FOREST MANAGEMENT PLANNING («ЛЕСОУСТРОЙСТВО») IN TAJIKISTAN

- FINAL REPORT -

Prepared by A. Gradel and W. Grüneklee in the frame of the EU-funded programme part "**Forest and Biodiversity Governance Including Environmental Monitoring"(FLERMONECA) – FLEG Component.**

Forest and Biodiversity Governance Including Environmental Monitoring (FLERMONECA) is the EU support for the sustainable use and management of natural resources in Central Asia in the areas of climate change, forest governance (Forest Law Enforcement, Governance and Trade – FLEGT) ecological recovery and environmental data collection, exchange, monitoring and assessment. It is part of the EU-funded EURECA programme (2012-15), which is strengthening regional cooperation and partnership with the EU in the fields of integrated water resource management, forest and biodiversity governance **–** including environmental monitoring and environmental awareness-raising **–** as well as improving coordination on environmental issues region-wide through the EU-Central Asia Environment and Water Cooperation Platform.

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FIGURES OF THE MAIN TEXT (Alexander Gradel and Mats Mahnken)

Additional material (including tables and figures) can be found in the appendices (pp. 55-78).

I INTRODUCTION (Alexander Gradel)

The general objective of the EU-funded programme FLERMONECA is to enhance regional cooperation and partnership between Central Asia and Europe in the fields of forest and biodiversity governance. The component Forest Law Enforcement and Governance in Central Asia (FLEG) promotes legal and sustainable forest management and utilization practices that strengthen the rule of law, tackle the growing problem of illegal forest activities and enhances local livelihoods (www.flermoneca.de). The institutional and legal reforms during the last years resulted in a new forest code. The new forest code provides the legal framework for the introduction of sustainable use of forests and relevant schemes that ensure involvement of local population. The Forestry Agency was separated from the Committee for Environment Protection in 2014 and gained the role as the implementing political organization of the government of Tajikistan for forestry and forests. The Forest Research Institute provides information and support. The leskhozes (State Forest Enterprises) are responsible for the management. The State Forest Inspection shall be the responsible institution for the control, but is not established yet. The new Forest Sector Strategy (2016-2030) sets out clear targets for the forest sector. This regards for example: afforestation, forest rehabilitation, production of forest products and contribution to economic development and meeting the needs of economy and population in forest products. Implementation of these targets depends not only on necessary reforms and investments but also on reliable information. Basic instruments for the implementation of sustainable forest management are technical maps and forest management plans. The last substantial inventories in Tajikistan have been carried out during the 1980ies. Simultaneously anthropogenic pressure, especially during the time of the civil war, and climate change promoted the degradation of the remaining forest areas. In order to get a first overview of the forest conditions and to provide baseline values for a monitoring an inventory methodology (based on a grid with sample points) has been developed and tested in Penjikent. Recently a local consultant team (TAJIKLES-service) has been established and contracted for the development of the methodology on forest management planning by GIZ. The management planning process shall be developed in way that it is time-wise and economical feasible, complies with the current policy for forest management and planning needs of leskhozes and the Government of Tajikistan and is based on appropriate inventory technologies. The main objective of two German forestry experts (Mr. Wolfram Grüneklee, HESSEN-FORST and Mr. Alexander Gradel) was to provide advice and backstopping to the local consultants on the development and approbation of a methodology of forest management planning (“лесоустройство”) for the leskhozes. The process should thereby be illustrated with reference to a flow chart.

II FOREST MANAGEMENT PLANNING («ЛЕСОУСТРОЙСТВО») ON STATE FOREST FUND LAND IN THE REPUBLIC OF TAJIKISTAN (OUTLINE)

(Alexander Gradel, Behruz Ilnazarov, Mats Mahnken, Wolfram Grüneklee)

Background

SFF-land consists of different land use classes, including forested areas, pasture land, cropland, garden, non-usable lands, etc., thus the management should consider all natural resource and land assets and the respective management activities. However, since by its provisions and nature the leskhozes are dealing with forest management, the non-forest resources are considered as assets providing income through leasing agreements with users and user groups, which in turn can be invested in forestry. The governance of these areas stays in the responsibility of the leskhozes. The last management planning and monitoring of forest resources in Tajikistan was carried out in the beginning of the 1980ies, when Tajikistan was an autonomous Soviet republic (TSSR). These data with some smaller adjustments form even today an information basis for decision making in the leskhozes. But these data are increasingly outdated. Updated knowledge about the spatial organization of the area to be planned and about the features of the different subcompartments is essential for the management planning. Thus in September 2015 Tajik and German experts from various institutions met and discussed the methodology of a stepwise approach for a new frame of forest management planning. Workshops and meetings were held in Dushanbe with subsequent field trips to the project area Penjikent. A methodology that combines old and new approaches was outlined and it was decided to test it in the field. The presented outline aims to provide a baseline and framework in order to facilitate a new management planning on the *State Forest Fund* (SFF)-land of the Republic of Tajikistan.

Forest management planning needs different data types and from different relevant sources to ensure an efficient production of management plans in the light of limited budgets. Besides remote sensing data and data gained in the field, all usable and reliable data from Soviet-times should be taken into account. This data is freely available while new data needs to be bought or raised in the field. The forest management maps from the TSSR-time shall be digitized in order to use the delineation of the compartment borders for structuring the SFF-land. With help of satellite images the subcompartments shall be delineated in order to establish management units based on land cover classes. Forests will be divided preliminary according to main species and density. Additional information needs to be gathered in the field. However, the topography of Tajikistan is very challenging in terms of data assessment

in the field and the forest utilization focuses on fuelwood and non-wooden products. Therefore different approaches were integrated and the common methodology adjusted. So far there exists hardly reliable information on increment and growth, which is necessary to determine threshold values for a sustainable forest management. There exist, however, some yield tables with information of volume and NWFP–harvest from Soviet-times, which seem to be useful for estimating some stand and harvest variables. For the financial evaluation more information about costs per unit are needed and normative tables need to be elaborated. Finally the control-system needs to involve external supervision from other Tajik institutions. This especially refers to the Forestry agency, respective leskhozes, the Forest Research Institute or the Forest inspectorate (to be established). But also other organizations are important (e.g. universities, research institutions, NGOs) for the implementation as they provide important knowledge and capacity and can also support the development of a new generation and capacity development of forest specialists for Tajikistan. The different stakeholders need to be involved in this. Especially during the first years foreign experts need to accompany this process. The national strategy is expected as a guiding document for the definition of management objectives of each leskhoz. Inventories will provide a basis for the planning. The proposed methodology is based on a stand by stand approach and will be tested in one compartment in Penjikent. The methodology can then be adapted and further developed. It is important to involve the respective state organizations during the whole process and recommended to provide expert support.
The flowchart (figure 1) gives an overview about the steps proposed to produce a forest management and business plan. The flow chart and the descriptions are based on an earlier report on instructions on land use planning (Mahnken 2015) and developed further.

