

Rehabilitation of degraded rain fed agricultural land in Southern Tajikistan through household energy efficiency improvement!

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Abstract

Tajikistan is a landlocked country in Central Asia with predominantly continental semiarid climate. Due to the rough topography of the high mountainous region only about 7% of the country's surface land is suitable for agriculture. During the period of Soviet Union (1924-1991), large amounts of heavily subsidized agricultural inputs and fossil fuel sources were available for the overwhelming rural population. Nowadays large parts of the country's rural population are not in the position to regularly purchase expensive external agricultural inputs. Instead they strongly rely on the locally available natural resources, which are nevertheless often used in a very inefficient and wasteful manner. As a result signs of severe natural resource degradation are widespread.

The consumption of large amounts of firewood and animal dung by rural households as major fuel source for cooking, bread baking and winter heating is one of the major driving forces for advancing natural resource deterioration. The amount of dried animal dung used as fuel source can be as high as 25 tonnes per year for one single family. Low cost options to improve household energy efficiency have shown the capacity to drop fuel requirements of rural families by 50% and allow even resource poor farmers to return large amounts of animal dung back to their plots and to improve agricultural production by their own means.

1. Introduction

Tajikistan is economically the poorest country of the former Soviet Union. Most of the country's territory consists of semi arid high mountainous land and only about 7% of the country's surface land is suitable for agricultural activities. More than 50% of the country's populations of approximately 6 million people live in rural areas.

Since February 2007, respectively January 2008 Welthungerhilfe is implementing two EC TACIS supported integrated rural development projects in the three districts Baljuvon, Temurmalik and Khovaling of Southern Tajikistan. Most of the land in the predominantly rain fed area is severely degraded. Water and wind borne erosion, deforestation, removal of agricultural crops as well as the regular collection of animal manure as fuel have contributed to sharply reduce the nutrient and humus content of soil.

Annual precipitation in the area varies with the altitude and additionally shows a high variation from year to year. As an average the area receives an annual precipitation of 400-1000 mm in the period between autumn and spring whereas the long summer periods tend to be hot and dry. Key water-related problem in the area is not the unavailability of sufficient precipitation for agricultural activities as such but its uneven distribution combined with reduced capacity of water infiltration and retention by the degraded soil. In particular during the second part

of the summer period water scarcity negatively affects the crop development. Agricultural yields in the project area are often not even allowing farmers to recover their investment costs.

During the period of the Soviet Union (1924-1991) “resource use efficiency” was not considered important. Instead the population was used to have access to large amounts of highly subsidized agricultural inputs and fuel sources such as gas and coal. After the country’s independence the situation changed dramatically. Due to financial constraints nowadays large parts of the population are not even theoretically in the position to purchase agricultural inputs or expensive fuel sources on a regular basis. Instead most rural families strongly rely on the locally available natural resources, which are however till the present often used in a very wasteful and destructive manner.

To address dwindling agricultural productivity on degraded rain fed land in semi arid regions of Tajikistan numerous projects have concentrated their efforts in past years on the distribution of “improved seeds” and chemical fertilizers to the local population. Large amounts of money have been invested on purchasing and distribution of expensive external agricultural inputs. The approach has clearly failed to improve local agricultural production in a lasting manner. By the end of project implementation period most local families were unable to buy expensive agricultural inputs by their own means. Apart from that, the application of chemical fertilizer and improved seeds are not able to address one of the most severe limitations of rain fed agriculture in the region: the low water infiltration and storage capacity of the soil, which is affecting water availability for the crops during the long dry period.

Table No.1: Comparing important characteristics of mineral and organic fertilizer in the Tajik context

	Mineral fertilizer	Organic fertilizer
Type of nutrients	only N, P, K	many different macro and micro nutrients (N, P, K, Mg, Ca, Fe, Cu, Zn, Mn)
Price	expensive, constantly rising prices	free of charge or at low price
Availability	not always (some types only produced in Uzbekistan)	locally available
Other properties	only successful when other conditions (water, temperature) are optimal	improves general conditions of the soil, longer-lasting effect

2. The need for a more integrated approach to address root causes of low agricultural productivity

To achieve lasting positive impacts on agricultural production, the major constraints of current low productivity of crops need to be thoroughly analyzed and understood. In the case degraded rain fed areas in Southern Tajikistan the implementation measures to improve the water storage and retention capacity of the soil plays a particular important role for improved crop development. Whereas the application of chemical fertilizer is not able to make a significant contribution for enhancing water availability of degraded soils, the use of organic fertilizer can help to substantially increase the water infiltration and retention properties of the soil. One ton of dry animal dung has the capacity to store about the same amount of water!

Most of the local population in the project area is at the same time engaged in subsistence agriculture and extensive animal husbandry. Large amounts of animal dung from donkeys, cows, sheep and goats are locally available- but so far hardly used as organic fertilizer. Instead, influenced by the lack of affordable alternatives, large parts of the local population use most of the available animal dung together with increasingly scarce fire-wood as major fuel source for cooking, bread baking and winter heating. Efficiency of locally used facilities is very poor and annual consumption of dried animal dung as energy source at household level can be higher than 20 tonnes per family.

