CAMP – Central Asian Mountain Partnership

Agroforestry in Tajikistan

Overview of the Current Situation, the Potential, and the Influencing Factors of Agroforestry Systems

Beda Romer

September 2005

DEZA
DDC
DSC
SDC
COSUDE

CAMP
Central Asia Mountain Partnership

cde centre for development and environment

Agroforestry in Tajikistan

Overview of the Current Situation, the Potential, and the Influencing Factors of Agroforestry Systems

Beda Romer

DEZA
DDC
DSC
SDC
COSUDE

CAMP
Central Asia Mountain Partnership

cde centre for development and environment

Impressum

Editor: Beda Romer

Graphic Design: Beda Romer

Cover photo: New established intercropped orchard in Karsang (Photo: Romer B., 2005)

Supervising Organization: CAMP

CAMP
12, Istravshan Str., apt 5
734025, Dushanbe
Republic of Tajikistan

Tel.: (992-372) 21-02-27
Fax: (992-372) 23-51-84

www.camp.elcat.kg

Summary

Agroforestry is the traditional practice of growing tree on farms for the benefit of the farm family. In Tajikistan such multifunctional land use systems including trees have been common during Soviet times and probably even before. After the fall of the USSR and during the civil war many agroforestry systems were lost because people in rural areas used wood for covering their energy needs. Many practices became insignificant due to the lower production inputs.

Nowadays many farmers start to rebuild and adapt what was lost and try to find solutions to adjust the production systems to the new situation. In the last few years farmers have been additionally integrating trees in farmlands and farming systems were integrated into forests. Therefore agroforestry can be found both, inside and outside of Tajik forest territories.

In forest territories the extension of agroforestry is legally established and supported by the current policy. Mainly two systems can be found; livestock grazing in mature forests and arable cropping in new established plantations. Outside Lezhoz territories several agroforestry systems are widespread. Commonly one can find intercropped orchards and multipurpose tree strips alongside roads. Furthermore Apiculture practices and home gardens are frequent in many regions of Tajikistan.

However, it seems that there is still a considerable potential for the improvement of the existing systems and the further dissemination of agroforestry. Principally pasture grounds and land suffering from different kinds of degradation could be enhanced by introducing adapted agroforestry technologies.

Interviews with rural households in mountainous Tajikistan showed that two factors mainly were constraining for agroforestry extension; the scarcity of land and financial shortages for the introduction of trees. These factors are often symptomatic for a whole village. On the level of individual households also very peculiar problems either of biophysical or socioeconomic nature can be found.

In addition, factors from outside the rural household – so called off-farm factors – are influencing agroforestry. Generally these influences are from a minor significance compared with the on-farm factors. Low land tenure security, which often presents a major obstacle for long term investments in developing countries, is not considered as hindering in Tajikistan. It goes at least for land plot with individual and collective access while open or communal accessed land is rarely used for agroforestry.

However, there can be mentioned the following hindering off-farm factors:

- Low access to private loans and bank credits
- Bad infrastructure in mountain areas. It raises the prices of commodities, worsens market information situation and restricts individual access to market,
- Low possibility for selling different Non-timber tree products due to lacking processing industry and low access to supraregional markets.
- Lacking planning and management skills as well as deficient information concerning work with trees.

Organizations working with agroforestry are supposed to consider these constraining factors and to find possible solutions to meet them. A number of recommendations concerning the improvement and extension of agroforestry is listed in part E of this report.

Table of Contents

List of Figures, Maps and Tables

Cover Photo: New established intercropped orchard in Karsang (Photo: Romer B., 2005)

Abbreviations and Acronyms

AF	Agroforestry
ALS	Method for Autodidactic Learning for Sustainability
CAMP	Central Asia Mountain Partnership
NTFP/ NWFP	Non Timber Forest Products / Non Wood Forest Products
RT	Republic of Tajikistan
SCSRT	State Committee on Statistics of the Republic of Tajikistan
SCEPFRT	State Committee on Environment Protection and Forestry of the Republic of Tajikistan

Terminology

AF practice/technology	An Agroforestry practice denotes a specific land management operation of an Agroforestry nature on a plot and usually consists of arrangements of Agroforestry components. “Several such practices are involved in the constitution and maintenance of an Agroforestry system” (Nair, 1990). The term ‘technology’ is often used as synonym for ‘practice’.
AF system	“An Agroforestry system can be considered a type of land use that is specific to a locality and described according to its biological composition and arrangement, level of technical management and socio-economic features” (Nair, 1990).
Fuelwood	All types of woody vegetation (trees, bushes, shrubs) used for burning
Taungya system	Method of raising forest trees in combination with (seasonal) agricultural crops. Used in the early stages of establishing a forest plantation. It not only provides some food but also can lessen the establishment costs.

Local Terminology

Dehkan farm	Dekhan Farms can be either small, independent farms or large, collective farms. They are private and independent from state in terms of investment decision
Lezhoz	Governmental forestry office
Kolkhoz	Collective farms. Apart from the land, the capital and the productive assets belong to the workers
Mullah	Mullahs are Islamic clergy who are considered experts on related religious matters in this religion. Mullahs are considered to be able to give direction and make judgments based on their religious studies.
Navruz	Pre-Islamic festivity of Persian speaking peoples. Originally the word means New Year and is kept on 21 March. Farmers traditionally start field work after Navruz.
Oblast	Province
Rayon	District
Tapak	Energy material consisting of dung mixed with cropping residues like straw. The size and form of tapak depends on the local form of stoves and on traditions.
Somoni	National currency of the RT
Sovkhoz	State farms. The land and all other property belong to the state, the workers are employees of the state with fixed salaries and the state absorbs all the profits and losses of the sovkhoz

A Introduction

1 Foreword

A more systematic approach of land use systems including trees and forests also outside of the traditional forest areas promises to be an interesting approach to deal with the transformation going on concerning land degradation and land rights, agriculture and sufficiency, as well as for the supply with energy sources and construction wood. In the frame of ALS-workshops on water and soil conservation CAMP made experience with agroforestry technologies; as a result of the workshop, CAMP proposed the introduction of several adapted technologies in order to reduce land degradation processes. Among the proposed technologies were also some agroforestry practices. The previously conducted group discussions with farmers showed that socio-economic, bio-physical and other factors have a huge importance for the acceptance and dissemination of agroforestry.

The relevance of this work is to find out more about the framework for the extension of agroforestry. It isn't reasonable to propagate the idea and the technologies of agroforestry without the exact knowledge of their potential and relevance for the households. Also Nair (1989) stressed, that "the literature is full of description of agroforestry systems at the household level, but the rigorous analysis of the underlying socioeconomic processes involved is limited." Therefore this paper aims at the holistic view of the framework within which agroforestry systems are embedded. The recommendations based on this framework will suggest organizations dealing with agroforestry which aspects to take into consideration and where to put the focus of their activities. The results of the research are meant for a wide group of specialists and organizations working on agroforestry and related topic of mountain territories in Tajikistan.

2 General information on Agroforestry

2.1 Definition

Several definitions of agroforestry have been suggested by different authors, most of them put the stress on the topic the publication is dealing with. Therefore some definitions emphasize more the social component of the agroforestry while others stress the sustainability, the ecology, environmental or economic properties. However, three elements can be found in most definitions; the inclusion of woody plants, the economic and ecologic interactions between the components and the note that agroforestry describes a collective term. One of the most quoted definition is the following:

"Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems there are both ecological and economical interactions between the different components." (Lundgren and Raintree, 1982)

The goal of agroforestry is to contribute to the improvement of live primarily in the rural sphere.

The objectives are firstly to maintain a sufficient, regularly and diversified level of consummation and service goods and secondly to ensure the perennial action of production factors. The soil fertility is especially concerned. The conservation and enhancement of soils take a central part in almost every agroforestry system.

2.2 Description and classification of Agroforestry systems

Agroforestry systems can be categorized according to the following sets of criteria (Nair, 1990):

- Structure: refers to the nature of the components and their arrangement in space and time,
- Function: refers to the major role and/or output of the components,
- Agroecological and environmental adaptability: refers to the environmental condition and ecological suitability of systems, assuming that certain types of systems can be more appropriate for certain ecological conditions,
- Socio-economic and management level: refers to the level of inputs of management and the economic goals of the system.

The three major types of agroforestry systems are agrisilvicultural (crops[1] and trees, including shrubs/trees and trees), silvopastoral (pasture and/or animals and trees) as well as agrosilvopastoral (crops, pasture and/or animals and trees) systems. agroforestry systems are usually also classified according to the arrangement of the components in time and space as well as depending on their productive and protective functions. Sometimes Agroforestry systems and practices can also be grouped according to their suitability for given agroecological conditions (e.g. intercropping with tobacco only on irrigated land). Further criteria can include the level of management input or cost-benefit relations. However, these socio-economic factors are likely to change with time and management conditions and are therefore only of limited value for an objective classification system (Nair, 1990).

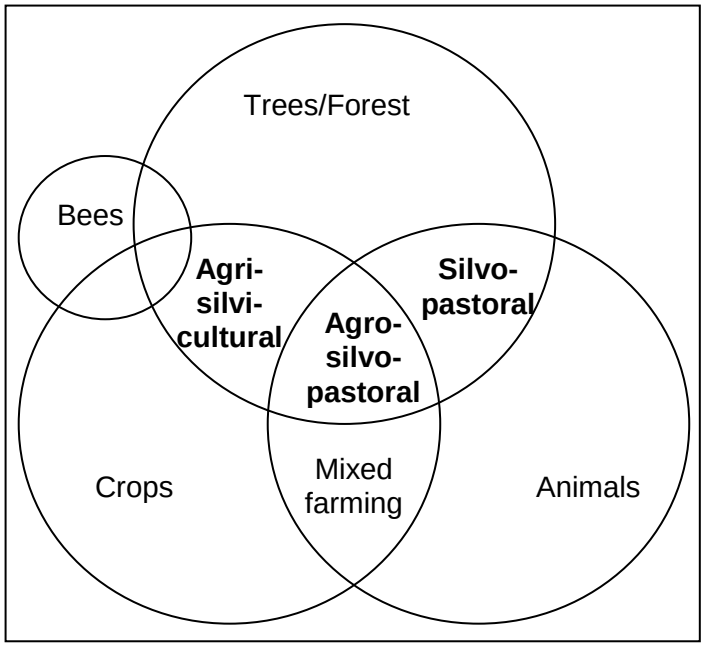


Figure A-1: The tree major types of Agroforestry

For categorizing systems generally the structural and functional aspects are taken as the primary considerations whilst the agroecological or environmental and the socio-economical factors are taken as a basis for grouping the systems for definite purposes rather than for classifying them (Nair, 1990).

For a detailed account of agroforestry classification, which is outside the scope of this paper, the reader is recommended to consult Nair (1985, or 1993) or MacDicken and Vergara (1990).

[1] In the following text the terms 'crops/cropping' always includes forage crops/cropping (clover or grass hay as an agricultural crop). Therefore, haymaking within Agroforestry systems is accounted for agrisilvicultural and not silvopastoral practices. If the term arable crops/cropping is used, hay making is excluded.

2.3 Possible advantages and disadvantages of Agroforestry

Appropriately selected woody components may contribute to both the productivity and sustainability of farming systems on marginal land in several ways. There can be distinguished roughly two different groups of roles; the production roles and the service roles. The production roles normally have a direct impact on farmer's income while the services mostly have an indirect economic impact by enhancing the conditions of production.

Production roles:
The total dry matter and energy content of all agroforestry components harvested on a given area is always higher than from sole cropping or pure forestry. Not only the produced biomass but also the diversity of agroforestry products are generally bigger than from systems consisting only of crops; "Trees play a role in supplying food, fodder, fuelwood, building materials and other raw materials for rural industries" (Raintree, 1985).

- Fuelwood: Wood is still the most widely used source of fuel in the developing countries, where wood-based fuel accounts for 81 percent of the wood harvested (FAO, 1999) agroforestry systems in Asia are crucial to fuelwood supply. Proximity coupled with the ease of agroforestry system management does make them an attractive and important source of fuelwood. And while it is not the main purpose of orchards to produce fuelwood, that is often an important side effect, especially in the developing countries (Bellefontaine et al., 2002).
- Timber: Off-forest tree resources provide service wood for planks, poles, beams and material for construction and fencing. Nevertheless it has to be mentioned that timber is not generally the foremost end product of most tree species in Tajikistan.
- Non-wood forest products: "Just as many non-wood forest products are harvested from trees in orchards and agroforestry systems as from forest species. The non-wood products of forest species are termed 'non-wood forest products'. As forest resources dwindle and the need for certain non-wood products mounts, trees growing outside forested areas are increasingly meeting the demand. The non-wood forest products consist of high valuable items like fresh and dried food, animal fodder, honey or medicinal plants" (Bellefontainte et al., 2002).

Service roles:
Besides the direct production roles appropriately selected trees and bushes have also important function regarding the productivity and sustainability of farming systems (Raintree, 1985). These "service roles" are in addition to the direct "production roles" of trees.

- Potential reduction in soil erosion: Trees, shrubs, and other permanent vegetation in the landscape create stable areas that reduce or eliminate wind and water soil erosion. Windbreaks or contour planting within a field limit the distance water can mover downhill, thereby reducing its velocity and erosive power (NAC, 2003).
- Enhancing nutrient capture and retention: Deep-rooting trees are collecting nutrients in soil horizons not accessible by roots of herbaceous crops and making them available for the whole system through leaf litter (Sorg, 2000).
- Improvement of soil chemical, physical and biological characteristics: More intensive and deeper rooting in various soil depths by more than one plant species improves soil conditions. Including leguminous crops or trees allows for nitrogen fixation. Animal component offers cheap organic fertilizer. Shade from tree canopy improves soil biological activity and nitrogen mineralization (Wilson, 1990; ICRAF, 1993).
- Water quality: Trees protect water quality and safeguard clean water supplies. Trees also help to stabilize stream banks by armoring banks against the force of flood waters (NAC, 2003).
- Biodiversity: Agroforestry plays a major role in the reclamation of degraded and abandoned lands and is generally considered the most workable approach to mimic natural succession and increase biodiversity (Anderson, 1990).
- Reduction in micro-climate extremes: Shadowing and (nearly) continuous soil cover reduce temperature and moisture oscillation close by and in the soil thus leading to better plant growth conditions. This is of special significance in semi-arid areas (Sorg, 2000).
- In dry climates tree windbreaks can increase crop productivity and hay yields. This is due to their ability to moderate the effects of hot, drying winds which increase evaporation and plant transpiration by crops (NAC, 2003).

- Conserving energy: Heating costs can be cut by 10 to 25 percent in homes protected by windbreaks, especially in the high wind regions (NAC, 2003).

However, the interactions between the agroforestry components aren't imperatively positive. Sanchez mentioned that plants growing in proximity to each other can interact in positive ways (complementary) or in negative ways (competition). "The biophysical bottom line of agroforestry is how to manage the interaction for light, water and nutrients between the tree component and the crop and/or livestock components for the benefit of the farmer." (Sanchez 1995) Also Jensen (1995) pointed out that agroforestry systems aim to optimize the total output of the different products and although crops may benefit each other, it is not possible to obtain maximum productivity of all individual species. "In some case lowering the tree production in order to increase the production of other crops may be desired. Apart from reducing the number of trees, this can be obtained by root pruning, reduced fertilization or watering or by other means" (Jensen, 1995).
Further disadvantages of agroforestry systems may be allelopathy which hinders growth of one or several components and the unintentional support of pests which might be alternatively hosted on agroforestry components. Furthermore, trees and crop components can be damaged from field activities or livestock.