The main participants of the workshops, field training and the development process of forest management planning in Tajikistan are presented in table 1.

Table 1: *Main participants of the workshops, field training and the development process of forest management planning in September 2015. The national participants where financed as local consultants by GIZ.*

Surname	**First name**	**Institution**
Sharipov	Davalatali	Forest agency
Ustyan	Iwan Petrovitsh	Forest research institute
Saturov	Jamshed	Plant genetic Research institute (Agrarian University of Tajikistan)
Raimov	Nurali	Agrarian University of Tajikiatan
Qadamshoev	Habib	Inventory specialist (freelancer)
Nasarow	Umed	Inventory specialist (freelancer) and PhD-student (Forest Research Institute)
Gafforov	Ismoil	Economic Consultant
Mohamadiev	Nemadjon	NGO (Dushanbe)
Shodiev	Furuzon	NGO (Penjikent))
Mahkamov	Hokimboi	District Forest Officer Penjikent
Shamsullo	Tagoec	Local forester (Penjikent
Nazarov	Sergey	NGO Dushanbe
Uhlemann	Kathrin	GIZ Tajikistan
Gradel	Alexander	Consultant
Grüneklee	Wolfram	GIZ Short Time Expert (Hessen-Forst)

Workshop I, TAJIKLES-service, Dushanbe 17th of September

Short description of the flowchart for forest management planning in SFF land

The presented flowchart is a scheme of consecutive steps in order to facilitate the basis for forest management and business planning. The main steps are:

1. The organization of the *State forest fund* land refers to the creation/delineation of administrative units (compartments) and management units (subcompartments/stands) of the respective land. This can be done based on different methodologies. One option is to use information of the management units of the last land use or forest management planning inventory (лесоустройство). The classification is applicable after verification, accuracy assessment and potential adjustments. In cases/regions where this is not applicable (for example if management unit maps are not available, or land resources have been assigned as SFF only recently) a totally new assignment of land use classes needs to be conducted. This approach relies especially on satellite images. The expert feedback in Dushanbe recommended to combine the main approaches. It was decided to utilize the already existing maps from the last "лесоустройство" and verify and adjust the compartments based on comparison with satellite images. The subcompartments/forest stands will be newly delineated with help of satellite images and a forest cover map of the respective area.
2. In the context of this work the main relevant land use classes are *forest area* and *non-forest area*. Forests are defined according to the Tajik law on forests (minimum crown coverage: 10 %, minimum area size 0.5 ha, minimum width: 10 m). The preliminary result of the digitization and delineation is a map of compartments and subcompartments including the respective forest stands. The different areas that have been identified as *forest,* still vary in terms of their features. This includes for example stand attributes (on forest land for example: tree species, regeneration, their potential of NWFP, etc.). Based on selected criteria and respective GIS-layer the assessment intensity of each subcompartment will be defined (C1). Every subcompartment shall be assessed via a simple description during field work (C2). We divide between an *onsite description* (accessible subcompartments) and a *distant description* (inaccessible subcompartments). As the capacity of forest experts is currently low in Tajikistan additionally measurement data need to be collected in the forested subcompartments (forest stands). These data shall be assessed in sample plots. The measurement also includes regeneration and NWFP-assessments (C21,C22, C23). The inaccessible forest stands shall further be described with the help of representative reference stands and reference plots ("Weiserflächen"). Depending on the assessment results and the management aims of each

management unit appropriate management measures (e.g. for creation of income revenue, rehabilitation etc.) are assigned/proposed (C3). In such stands also different management measures can be tested. During the field assessment recommendations for management measures are assigned to each stand (e.g. activities related to rehabilitation, NWFP-collection etc.). Forest management guidelines need to be elaborated in order to ensure sustainability in ecological, economic and social terms (C6). In the first phase some of these guidelines need to be based on expert knowledge until more solid data is available. Non-forest land will be assessed via a descriptive form as well, but so far no measurement of field data is required (C8). This will provide an overview of fore example pasture land (relevant for leasing; C9). Based on the satellite data and field assessments thematic maps will be created. The respective leskhoz will then have a planning basis in order to evaluate their capacity in terms of different management tasks. This is also important with regard to the implementation of objectives of the Tajik Forestry sector strategy on leskhoz-level C4,C5).

3. Thematic maps and a catalogue of planned measures are the results of the assessments. Based on the planned measures the expected financial revenues and investments/expenses can be calculated (see D). Budgetary funds are all funds allocated to the State Forestry Agency by the Government of Tajikistan (GoT) that can be used by the leskhoz (D1). The balance of benefits and costs result in positive, neutral or negative income generation. The calculation evaluates if the planned measures are economically beneficial. The financial evaluation should be compared to the formulated goals. This means that important activities, which create no income, but high costs for the leskhoz in the current season (especially afforestation), should not necessarily be cancelled but financed by external sources (e.g. financial support in the frame of international cooperation). The costs of all cost units per hectare are summed up to the leskhoz-level (financial plan). With respect to forests it means the calculation to one hectare forest land and then to one hectare SFF-land. Examples of calculations of afforestation are presented in the detailed description of D3. After the financial calculation the implementation of management measures may be adjusted.
4. The selected management measures are finally implemented in practice. For different reasons the implementation (E1) often deviates from the proposed measures. The controlling can be implemented via an event assessment during the implementation of the measures or during the next forest stand assessment (usually after 10 years; E2). The first planning period in Tajikistan, however, should be shorter than 10 years in order to allow soon adaptations and utilization from “on the job training” of involved

staff. Executed measures are noted in the catalog of planned measures and compared to the planned measure. This comparison is done in a record book. The control of certain tasks (e.g. planting, timber harvest) needs to involve external specialists. At least for larger or more important tasks this should be done by experts in the respective field, which belong to supervising institution (e.g. the Forestry Agency or the Forest Research Institute or a Forest Inspectorate). During the first years foreign experts will have to accompany this process. The control system also needs threshold values in order to define what are only minor or major mistakes or a complete failure. A strict control scheme, which enables a supervision during the process is especially recommended for planting and rehabilitation measures. A good control system will guarantee success of certain implementation activities but also satisfy potential financial donors, ensure project evaluation and simultaneously provide capacity development of the respective staff involved. The national institutions of Tajikistan can then step by step adopt the responsibility for the full supervision of the controlling.