In the case of extremely poor households the percentage of available animal dung used for cooking and heating can reach up to 100%.

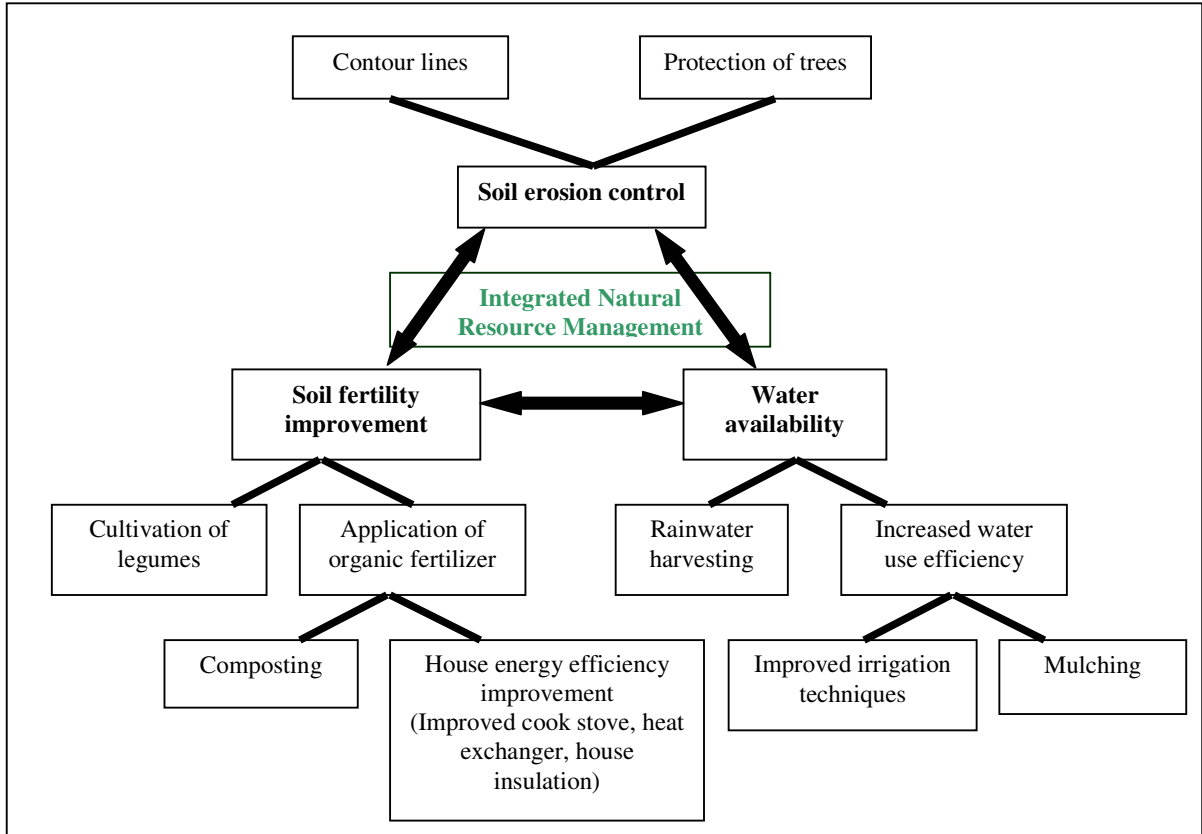
Table No 2: Overview about annual house energy consumption of a rural family in Temurmaliik District, which use exclusively dry animal dung as locally available fuel source at household level

	kg per summer period (7 months, 214 days)	kg per winter period (5 months, 151 days)	total kg per year
Cook stove	21,5 kg per day 4,60 to. per summer	0	4,60 to.
Iron stove	0	40 kg per day 6,04 to. per winter	6,04 to.
Bread oven	80 kg per week 2,40 to. per summer (30*weekly consumption)	100 kg per week 2,10 to. per winter (21* weekly consumption)	4,50 to.

To break the vicious cycle between decreasing soil fertility and deteriorating agricultural yields, Welthungerhilfe is following an integrated approach, which is linking the activities to raise resource use efficiency at household and farm level. To improve agricultural production, special emphasis is given on the reduction of soil erosion and increasing humus content of the soil. The humus content is of particular importance as organic material has the capacity to substantially increase both: soil fertility as well as the infiltration and water storage capacity of the soil.

To address the inefficient use of important natural resources at house level, a number of innovations and complementary measures have been developed. Rather than seeking to promote sophisticated measures, which might be very efficient but expensive and difficult to multiply under the local conditions, emphasis is given to options that are simple, cost efficient and easy to replicate.

Figure No.1: Major elements to be considered for the rehabilitation of degraded rain fed land in S-



To enhance the general sense of responsibility and ownership, Welthungerhilfe expects, in general, significant personal contributions from the target population for different project activities. Nothing is given to the local population for free. Instead apart from labour, on an average personal financial contribution between 50-100% is expected to cover expenses for required materials.