"Agroforestry systems offer apart from biological also socio-economical advantages. The increased crop diversity reduces financial risks in case of extraordinary environmental conditions, increases income opportunities, improves income distribution over the year and offers the potential for an improved human and animal nutrition. Major economic drawbacks can be the high primary investment needed (mainly for tree planting) and a possible increase in labour requirements (especially if the design of the system is restricting mechanization)" (Messerli and Juldashev, 2000).

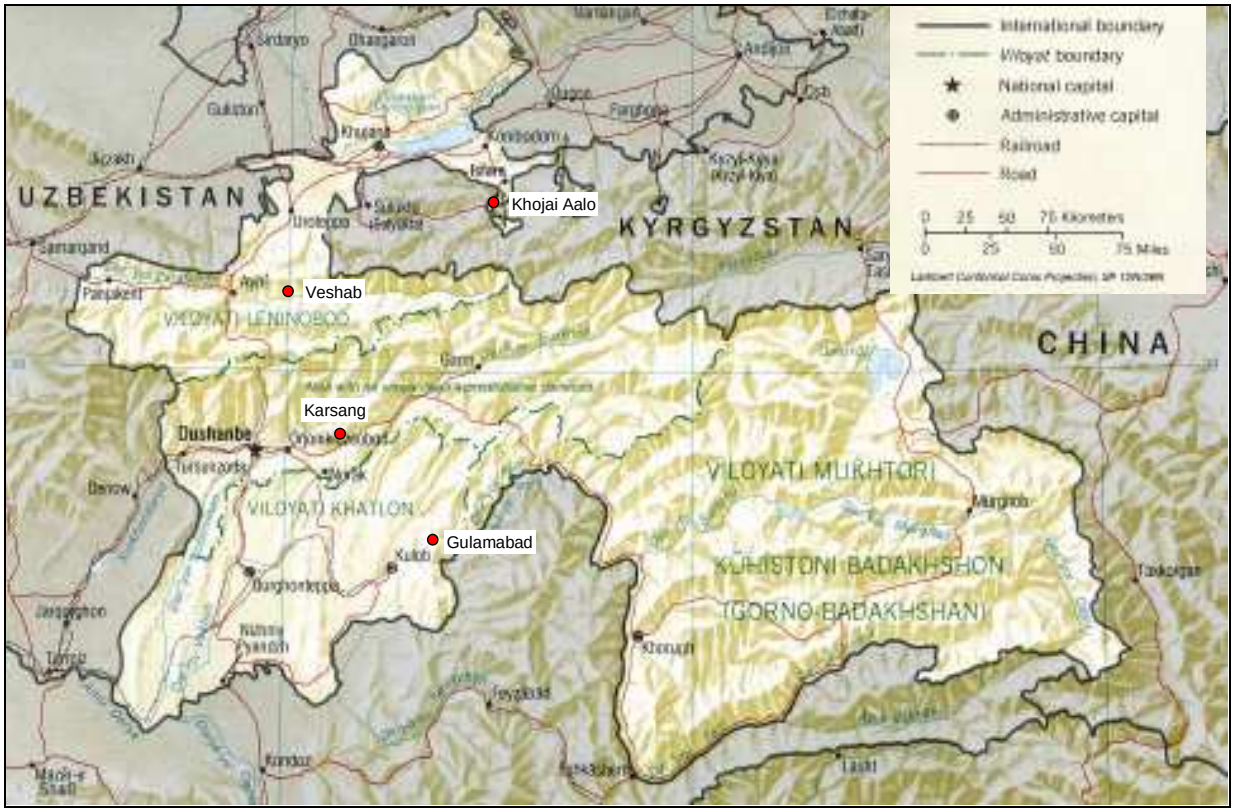
B Study methods

1 Study area

1.1 General background

Tajikistan is a mountainous country. 93% of its territory is surrounded by mountains, referring to the highest mountain systems of Central Asia: Tyan-Shan and the Pamirs. Almost half of the territory of Tajikistan is situated at the altitude of more than 3000m. The topographic situation has a vast influence on the climate, which is generally continental and characterized by sharp seasonal and daily fluctuation. The cold winter passes into rainy spring and is quickly replaced by dry summer, with the exception of Pamirs. Tajikistan belongs to two climatic areas: Asian and Central Asian.

There are four main natural zones: The Pamir mountains and plateaus in the east (Gorno Badakhshan), the center zone dominated by three east-west mountain ranges (Turkestan, Zarafshan and Hissar), the Khatlon province located in the south-west between the Hissar range and the Amu Darya (or Pandzh) river, and in the north the former Leninabad province (renamed Sogd province in 2000) in the river valleys of Zarafshan and Syr Darya (Akiner, 2001).



Map B-1: Tajikistan. Source: University of Texas (2001): http://www.lib.utexas.edu/maps/, adapted

Tajikistan is the poorest country in the Commonwealth of Independent States (CIS). The World Bank estimates that for the years 2002/2003 80% of the population were living under the poverty level and the unemployment rate was seen to be at 40%. The population of Tajikistan increased considerably during the past decade from 5.3 million (1990) to 6.44 million in 2002. Agriculture is the main occupation in this mountainous country: Two thirds of the population is occupied with cultivation of cotton, wheat, potatoes, grapes, rice, barley and corn (www.adb.org).
The information given in Part C of this report goes for the whole Republic of Tajikistan while the study of Part D base exclusively on mountainous villages. Four study villages have been chosen in different natural zones: Gulamabad in the South-East of Khatlon province, and three villages in the center zone; Karsang on the southern foothills of Hissar Range, Veshab in between of the Zarafshan and Turkestan Ranges and Khojai Aalo on the northern foothills of Turkestan Range. In the Pamir region, no study village has been chosen.

1.2 Short description of the study villages

All of the four study villages are geographically situated either in or near mountainous zones. As in most villages of Tajikistan, they are not permanently provided with electricity. During winter times the electricity supply is limited to four hours a day; two hours in the morning and in the evening each. Important differences may be observed on the subject of village history and the present state of natural resources and infrastructure.

Gulamabad

The village Gulamabad lies in the district Muminabad on the foothills of the mountain chain fixing the border to Afghanistan.
The village was recently rebuilt. After 1937 the existing village was left and the land wasn't cultured any more till 1990. From then on, farmers from different districts started again to settle and cultivate the land. The number of households eventually increased till today. At present there are 40 household established.

In the surroundings of the village there is a lot of rented land plots, most of which are covered with either barley or wheat. Furthermore there are some orchards (mostly apple, rarely mixed with pear), private grassland (for haymaking) and public pasture. 5 km from the village, one can find large forests.

A bad maintained and bumpy road of 17km connects Gulamabad with Muminabad. After rainfall exclusively cross-country vehicles are able to drive the road. Only six villagers own a car.

Karsang

The village Karsang lies in the district Faizabad on the south-exposed hills of the mountains between the Rhomit valley and the Kofornion valley.
The village was founded in 1961. In 1965 a large experimental station was established by the soil science institute. The station owns a two roomed house which is usually used for assemblies and training courses.
At present 70 households are located in the village. Most of the inhabitants are working in the primary sector. In 1996, the first Dehkan farm was established in Karsang.

Faizabad is said to be the orchard of Tajikistan because of an important territory, planted with diverse fruit trees (apple, pear and walnut) and vines. The rain-fed land is either used for pasture or cropping with wheat. The forest is situated in the mountains, about 5 km behind the village. In earlier times there were 600 ha of orchards destroyed.

Karsang is located near the main road between Dushanbe and Garm. The distance to the district center Faizabad is about 10 km.

Veshab

Veshab is situated in the steep and stony southern slope near Zarafshan River in the district of Aini. In the steep and densely built village live 1845 people, most of whom earn their livings with agriculture.

The arable (irrigated) land is arranged in flat terrace-like spots. On these spots different vegetables, grains and fruit trees (apricots) are cultivated. Besides the irrigated land, the landscape is characterized by steep slopes covered with unstable boulders and high mountains surrounding the village. The water is lead from the springs to the fields by smart systems of stone channels framed by poplars. Veshab has an old tradition in building these remarkable channels. As the non-irrigated land around the village is stony and for the most part bleak, herdsmen lead the livestock during summer to remote grounds. There is forested land behind the next mountain chain in some 10 km distance to the village.

The district center is Aini (the former Leninabad), where also the main market is situated. The distance between Veshab and Aini is about 45 km and takes more than one hour because of the bad condition of the road.

Khojai Aalo

Khojai Aalo lies in the district Isfarah sharply at the Border to Kyrgyzstan. Many Kyrgyz people are living there, even though Khojai Aalo is actually a Tajik village. The ground is a patchwork of Kyrgyz and Tajik properties. Different infrastructural assets like schools are separated for the two peoples. In Khojai Aalo live about 3000 Tajik. There are different workshops (among them two wheat mills, three rice mills and one blacksmith), a big mosque and schools in the village.

The village is surrounded by large orchards consisting mainly of old apricot trees. Apricot has a big tradition as tree cultivation was already present in pre-Soviet times. In the more recently established gardens there are also vegetables and grain crops grown between the rows of trees.

A relatively good road enables to cover quickly the 27 km distance to the district capital Isfarah, where the most important regional market for rural products is located.

2 Working definition of Agroforestry

The definition proposed by Lundgren and Raintree (see Chap. A 2.1) will be used as working definition for this study. The condition of economic and ecologic interaction is normally fulfilled by most of the farming systems containing trees or shrubs. The economical interaction is generally expressed in terms of an increase and diversification of the total production. The ecological interaction is more difficult to show but it can usually be shown that the components interact in a way that production factors (soil production potential and water availability) are enhanced (Sorg, 2000).

The different components of Tajik Agroforestry systems are mostly deliberately combined; this is expressed by the fact that normally as well the crops as the trees are either sawn or seeded. In forests, cropping and grazing practices are intentionally introduced in order to enhance the resulting system output.

3 Research design

While throughout the world exist scientific studies on biophysical aspects of land use techniques, little information exists on the institutional, administrative, political, and socioeconomic aspects that constitute the framework within which agroforestry production systems are embedded. Research on agroforestry shouldn't be limited to biophysical aspects but also include aspects from the social situation. "The need to develop a predictive understanding on how farm households make decisions regarding land use is as essential as developing a predictive understanding of competition between tree and crop roots. In both cases there is a great deal of site specificity: cultural values, policies and income levels in one case; tree and crop species, climate and soil properties in the other" (Sanchez, 1995).

The objective of this study is to provide a deeper analysis of the factors influencing the extension of agroforestry in Tajikistan, which is synonymous to the analysis of the framework conditions. Thereby the focus will be on privately operating farms of mountainous regions of Western Tajikistan.

A promising approach to get the desired results seemed to be the closer research of the processes and influencing factors of household's decision-making as regards implementation or extension of agroforestry.

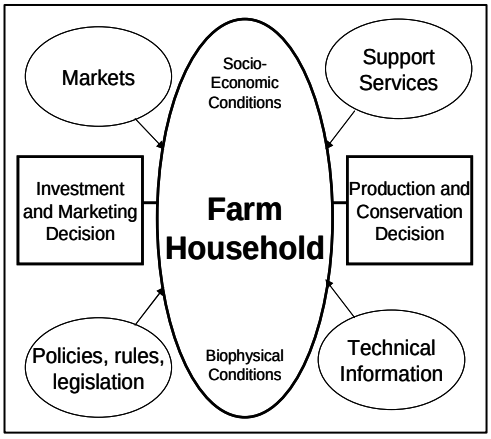


Figure B-1: Interaction between all factors influencing household decisions.
Source: French (1995)

FAO livered a tool to help understand these complex farm management decisions so that based on this appropriate extension and development propositions can be developed (French, 1995).
The publication proposes a framework for the analysis of farm-level decision making where the farm household is used as the primary unit of analysis.

The farm household is the level at which most resource allocation decisions are made. Division of roles and responsibilities among different family members occurs naturally among men, women, productive youth, and the elderly (French, 1995).

Each household has a unique set of socioeconomic and biophysical conditions[1], which are so called On-farm Factors. Agroforestry technology and investment decisions are evaluated by farmers and agricultural entrepreneurs based on key external factors (Off-Farm Factors) including: access to markets; access to support services; access to scientific and indigenous knowledge; and policies, rules and regulations (French, 1995).
It should be pointed out that people do not use a linear decision making process. Rather, farmers consider many factors simultaneously (French, 1995).

4 Data generation

4.1 Household Interviews

The approach of this study requires to get a qualitative insight into decision-making at the household level, and not to perform a represantive quantitative analysis based on statistical evaluations at the regional level. Therefore only four mountain villages situated in different oblasts were used for the investigation. The study villages Gulamabad and Karsang were identical to the project villages of CAMP's workshops on soil and water conservation; besides logistical and organizational advantages this constellation was positive for the interviews itself since they were thematically related to the workshop. In the study villages Veshab and Khojai Aalo no workshops on water and soil conservation were conducted.

In each village, the number of households interviewed was fixed at a number of six and not adapted to village size to reach a representative sample. The selection was made while considering the following aspects:

- Household categories: it was tried to select households of each category: poor, average and rich. The categorisation was subjectively done by a village member.
- Size of the household: the numbers of household members had to vary between small (less than 8 members) and large (more than 14 members).
- Gender: The questionnaire contained also gender issues so that it was crucial to integrate also women into the interviews. As it was difficult to integrate both the wife and the husband into the discussion, commonly only one person emerged as the interview partner.

Between April and June 2005, 24 interviews with farmers were conducted. The oral semi-structured interviews were based on a questionnaire and on occasion linked with a visit on the plot(s) concerned. Apart from the advantage of establishing an open atmosphere, which leads to the discussion of the issues regarded important by the interview partner, SSI do have some disadvantages such as incongruities in answers, picking up and overweighing of rumours or misconceptions.

Prior to fieldwork, the interpreters were briefly introduced into the topic of research and into the way to conduct interviews, nevertheless the lacking interview skills and problems with terminology could have led to information loss. Due to unfortunate organisation, the constellation of the interviewing team was changing several times what involuntarily led to inconsistent interview procedures.
A second problem was the access to women. Firstly it wasn't easy to find women who were willing to conduct interviews and secondly it was difficult to reach an open kind of interview as the women obviously felt uncomfortable speaking with only male interviewer and interpreter. Therefore only 6 interviews were performed with female participants.
The interviews with household members were held in Tajik as most of the farmers do not feel comfortable speaking Russian and some of them even do not know it at all. The questions and the answers had to be translated between English and Tajik (in Gulamabad) respectively between German and Tajik thus increasing the risk of distortions and information loss.

4.2 Interviews with experts

In expert interviews not the respondent himself, but rather his knowledge becomes the focus of the discussion. The interview partner is seen as a representative of a distinct group with undisputed knowledge about a certain field of interest. (Flick, 1999) Some interviews were conducted in Dushanbe: Soil science institute, Agrarian University, State committee for the protection of environment and forest.

[1] It should be noted, that the author of the mentioned publication uses a quite large definition of the term 'socioeconomic'; this category contains not only the social and economic conditions but also traditional and cultural settings.