The following pages provide a more detailed overview on the single steps of this process. Recommendations for the local consultants are drafted below the respective descriptions.

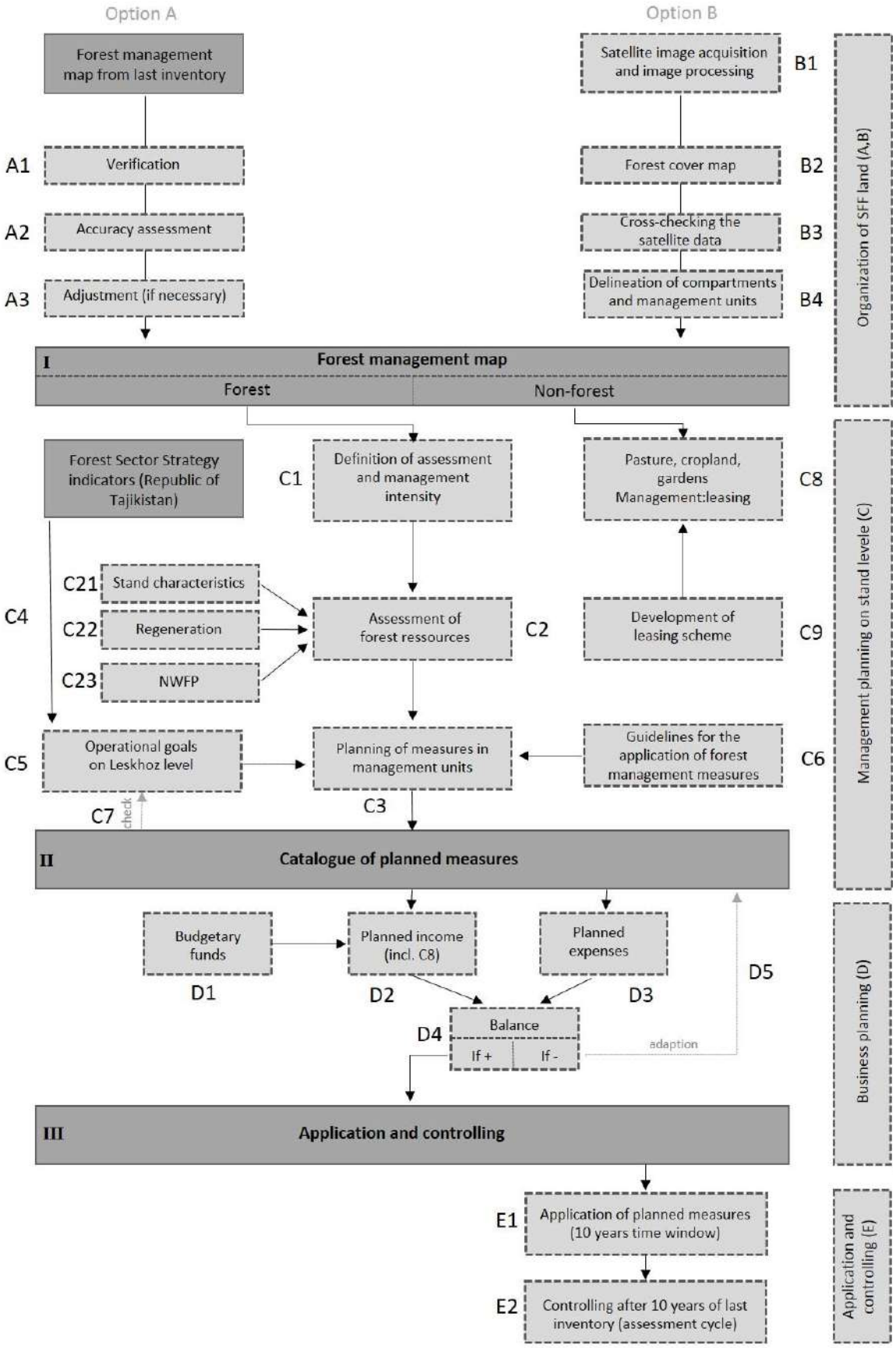


Figure 1: *Flowchart for the implementation of forest management planning (after the first expert consultation with Behruz Ilnazarov in the first week of September 2015).*

Detailed description of flowchart process steps

Spatial organization of SFF land

After expert consultation and workshops a combination of utilizing old map information and new satellite information is favored for the elaboration of new maps. The description of approach A has been adjusted respectively. The practical test will finally show in which way this approach can be implemented or where to change something. The alternative option, if old maps are not available, is additionally described.

A1: Forest management map – verification

The last management planning and monitoring of forest resources in Tajikistan was carried out during the time of the Soviet Union, in the beginning of the 1980ies, when Tajikistan was an autonomous Soviet republic (TSSR). Information from this last management plan («лесоустройство») is still available and includes maps of forest compartments and catalogues of forest management measures. Compartment maps provide information of the spatial arrangement and specific features of the management units. These management units are usually the subcompartments. All land use types that are generally managed (e.g. forest, pasture, cropland, etc.) are basically divided into such subcompartments. Forested subcompartments are usually forest stands which can be distinguished from neighboring stands by specific features (e.g. basal area/ ha, age etc.). Each subcompartment is assigned to one land use class. These maps have to be checked as they were elaborated with a different technology and are more than 30 years old. It is likely that the forest cover has changed during this time especially during the civil war in Tajikistan when the forests were exposed to high anthropogenic impacts. The main question in the context of the verification is if the subcompartments (e.g. forest stands) of the old maps are still corresponding to the current land type classes. Such maps as it was mentioned above contain information about the spatial arrangement of administrative units (e. g. the border of lesnichestvo, delineation of obkhods and etc.) which the local leskhozes (forest enterprises) are still using as management basis. For that reason the printed or drawn maps need to be scanned, georeferenced and digitized. For digitization a scan of the map can be produced and the polygons depicted in the map can be digitized manually using a geographical information system (GIS). Georeferencing can be realized by collecting ground control points (GCPs) with a GPS device in the areas on the map. The GCPs should be located at easily distinguishable places that can be found without difficulty on the map and in the field or respectively on georeferenced satellite/aerial imagery. Nevertheless the mentioned maps were elaborated using different technologies and usually even with a high number of GCPs

some location errors will occur. After preparatory work, the map can be viewed on a computer. Comparison of the information of the land use types of the subcompartments with very high resolution satellite imagery (e.g. Google, Bing) or the general comparison with a *forest cover map* (see B2) of the region should give a first impression on the quality of the map.

