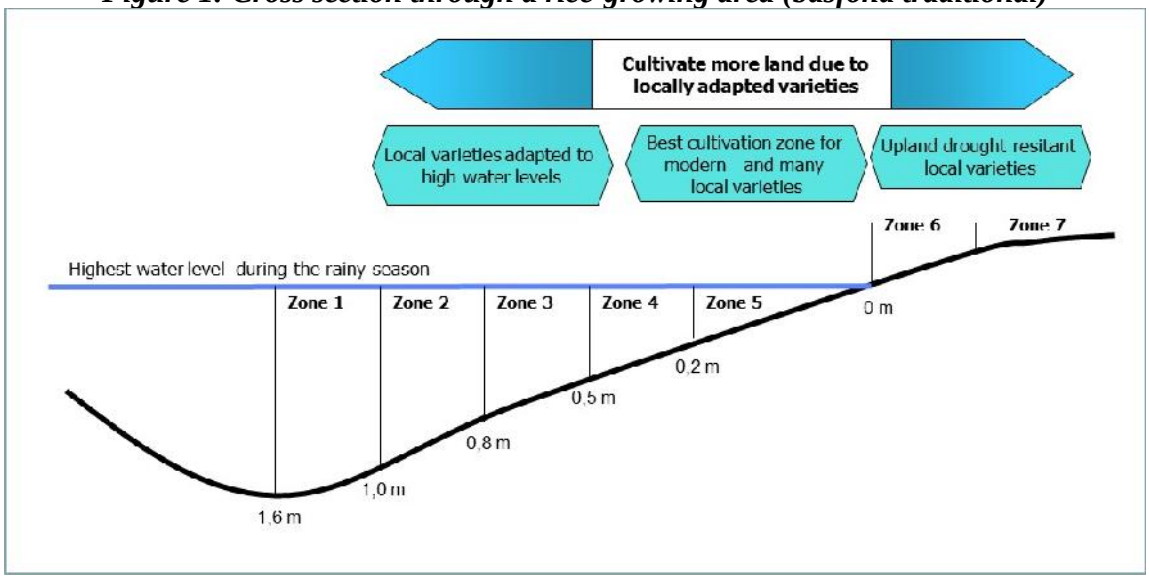
Results and discussion

Productivity. The farmer-managed testing plots showed that under ecologically sound low input conditions, local varieties performed at least equal (22%) or even better (52%) than modern varieties. Average yield for local rice varieties was 2,35 t/ha against 1,94 t/ha for modern varieties. An explanation for this at first surprising result (+21%) is, that modern varieties generally require well-levelled land that is not too deep are not too shallow and well fertilized. Rice growing conditions are very far from that ideal. ProSEHA found out, that in particular on these difficult lands, the older traditional varieties showed their merits. Very recent research of University Bonn in Germany with 100- year old wheat varieties confirmed exactly this ProSEHA finding in Benin: Old varieties are out-competing new varieties under low input conditions.[3]

The project started in 2016 with less than 20 farmers, and by 2019 already 538 farmers participated in seed sharing. Information is multiplied by annual seed fairs and the approach is spreading much further since five rice cooperatives have adopted the concept among their members and created small rice kiosks to display, share and conserve all varieties. An evaluation of the process with farmers highlighted that they appreciated in particular to have more choices of what to cultivate.

They can grow in both deeper water conditions and under conditions of water scarcity. This enlarges the area of rice that can be planted, it increases and stabilizes yields and, thus contributes substantially to food security.

Figure 1: Cross section through a rice-growing area (basfond traditional)



Marketing promotion of old traditional varieties also helped to raise the selling price for local varieties and to raise local incomes. Traditional rice varieties generally have higher contents in minerals and vitamins and that create additional synergies for health.