Furthermore there were experts interviewed from Lezhoz in Muminabad and Aini as well as scientists of soil melioration stations in Gafurof and Bohtar.

The interviews with specialists and stakeholders were held in Russian. As the author doesn't sufficiently speak Russian, the help of translators was indispensable.

4.3 Other methods

For the research diverse primary information was needed which included statistical data, literature on agroforestry and material of seminars conducted in the project villages. The literature about agroforestry contains a huge range of publications. Due to the reduced availability of such publications in Tajikistan only a small fraction of useful literature served as basis for the work.

The original data upon which this work is based come from sources in different languages: English, Russian and Tajik. This demanded a lot of translation processes during which some information might have been lost. As the author's mother tongue is German language, specific aspects could not be considered in the qualitative analysis.

C Overview of the Relevance of Agroforestry in Tajikistan

1 History of agroforestry in Tajikistan

1.1 AF technologies and knowledge in Central Asia during the Soviet time

Agroforestry was brought into the forefront of agricultural research less than three decades ago. But the concept was basically known and used long before. In China for example one or another form of agroforestry has been practiced since ancient times. Already during the Han Dynasty[1], administrators recommended the development of forests together with the raising of livestock and crops according to different site conditions (Zhaohua et al., 1991). Due to its Soviet past behind the iron curtain Central Asia is up to now rarely found in international Agroforestry literature. “If looking through publications dating back to the Soviet area quite a few practices and systems can be found. These are mostly scientific approaches that partly have lost their significance within the current economic framework due to their high costs and machinery dependency” (Messerli and Juldashev, 2000).

The shelterbelts

A considerable amount of literature studying the ideal design as well as the effects of shelterbelts has accumulated during Soviet times (Messerli and Juldashev, 2000), that indicates the importance that has been given to them. For instance, Onishenko (1991) looked at the management of shelterbelts in the Chui valley in Kyrgyzstan. The average distance from one shelterbelt to the next one was 400 – 500 m. The species found in shelterbelts were apple, apricot, ash, basswood, birch, elm, maple, oak, poplar and willow.

Trees and crops on terraces

Terracing in order to use steep lands under consideration of conservation of water and soil was historically widely practiced in Tajikistan. According to Bulychev (1997) first records concerning terracing in Central Asia can be found already at the end of the 19th century. He describes two traditional terrace types (with inwards and outwards sloping design) which were mainly used for hay making or grazing. Trees grown on the terraces were *Eleagnus angustifolia* and juniper, walnut, acacia, apricot, almond, tree of heaven (*Ailanthus altissima*) and green ash (*Fraxinus pennsivanica*).

Inter-row cropping in orchards

Orchards were very common in Tajikistan during Soviet times and covered a bigger area than today. Before the 1930s the territory was even larger. The territory decreased afterwards as in these years cotton monoculture was given greater emphasis than ever. It is reported that in that time many orchards and mulberry groves were uprooted and vineyards plowed to make way for more cotton (Matley, 1994).

Dragavzev (1958) classifies orchard systems encountered up to the 1950ies in the Soviet Union (especially in the Caucasian region and Central Asia) according to the type of intercropping and its effect on soil organic matter content. Inter-row arable cropping reduces organic matter content, grass leys mulched or cut for hay stabilize it, whilst complete fallow increases it.

Agroforestry in forest territories

During the Soviet period the forests were exclusively managed and used by Lezhozes. Other utilizations as grazing practices or agriculture by farmers were not allowed. But it is said, that namely young plantations were left to farmers for the cultivation of different crops between the young trees. In response they protected and tended the plantation. But this practice only concerned cropping while grazing of livestock was generally neither allowed nor practiced in forests.

The readers interested in valuable information from Soviet times for improving existing Agroforestry systems or implementing new ones is recommended to consult Messerli (2000) where a short review of Soviet literature concerning agroforestry-related technologies and approaches is made.

1.2 Development after the collapse of the USSR

The development in agriculture and forestry of Tajikistan in the last few years was strongly shaped by two decisive events. One was the break of the USSR which forced all of the resulting autonomous

[1] 206 B.C. - A.D. 220

states to changes due to the new political and economic conditions. The second main influence was the civil war which shook the young state for five years.

After the collapse of the USSR in 1990 many things changed authoritatively. The first and foremost transformation was the reduction of the typical Soviet-planning from top down which excluded the farmers and the farmer's cooperatives of investment and production decisions. With the planning and monitoring also the financial and technical support was largely stopped after the break of the USSR.

"Herein many the so called resource conservation technologies, including soil protection which were used during Soviet time became obsolete, require major costs, time and labour resources and is beyond of simple individual farmers' capacities who are running subsistence farming. Development, implementation and spread of principally new technologies adapted to present farmers' needs require also a lot of time and money." (Asanaliev and Sydykbekov, 2004).

But the break had also positive influences on the development of agriculture and forestry in the ex-Soviet republics. "The Soviet land use system of clear organizational distinction between forest and agricultural land, it's large-scale operations as well as the bureaucratic top-down planning and monitoring of all aspects of farming and forestry did not foster the development of any farmer-driven Agroforestry technologies and approaches" (Messerli and Juldashev, 2000). With the removal of the strong top-down decision making and with the waking awareness of collective farms and private households for responsibility of their living, people had to find a way to ensure the subsistence and enhance their incomes. The farmers have now stronger personal interests in improving the conventional practices and in developing new ones.
It is often mentioned that people who were used to the comprehensive Soviet security service, now have problems to adapt to the new situation. They are said to suffer from a certain helplessness and passivity. Nevertheless there are also farmers with strong enterprising attitude who are developing new solutions regarding the enhanced and sustainable use of their resources by driving corresponding experiments in a small style.

During the civil war fought between 1992 and 1997 many of the agroforestry systems were destroyed because the people in the rural areas needed the wood for energy. Furthermore the food became scarce in some regions so that the farmers uprooted many vineyards and orchards in order to cultivate crops characterized by high yield and low investment like wheat and barley. A further reason for the loss of agroforestry surfaces were the difficulties for maintenance of these systems during civil war. Tajik farmers were forced to inactivity during this period. This inactivity contributed to loss of a big part of farmer's agricultural skills and know-how, which was already to certain extent lost through Soviet farm production systems. "Farmers no longer know the range of crops they can grow, how to irrigate the fields and when to seed and harvest" (Gulmahmadov, 2004).

Since the end of civil war the surface with applied agroforestry and the diversity of its technologies has been increasing. On the one hand farmers try to reduce risks and to satisfy most of their basic needs directly from their cultivated land and on the other hand tree products as fruits, nuts and construction wood reach normally high prices in the market. Therefore in many parts of Tajikistan, farmers continue or start introducing trees in their farmlands.

2 Appraisal of Agroforestry currently used in Tajikistan

Agroforestry could find application in the broad geographical and thematic sense. The following section informs about the current use and spread of agroforestry in Tajikistan. The data base on statistics, oral information of specialists and observations on field trips. Of course the list does not mention all systems and can not respect all local variations and adaptations. Therefore only general indications of the most frequent systems are indicated. The classification will follow the proposition put forward by Nair (see chapter A 2.2). For the sake of simplicity the classification used for this paper does not use all criteria, which are not totally independent. Mainly the systems will be categorized according to the nature and arrangement of their elements.

Among the rare systems some with experimental character could be found. Three of them with promising results are presented below.

Life fences on pastures and around agricultural land plots: As iron fences are expensive (around 2$ per m) and wood is in short supply, it often shows to be difficult keeping off animals of arable land. In many regions stone walls are the usual mean to separate grazing land from other lands. Where stones are not abundantly lying on the surface, farmers often protect their agricultural land plots by digging

ditches of about 1m depth around them. The runoff water from the neighbored land is collected and channeled in the ditches and erodes the ditches running in direction of slope. This can eventually create huge gullies. One possibility to prevent such degradation processes is the introduction of life fences. Life fences are single- or multiple rowed lines of woody species which are resisting to browsing damages and tend to build dense bough system. In Tajikistan most of the life fences consist of either rose hip or Russian olive.

Windbreaks for orchard systems and grazing land: In many regions of Tajikistan strong seasonal or daily winds decrease the productivity of annual and perennial crops. Furthermore wind erosion takes often place on lands with meager vegetation cover as overgrazed pastures. Although the multipurpose trees trips alongside irrigation channels and roads are known to be helpful for the reduction of wind velocity, on pastures and in many orchards[1] no corresponding systems can be found. Farmers often fear the shadowing and 'space wasting' effect of windbreaks. On pastures, the reluctance for planting trees is partly due to high expenditures to protect seedlings from livestock.

Tree-Tree-Taungya systems: While examples of intercropped orchard systems including more than one tree species are very common and diverse in South Kyrgyzstan (Messerli and Juldashev, 2000), they were only rarely found on the field visits in Tajikistan. The idea of such systems is that trees with short life time cycles are mixed in the row with trees with late maturity characteristics thus forming a tree/tree-Taungya system. The few systems found were:

- Plantation of nut trees with two apple trees in between.
- Mixture of peach between apricot or apple trees.

[1] Many orchards are obviously limited in their production as trees are pruned in relation to the direction of the main winds. Because of this reason the horizontal branches have to be cut more strongly on lee side while the (mostly vertical and diagonal) branches on windward side can't be cut. This reduces the yield since it is known that predominantly horizontal branches tend to produce bloom buds.
Heavy fruits as pears and apples put weight on the trees in time of ripeness. Additional wind leads to deformations and breaks of branches, furthermore fruits fall down ahead of time.

Table C-1: Agroforestry systems in Tajikistan						
Name of the system	**Short description concerning main functions**	**Components**	**Market-orientation of the system**	**Natural conditions**	**Spread of the system**	**Scale**
AGROSILVICULTURAL SYSTEMS						
Orchard systems including Taungya orchards[5]	Agrosilvicultural system for fruits and Haymaking/arable cropping	Fruit and Nut trees and arable crops or hay	Commercial. Strong demand for fruits	Rainfed and irrigated	Very common 99'800 ha of orchards in RT (2)	0.5 – 40 ha
Cropping in forests	Agrosilvicultural system for haymaking/arable cropping and NTFP	Forest trees and hay or crops	Subsistence - commercial	Normally irrigated. In new planted forests	Very common	0.5 – 5 ha
SILVIPASTORAL SYSTEMS						
Grazing in forests	Silvopastoral system for milk, meat and wool production (and NTFP)	Forest trees and livestock or poultry	Subsistence - commercial	Can be found in forests all over the RT. Except in nature reserves	common	
AGROSILVOPASTORAL SYSTEMS						
Homegardens	Agrosilvopastoral system for smallscale production of food, fodder, firewood, construction materials	Different fruit trees, firewood and construction wood trees and Crops/fodder as well as poultry and young livestock	Normally for household's own use	Irrigated land, Use of natural or chemical fertilizer	Very often in whole Tajikistan Totally: 172'500 ha (1.2%) (2)	Max. 0.25 ha (or 0.4 ha in rain-fed areas) (3)
OTHER AGROFORESTRY SYSTEMS						
Apiculture	Apiculture with trees for honey production	Bees and forest/fruit trees/grasses/herbs	Intermediate Only 1% of beekeepers sell to shops or supermarkets (1)	Near or in forests, maximal altitude 2500 m ASL	Increasing, 537 t in 2003 (2)	ha-km^2
Tree strips alongside roads and irrigation channels	Avenue trees for silkworm or livestock fodder and/or construction wood and/or firewood production	Usually mulberry trees and/or willow trees, poplars, acacia,…	Mulberry leaves are usually used for commercial Silkworm production Other tree species for own use	Normally irrigated	Very common in central and southern areas of the RT	km

Sources: (1) Khojanakhmad, 2002, (2) SCSRT, 2004, (3) Art. 71, Law on land of the RT

[5] In many orchards, the spaces between trees are grazed after the harvest of arable crops. Actually these systems should be classified as agrosilvopastoral systems. However, often a precise classification is difficult as the grazing depends on the planted crop, which can change from year to year. Furthermore grazing practices are usually only possible in mature orchards when trees aren't endangered by grazing or trampling damages.

3 Potential for the extension of Agroforestry systems

The following appraisal of the future potential range of agroforestry application in Tajikistan is mainly based on the combination of actual land degradation problems with the possible advantages of agroforestry systems. Of course these propositions have only a theoretical character thus needing further background information and experimental implementation before a large-scale application. The most information on agroforestry effects originate from tropical and subtropical climates because most research has been done in Africa and South-East-Asia and is therefore not necessarily applying for Central Asian conditions. Namely in the beginnings of the young science, the enthusiasm based on successful examples of agroforestry "from high-potential environments, where water or nutrients were not major limiting factors" (Sanchez, 1995).

"There are two fundamental ways of arriving at agroforestry: by integrating trees into farming systems or by integrating farmers into forests" (Raintree, 1985). The following section provides a short outline of the actual land use problems of farming systems and forest. It shows the potential improvement agroforestry could possibly bring.

3.1 Overview of Farming systems

With 93% of the country covered by mountains, land for farming is scarce: Only 713'000ha of Tajikistans land resources are categorized as agricultural land. 498'000ha of it are irrigated, this makes up 0.21 hectares per capita. Amongst the Central Asian Republics, Tajikistan has the lowest land rate of irrigated land per capita (UNDP, 2003). This offers a very small basis for the agricultural sector.

Cropping land

Table C-2: Farming systems in the RT. Source SCSRT (2004)

	Total agricultural sector [1000 ha]	Kolkhoz and Sovkhoz [1000 ha]	Dekhanfarms [1000 ha]	Homegarden [1000 ha]
- Plowed lands	713	321	393	129
- Long-standing cultivations	98	47	51	23
- Deposits	23	12	11	
- Hay mowing	17	8	9	
- Pastures	3065	1555	1510	
Total agricultural used land:	3916	1943	1974	172
Controlled land	7801	3557	4234	172

In order to use the scarce land in the most efficient way, in wide regions cotton is planted, which is considered to be the main wealth of the land. Tajikistan is a principal producer of the fine-fiber cotton. Its record crops are produced here (Mohabatov, 1999). With 43% of Tajikistan's irrigated lands planted for cotton in 2001, little space is left for grain and vegetable crops, contributing to the country's food deficit.

The state is directly and heavily involved in this lucrative sector, and private farms are also forced to plant cotton (although many of these are only private on paper): if they do not, inputs such as water, seed and fertilizer may be withheld by the local authorities and suppliers[6]. Owing in part to the state-sanctioned emphasis on cotton production, many farmers lack the opportunity or the skills to diversify into other crops. Without a more diverse mix of crops, many agricultural workers are dependent on this one commodity for their livelihoods. (UNDP, 2003)

Agroforestry solutions

- "Of late, many countries face the problem of diminished arable land and the needs of population. To increase production, agroforestry development seems very important. As the development of a new branch of science, agroforestry has an important role to play in modern production technology. (Wu, 1991)"

[6] The farmers capture little of the benefits of the good prices on the export markets. A range of factors like high interests rates, low concurrence among the ginneries, high transportation costs, dependence on the investors and taxes extremely reduce the returns to the farmers (Nissen, 2004).