A2: Forest management map - accuracy assessment

If the map was judged to be useful in step A1, the accuracy of the map should be assessed. By selecting random points on the map generated by a GIS and comparing land use map information associated with the randomly selected point to real land use information, the overall accuracy of the map can be estimated. The collection of real point information can be done in the field or using freely available high resolution satellite imagery. It should be noted that collecting information in the field can be more costly but also provides better results because not all relevant aspects can be seen from remote sensing data. After comparison of the randomly generated point's information on the map and in reality there will be a list of data pairs for each point. For each land type class an accuracy can be calculated and by summing up the land type accuracies the overall map accuracy can be determined.

Example: Of 20 randomly generated points on the map's areas, 10 fall into the 'forest' land use type. By assessing these 10 points on Google imagery one determines that only 7 of these 10 points are located in 'forest' according to the satellite imagery. Assuming that Google imagery gives correct information on land use types we can say that the map accuracy for 'forest' is 70 %. By multiplying map accuracies from all land use types the overall map accuracy can be calculated.

A3: Forest management map – adjustments

The delineation of the old TSSR-compartments may deviate on some borders from the actual topographic feature (e.g. mountain ridges). The digitized map can be adjusted to compensate for map inaccuracies, georeferencing errors and timely changes in the physical distribution of the land use types and compartment arrangement. The adjustment can be done manually in a GIS by utilization of recent high resolution satellite imagery (e.g. Google, Bing). A second option for adjustment of compartments is a field visit. GPS devices and printed subcompartment maps are the tools that are needed for this field work. Manual adjustment of the management subcompartments is timely and does not have always major benefits. The adjustment and delineation of the management subcompartments are usually done by hand with extra field visits especially when experts are in the field anyway. While assessing forest resources (step C2) the experts can also check the management

subcompartment, especially the stand borders, and draw changes by hand on prepared and printed maps or taking GPS points with a GPS device. Borders for subcompartment delineation should be objectively detectable. Borders can be mountain ridges, rivers, land use types, etc. The adjustment of the old management subcompartment maps aims to change, delete or create borders between management compartments where it is necessary or reasonable for a better spatial organization of the SFF land for management.

Figure 2: *Management subcompartments (white borders) from last forest management planning (thematic map, 1981) in the leskhoz of Penjikent compared to current very high resolution satellite imagery (Google Earth, 2015).*

Figure 2 shows the subcompartments that were defined in soviet times. Even though the borders are not always located correctly on ridges, rivers or forest borders, one can see that the subcompartments were delineated according to specific criteria, especially topographic features. Adjustment of the subcompartment borders in a GIS using very high resolution satellite imagery is a valid possibility to improve the accuracy and thus the usability of the old compartment maps.

The old maps contain also information about species composition and density of the respective management units. This information should be crosschecked during the assessment of the forest resources (step C2). Age information can be updated.

B1: Image acquisition and image processing

Option B is only applied if the necessary maps from soviet times are not available. This method is more time-consuming and costly than using old maps since new land use maps and compartment organization have to be developed from scratch. Therefore it is recommended to put considerable effort in obtaining the data and maps from the last management planning to save time and funds. The SFF land that is managed by leskhozes needs to be classified and divided into land use classes. This division is necessary to gain information about the sizes of the different land use classes and their location to be able to

prepare meaningful management plans with spatial reference in the specific areas. The classification can be done using remote sensing techniques involving high resolution satellite imagery for example L3A RapidEye data. Depending on the level of processing the satellite images need to be pre-processed. So that afterwards the implementation of a classification algorithm is able to produce meaningful results (e.g. geometric correction, atmospheric correction, topographic correction). Selecting the appropriate remote sensing data is an important step. The high resolution multispectral images are very expensive and utilization of such materials demand involvement of more experts in this field. Experience shows that using Rapid eye images is beneficial as they have a special Red Edge band which is specially designed for detection of vegetation.

B2: Satellite imagery - forest cover map

For a basic overview a forest cover map can be generated, which can provide a first spatial overview about the distribution of forests on the SSF-land. The forest cover layers should be produced taking into consideration the official forest definition of Tajikistan. The mapping of forest cover based on the minimum crown cover criterion requires the detection of tree crowns which is a challenging research field. In general the ability to detect tree crowns in remote sensing data depends on the spectral and spatial resolution of the sensor and the landscape / forest that is under observation. Such a map can usually be produced in the office, if high quality satellite images are available. The *forest cover map* can also be used for checking the accuracy/validity of the land-use classes of TSSR-compartments.

B3: Crosschecking the satellite data

Besides topographic correction and atmospheric correction the imagery needs to be prepared for further processing steps. For more detailed assessments that consider species composition or densities and go beyond a forest cover map reference plot information is collected that afterwards will be linked to the satellite imagery to predict the land use class outside the reference areas. The information that is needed to run a supervised classification algorithm needs to be collected in the field on sampling plots. Using the data observed in the field on the reference areas, a supervised classification of the satellite imagery can be performed. After the classification, the accuracy of the produced land use map must be assessed to gain knowledge about the quality of the map. The accuracy assessment can be performed as described in step A3. Table 2 shows a possible land use classification with a focus on the classification of forest.

B4: Manual delineation of compartments and subcompartments

Subcompartments (the management units) are established for the spatial organization of the SFF land. Measures are planned on management unit level. After the delineation of the compartments the management units, usually sub-compartments (e.g. forest stands), sometimes maybe even whole compartments are to be assigned. A detailed delineation of subcompartments solely from satellite images is hardly to implement and requires additional field work. Forested areas and non-forest areas are divided in order to be able to plan measures for a given area that is clearly delineated and borders other management units where the planning of measures will be done separately. The delineation of non-forest management units, like pasture plots or cropland plots, aims to provide leasable area sizes. The delineation of the single management units inside a forest however, usually requires not only the delineation of compartments but the division into stands which involves extensive GIS- and groundwork.

Test the selected approach

The different approaches have been discussed at meetings and at one of two workshops (Sept. 2015, Dushanbe) with different Tajik experts and foreign consultants. The conclusion was to combine and crosscheck the information of the forest management maps with the new GIS-technology (corresponding to the presented adjusted description of approach A). The maximum management unit area (subcompartment/stand) should not exceed 70 ha and the minimum management unit area should not fall below 20 ha, because a definition of smaller compartments is more time consuming and requires more resources with less expected benefits for forest management. Adapting the minimum and maximum management unit areas is one goal of the testing phase.