Types of energy efficiency improvements developed for household energy efficiency increase

Improved cook stoves

Locally used cook stoves are commonly made out of clay. To raise their efficiency, simple adjustments have been developed to improve airflow and to optimize the position of the pot towards the fire. A simple metal sheet is used to avoid heat loss through the open front part. Due to a cleaner burning process, smoke concentration level in the kitchen can be significantly dropped. The modification of local cook stoves can be realized in about one hour and can help to reduce fire requirements by around 50%. Dedicated and enthusiastic local women are integrated into the project work as promoters.

Promotion of more efficient bread baking

Bread is one staple food of the Tajik population and around 30% of fuel material consumption in the project covered rural areas is used for bread baking alone. In the

project area bread is prepared two-three times per week. Currently many local women are baking alone, using in each occasion an average 9kg of wheat flour. Per kg of wheat flour consumes an average of 0,9 kg of firewood or 1,8 kg of dried animal dung in the process of bread baking. Most of the energy is used for bringing the temperature of the room to around 30°C from outside condition. If several women bake their bread one after another, huge amount of fire-wood can be saved. In this case, rather than promoting mainly technical adjustments to the bread ovens, Welthungerhilfe promotes “joint bread baking” activities among rural women to decrease fuel consumption.

Raising the efficiency of winter heating systems

During the cold winter period traditionally simple iron stoves are used at the same time for cooking and to warm one room of the family’s house. Conducted energy efficiency assessments revealed that most of the produced heat is lost through the exhaust pipe. In order to address low energy efficiency of traditional winter heating systems, a complementary element called “heat exchanger” has been designed and further adjusted. The “heat exchanger” is integrated into to the exhaust pipe of traditional winter heating system and its main purpose is to reduce the flow of hot air in the pipe and to increase the surface for heat transmission into the room. A box integrated into the heat exchanger can additionally be used as an oven. By using “heat exchangers” fuel requirements can be dropped by 50-70%.

Enhancing house insulation

Due to poor insulation, in many rural houses, generated heat in the room vanishes quickly. As a first step to address the situation, actions have been initiated to promote low cost insulation of house ceiling, doors and windows with utilization of locally available materials (mainly wheat straw, clay and sheep wool).

Promotion of low cost rainwater harvesting structures

As a complementary measure to contribute to more efficient resource use at household level; low cost plastic rainwater retention ponds have been developed. The benefits of these structures are manifold and include increasing (woody) biomass production during the dry summer period as an additional and sustainable source of fuel materials.

3. Current state of achieved impact and perspectives

So far around 1200 local families have shifted to the use of improved cook stoves, 100 families have acquired heat exchangers for improvement of winter heating systems and more than 250 families have improved insulation installed in one room within their house, which is occupied in winter period by the entire family.

Families, who have adopted some of the developed low cost innovations, have been able to experience substantial positive changes. Women and children, who in rural Tajikistan carry most of the responsibility for procurement and preparation of fuel material, have been relieved from this part of their high daily workload. The use of improved cook stoves has created a healthier working environment at kitchen level. The conducted activities in the field of household energy efficiency improvement have allowed the projects to substantially improve its cooperation with rural women, who tend to be largely under-represented in many other project activities.

With fuel requirements dropped to as much as 50% (which in some cases is equivalent to annual savings per family of 10 tonnes of animal dung as fuel material), the introduction of innovations at house level have open even resource-poor households a viable path to return large amounts of animal dung as organic fertilizer back to the agricultural plots. Local farmers who have started to apply more organic fertilizer and erosion control measures on their land have, already from the first year, been able to observe tangible positive changes in terms of plant development, drought resistance and yields. If the application of activities to raise energy efficiency at household level as well as the application of appropriate soil management continues to increase, the resilience of rural families and entire communities to drought should further raise.

Initiated activities by Welthungerhilfe in Southern Tajikistan represent the largest successful initiation of energy efficiency improvement campaign for rural areas in recent decades, not only in Tajikistan but in Central Asia as a whole. However, so far the positive impact has been mainly achieved at family/household level. In order to reach a lasting positive effect on natural resource development at community level as a whole, the amount of participating families is still too small. So, there is a need to think for viable options to further spread and scale up the initiated activities in the field of household energy efficiency improvement.

Apart from ongoing promotional activities within the project area, since an early stage complementary activities for information sharing with governmental institutions, donor organizations and other project implementing agencies have been launched. Governmental institutions so far remain largely inactive apart from verbal support; at donor and implementing agency level positive developments can be observed. In several cases other organizations or projects have already started to promote some of the developed innovations in their own working area.

Last but not least it is worth to mention, that the initiated activities in the field of household energy efficiency improvement have not only triggered positive impacts among rural families but have at the same time helped the project itself to use its own resources in more efficient and sustainable way. Rather than spending large amounts of money for the distribution of agricultural inputs, which once the project intervention ends, will again become unaffordable for large parts of the rural population, the project's interventions in the field of raising resource use efficiency at household level are expected to produce lasting positive effects even long time after the project has come to an end.