- Fruits and nuts originating of agroforestry systems have the advantage of augmenting the rural food supply. Not only for self supply but also for export apple and grapes present lucrative alternatives to cotton for Tajikistan's farmers (Nissen, 2004). According to World Bank figures, they return gross margins of $404 and $48 per hectare respectively, compared with $17 per hectare for cotton, under the present structures. Furthermore Tajikistan has favorable climatic conditions for fruit cultivation and the old tradition of fruit cultivation and export. Different types of orchards are therefore good options to the cotton monoculture and a possibility to meet the problematic about land scarcity.

Poor management and limited drainage infrastructure have resulted in salinization and waterlogging. 16% of Tajikistan's irrigated lands are affected by salinization. Farmers try to flush salt out of the soil by applying large volumes of water before the growing season. This practice known as leaching is made difficult by the constraints in delivering water to the fields (UNDP, 2003).

Agroforestry solutions

- Waterlogging and the resulting increase in salinity could be overcome by the means of biodrainage. An effective mean has been tested in Vakhsh valley where poplars were planted on land with poor horizontal drainage. Poplar is the tree species most suitable to accelerate the decrease of water table levels in Tajikistan. In the inter-row space between the poplars a mixture of grain crops and beans may be grown, thus presenting an agroforestry practice. This technology was developed by the SRI of Soil Science under the project of International Centre for Agricultural Research (ICAR) and at the present time is widely applied in the zones of waterlogged land (WOCAT, 2004).
- A second technology - developed by the Kyrgyz Agrarian University - is even able to cope with salizinated marshy land. A farmer from the Moscow-rayon in Kyrgyzstan planted new, salinity resistant poplars and uses the inter-row segments for cultivating forage crops. This technology could be implemented everywhere where the water table is close to the surface or comes out on the surface (WOCAT, 2004)

The plowed land has been decreasing since the end of Soviet system. The basic reason for it is the degradation of soils. As a result of erosion a considerable area for agriculture is destroyed and their fertility is sharply reduced. Erosive processes have high significance and wide distribution in Tajikistan. The area with eroded soils yearly grows and covered in 1999 about 1100 thousand ha of agricultural lands. (SCEPFRT, homepage)

Agroforestry solution

- The rate of soil degradation has now largely outstripped soil regeneration. This situation cries out for agricultural systems that respect the environment, nurture biological diversity, and maintain soil fertility. Trees outside forests are well-placed to meet this challenge effectively. In dense or thin stands, line plantings, singly or in hedgerows, trees preserve the organic matter contained in the soil (Roose, 1994) and boost its fertility. This is universally acknowledged, as is the role of trees in halting the advance of the desert, checking wind and water erosion, facilitating the percolation of rainwater, and enhancing agricultural production in the long term (Bellefontaine et al., 2002).

Pastures

The totality of livestock sank dramatically after the collapse of the Soviet Union. But since this collapse the number of heads was eventually increasing and reached in 2004 88% of the number at the end of the Soviet time. In the case of cattle the actual stand is even some 8 percent higher than in 1991 (SCSRT, 2004). While the number of heads has largely regenerated, the meat production is still on the very low level; livestock and poultry together reach only 59% of the state at the end of Soviet time (SCSRT, 2004). It indicates the rather bad state of livestock resulting from deficient feeding.

Even thought the quantity of livestock in Soviet times was generally higher than today, the pastures were in a better state. This was due to smart grazing management; the herds rotated on the pastures by respecting an adapted regeneration period. The herds were also led to remote places in the mountains, where infrastructure as drinking places and shelter for herdsmen were maintained.

Agroforestry solutions

- One possible production role of trees is the fodder production for livestock. This possibility is seldom used in Tajikistan. Mainly in the late grazing season (October – November), when the grass is sparse and dry, fodder trees still are green and can provide a source for energy and proteins (e.g. Leguminous trees).

- The inclusion of fodder tree species (e.g. mulberry, *Ficus spp*.) in homegarden can contribute to a reduction of grazing pressure. For instance “in Nepal it is estimated that 13-19% of the total amount of fodder is obtained from fodder trees, between 20-80% of these trees are private owned” (Gilmour, 1997).
- Furthermore trees on pastures present shelter from climatic inconveniences to both the livestock and the herdsmen. Researches in America showed that in cold weather, livestock protected by trees exhibit improved weight gains of as much as 10 percent and require up to 50% less feed.

Since the collapse of Soviet system the grazing management has sharply changed in many regions; early grazing of livestock and overloading especially of pasture areas located close to the villages result in degradation processes; under large and nonsystematic loading, grass is constantly eaten without any chance to grow up and produce seeds. As there are some weedy species which are preferred by the livestock, the variety of species eventually decreases. The few resistant species (normally poisonous plants and thistles) spread over the pasture because of the reduced interspecies light- and root concurrence. These resistant species have the same rooting horizon and therefore a lower ability to prevent earth slides. The problems resulting of the poor grazing management can be mainly observed in central and southern Tajikistan, where pasture grounds are close to villages and the herdsmen change daily.

Agroforestry solution

- Trees, shrubs and other permanent vegetation have different rooting depths which help create more stable pastures and help prevent earth slides. The deep roots act like anchors keeping the soil together.

It is known that the plant cover plays an important role for the conservation of soil; experiments have shown that top-soil erosion on slopes is considerably reduced if there is vegetation with high projective cover. Vegetation improves the water permeability in the earth and decrease the kinetic force of the rain drops. Topsoil erosion through wind and rain go together with a decline of soil fertility. The ladder is also negatively influenced by the widespread practice of collecting dung for heating and cooking.

Compacted soil bared of grass cover is susceptible to wind and water erosion. The daily migration of animals (dairy cattle) to more distant places has resulted in track formation. The animal tracks constitute a potential starting point for earth slides and glides.

Agroforestry solution

- “Trees outside forests, regenerating spontaneously and/or planted to maintain or extend tree cover, are of great benefit in reducing soil degradation and controlling desertification. The trees on pasture bid shelter from wind thus reduce wind erosion. In addition the soil cover can be increased and the water introduction and regulation in soil improved. This effect enters in line on sloppy lands, where run-off effects are diminuend by trees” (Bellefontaine et al., 2002).
- On the other hand it can be argued that the increase of woody plants in pasture further reduce the clean pasture area thus aggravating the situation of overgrazing. This statement has been made in many different regions (e.g. Gareeva, 2004). A possible compromise is the creation of a type of parkland; dispersed trees with branch free stems allowing the growth of grass below and between them.

But in any case the problems concerning grazing grounds can only be resolved by introducing better grazing management. In order to respect the regeneration period of the grass layer, a rotation including also more remote grazing grounds is indispensable. However, live fences or rows of trees can help to divide and mark the compartments.

3.2 Overview of Forests

Table C-3: Forest surfaces. Source: Tajik forest authority		
	Surface [1000 ha]	**Share of the total area of the RT [%]**
Juniper forests	150	
Pistachio forests	78	
Maple forests	44	
Mixed forests and other (poplars, willow,…)	138	
Total area occupied by forests	410	2.9
Total surface controlled by the forestry organs	1'821	12.8
Part used by Kolkhozes and Sovkhozes	1'200	8.4

Only about 3% of Tajikistan's area is currently classified as forest. This is the least percentage of all Central Asian countries. Practically all of the forests are situated in the mountains where intensive processes of erosion take place due to soil and geology properties. Therefore all of the forests belong to the group 1, which means that the forests fulfill mainly a protective role with respect to soil conservation and water regulation. The whole force and interest of the forestry must be put on the development and the amelioration of the forest's situation.

From the year 1992 on the state of forests considerably deteriorated because of the lack of means. Furthermore the efforts for reforestation became minimal. The purchase of transportation and labor vehicles, measures for silviculture and fire protection, the research and reforestation immediately stopped. Also apiculture, sustainable hunting practices and tourism were interrupted.

Illegal woodcuttings increased during the period of civil war. Two major reasons for the cutting of forests can be found; the need for fuelwood and the pressure of agriculture.

Need for fuelwood

The most evident cause for the deforestation is the need for cooking and heating energy. The fact that the mountains, where the most part of Tajikistan's forests grow isn't completely and permanently supplied with energy, urges the local people to look for alternative energy sources.

The vast majority of mountain people are still totally dependant on fuelwood, dung and crop residues to provide energy for cooking, heating and lighting. Increasing demand for energy as a result of rapid population growth and changing needs of mountain communities exerts growing pressure on the limited natural resources. The impact of this aggravating energy situation includes increasing deforestation and added drudgery, especially for women, in procuring the energy needed for household and farms. Inefficient use of fuelwood and significant losses in agricultural production because crop and animal wastes have to be used as fuel, make the situation even worse. (Kadian & Kaushik 2003; Rijal 1998)

Agroforestry solution

- A renting system for additional agricultural use of forested land could help reduce the illegal cuttings of trees. A precondition is a smart system of benefit and responsibility of the tenant. If the contract designs the tenant as main responsible of the trees on the rented land, it will be in his interest to guard and save them; this might be a possible instrument to preserve forests in the vicinity of communes without an increase of lezkhoze's expenditures.
- Not only the integration of agriculture in forests but also the integration of trees into farming systems plays a major role in the preservation of forests and the improvement of forest management systems; by providing farmers with a means of producing fuelwood, timber, building poles and other forest products on farmland, agroforestry can significantly reduce the demand on forests and natural woodlands (Raintree and Lundgren, 1985)

Pressure on forested land

The second reason for the deforestation was the food crisis during the years of civil war. The decreasing supply with foodstuff, the change in the demand on market and the possibility for selling changed also the farmer's preferences in crop cultivation and their need for arable land. Therefore a lot of orchards and forests were cut in order to make place for essential foodstuff. In many regions old traditions of fruit-growing and beautiful orchards were lost by this practice. In recent years of the shortage of food products and fuel, the population was also forced to master steep mountain slopes and to clear-cut mountain forests, in connection with which the intensity of erosion and desertification in many regions of the republic increased.

It again testifies the fragile stability of mountain region to different natural-anthropogenic actions. The least disturbance of mountain ecosystem can have catastrophic consequences. About 95% of the

mountain territory is subjected to the increased risk of ecological destabilization. (SCEPFRT, homepage)

Until today the taken measures for the artificial reforestation were for a big part in vain. Out of the 3.2 thousands of hectares which were reforested each year only 68% was successfully installed for a longer term (Tajik forest authority, 2000). This is a consequence of the difficult site factors (above all the climate and soil) and of the weak tending of the young plantations.

Agroforestry solution

- The pressure for the conversion of forests into farmland can be met by enhancing and sustaining agricultural productivity on existing farmlands. One of the possibilities to reach this goal is agroforestry. With its potential to enhance soil characteristics the need for supplementary farming land and in consequence also the pressure on forests can be reduced.
- A different approach to reduce the pressure on forested land resources is the integration of farmers into forest management schemes through the use of “compromise” land-use systems based on agroforestry, as “may be one of the few realistic ways of sustaining forestry production on agriculturally pressured forest land” (Raintree and Lundgren, 1985). 7

While the governmental policy does not support the integration of trees into farming systems, the integration of agriculture into forests is considered to cope with the scarcity of productive land resources. In fact the committee of environmental protection and forests of Tajikistan is elaborating a strategy for the “complementary use of forests”. Concerned by this strategy are mainly Non-Timber forest products as honey, fruits and nuts. But also cropping and pasture practices are being extended. If organized and managed in a clever way, this may have positive long-term effects on the conservation of the forested area since the two main problems – the illegal cuttings for firewood and the pressure for conversion of forests into farming land - could be defused.

[7] This system is already widespread in Tajikistan (See also table C-1). Farmers can rent plots in forests; normally they don’t pay a yearly fee but they have to give up a part of the yield. This part is normally set each year separately.

D Factors influencing the extension of Agroforestry in mountainous Tajikistan

1 Overview of the most limiting factors

For getting an idea what farmers think to be the limiting factors for the extension of agroforestry systems, they were told to mention spontaneously the principal constraint.

The table shows the major restricting reason per household. It obviously depends rather on the general situation of the village than on the individual situation of households. Gulamabad and Karsang have enough land reserves. Farmers even indicated to have sometimes problems to cultivate all the land under their use rights[8]. Veshab and Khojai Aalo are situated in topographically and edaphically restricting areas where most of the potential arable land is already used (often by agroforestry practices) and doesn't provide extension possibilities to the growing population. There, scarcity of land is said to be the biggest problem concerning agroforestry extension.

Table D-1: Most hindering factors named by households

Village	Financial restrictions	Size of land plots	Biophysical reasons	Others
Gulamabad	5			1
Karsang	2		3	1
Veshab	1	5		
Khojai Aalo		6		
Total	8	11	3	2

If land is abundant, other reasons can enter in line. Mostly these are financial restrictions. For the detailed description of all factors see the chapters below.

2 Biophysical factors

"Biophysical factors are, for the most part, beyond the direct control of the farm family. These factors have a major influence on the selection of crops" (Koppelmann and French, 1996).

Gulamabad

The conditions of precipitation are quite advantageous for vegetation. The time between December and May go for the biggest part of the annual precipitation while the summers are normally dry. The soils dry out only in June or July.

Table D-2: Figures Gulamabad

Altitude	Around 1400m ASL
Exposition	North-west
Slope	Hill slope
Soil	Brown soils and dark meadow grounds
Annual rainfall	300 – 700 mm

As the region is very warm during whole year, the length of growing period reaches 250-300 days in the lower parts of the districts. A real winter practically doesn't exist below 600mals. The available reserves of warmth enable the cultivation of cotton in selected parts of the rayon. Some higher till about 1500m, the growth of medium mature vines, and till an altitude of 1900m ASL early and very early mature sorts of vine is possible. Early sorts of apricot can potentially be grown till some 2500m ASL. The upper limit of grain crops can be found above 3000m ASL.

[8] The government has made provisions in the Land Code (1996) that determine when the land is deemed to be confiscated from the property holders. These include among others failure to use the land plot given for agricultural production in the period of one year.

Karsang

The agro-climatic conditions with sufficient warmth and ample precipitation components allow rain-fed grain cultivation. Therefore this region counts as the biggest area of arable cropping in Tajikistan. Grain crops grow till the altitude of 2900-3000m ASL.

Table D-3: Figures Karsang	
Altitude	Around 1400m ASL
Exposition	South
Slope	Hill slope
Soil	Brown carbonate soils
Annual rainfall	600 – 1600 mm (increasing with altitude)

The highest moisture in the course of the year is between December and April. Soil droughts occur only in June or July. This fact allows good harvests of rain-fed grain cultures in every zone. The potential for growing trees is also high. Almost every tree species including apple trees and walnut can be grown on rain-fed land. Trees need irrigation only during the first some years after plantation (when root system isn't yet developed in a sufficient manner).

The frost period is between 70 and 250 days a year. Severe winters practically lack until an altitude of 1000m ASL. Here the vegetation period is very long and come to 65% of the year.

Veshab

Veshab belongs to the agro-climatic zone of Zerafshan. The upper part of the Zerafshan valley is very dry. The few small plots are normally fertile and used by farmers for the cultivation of different crops. However the main share of the valley is used as pasture grounds.

Table D-4: Figures Veshab	
Altitude	Around 1500m ASL
Exposition	South
Slope	Mountain slope
Soil	Light brown and brown carbonate soils
Annual rainfall	200 – 250 mm

The period of temperatures above 10 degrees is 200 -210 days in the lower altitudes. In the lower parts winters are normally mild with only 30-40 frosty days.