Table 2: *Possible land use classes for the classification of SFF-land. If necessary some land use classes can be linked to each other and combined in order to make them compatible with the terminology of respective inventories (e.g. Tugai with Small leaved as overall type "Tugai") or even further divided.*

	ID	Label	Description
Forest (1)	11	Juniperus	Land with > 10 % tree crown cover of mostly *Juniperus* spp.
	12	Tugai	Land with > 10 % tree crown cover of mostly *Salix* spp., *Populus* spp. and *Hippophae rhamnoides*
	13	Broadleaved	Land with > 10 % tree crown cover of mostly *Juglans regia*, *Malus* sp., *Acer* spp. and *Platanus orientalis*
	14	Shibliak (Xerophytic)	Land with > 10 % tree crown cover of mostly *Amygdalus bucharia*, *Pistacia vera*, *Calophaca grandiflora*, *Cercis griffithii* and *Rhus coriaria*
	15	Small leaved	Land with > 10 % tree crown cover of mostly Betulae, *Populus* spp., *Salix* spp., *Hippophae rhamnoides* and *Fraxinus* sp.
	16	Plantation	Land with > 10 % tree crown cover and artificially established plants with high yields of timber, fuelwood or fruits/nuts
Non-Forest (2)	21	Pasture	Land dedicated for grazing purposes
	22	Cropland	Land dedicated for the cultivation of agricultural products
	23	Garden	Land rented to individuals or groups of individuals for recreational and agricultural use
	24	Water	Waterbodies (rivers, lakes, etc.)
	25	Bare rock	Land without soil layer or vegetation
	26	Road	Roads suitable for motorized vehicles
	27	Settlement	Closed settlements

Local consultant: The local consultant should test the feasibility of the selected approach for one or several compartments.

C: Management planning on stand and compartment level

C1: Definition of assessment and management intensity

Assessment intensity and management intensity need to be defined for every defined subcompartment/stand for the reason that the undertaken effort should correspond with the expected benefit due to limited resources in the planning and the management phase. The level of assessment intensity and management intensity of one stand may not always be the same. A lot of relevant information can be generated from satellite (forest cover and slope, road maps). But certain features will only be clear after the field assessments.

One approach is to assess the forest structure in the field based on simple stand description forms by well-educated experts. In this approach the assessment is largely based on an experience based visual judgement. The advantage of this approach is that it is less time and work consuming, the disadvantage is that it requires very well educated specialists with a lot of work experience. Another option is to conduct the assessment based on a narrow systematic grid of sample points in order to acquire secured measurement data (as local inventory; with a dense grid in order to catch every stand). With respect to the special conditions of Tajikistan (remote area, low forest productivity, low capacities) a combination of these two approaches seems to be feasible. A description of the main features should always be conducted but where possible measurement data should be added. The application of the respective approach is reflected in the assessment intensity. For this purpose a dense grid of sample points should be distributed in a GIS-layer. This basic grid can then be thinned out according to the criteria of the assessment intensity.

Definition of assessment intensity

Useful criteria for the definition of the assessment intensity are forest cover and estimated accessibility of the respective subcompartment. Both can be checked via respective GIS-layers. As the terrain of most regions is difficult and financial resources are limited a very detailed description with measurements of areas with no or only low forest cover should be avoided. Such areas provide little options for wood utilization (even for fuelwood). If accessible, however, all forest stands shall be described by an *onsite* description, which implies a field visit to the respective stand. The assessment of forest stands with higher percentage of forest cover, however, should also include measurements on sample points. In this case the assessment intensity increases with the forest cover of the respective stand. Clearly inaccessible sites will be assessed via a *distant description*, as a site visit may hardly be possible, is extremely time consuming or may even be dangerous. The accessibility for the assessment can be estimated via a topographic GIS-layer, which contains information

about the slope. All stands with a slope of more than 45° (indicative) will be assessed via *distant description*, which implies a visual evaluation from a suitable place close to the respective stand (e.g. by binocular from the opposite slope). Such descriptions can add useful information to the basic information gained by satellite data. Table 3 provides a baseline overview in form of a recommendation. In practice the threshold values may be adjusted according to forest type, homogeneity and stand size. For example an assessment of a Pistachio-forest with low density via sample points might be also interesting in economic terms.

Table 3: *Definition of the assessment intensity of the respective SFF-land. These definitions are only indicative. Depending on different criteria (e.g. forest type or stand size) different threshold values may be reasonable.*

inten-sity	State forest fund land	Forest cover	Assessment intensity if slope < 45 °	Assessment intensity if slope > 45 °
1	forst area (1)	>= 0,5	Stand description and sample points (4-6 per stand)	distant description
2	forst area (2)	>=0.25 and <0.5	Stand description and sample points (1-3 per stand)	distant description
3	forst area (3)	>=0,1 and <0,25	Stand description (onsite)	distant description
4	non-forest area	<0,1	description	distant description

Reference stands and permanent reference plots support forest descriptions and management decisions – especially in remote and inaccessible areas

As many sites can be expected to have low forest cover or are hardly accessible an additional concept is recommended. The concept of reference stands and reference plot is suitable. Reference stands, which are representative for the main forest formations should be selected and monitored via permanent reference plots. These plots will add baseline information for the remote forest descriptions. If the selected site is representative, the results can apply for areas of up to 1000 ha and potentially even more. Additional the plots will provide detailed information about increment after some years, which is needed for sustainable planning. They also allow the monitoring of forest structure change over time, which provides options to link forest monitoring with forest scientific institutions. Long-time studies on such plots may be especially interesting in the context of questions related to climate change impact and anthropogenic utilization on forest structure. The results from such reference sites can then be used for the evaluation and forecast on subcompartments with similar stand features. The selection of reference stands and the establishment of reference plots shall be conducted in close cooperation with the Forest Research Institute

and the Agrarian University in Dushanbe. Permanent reference plots should be established in the following context:

- The level of degradation of certain forest types is currently not known. Reference values (e.g. stem number, basal area, volume, species composition etc.) need to be assessed and monitored in respective undisturbed forest stands (if such stands can still be found). These values can then be compared to larger forest areas and the comparison allows a more objective evaluation about the level of degradation of a certain forest type.
- For each forest type reference values, for example of increment (if possible related to yield classes) and regeneration capacity, need to be established. These values are necessary to derive sustainable forest management measures, which can be utilized for concrete management guidelines.
- Long term monitoring of forest structure change in the frame of climate change.
- Estimating values of certain forests stands that are assessed via *distant description* (e.g. hardly accessible forests). Regeneration can be measured in the reference plots and then used for estimating the regeneration of larger forest areas in the distant description.
- On some of the plots certain management measures may be tested (for example fencing, selective cutting etc.). The impact of these measures (e.g. on regeneration) can be monitored. Results can be utilized for concrete management guidelines of certain forest types.