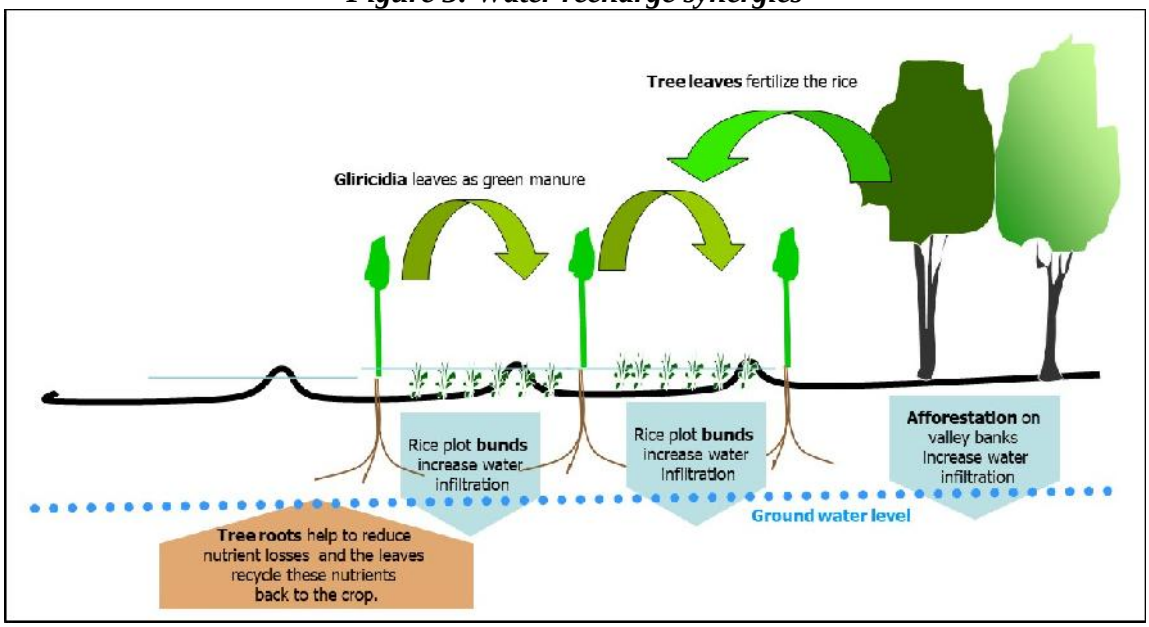
Preserving biodiversity. Creating awareness for the benefits of traditional rice varieties is a topic that was well appreciated by farmers. Now farmers grow more varieties simultaneously. That is a major impact in preserving agricultural biodiversity. It creates synergies between old and new varieties. More diversity helps to reduce the risks coming from increased climate variability. In this respect the project can make contributions towards the international Aichi targets number 1,7 and 14 of biodiversity conservation set under the Nagoya protocol in Japan in 2010.[4]

Figure 2: Aichi targets

Water recharge. Contributing towards sustainable water recharge is a major objective in any water programme. Recent research for semi-arid conditions reveal that pasture and agroforestry land use systems are best for groundwater recharge, leading to a slightly higher net water retention then even pure forest vegetations.[5] Building on this science of these best practices, ProSEHA has established five demonstration plots in all of its communes. These demonstration plots highlight multiple synergies for both water recharge and farm productivity. Farm bunds retain water, increase rice yields, and increase water recharge. Trees also contribute to recharge and the roots increase the filtering capacity of the soil to obtain clean ground water. The leaves of

trees help to fertilize the rice, increase yields, and help to avoid chemical fertilizers that would increase ground water pollution.

Figure 3: Water recharge synergies



The ProSEHA demonstration plots give a good example how the need for food production can be harmonized with environmental protection requirements in a sustainable way.

By combining the provision of save and clean drinking water with an array of other improved methods and services, such as enhanced hygiene practices, seed exchange for more biodiversity, improved land use and cultivation practices, all measures combined lead to better water conservation and multiple benefits for Benin's population. In this way ProSEHA contributes strongly towards several sustainable development goals (SDGs) set by the international community: SDG2 zero hunger, SDG6 clean water and sanitation and SDG13 climate action.

References

[1] UN (2019): World population prospects. https://population.un.org/wpp/Download/ Standard/Population/ and own calculations

[2] Sylla, N. &F. Giorgi and Wisser (2015): Projected robust shift of climate zones over West African response to anthropogenic climate change for the late 21st century. Springer Science+Business Media. Dordrecht. The latest climate scenarios specific for West Africa are found here: https://climateanalytics.org/projects/ impact -climate-action/west-africa/

[3] Gaiser, Ewert et. al (2018): Genetic yield gains of winter wheat in Germany over more than 100 years (1895–2007) under contrasting fertilizer applications. Environmental Research Letters · September 2018. DOI: 10.1088/1748-9326/aade12

[4] Convention on Biological Diversity (2020): Aichi biodiversity targets. www.cbd.int/sp/targets/

[5] Owuor, Butterbach-Bahl. et. al (2016): Groundwater recharge rates and surface runoff response to land use and land cover changes in semi-arid environments. Ecological Processes (2016) 5:16; DOI 10.1186/s13717-016-0060-6