The water conditions in the eastern Zerafshan are characterized by low precipitation with its maximum in March and August. Because of this low precipitation arable cropping is only possible on irrigated land.

In the stony slopes fruit trees don't grow without irrigation. Under these difficult conditions only some uncultivated tree species as juniperus are able to establish on some chosen micro sites.

Khojai Aalo

The period with positive temperature comes to 270 days in the plains of Isfarah (around 400m ASL) and decline in higher altitude. In 1000m ASL only 115 days reach temperatures above the freezing point.

Table D-5: Figures Khojai Aalo	
Altitude	Around 1200m ASL
Exposition	flat
Slope	Valley floor
Soil	Grey soils with high stoniness
Annual rainfall	100 - 200 mm (in the plain)

Precipitation is rather small. Rain falls mainly in March and May with 40 -125 mm each.

Cotton production prevail the plains of Isfarah. At the foothills exist orchards consisting to the big extend of apricot. Medium matured kind of vines can be found till an altitude of 1300-1400m ASL, early matured vine sorts even till 1700m ASL. Cultivation of grains is possible till 2700 – 2800m ASL.

These descriptions give only a rough summary of the agro-climate and soil conditions. These abstract facts can vary between different villages of the same district and even within one farm, where the microclimate can show considerable variations.

Problems with the biophysical environment were only mentioned in Karsang. There, three farmers stated that irrigation hindered the successful planting of trees. But Karsang is actually the village with most rainfall among the four study villages and some farmers of Karsang declared that planting of apple and nut trees is even possible without any irrigation. Maybe there are important differences in microclimate between the different plots or the people just lacks information on the growing needs of the different plants.

It is puzzling that none of the interviewed farmers of the other villages mentioned biophysical constraints for the extension of agroforestry although the precipitation, soils and temperature are not in every case favorable for agriculture in general and planting of trees in special. Farmers are obviously used to influence the conditions on their land plots by irrigation, fertilization, mitigation of extreme climatic conditions with shelterbelts or terracing of steep slopes. By doing so, they adapt the conditions by removing the limiting factors on their land with a given biophysical environment.

“It should be emphasized that, when one limiting factor is removed, other factors become limiting factors for optimal production. Since all interventions consume money and/or labour, socioeconomic conditions can also become limiting for optimal production (Koppelmann and French, 1996)”

Farmers intuitively decide how to cope with the biophysical circumstances and how to invest the socio-economic resources for it. The close relation between these two types of on-farm-factors makes it difficult to distinguish clearly between biophysical and socioeconomic restrictions. Low fertility of soils, for example, can be expressed as a pure biophysical constraint but from a different point of view it can be described as the lack of financial means for purchasing fertilizer. The interviewed farmers tended to adopt the second thinking. For this reason the biophysical and socioeconomic factors have to be taken into consideration simultaneously.

3 Socioeconomic factors

3.1 Social settings

Household composition and allocation of different responsibilities

Stellrecht and Berg (2001) conducted a study on household security in mountain regions. They found out that the structure of the household holds distinct possibilities for the generation of capital. Big families and families consisting of different generations have clear advantages; when brothers work together the possibilities of specialization or at least the division of labour can be enabled. The older generation often has a big knowledge and their pensions bid secure (but small) financial income for investments.
Big family sizes are advantageous for the extension of agroforestry as most agroforestry systems are not only diverse in their functions but require also diverse skills and knowledge.

As in the studied villages the average household size is very big, the available labour force was normally no restricting factor for the extension of agroforestry. The size of interviewed households was between 5 and 20 members. Small households can rely on the help from their social network. For example they could obtain the help of relatives and neighbors during seasons with high labor needs. Also work demanding special knowledge and skills could be done by competent people from other households. Therefore the network of the household can increase the number of available able bodied persons - at least for short term works.

Only one household indicated to have insufficient workpower for the installation of a planned agroforestry technology. Amazingly it was the biggest household interviewed. It has not enough manpower for the creation of a planned intercropped orchard. This household is in a special situation since it consists to a big part of young children and elderly people. The men out of the middle generation are working in Russia.
The family therefore invested their work resources in the cultivation of annual crops. This is in the line with Dove (1992) who found out that in the case of limited work power within the family, priority will usually be given to the cultivation of food crops.
Only in situation where tree products trade can provide a (quick) cash income for purchasing immediate household needs trees may, however, receive a higher priority (Jensen, 1995).

Gender

The **investment and production decisions** of agriculture are mostly taken by the elder male members of households. So men decide what, how and where to plant. Their decision making bases on the knowledge they got from ancestors and school education. Most farmers also mentioned that their decision making is influenced by experiences and opinions of neighbours, relatives and local specialists.

Also the **decisions for marketing** are usually made by men. This was reflected by the fact that interviewed women had only low knowledge of the prices and markets for agricultural products.

Normally the man who acts as leader of the family is also the tenant of Land Use Certificate. The research “Evaluation of rural women’s needs in approving their rights to the land in Tajikistan”, which was conducted by UNIFEM, shows that although women carry out the heavy work in agriculture, they

do not have equal rights to resources, especially to land[9]. According to old traditions and customs as well as the traditional role of men as leaders, women have access to land only through men. (Sabates-Wheeler, 2002)
Rural women are unaware of their economic rights, land use rights and their rights to natural resources. Thus, men are becoming the owners of property. This situation is not only connected to the poor knowledge of women but to inappropriate law norms and lack of access of women to credit and funding (Government of RT, Resolution No 196).

In the interviews both men and women indicated that they do the same agricultural work and that the profit of household's work also will equally be of benefit to all members of the household. But asked for further precision regarding the work related with trees and agriculture, it was shown that the mentioned work equality only covers some kinds of field work. Some other activities were obviously gender related:

- Simple field work like tending of crops in the growing season and harvesting is normally completed by all able-bodied persons of the household
- Skill and experience demanding work like grafting or cutting of branches are normally done by men. Also the foundation of crop cultures belongs to the duties of men: e.g. seeding of annual crops and planting of trees.
- Work related with domestic work and childcare is mostly done by women. Also collecting, processing and storing of energy sources as fuelwood and tapak is – at least in some regions – in charge of women and children.

"The division of labour and decision-making between men and women is dedicated by a complex mix of tradition, religion and cultural norms" (Sabates-Wheeler, 2002). One consequence regarding agroforestry is that men, who normally decide what to cultivate, are not involved in the gathering of energy resources for fire-based heating and cooking systems. Men are not affected by the hard and time demanding work of collecting dry branches and other organic material in remote areas. Therefore a direct relation between perceptions of the woodfuel situation and priorities for tree growing might be sometimes lacking.

[9] Monitoring of land reform in Tajikistan shows that in Khatlon region in January 2004 out of 7173 Dehkan Farms only 240 farms were led by women, which represents 3,3% and in Sogd region out of 4725 Dehkan farms only 239 farms were led by women, which represents 5%.

3.2 Cultural habits

Trees and forest lands play also a role in the social life. The importance and role of trees as part of cultural and traditional life varies a lot between the different regions and villages. Normally the cultural settings are spread in the form of oral tales or celebrations on special occasions. All people of mountainous villages know them but not every farmer pays attention to them. Written traditions like epos have a minor significance in the rural milieu.

Farmers from Gulamabad know only one tale concerning trees while Veshab is very rich in such tales. It can be supposed that this intensity of traditional and cultural settings is connected with the history and natural environment of the village. Veshab has only small land resources and people have been strongly depending on the services and production goods of trees for centuries while Gulamabad is a new built village in a region where agricultural and forested land resources are abundant,.

The forest related aspects in social life can be roughly divided in two categories:

Customs and tales basing on sustainable use of trees

- Tale: Trees older than the own children must not be cut (Karsang)
- Tale: An old person was asked why he plants a tree even though he probably won't take profit of it. He answered, that he also profited from trees planted by his ancesters (Veshab)
- Custom: When a child of a family first time walks on his own feet in a garden, a fruit tree will be planted, bearing the same name as the child (Veshab)

Customs and tales basing on properties of certain tree species

- Tale: Hawthorn must not be cut because they have once protected Muhammad from his pursuers. Cutting a hawthorn shrub has the same meaning as cutting a man's had. (Karsang[10] and Gulamabad)
- Tale: In the shade of walnut (Veshab) or plane (Karsang) one mustn't sleep. Possible explanations brought forward by farmers: Plane produces an allergy causing dust and walnut is said to absorb much oxygen.
- Proverb: in the time of apricot harvest, everyone is happy (Veshab, Khojai Aalo)

3.3 Traditional settings

"Each farming system has its unique advantages, resulting in a special lifestyle of the farm family. They have adopted special skills in maintaining the system." (Koppelmann and French, 1996) The indigenous knowledge determines also the pattern of production, heating and nourishment systems. During time different influences and settings have led to traditional systems specially adapted to the life in the concerning household and village. "Indigenous knowledge of this particular system can be very high. However, this indigenous knowledge can have its shortcomings when the system needs adjustment." (Koppelmann and French, 1996)

Production systems

All of the interviewed farmers were told to judge the importance of products which generate income for the household. The products were grouped in animal husbandry, crops resulting of annual plants and products of trees and bushes. Of course this ranking has no statistical meaning because only 6 household of each village were taken into consideration. Furthermore there were also some pure subsistence farmers among them who ranked all of the products as 0. Nevertheless this graphic may give an impression on the revenues from different products depending on villages. A further important source of income is money generated by activities outside the farm. These returns will be separately discussed below.

Trees were generally indicated to be important or even very important for the income. In Gulamabad, Veshab and Khojai Aalo tree products were even the crops with highest importance. Only in Karsang with high precipitation and moderate climate grain crops are more important than tree products. Also the financial and topographic possibilities for mechanised land performance might be a reason for the

[10] After a local mullah judged this tale as being wrong, almost all hawthorns around Karsang were cut.

higher importance of crops in Karsang. With the help of tractors big surfaces can be ploughed and harvested with only small expenses of time.

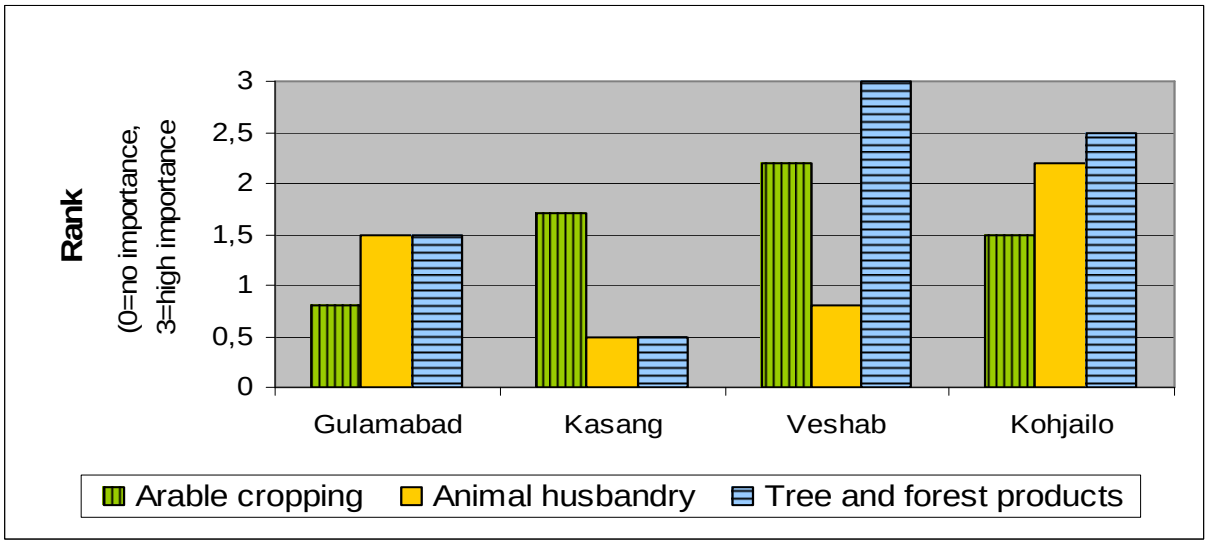


Figure D-1: Ranking of income generation

Many farmers in Karsang and also some of Gulamabad just started to plant fruit trees with inter-row cropping between them. Therefore these products might be of lower weight for the moment but they will turn more important after maturity of the agroforestry systems.

The importance of trees for income was highest ranked in Veshab. The farmers there strongly depend on apricot harvest as it seems the best possibility to use the scattered and steep land with its stony soils.

Heating systems

If there is no pressure from outside the farm, traditions based on experience of former generations are often continued without important adaptations. But when external factors put pressure on the traditions, the systems may be changed and become unsustainable. In the case of Tajikistan mainly political changes have caused a change in the resource use tradition (see chapter C 1.2). The cheap coal provision from Russia stopped with the end of Soviet Union. In consequence people had to find other possibilities to cover their energy needs. The cheapest opportunity was presented by firewood from forests. That this practice isn't sustainable becomes evident by comparing the map of forests (which was for the last time produced in Soviet times) with the current forest area.

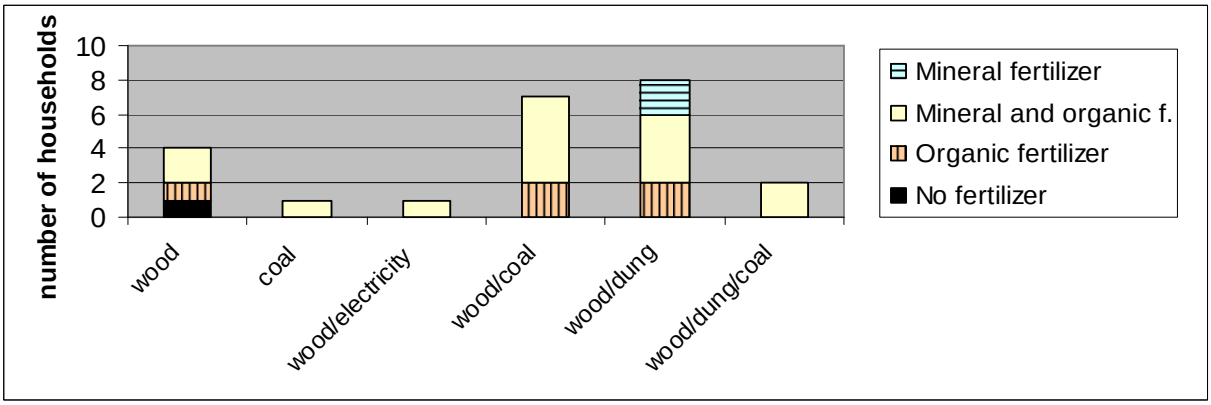


Figure D-2: Heating systems and fertilizing

The most important energy source for cooking and heating is fuelwood. Only one of the interviewed household does without fuelwood. From the 23 households using fuelwood 7 indicated to collect it partly in the forest[11], the others use exclusively wood which arises from their fruit trees or trees planted for the purpose of firewood production (mostly willows). Wood is the preferred type of energy because it is free

[11] As this topic may cover some illegal activities like cutting of trees and branches in forests it can be suspected that the interviewed partners not always came up with the whole truth.

available, it is easy to process and in case of wood from farmland, the transport is uncomplicated and free of charge. Therefore fuelwood is an important product of agroforestry systems that will continue to be a source of energy in the rural regions of Tajikistan. “In contrast to earlier views of forests as the most important woodfuel supplier, a major part of woodfuels has been found to originate from trees on non-forest land, which in many cases will mean from some kind of agroforestry system. Agroforestry systems are therefore beyond any doubt a very important woodfuel supplier, and this may become even more pronounced as the use of agroforestry systems is further promoted” (Jensen, 1995).
However under the climatic and socioeconomic conditions in Tajikistan it is normally not possible to cover the total energy need by trees outside forests. The average rural household demand for fuelwood is according to a FAO study 481kg per capita and year. This is around 0.7 m^3. In mountainous regions with cold winters and insufficient insulation this figure is supposed to be higher; in rural areas of Nepal the yearly consumption of dried firewood is 510 kg per capita; in Bhutan even 1085 kg per capita (Jensen, 1995).
Since fuelwood from agroforestry normally does not cover the needs, most of households have to use a combination of different heating materials or to complete the stock of fuelwood with branches and stems from forests. For example a mature apple orchard of 1.5 ha covers only about 30% of heating and cooking energy of a 12-headed household.