See the appendices (A_1) for a short description of the concept of reference stand and reference plots. Every *lesnitshestvo* shall have a set of its own reference sites (e.g. 3 reference stands with plots).

Definition of management intensity via the management intensity index

After the assessment, which also provides more detailed information on the overall accessibility (e.g. forest stand with low slope, not accessible by motorized vehicle but with donkey), site conditions, grazing impact and on the economic potential each forest stand is given a management intensity (A-D), being A highest management intensity and D no active management (protection). The intensity is defined by the parameters: overall accessibility (accessibility /next village, slope); expected economic potential (soil type, grazing pressure, tree condition, stock, etc.) and importance for erosion security (location, slope, etc.).

The MI is a measure to divide the SFF land, including forested and non-forested area, into focus areas and areas of less concern. This is done in the light of limited financial resources. Focus areas are segregated from the rest of the SFF land by applying the MI-classes to each part of the SFF land. This way there will be A-class subcompartment that form the focus

areas with high management intensity, whereas the lower MI class subcompartments can be included into the focus of land management if sufficient funds are available.

Table 4: *Indicative criteria for the classification of subcompartments into MI-classes.*

Parameter	MI-points	Criteria
overall accessibility	3	low slope, accessibility by motorized vehicle possible
	2	low slope, not accessible by motorized vehicle, but with donkey
	1	not accessible by motorized vehicle or donkey
	0	Slope > 45 °
economic potential	3	high expected return-on-investments
	2	moderate return-on-investments expected
	1	return-on-investments expected
	0	no economic benefit expected
erosion security	3	no erosion (vegetation / top soil undisturbed)
	2	Slightly erosion (vegetation / top soil partly lost)
	1	Serious erosion (vegetation / top soil lost)
	0	Heavy erosion (bare soil affected by water / wind erosion / land slides)

Table 5: *Explanation about the management intensity (MI)-classes. The examples are only indicative and not verified by field work.*

MI-class	Description	MI-points	Example may be ….
A	High MI	8 - 9	highly productive pistachio plantations
B	Medium MI	6 - 7	productive Tugai forest
C	Low MI	3 - 5	productive Tugai forest with high river dynamics
D	No MI	0 - 2	very remote sparse juniperus forests

By evaluating the subcompartment regarding the parameters depicted in table 4 and summing up the MI-points of the respective parameters the MI-class is defined (see table 5).

Local consultant: The procedure and threshold values of the assessment and management intensity should be tested for one or two compartments before finalizing the methodology for application on larger scale. One question is if the selected criteria work out and what should be the criteria for restrictions concerning slope (indicative 45°; potentially the ground cover is also important). Another question is if the stepwise approach of first defining assessment intensity and afterwards management intensity is useful. Another option may be to obtain values for assessment and management values simultaneously.

C2: Assessment of forest resources

Forest resources are assessed in the field. An assessment via sample points in the field is only required in subcompartments that contain forest. The assessment of non-forest land requires less specific data in order to make management decisions. Also non-forest areas are ideally not managed directly by the leskhoz but leased to tenants. In fact most forest enterprises undertake agricultural activities incl. life stock production, but the leskhoz should concentrate more and more on forest management. For this reason, non-forestry activities are not laid down in the management plan at all. Subcompartments that have a low assessment intensity are only assessed via distant stand description.

C21: Assessment of stand characteristics – stand description form

The descriptive assessment of stand characteristics aims to provide especially information about the site conditions and tree resources of the standing stock. The methodology needs to be quick and easy to perform. Forest resources are assessed by experts familiar with the methodology or trained personnel. There are different options for the field assessment. The presented field form for the stand description is based on the field forms of the inventory on sample plots in Penjikent (forest eye consultancy Goettingen in cooperation with GIZ Tajikistan; Ilnazarov B, Fehrmann L, Magdon P (2015) Руководство по полевым измерениям) and was adjusted to a field form for the forest stand according to the input from Tajik and German experts (workshops Dushanbe and field assessments in Penjikent; Sept. 2015). The descriptive form includes a set of several parameters. Most of them can be found in the manual of the national inventory (forest eye). The order of some parameter has been changed. Only changes and additions of parameter are explicitly explained here.

ID-information of the compartment, stand and assessment intensity is required.

SLOPE: slope in degree is available in different classes. This is necessary because in *distant descriptions* the dominating slope of the forest stand can only be estimated.

POSITION ON SLOPE: important feature with implications on management (productivity and accessibility).

SOIL: soil depth < or >10 cm is added, as this is easily assessable and can have implications for potential planting activities.

CROWN CLOSURE: a class denoted “very open” is added. The classification needed more differentiation concerning open forests, as low density is a common feature of many Tajik forests.

MANAGED: differentiates first between currently unmanaged and managed and then between different degrees of grazing impact (which is one of the very common impacts in Tajik forests).

MATURITY /NATURAL STAND AGE: especially necessary for distant descriptions, where measurement values are not available. Maturity contains the following classes:

- Young stands/Thin tree wood: < 15 cm DBH
- Pole wood: 15 – 20 cm DBH
- Minor treewood: 20 – 35 cm DBH
- Medium treewood: 35 – 50 cm DBH
- Major treewood: > 50 cm DBH

The classification of the major forest types seems feasible, also in terms of management activities.

MAIN TREE SPECIES (WITH AGE AND YIELD CLASS): Age and yield class may be estimated (e.g. with help of yield tables), or if not possible later be added by updating the data of the last forest inventory.

IF AVAILABLE (E.G. JUNIPERUS): ESTIMATED HEIGHT; SEE YIELD TABLE FOR BASAL AREA**:**
Of special difficulty may be the assessment of Juniperus-forests. A comparison between our measurement results from the Juniperus forests (field assessment in Penjikent; Sept. 2015) indicated that the tables from the time of the TSSR are useful in estimating basal area and volume in relation to height (see A_2). This means such tables will be especially useful for evaluating the productivity of such stands during distant description if height can be estimated.

REGENERATION: A measurement of regeneration is in the distant description of largely inaccessible forests not possible. If possible, the regeneration should be estimated (secured or unsufficient). This may often not be possible. However, in the future the regeneration of areas with distant description should be estimated based on reference plots.

The field form for the stand description is added in the appendix.

Assessment on the sample plots

The design of the sample plots is shown in the appendices (A_3). It has been discussed, tested and adjusted where appropriate with core persons from the field crew in Penjikent and the backstopping expert from HESSEN FORST. As regeneration has the tendency to occur highly clumped a sufficient number and spatial distribution of the regeneration plots is necessary. Based on experience the size of the plots should vary between 0.05 and 0.1 ha. In a Tugai forest for example 0.05 ha may be sufficient, whereas for the assessment in a less dense Juniperus-forest 0.1 ha may be the appropriate size. Each field crew should consist of three workers. The list of equipment is presented in the appendices (A_4).

The data sheets for the assessments on the sample points (appendices A_5) are based on the data sheets of the inventory on sample plots in Penjikent (forest eye consultancy Goettingen in cooperation with GIZ Tajikistan) and were adjusted according to the input (workshop Dushanbe, field tests Penjikent) from Tajik and German experts. The following changes / additions were made:

VITALITY: in order to estimate also the amount of standing dead wood, the vitality of the trees is also assessed. 1 - living, 2 - dead.

LAYER: The layer (hierarchically decreasing form 1-3) of the respective tree.

Local consultants: The respective field forms shall be further tested in the field for one or two compartments.

C22: Assessment of regeneration

The assessment of regeneration in the forest compartments is important for further planning of the forest management measures. Secured regeneration is the most important element for a forested area to stay forested. Therefore the abundance and composition of regeneration need to be assessed.

For the assessment of regeneration the cover can be estimated or the actual number is assessed in subplots, meaning that the two regeneration classes are assessed in subplots (e.g. circles with a radius of 1.78 m = 10m² or square plots with 4 m²). It is recommended to use a radius that facilitates the calculation to one hectare (common reference size for

comparison in forestry). As regeneration occurs often much clumped there need to be several plots in order to catch the variability of the site.

After the discussion with Tajik and German experts we recommend to assess the regeneration in 5 subplots with a size of 4 m² each (one close to the center and 4 in a distance of 10 m according to the clockwise cardinal points of the compass (north, east, south, west). On flat terrain the poles can be used to frame the borders of the subplots. If the slope exceeds more than 10° on the respective place, we recommend to determine the size via the Vertex (HD-function: horizontal distance), or to use the attached correction table (in A_5). The height classes of the regeneration are the same as in the data sheets of the inventory on sample plots in Penjikent (forest eye consultancy Goettingen in cooperation with GIZ Tajikistan). The assessment however changed slightly. Only the first two regeneration classes are assessed in the subplots (<50 cm and >50-150 cm). Many forest sites in Tajikistan and the project region Penjikent are sparse in regeneration. Therefore the rather secured regeneration (third class >150 cm and less than 7cm DBH) is counted throughout the whole sample plot.

Local consultant: Especially the suitability of the height classes of regeneration shall be reviewed and tested during the testing phase in the field.

C23: Assessment of non-wood forest products (NWFPs)

Non-wood forest products play a major role in Tajikistan due to their abundance and diversity. The assessment of NWFPs needs to take into account the wide variety of the forest products. Therefore there is not one methodology for the evaluation of NWFPs but there are nearly as many methodologies as there are NWFPs itself. Furthermore the seasonality of most of the NWFPs needs to be considered since not all of the products can be assessed at all times of the year. Basically two main approaches can be distinguished: the "*natural science approach*" and the "*social science approach*". The first approach relies on rather statistical survey methods in the field, which aim at measuring NWFP-resources. The second approach relies on surveys of resource persons, usually locals, and rather estimates NWFP-resources. Depending on the focal species the selected approach may differ. Combinations are also possible.

Special attention should be given to the methodology for NWFPs assessment that has existed in former Soviet-times. Depending on species the number or coverage per area was assessed. The size of the sample area corresponded to the size and distribution of the plant species: herbs were assessed on smaller sample plots (e.g. several plots in one stand with a

size of just 1 m²), bushes were assessed on larger plots (e.g. 100 m²). Each NWFP had an own symbol, which can be used on respective maps. The harvest capacity of certain species was estimated based on the estimated coverage and reference values from tables. The expected harvest for the area with 100% coverage (taken from reference tables) multiplied by the actual coverage in % and then divided by 100 gives the expected maximum harvest for the assessed area. More detailed information can be found in Бочарав и др. 1987 (МЕТОДИКА ВЫЯВЛЕНИЯ ДИКОРАСТУЩИХ СЫРЬЕВЫХ РЕСУРСОВ ПРИ ЛЕСОУСТРОЙСТВЕ). Tables that indicate the harvest potential based on crown size are available. Respective literature and copies of the tables have been submitted to the local consultant TAJIKLES service. If and for which species this should be applied needs to be further tested and decided. Examples of assessment tables, symbols etc. are presented in the Appendices (A_6).

Our current proposal: distinguish in the assessment between bushes and herbs

The coverage of bushes below 100 cm height (bushes 1) shall be estimated according to coverage classes. Bushes with a height of more than 100 cm (bushes 2) are counted within the whole plot. One species may occur in both height classes, but a species that is considered a bush cannot also occur in the data sheet for trees and vice versa. Every wooden species can only be either tree or bush. This must be clarified on a species list before the assessment. With this approach not only several NWFP can be assessed and quantified, but for example also the protection potential of bushes against erosion. See A_4. The occurrence of herbs, however, should be assessed differently. The occurrence of relevant herbs shall be mentioned and commented on the utilization option in the respective area (one or several stand). This should especially be discussed during meetings with the respective resource persons (e.g. forester) of the region.

Table 6: *Overview of NWFPs of special relevance in the forest areas of Tajikistan and proposals for their assessment in the frame of the new „лесоустройство“.*

NWFPs	grouping	assessment/estimation
Rheum sp.	herb	descriptive and resource person
mushrooms	mushroom	descriptive and resource person
Allium sp.	herb	descriptive and resource person
Lonicera sp.	bush	in sample plot
Carum carvi	herb	descriptive and resource person
Berberis sp.	bush	in sample plot
Rosa canina	bush	in sample plot

Finally the occurrence of the respective NWFP-plants can be added via symbols on the map.

Local consultant: A clear list on which species are herbs, bushes and trees need to be provided/elaborated. Trees can only be counted as trees, bushes as bushes, herbs as herbs. The field test in Sept. 2015 showed that there is not always consensus between the different experts. This needs to be clarified. Only the really important herbs shall be mentioned on this list. The current proposal for the assessment needs to be tested with Tajik experts in the field. The integration of indicative measures for estimation of harvest volume (e.g. measurement of crown size; see A_6 part 2) shall further be discussed and tested.