Coal and dung have high significance for cooking and heating systems. While dung is generally used in every village, coal was only common in Veshab and Khojai Aalo. This may be connected to the availability of coal and also to tradition.
Dung is a popular mean for heating. Traditionally ‘tapak’ is prepared for this purpose. The use of cow dung is also widespread in some areas of India, Pakistan and Burma and is obviously very unfortunate since the dung was much better used as an organic fertilizer and soil improver in agricultural field (Jensen, 1995). So farmers have to use mineral fertilizers for keeping the soil fertility on the adequate level. But as these fertilizers are quite expensive[12] only rich farmers can afford a sufficient amount of mineral fertilizers.

Electricity is rarely used for heating as it is only provided for about four hours per day during winter times. The farmers also claim that the tension voltage will get too low if many households use appliances. Therefore electricity is normally used only for radio/TV, light and sometimes for cooking during summer.

Food habits

Many tree products are considered as precious elements of nourishment[13]. Many people know about the high contain of vitamin in some special fruits and therefore many households cultivate different kinds of trees species in homegardens. Homegardens are often a combination of trees and vegetable garden or trees and grass for either hay production or for the keeping of poultry and young livestock. Sometimes there can be found five or even more different fruit trees fulfilling different roles in the cooking habits of households.

Traditional food and production habits influence the introduction of crops with potentially high revenue given local conditions. In each village a specification on one or some certain cash crops could be observed. In Isfarah for example almost exclusively apricot is planted outside the homegardens. The farmers justified it with the long tradition and in the same time with the high knowledge the people have appropriated. Furthermore it was argued that the climate is ideal for the cultivation of apricot and that apricot was a good and healthy food for the family. [14]

Sometimes it could be helpful to test new schemes and crops for agricultural productions. Farmer driven experiments are related to the economic situation and the strategy of a household. If the savings and state of assets are low or if the household is even in debts, the farmers will hardly decide to test new risky crops and technologies.

However, if pressure is too high, farmers are usually bound to find new solutions. This experience was made in Aini district where excellent tobacco was harvested in Soviet times. After the collapse of Soviet Union the possibilities to sell tobacco to a reasonable price became rare. So farmers found other cash crops in onion, tomato and potato.

[12] 100kg cost about 60 somoni; the same as 1 ton of tapak
[13] One old farmer even brought the better health of population during Soviet time in connection with the use of mulberries for food. In earlier times the mulberries were eaten in fresh and dried form by the population. Nowadays mulberry twigs are fed to silk worms.
[14] Also researchers of the Soil Science Station in Boturof claimed that no research is done in the improvement of apricot gardens as this crop has a long tradition which proves the effectiveness and perfection of this land use type

3.4 Economic conditions

The economic situation of the household is crucial for the extension of agroforestry. Especially the size and geographical qualitative situation of the land plot are critical. This determines the possibility for mechanization, the need to do off farm labor and the possibility to include place and time demanding practices.

Sizes and geographical situation of land plots

The rented land in Gulamabad and Veshab is normally extensive and continuous. This allows the farmer to introduce Agroforestry systems in nearly any composition and scheme. Also as place demanding systems as orchards including walnut trees are possible.

In Veshab the situation is totally different. Due to the topographical, climatic and edaphic situation the land reserves are limited, small and scattered. The small land plots impede the mechanization and have a direct influence on the production decisions; trees like walnut are too big for agroforestry as they can shade surfaces of more than 0.06 ha under which nothing else can be cultivated. ICRAF writes on its homepage that “a major strength of agroforestry is, that it can be used in many diverse agricultural situations, from small home gardens to large commercial farms, with equal success.” Of course one has to be aware that this statement isn’t valid for any system. If a land plot is smaller than the plantation scheme or even the shading perimeter of one single tree, the implementation of this system will not be feasible.

However, some agroforestry practices including smaller woody components as mulberry or apricot are actively used in these regions and have a long tradition of which people are aware. It can be supposed that agroforestry has reached a very high standard specifically in these regions resulting from experiences and adaptations of all generation living there under the same difficult circumstances. “Intensive agroforestry systems are most commonly found in areas with a long history of population pressure, indicating their general efficiency as a land-use system” (Raintree, 1985).

Small land sizes due to the population pressure have a long history in Central Asia. Even before Soviet times this problem became highly important. “Mulk [property] land then formed the whole basis for agricultural life in Central Asia. The average holding was small, farms of fifteen to twenty acres predominating, but much smaller irrigated plots were cultivated in many localities [...] Because mulk lands were held on a hereditary basis, they were passed on to the next generation according to Muslim law, which provided that a man’s property parceled out among his children. This led to considerable fragmentation, and the emergence of a group of people, especially in the Ferghana Valley, who owned little or no land at all....” (Matley, 1994) This fragmentation demanded a high intensification of agriculture by guaranteeing the sustainability. As a result the typical Taungya systems including diverse adapted apricot trees were developed over the decades.

Also the distance from the household are influencing the type of agroforestry. “For example, the home garden is usually located near or around the household residence. It tends to get closer attention from women, receives more regular watering and fertilizing, and is more closely associated with subsistence than commercial objectives.” (French, 1995)

Off farm work

Off farm work is closely linked with small land sizes. The total cultured land size per household determines how many people can work on it and how many people can live of its productive outcome. Increasing population pressure in rural regions demands the creation of opportunities for off-farm income in order to reduce pressure on the land.

For instance the households in Veshab cultivate usually less than 0.3 ha and depend consequently strongly on the financial support from outside. Three of the six interviewed household generated more than 50% of their income by off-farm labour. But also in other villages household member try to work outside the farm whenever possible to ensure additional income and thus enhance the household security.
Only 7 of the 24 interviewed household did it without any off-farm-income. The others had one or even different sources for additional income. Mostly these incomes are pensions (a rather insignificant share

of the total household income), temporal or permanent occupations in the region and salaries from household members working in Russia. [15]

Off farm work has two potential divergent influences on the extension of agroforestry;

- The additional income helps to finance extension projects. This factor can be crucial for household where finance is the most constraining problem.
- On the other hand off-farm work is usually executed by young men who seek better income opportunities abroad. The notably reduced remaining manpower on the farm may be insufficient for the realization of labor-intensive projects.

However, the labour requirements needed for the implementation and maintenance of agroforestry systems could also be faced by employed workers. Provided that money for salaries or products for barter is available this should be no constraint for mountain farmers as there is abundant labour available in Tajikistan.[16]

4 Policies, rules and regulations

4.1 The influence of land tenure

“A central factor affecting investment, production, and conservation decisions is the farmer's level of control over his land. A farmer with secure tenure is much more likely to think of long-term production and conservation activities than are sharecroppers or migrant laborers” (Koppelmann and French, 1996).

Different to neighbouring countries as Kyrgyzstan or Kazakhstan the constitution in Tajikistan fixes land to be sole property of the state. For private farmers (that means farmers outside the sovkhozes or kolkhozes organizations) different possibilities of land tenure exist:

Dekhan farms
The adoption of the law on Land Reform in March 1992, and the Law on Dekhan Farms in May the same year marked the beginnings of farm restructuring where substantial land-use rights and farmer autonomy over specific plots of land were formally devolved from the state. Such Dekhan Farms can be either small, independent farms or large, collective farms. They are private and independent from state in terms of investment decision. (Sabates-Wheeler, 2002)

Presidential land
Decree No. 342 called for the assignment of 50’000 ha of land to be transferred from the sovkhozes and kolkhozes to private household plots. This enabled households to expand their production capacity from their garden plots to include more land on average. A further decree in 1997 (No 874) provided an additional 25000 hectares. The land distributed under these two decrees are commonly referred to as ‘presidental lands’ (Sabates-Wheeler, 2002)

‘Arendators’
Many farmers are so called ‘arendators’, lessees of land leased by kolkhozes, sovkhozes and other local land claimants (Article 4 of Law on land 6. December 1990). The law of the Republic of Tajikistan ‘On Lease’ (November 1995, No. 126) determines the goals and objectives of lease, concept of lessees, lessors and contracts of lease, and also the terms and procedure of purchase of the leased property.

4.2 Long-term character of land tenure

“Insecure land tenure is linked to poor land use which in turn leads to environmental degradation. Lack of clear rights can reduce the incentive to implement long-term resource measures. In the case of privately-held land, for example, tenant farmers with short-term leases may not undertake soil protection measures, plant trees, and improve pastures if they do not hold the land long enough to receive the benefits of their investments.” (FAO, 2002) Therefore the long-term character of land tenure is crucial for the extension of agroforestry.

[15] At least 800’000 Tajik men are believed to be working abroad, either permanently or temporarily (OSCE magazine July 2004)
[16] According to poverty reduction strategy paper the estimated unemployment rate is 33% (Government of Tajikistan, 2002)

For both, dekhan farmers and farmers on presidential lands, long term use rights are guaranteed. “Essentially land claimants are entitled to lifetime, inheritable leasehold of the land. Use rights are not easily transactable, being passed on only through inheritance or leasing.” (Sabates-Wheeler, 2002)

Also for lessees the long-term tenure is guaranteed; Article 12 of the law on lease (Republic of Tajikistan) assure the right to renew the lease at the lessees option after expiry of the term of lease.
Amazingly only few interviewed households had knowledge of a lease term in the written contract. Some ‘arendator’-farmers even indicated that no lease term was determined. It couldn’t be found out, if these statements are realistic or if farmers just don’t know of the indicated terms of lease because for ‘arendators’ this is legally foreseen[17]:

The lease shall determine the terms of lease. Thus, lease of natural resources, enterprises, buildings, constructions shall be of long-term character – from 5 years and more. Conclusions of the lease shall obligatory stipulate that lessees should provide scientifically – grounded crop rotation. In this connection the minimal term of lease of land cannot be one rotation of fields of crop rotation. Article 12. Terms of lease.

Not one single interviewed household member judged the land tenure status as limiting factor. All farmers were sure of the continuous land tenure of their cultivated lands and had therefore motivation to introducing perennial plants.[18]

In many other developing countries long term rights and access to land aren’t guaranteed thus leading to situations where farmers are highly reluctant to spend any money or labour on long-term investments such as tree planting or tree care-taking.

4.3 Property rights for trees outside forests

In the interviews it turned out that many farmers are not exactly aware of their use rights and duties of trees outsides forests. Many uncertainties and confusions exist concerning the question of ownership and management of trees. Some tenancy-farmers claimed that the trees belong to the lessor, some believed that the trees belong to the lessee and some indicated that it depended on who it planted.

Legally the trees on the land belong to the state. Trees planted by the ‘arendator’ or land user must not be cut without permission. At the end of a leasing term trees will pass with the land to the state.

All trees inside and outside forests are under the control of lezhozes. Practically it means that every cutting of trees requires permission. So the officials theoretically have strong influence on the management of trees outside forests.

This is in line with Bellfontaine who summed up that “in countries with extensive forest cover, the state will intervene in the logging sector, stimulating the wood industries and fostering tree-planting, and trees outside forests will receive less consideration. In the arid countries with their scant tree cover, forest and farmland are more integrated, and so the distinction between forest and agricultural policies tends to be rather blurred. The tree is perceived as a means of enhancing production systems and satisfying the need for energy, service wood and `forest' products. This may produce forest policies that give consideration to how farmers and rural people use trees” (Bellfontaine et al., 2002).

4.4 Rent of land plots on forest areas

Long-term lease properties in forests are quite common. Normally the lease contract base on consisting contracts between lezhozes and farmers which allow the latter to use Non-timber-forest products by handing over certain percentage of the harvest to the lezhoz. This right is written in the forest law:

The duties and rights of state forestry are;
[…] to provide that unforestet land can be used for orchards and cultivation of grains and vegetables.
to allow farmers and other inhabitants the use of forest products as wood, building materials and fruits wherever and whenever possible. (article 5, Law on forestry of the RT)

[17] In many cases it seemed that the use of land cultivated by private farmers was not legitimate. Farmers often use land without any registration at the Hukumat.
[18] In two cases the farmers indicated that land tenure was even a reason for planting trees; one marked the borders of his territory this way and the other farmer thought that the claim for continuation of the lease contract will be weightier when long term investment was done.

The cultivation of crops in established forests are normally allowed and practiced. It also requires a contract with the forestry administration.
The grazing in forests is only allowed in forests where the regeneration is not endangered. In new established plots with artificial regeneration the grazing is categorically forbidden.

4.5 Strategies and programs

The governmental policy tends to use the rare land resources the most efficient way. In regions with suitable climate the first crop promoted is cotton (see also chapter C 3.1.1). Normally trees find no or only marginal places in these land use systems.
However, on oblast and district level the strategies may vary according to the regional peculiarities and traditions. For example in Sugd region the traditional apricot plantations which are in the first 5 – 7 years after their foundation combined with different crops as maize, potatoes or even cotton, are supported by the oblast government.

In forest territories the situation is different. Almost 66% of lezhoz territories are used by kolkhozes or sovkhozes. The share of forests used by individual or cooperative farmers is significant and the forest administration is still developing strategies to increase the 'additional use of forests'.

There are several programmes running or planned which are expected to affect the extension of specific agroforestry practices:

- Strengthening of beekeeping
  The Ministry of Agriculture of the Republic of Tajikistan Conjointly with the State Committee on Environment Protection and Forestry of the Republic of Tajikistan, and Academy of Agricultural Sciences of Tajikistan are asked *to develop Beekeeping Development Programme and to submit it to the Government of the Republic of Tajikistan for consideration by 1 August 2005.* (Resolution No 50)
- Planting of orchards
  State Committee on Environment Protection and Forestry of the Republic of Tajikistan conjointly with local public administration bodies and law enforcement agencies are asked *to strengthen State ecological control and rational utilization of natural resources in accordance with the laws of the Republic of Tajikistan and to conduct planting of trees and gardens in an organized manner in 2005;* (Resolution No 50)
- Further support of mulberry and silk production
- Sea buckthorn
  The development concept of state forestry Tajikistan plans the finalization of the sea buckthorn processing department in the wild plant processing factory 'Kofarnihon' (Tajik forest authority, 2000).
- Nuts
  The Development concept of state forestry Tajikistan plans the development of nut cultivation based on scientific selections. The concerned species are walnuts, almonds and pecan nuts (Tajik forest authority, 2000).

5 Markets

Timber and Non-timber tree products play an important role in the self supply of households. As explained in chapter D 3.3, they are important attributes for certain cultural and traditional settings as food or heating habits. Many of the products for households' own needs are produced in homegardens or in forest territories. But beside this subsistence function and in addition to the service roles, agroforestry practices can also have a strong commercial orientation.

5.1 Fruits and nuts

Access to market and organisation of selling

The access to markets for commercial tree products was provided for all interviewed farmers. However, the distribution channels for selling fruits and nuts were differing between households and villages. Roughly they can be divided into three groups:

- Individual selling on markets: In Karsang, Gulamabad and Khojai Aloo some farmers sold the products directly to middlemen on regional markets. So the farmers have a higher control over the prizes but they have to organize and pay the transportation by themselves. One farmer stated to have lost over 40% of the harvest because of problems with the organization of transportation in the right time.
- Individual selling on the production place: In Gulamabad, Veshab and Khojai Aloo some of the farmers sold their products to traders from outside the village (Isfarah or Usbekistan). These middlemen sell the products afterwards either in the local area or to foreign countries (Russia). The advantage of these solutions is the quick and easy selling procedure with no expenses for logistics. This practice is suitable for villages where roads to the markets are long and where transport opportunities lack.
- Selling in groups on markets: In Khojai Aalo some farmers founded a group of about 10 farmers who collectively sell their dried apricots to Russia. The transport is lead by one of the farmers. In Soviet times the selling of apricots to Russia was the usual way to sell products but after, crossing the borders became difficult due to the established custom clearings and directions.
- Selling in groups on production place: In Khojai Aalo, farmers grouped together to agree with the buyer on the spot a price for the trading goods. Advantage: Not every single farmer has to negotiate a price.

The direct selling to the consumer on markets is not usual since this requires a lot of time. Selling stands are sometimes difficult to get because of the obscure structures and organization of markets.

The prices for dried apricot vary between 0.6 and 1.2 somoni[19]/kg, the fresh apple between 0.8 and 1.5 somoni/kg and dried walnuts between 2.5 and 3.0 somoni/kg. The prices depend on the quality, the local and temporal market situation. The information about actual prices and possible buyers is spread directly from market director or via middlemen to farmers and is also communicated among neighboured and relative farmers. The information about alternative selling options is rather sparse. "A survey conducted among farmers producing walnuts and pistachio showed that only 15% had information about buyers of their products. 24% wanted to improve their commercial skills" (Khojanakhmad, 2002).

Processors and market size

For fruit, nut and other food preparation about 11 companies and 52 small and medium-sized processing enterprises specialized in preserving and processing products are located in Tajikistan. The largest enterprises are located in the regions rich in raw inputs such as Isfarah (Khojanakhmad, 2002). None of the interviewed farmers indicated to sell directly to processing enterprises.

"In whole Tajikistan, some 5000 families are involved in growing walnuts, 6500 in gathering of pistachios. The processing of the fresh nuts takes place in individual primitive house style processing workshops." (Khojanakhmad, 2002)

[19] 1 US $ = 3.04 Somoni (by April 4, 2005)

5.2 Fuelwood

Fuelwood is rarely traded. The amounts of fuelwood resulting from the agroforestry systems are generally very small so that it is hardly enough for covering the energy needs of the producing household. The prices of the few fuelwood which is traded between the household costs about 20 (Kohjai Aalo) to 50 somoni/m^3 (Veshab). The amount of fuelwood sold by lezhoz is rather modest. According to the conception of forestry in Tajikistan it is planned to sell totally 7600m^3 per year (Tajik forest authority, 2000). The prices for lezhoz fuelwood are very cheap; 10 – 20 somoni/m^3.

5.3 Timber

Timber is usually grown for the own use. Only few stems are sold to buyers inside or outside the village. However most of the wood sold on Tajik markets is imported from Russia. The prices for construction wood are very high. In Veshab it was indicated that old poplars can be sold for 100$ per piece. Poplars are appreciated for their quick and straight growth, the simple propagation and the good properties with regard to construction. Besides poplar some willow species are also said to be suitable for construction but they are by far less widespread than poplar.

In spite of the high prices poplars are rarely produced for commercial use[20]. To a big part it may be due to traditions. The second reason is space limitation. Poplars are usually grown in one or two rowed strips at the edges of land plots. This practice aims to avoid shading. Therefore the poplars can often be found at the northern and western side of home gardens.

Wood from fruit trees as apricot or nut is only temporary sold; the demand for it on regional level is very low. The most part of apricot trees is used as firewood, only few stems can be sold to a low price for the production of music instruments. Some of nut trees are sold to handymen and furniture producers. The price is about the same as for firewood; 50 – 70 somoni per m^3.

5.4 Medicinal and decorative plants

These plants or part of plants are normally only used to cover the household's needs. None of the households indicated to sell any medicinal or decorative plants. Working processing industry with a direct or indirect channel to buy products from local farmers is lacking in the regions of study villages.

5.5 Honey

Honey production needs a high level of knowledge and causes important investment costs. Therefore apiculture on household level is rare. Honey is produced by specialized beekeepers with mobile beehives posed on different places near forests since grassland is normally getting dry in July. The most profitable channel is the direct sale to an established customer base either from home or at farmers market. One kilo makes up around 2,3 US$. A considerable volume of domestic honey is not channelled to buyers at all (Khojanakhmad, 2002).

6 External support services

Financial shortages were most often mentioned to be the constraining aspect for the augmentation of agroforestry. Many farmers can't afford sufficient amounts of seedlings even though the local markets provide them in all of the examined regions. Sometimes even cooperatives in the villages grow seedlings in own nurseries. The prices are modest; tree seedlings make up 1 – 5 somoni per piece depending on species and region. But for larger land plots to be covered with some agroforestry technology the costs can get too high, especially for subsistence farmers. As a result of the relatively high fuel costs technologies requiring high inputs in machinery for establishment or maintenance are outside the possibility of most farmers. Also mineral fertilizers involve important expenses (see chapter D 3.3.2).

6.1 Credit institutions

[20] However, there exist project plans (FAO) for the establishment of a commercial forestry on national level.

14 households indicated to be considerably held up in the realisation of agroforestry extension plans by finance shortages. For 8 household financial problems was even the main constraining factor for the extension of agroforestry. Out of the 14 households with insufficient financial means for agroforestry extension only four have ever applied for credit. Out of these households three have asked other households or cooperatives in the village but none of them succeeded as the potential lenders were also in inopportune pecuniary situations. Only one household tried to get credit from a commercial bank.

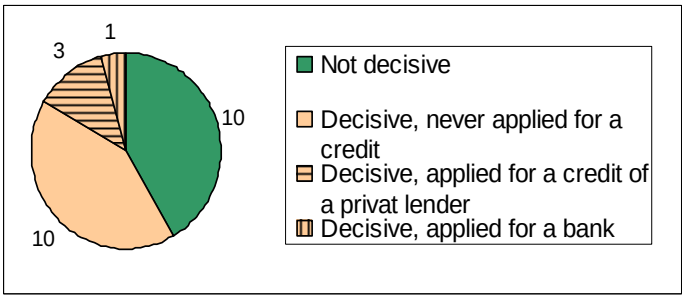


Figure D-3: Influence of financial scarcities on the extension of Agroforestry

The farmers obviously refuse to borrow money from banks. The mentioned reasons are

- Money is lent on security, which poor households can only ensure with essential assets like houses. This endangers them to fall in severe situation in case of failure of production system.
- Monthly repayments aren't compatible with the uneven household-income over the year. The important amount will only be reached after harvest in late summer or autumn.
- As it is in the nature of agroforestry the investment is for a long term and it can take several years till the break even point of certain systems are reached. Most of small credits in contrary are from shorter duration.
- In few cases a certain pride was also the reason for doing without money from outside the household.

The farmer's reluctance regarding credits is to a certain degree justified as many negative and warning examples are known where credits were starting points for vicious circles of increasing debts and dependency.

With regard to agroforestry Jensen (1995) encapsulated that farmers have difficulties in obtaining favourable loans from commercial banks for investment in seedlings, fertilizers, pesticides or other improvements. "More often they have to rely on private money lenders charging very high interest rates and hence may quickly end up in a situation where the money lender dictates what crops to grow. This is more likely to be fast growing cash crops than trees" (Jensen, 1995).

6.2 The special situation of mountain villages

Mountain villages in Tajikistan are usually characterized by bad transport infrastructure. The insufficient quality of roads, the long distance and the lacking transportation means separates villagers sometimes considerably from the district capitals where the main markets and information sources are located. From the examined villages mainly Gulamabad and Veshab are affected by the bad state of roads. This handicap increases normally the prices of the products to buy (i.e. coal) and diminishes the margins on the products they sell on the regional markets. As most of the villagers have no own transport means, they are bound to organize such occasions for reaching the markets or processing units in time.

7 Technical information

7.1 Farmers

Even tough farmers generally do not know the term ‘agroforestry’ most of them are aware of its concept; the positive interaction between woody plants and herbs on the same unit. Since all interviewed farmer used some agroforestry technologies, they are supposed to know about the positive economic interaction of the system components. Also some ecological interactions like the influence on microclimate were known.

However, the direct production role was clearly in the centre of interest. The productions of fruits and nuts and to a lower extend the production of fuelwood and construction material was normally the main reason for agroforestry. The service roles were glaringly rarely brought up on questions concerning the use of trees in farming systems. Especially the eminent anti-erosive function of trees on the exposed hilly lands was hardly mentioned. To a certain extend this can be ascribed to the lacking knowledge.

Between the different villages some difference concerning the level of knowledge of the tree’s multifunctional roles in agricultural production could be found. In old villages with long traditions in tree cultivating, the type of trees and the plant scheme became part of tradition (see chapter D 3.3) which people sometimes apply without knowing the original motivation for it. But in new villages with low experience in cultivation and a lot of farmers having been occupied in sectors other than agriculture, a proved tradition lacks. Local farmers have neither traditions nor knowledge for using resources in a sustainable way.

Concerning post-Soviet farmers in Central Asia Asanaliev and Sydykbekov (2004) wrote that they plan and use arable land, pastures and haylands usually based only upon economic opportunities. As a rule they have little experience, knowledge and skills to manage resources. Unskilful land management often resulted in irreversible consequences.

7.2 Officials, organisations and others

Forestry officials on different structural levels were interviewed. None of them was familiar with the term agroforestry. Mostly they use a different terms for it.[21]

All of the interviewed officials welcome the further extension of agroforestry systems in forested areas. As they mentioned, there were generally positive experience made with private and collective farmers who used forest territories for arable cropping or animal husbandry.

There are numerous NGO’s and researchers working in Tajikistan. On the homepage of the United Nation Coordination Unit a listing of organization description shows that there are also some organizations experienced with tree related works. But if these activities include agroforestry in the proper sense could not be found out since none of the organizations was interested in taking up contact with the author.

[21] For instance the State Committee on Environment Protection and Forestry of the Republic of Tajikistan develops plans for ‘additional use of forests’. It means the legal contractual use of resources on Lezhoz territory, as grazing, beekeeping, agriculture and collection of nuts and fruits. But apparently these terms have no identical meaning.

7.3 Dissemination and research in Agroforestry

Universities, institutes and other institutions play an important role in gathering and disseminating information on agroforestry**. "**Such institutions are attached to several public sectors such as agriculture, forestry, environment and soil conservation autofinance. Within a research institution or university, agroforestry cuts across many disciplinary or commodity-oriented departments" (Sanchez, 1995). Therefore the diversity of institutions involved in agroforestry education and research is potentially high.

Education

In 1998 a chair for forestry was founded within the Agrarian University of Dushanbe. The initiative to do so was brought forward by the Committee on Forestry. Every year about 20 students matriculate at this chair for getting an education in forestry and in linked issues. The students are also formed in diverse subjects among them orchard cultivation, general agronomy, apiculture, fish culture, poultry keeping, etc. Therefore the study in forestry imparted basic knowledge of all concerned areas of agroforestry in Tajikistan. Furthermore the chair for forestry providedes a correspondence course especially on agroforestry.
Certain components and parts of agroforestry make also part of other departments of agrarian university; e.g. fruit production. Only these departments are normally highly specialised and focus on one agricultural product.

However, research in agroforestry has not yet been done by the university since the new chair is still in the phase of establishment and research is normally in duty of institutes and not of universities.

Research

One institute which was recently active in the field of agroforestry research is the Soil Science Institute. In the centre of its activities is actually the research in soil conservation and land amelioration technologies. These technologies include also some agroforestry technologies as terracing with fruit trees and crops, intercropping, planting of shrubs and trees in pasture fields and around agricultural plots, etc. The Soil Science Institute spreads information among farmers and conducts workshop on the gathered information. Also other institutes and stations are testing agroforestry technologies. One of them is the Institute of Orchards ('Bohbarbar') which runs a couple of agroforestry experiment on two experimental fields in different altitudes.

In the smaller style also few farmers are experimenting with agroforestry. They mainly try to integrate new kinds of trees in their farming systems. "Some farmers find some ways out by using simple technologies which they learned from reference materials, neighbours, personal experience, agricultural extensionists, invented by farmers themselves or inherited from ancestors. Such technologies were tested by the time and they are quite profitable for farmers as they use them till nowadays. It is required to find such experience, describe and spread it among other farmers" (Asanaliev and Sydykbekov, 2004).

E Conclusions and Recommendations

Apparently agroforestry can bid a lot of advantages if applied appropriate to the given ecological and socio-economic conditions. Many systems applied by either subsistence farmer or large-scale farms have proven to be a sustainable way to enhance productivity and livelihood in rural spheres. Actually most of research is done in tropical and subtropical zones of Africa and Southeast Asia and only little current studies focus on Central Asia.
Nevertheless some type of agroforestry has been used at least since the Soviet time and probably also before. Practices were developed and influenced the traditional way of performing and culturing land. After the fall of the Soviet system and the devastating civil war, a lot of systems were destroyed or lost their significance in the new framework. Farmers are bound to find independently new solutions for using the land resources under their control adapted to the different influences on and off the farms.
agroforestry can find an important place in this new situation due to its multifunctionality and broad sense of application. In some regions the agroforestry systems were kept over the difficult times in the 90ies and are applied without small changes till today while farmers of other regions are now beginning either to rebuild what has been destroyed during crisis or to find new ways to use their land resources. All of the interviewed farmers were interested in enhancing, enlarging or foundation of agroforestry systems. Many of the visited agroforestry plots have only recently been established. In this context it can be expected that organizations and institutions in future will have to work more specifically with agroforestry than it has been done up to now.

For the extension of agroforestry, different approaches can be chosen. One promising way is to find traditional technologies in Tajikistan's land use history. This may be technologies from Soviet times or even before. A different possibility is to introduce proven technologies from other countries with similar ecosystems. The third variant is to experiment with new promising schemes and components of agroforestry. It may be farmer driven experiments, scientific research in experimental stations or some kind of on-farm-research.

In any case the technologies should be adapted to the present network of influencing factors which fixes the households manoeuvre. This network imperatively influences the household's decision making about agroforestry and its knowledge constitutes a precondition for successful spread of the technology. "If a farmer is required to change his farming system, it will be difficult, since, from his point of view, his traditional system has proven to be successful for generations. Farmers can be conservative in changing their cropping system, even though they fear for the sustainability of their present system" (Koppelmann and French, 1996).

The most important influencing factors emerge from biophysical and economic conditions prevailing on the farms. These two kinds of factors are often closely linked. Hindering biophysical condition can often be removed either with labour or with money. However if scarce place is the restricting factor biophysical problems can not be solved by financial means.

The on-farm factors represent the most constraining factors therefore the focus should be laid on them. The influence on the decision for agroforestry extension from outside the household is from a minor importance. Nevertheless the off-farm factors are taken into consideration by farmers and therefore should also be addressed by organizations. As it is often difficult to influence the off-farm factors, solutions should be found to wear out the constraining factors and also to take advantage of the supporting factors. In this context the land tenure status is of special importance. While the insecurity about the land tenure is the major constraint in many developing countries, it seems to have no negative or even a positive influence on tree planting habits in Tajikistan. Farmers are assured of the long term character of their land-use contracts. However, this goes only for land with private access. Communal used land as pasture grounds are often bare of trees or shrubs. On pastures the incentive for planting trees is smaller as the biophysical conditions are often disadvantageous and trees have to be protected strongly from the grazing livestock.

Also the external support services have to be considered differentiated. While seedlings are easily available, the unsatisfying infrastructure of mountain villages handicap households in terms of higher prices for commodities and sparse information from actual market situation. Furthermore distant markets, where resources are highly valued, are difficult to reach for individuals.
Bank credits, a possible mean to resolve the financial problems, are hardly used by farmers as they have a big mistrust and aversion to them.

While many farmers know about the positive economic end result of a proper combination of trees and crops (especially in the form of orchards) they are often not aware of the service roles of trees. Maybe

as consequence of this information lack, practices with predominant protective role are rather rarely found (see table C-1).
In Tajikistan both can be found; scientific experiments on stations or farms and farmer driven experiments on private farms. But the latter is rare maybe because of a certain passivity of farmers and the top-down decision making during the long Soviet period. The experiments would often be more efficient if guided by specialists. Farmers could profit from additional management and planning skills which were lost during Soviet times. This goes not only for experimental techniques but also for every-days life on farms.

Based on these conclusions the following **recommendations** can be made. They are meant for organizations and institutions implementing agroforestry technologies or doing research in the sphere of agroforestry. Also organizations dealing with agroforestry in terms of consultation or training are addressed by the following ideas and propositions:

- The restricting factors vary a lot between the different regions. Therefore, the experiences made in one region can not really be applied to other regions. The biophysical situations on the farmlands are from decisive character for the introduction of agroforestry. The soil quality, irrigation possibility, exposition, etc. determine which practices can potentially be applied. Moreover, the distance between farmland and household should be noticed; labour and attention (watering, fertilizing) demanding practices should be situated close to the farm while low labour intensive production (e.g. fuelwood) can be further away from households.
  The problem of small-sized land plots can be addressed by systems including trees and shrubs with low light competence; e.g. short-stem trees and mulberry.

- Although men are usually leading the households decision making on investment and production, also women should be integrated in workshops and demonstrations about the implementation or improvement of agroforestry technologies and approaches. So the information and skills will remain on the farm when men leave the household for longer time to work abroad. Furthermore many households in Tajikistan are female headed; in some regions up to 40 percent of the total households, and they are among the poorest households in those areas (Sabates-Wheeler, 2002).
  Furthermore, the perception of woodfuel situation can differ between the genders since in several regions the women and children are charged with the collection, preparation and storage of energy sources. To make the decisions on agroforestry on proper basis, the women's perceptions must be considered.

- Financial problems present an obstacle for planting trees. Credits don't seem to be a promising solution since the time between investment and yield is often bigger than the credit term. The time lag can be overcome by combining tree plantation with crops which deliver an income at least in the first years after implementation.
  - Sophisticated methods are tree-tree Taungya systems. Tree species with different revolutions cycles and yielding delays are deliberately combined in order to guarantee continuous yields over the years.
  - Introducing early yielding sorts of tree species. The experimental station of the institute of orchards in Karsang is developing and growing different walnut sorts (besides a range of other sorts of fruit trees). A promising walnut sort bears already nuts after the second year.

  Furthermore it can be considered to grow individual or communal nursery either for the farmers own needs or for selling.

- While the law and regulations on land tenure don't bother agroforestry on individual or collective land, it seems that land with open or communal access is unlikely to be covered with agroforestry. But agroforestry can be advantageous compared with the actual grazing habits. For the integration of trees into grazing systems the following key questions have to be solved:
  - Who is responsible for the planting and tending of trees and bushes? Who will take advantage of the products? (communal or individual responsibility)
  - In which plantation-scheme are the goals (grazing management, shelter, erosion control...) likely to be reached? At the same time biophysical aspects must be addressed (irrigation, fertility, wind…)
  - Which trees are suitable (feeding properties, browsing, drought tolerance…) and how can they be protected from livestock (binding cloths, thorns or sticks around stems, growing protective plants next to stems…)

Some good examples regarding trees on pastures can be found in the FAO Project of Watershed Management near Faizabad executed by the Soil Science Institute in Dushanbe.

- Information on programs affecting Agroforestry planned processing units and market trends should be spread among farmers so that they take advantages of them. Farmers are often not aware of new opportunities and therefore don't include such reflections in their decision making for investment and production.

- The interviews with farmers showed that the productive function is the foremost reason for integrating trees in agricultural plots. Consequently it presents a good starting point for the proclamation and extension of agroforestry. In this context not only traditional fruits and nuts should be considered but also the potential of less known tree products. Innovative ideas to cultivate, harvest and sell niche products with a strong economic potential should be developed and supported.
  The following list mentions some ideas, which could be interesting in this regard:
  - Ephedra flox in steep slopes prevent erosion and is a costly ingredient for several perfume products
  - Salatka can be cultivated between rows of poplars or in forests and is a main ingredient for traditional cream eaten on Navruz
  - Dog rose is a suitable species for life fences and a valuable ingredient for juice, jam and tea, etc.
  - Sea buckthorn is a bush naturally growing on river banks with important stabilization effects. The fruits are rich in vitamin C and other vitamins. In western countries the Sea buckthorn products as jam or juice are sold very expensive.

  A supplementary approach to achieve higher profits and to widen the range of products would be the extension of farmers' skills in commerce. Farmers should therefore be provided with information about clients and marketing options.

- In villages where transport is expensive, the production of easily transportable and compact (dried) products can be advantageous. A further possibility to defuse the logistical difficulties is the organisation of transportation in groups or the selling of products via middlemen directly on the place.

- For organizations doing any kind of research the contact or collaboration with the soil science institute is recommended. In any case the scientific support and continuity in monitoring should be guaranteed for a long term since agroforestry covers many technologies with long-term effects. Many of the benefits (and disadvantages) of agroforestry become only evident in a later phase of the system.

- Basically agricultural skills and knowledge are spread by school education and by the social network. Concerning agroforestry the following points need further deepening and updating:

  - Service roles of trees
    Show up the importance of trees and bushes in terms of conserving, protecting and improving services. Mainly the role of trees for soil- and water conservation is immense in mountainous regions. Such factors can only influence the decision making if households are aware of them.
    The service roles are not restricted to the trees outside forests but logically they fulfill the same role in forests. Therefore also the sustainable use of forest- and tree resources should be propagated. Tales and habits concerning sustainability can be a starting point for the explanation of this concept.

  - Planning and management skills.
    The planning and management of agroforestry systems are fundamental reaching their aims. For reaching a good working and balanced Agroforestry system, it will be necessary to optimize the growth of each component and to regulate the interaction between them. For example the correct planting, tending and the proper adjustment of water and fertilizer are crucial.
    Planning and management skills are generally advantageous for all spheres of households' activities.

  - Tree related techniques
    While the application of grafting is well known, the practice of pruning of trees could be improved. The correct pruning in the correct time can remarkably increase the quality of yield. Changes of the structure of crown can change the microclimate, reduce fungi, increase the average weight of fruits and prevent frictions.

References

Akiner, S. (2001): Tajikistan: Disintegration or Reconciliation? The Royal Institute of International Affairs, London.

Asanaliev, A. and Sydykbekov, T. (2004): Water and Soil Conservation Technologies. CAMP Bishkek.

Bellefontaine, R. et al. (2002): Trees outside forests. FAO conservation guide 35.

Bulychev, A.S. (1977) {Буличев, А.С.}: Опыт террастрованття склонов и выращивания на них при различной ширине междурядий. *Внутри:* Защитное лесоразведение в Киргизии (Ред. Бурмистров,А.М.) Илим, Фрунзе. с. 5-31.

Dove, M.R. (1992): Foresters Beliefs About Farmers: A Priority for Social Science Research in Social Forestry. Agroforestry Systems 17: pp 13-41.

Dragavzev, A.P. (1958) {Драгавцев, А.П.}: Горное Плодоводство. Москва.

FAO (2002): Land tenure and rural development. FAO Land tenure studies 3, Rome.Flick, U. (1999): Qualitative Forschung. Theorie, Methoden, Anwendungen in Psychologie und Sozialwissenschaften. Rowohlt Taschenbuch Verlag GmBH, Reinbek bei Hamburg, p109.

FAO (1999): State of the World's Forests Rome, pp 154.

French, J.H. (1995): Farm household decision making and extension framework for understanding farm household-level decision making and design of agroforestry extension strategies. FAO, APAN, Asia-Pacific Agroforestry Network.

Gareeva, A. (2004): Multifunctional use and management of resources. Kyrgyzstan, Issyk-Kul oblast, Jety-Oguzski rayon, aiyl-okmotu Svetlaya Polyana, CAMP, Bishkek.

Gilmour, D.A. (1997): Forest management in a changing world. In: Biodiversity and sustainable use of Kyrgyzstan's walnut-fruit forests (Eds. Blaser, J. Carter, J. and Gilmour, D.). IUCN, Gland, Switzerland and Cambridge, UK and INTERCOOPERATION, Bern, Switzerland. P. 19-31.

Government of Tajikistan (2002): Poverty reduction strategy paper, Dushanbe.

Gulmahadamov, D. (2004): Breaking down barriers to land reform. *In:* OSCE Magazine Juli 2004, pp 8-10.

ICRAF (1993): Annual Report for 1992. ICRAF, Nairobi, Kenya, pp 47-49

Jensen, M. (1995): Woolfood productivity of Agroforestry Systems in Asia – A review of current knowledge. FAO, Bangkok.

Kadian, P. and Kaushik, S. (2003): Rural Energy for Sustainable Development. Participatory Assessment of Energy Resources. Deep & Deep Publications ldt., New Dehli.

Khojanakhmad, U. (2002): Support and Demand Survey on Food and Beverages. South-South Trade Promotion Programme, Tajikistan.

Koppelmann, R. French, J.H. (1996): A framework for understanding agroforestry decision making at the farm household-level. FAO, APAN, Asia-Pacific Agroforestry Network.

Lundgren, B.O. and Raintree, J.B. (1982): Sustained agroforestry. *In:* Agricultural research for development: Potentials and challenges in Asia (Ed. Nestel, B.). ISNAR, The Hague, pp 37-49.

MacDicken, K.G. and Vergara, N. (eds) (1990): Agroforestry – Classification and Management. John Wiley, New York.

Matley, I.M. (1994): Agricultural Development (1865 – 1963). *In:* Central Asia, 130 Years of Russian Dominance, A Historical Overview (Ed. Allworth, E.), Duke University Press, Durham and London.

Messerli, S. and Juldashev U. O. (2000): Trees and Agriculture in the Walnut Fruit Forests of Southern Kyrgyzstan: Current Situation and the Potential for Agroforestry. Les IC.

Mohabatov, K.H. (1999): Tajikistan. Rudaki Association, Paris, pp122.

NAC (2003): Agroforestry – Working Trees for Agriculture. USDA National Agroforestry Center (NAC), Lincoln.

Nair, P.K.R. (1985): Classification of agroforestry systems. *In:* Agroforestry Systems 3: 97-128.

Nair, P.K.R. (ed) (1998): Agroforestry Systems in the Tropics. Kluwer, London, pp 664.

Nair, P.K.R. (1990): Classification of Agroforestry systems. *In*: Agroforestry: Classification and Management (eds. McDicken, K.G.and Vergara, N.T.) John Wiley, New York.

Nair, P.K.R. (1993): Firewood Crops – Shrub and Tree Species for Energy Production, Volume 2. National Academy of Sciences. Washington D.C.

Nissen, S.W. (2004): Tajik's promised land a Farm of one's own. In: OSCE Magazine, July 2004, p4.

Onishenko, L.P. (1991) {Онищенко, Л.П.}: Эффекивность полезащитного лесоразведения в чуйской долинею Академия Наук Киргизкой ССР, Институт Биологии, Отдел Лесаю Фрунзе "Илим".

Raintree, J.B. (1985): Agroforestry pathways: Land tenure, shifting cultivation and sustainable agriculture. *In:* Unasilva No 154 (Ed. Wazeka, R) FAO.

Raintree, J.B. and Lundgren, B. (1985): Agroforestry potential for biomass production in integrated land use systems. Symposium on Biomass Energy Systems: Building Blocks for Sustainable Agriculture. 29 January-1 February, World Resources Institute, Washington.

Rijal, K. (1998): Sustainable Energy Use for Mountains Areas: Community-level Energy Planning and Management. *In:* Issues in Mountain development, 1998/4, ICIMOD Publication. www.icimod.org/publications/imd/imd98-4.htm.

Roose, E. (1994): Introduction à la gestion conservatoire de l'eau, de la biomasse et de la fertilité des sols(GCES). *In:* Soils Bulletin 70, FAO, Rome, pp 420.

Sabates-Wheeler, R. (2002): Land rights and economic security for rural women. United Nations Development Fund for Women, Dushanbe.

Sanchez, P. A. (1995): Science in agroforestry. In: Agroforestry Systems 30, Netherlands, pp 5-55.

SCSRT (2004): {Государственный Комитет Статистики Ркспублики Таджикисран}сельское хозяйство республики Таджикистан Статистический Сборник, Душанбе.

Sorg, J.P. (2000): Cours d'agroforestry. Haute ecole Suisse d'agronomie.

Stellrecht, I. and Berg, A. (2001): Haushaltsstrategien in Gebirgsregionen. Pilotstudie – Kyzyl Unkur, CAMP, Bischkek

Tajik forest authority (2000): Concept of the development of forestry in Tajikistan until 2005, Tajikistan.

Wilson, J.R. (1990): Agroforestry and soil fertility: The eleventh hypothesis-shade. *In:* Agroforestry Today 2(1); pp 14-15.

Wu, Z. (1991): Agroforestry Systems in China. The Chinese Academy of Forestry People's Republic of China and International Development Research Centre, Canada.

UNDP (2003): Tapping the potential, improving water management in Tajikistan, National Human Development Report 2003.

WOCAT (2004): World overview of Conservation Approaches and Technologies. World Association of Soil and Water Conversion.

www.adb.org (internet site of the Asian Development Bank)

http://www.lib.utexas.edu/maps/ (internet site of the University of Texas)

www.mop.tojikiston.com (internet site of SCEPFRT)

Zhaohua, Z. et al (1991): Overall study on Agroforestry Systems in China. *In:* Agroforestry Systems in China. (Eds. Zhu Z. et al), The Chinese Academy of Forestry People's Republic of China and International Development Research Centre, Canada.