C3: Planning of measures in forest stands

The preliminary planning of forest management measures is conducted in the field while assessing the forest resources (C2). We propose a simple assignment of the main suitable forest function to the respective stand and an evaluation of degradation and potential of planting options. These recommendations are initially based on the direct impression of the expert in the field, his knowledge and experience. A preliminary estimation with relevance to the quantities (e.g. m^3 or ha) should already be made in the field. The following main categories of management measures can be identified: planting activities (afforestation and enrichment planting); tending measures, fuelwood collection; timber harvest; NWFP collection; potentially a less intensive form of grazing management; others.

These categories may be differentiated into more specific action. For example planting activities can be divided into afforestation on non-forested land and enrichment planting on already forested land. This can be distinguished further with regard to certain tree species (e.g. number of plants and planting pattern will be different for poplar, Juniperus or Pistachio etc.). The respective leskhoz and the forester shall finally receive thematic maps after the assessment (e.g. map “enrichment planting options”, map “NWFPs”, map “volume/ha” etc.) with the catalogue of measures on stand level. They can review the proposed measures and finalize them before the financial evaluation. The final planning includes the prescription of the concrete forest management measures with quantities (e.g. 400 m of fence, 50 m^3 of fuel wood, planting 1000 seedlings) and the time of measure realization (e.g. in the next 5 years, 2017 - 2020, in 2020). It is desirable to include local population into planning and management if the management compartment is near settlements and the involvement is possible. This is especially recommended for planting and tending tasks. After the first planning period, with more supportive information from reference and research plots and after gaining more experiences in structured forest management planning in the leskhoz, the previous management plans can be analyzed to develop concrete management principles

per conditional forest type (development of C6). Table 7 provides some examples of relevant management activities and related financial aspects.

Table 7: *Some examples of some management activities and respective financial aspects, e.g. costs per unit of proposed measures on SFF land. The examples were collected from experts from the Agrarian University, the Centre of Genetic resources, the Forest Research Institute of Tajikistan and the Forestry Agency.*

management activity	financial aspects (currently)
afforestation	depending on planting scheme and species. Pistachio about 5000 TJS/ha
fuelwood collection	costs for license of gathering depending on leskhoz (1m³/105 TJS)
soil preperation (with rake for seedlings)	max. 10 % of the respective prize of plantation
hay making	license from leskhoz or agrementt on share in %
honey production	license needs to be purchased from leskhoz
collection of concrete NWFPs (e.g. fruits and herbs)	price per kg. Differs according to species and market conditions (e.g. fruits of Rosa canina: license for collection about 5TJS/kg, price for selling on market: about 10 TJS/kg.
rice cultivation / agriculture	leasing system; payment every year
fencing	costs/metre
protection by locals	possibly local village dwellers can be involved in protection of afforestation areas (payment per season)

The conduction of tasks can be implemented by leskhoz-staff (e.g. foresters), contractors, private investors (in the frame of leasing contracts) or via JFM-schemes. This need to be mentioned in the management plan.

Local consultant: The document of a management plan needs to be elaborated. Different implementation schemes (e.g. realized by leskhoz-staff, or for example JFM-contractors) need to be elaborated and connected to the management plan. If possible the recommendations of management measures during the stand assessment should already include quantitative measures. It needs to be clarified if fuelwood extraction is only limited to dead trees. It needs to be clarified if grazing is excluded in any case from forest land or if there are forms that are compatible with sustainable forest management.

C4: Forest Sector Strategy (FSS of the Republic of Tajikistan) indicators implementation

The FSS provides objectives and indicators for the defined goals that shall be achieved until the end of the program in 2030. The efforts conducted in the 15 years of the strategy aim to develop the forestry sector of the Republic of Tajikistan and rehabilitate Tajikistan's forests.

The objectives and respective indicators are defined as follows:

1. conservation of the forest biodiversity, restoration and conservation of forests, increasing their area and productivity
    a. stable populations of key species of plants and animals in forests of the country
    b. planting of 10000 hectares of new forests adapted to the region in conditions of the climate change
    c. doubling of the productivity of forests
    d. the cattle grazing is completely ceased on 30% of forest areas
2. improving the quality and quantity of ecosystem services in conditions of climate change
    a. increasing the supply of needs of the Republic of Tajikistan in commercial timber from 0.05% to 2%;
    b. doubling the profitability and efficiency of state forest husbandries
3. promoting the economic development by attracting entrepreneurs to the forest sector and improving the efficiency of the forestry management
    a. increasing the number of registered entrepreneurs involved in the forestry sector from 25 to 100
4. improving the welfare of local people through involving them into the forest management and provision with the forest products, based on the sustainable use of forests
    a. increasing the number of households involved in the forestry sector within the frames of contracts on the joint forest management from the 721 households (at the moment when the strategy was concluded) to 3500 households
5. enhancing participation of the civil society, particularly women, in issues of the forest policy at the national and local level
    a. supervisory boards are established at the national and local levels with involvement of the civil society, particularly women
6. enhancing the role of forests of the Republic of Tajikistan in implementation of international commitments and of global programs on sustainable development of forests and on mitigation and adaptation to the climate change

a. the forest sector of the Republic of Tajikistan participates in 5 global programs on the sustainable development of forests and on mitigation of the climate change

For the definition of operational goals on leskhoz level all objectives from the FSS must be taken into consideration. Some of the national indicators can be extracted from the FSS directly and others have to be broken down to leskhoz level according to transparent rules.

C5: Operational goals on leskhoz level

The definition of operational goals for the forest enterprise needs to be based on national strategic aims and the principles of sustainability. The legal framework for forest management is set out in the forest code of Tajikistan (2014). National goals for the forest development and forestry sector development in Tajikistan can be found in the Forestry Sector Strategy (FSS) for the period from 2016 to 2030. Since the FSS defines indicators that need to be met by the forestry sector as a whole, the indicators can be split up onto the regional level in the forestry sector, namely the leskhozes. Therefore each and every leskhoz has some operational goals in common that are already defined by the FSS. These are:

1. Protection of natural forest types

2. Afforestation: In a first step the overall objective of afforestation area of Tajikistan can be split to the relative area of each *leskhoz*. Planting of: $10000\ ha * \frac{leskhoz\ area\ (ha)}{SFF\ land\ area\ of\ Tajikistan\ (ha)}$ new forests adapted to the region in conditions of the climate change.

These objective needs to be communicated and the real conditions and capacities discussed with each leskhoz. Based on the forest management planning („лесоустройство“) the natural capacity of each leskhoz will be assessed. This facilitates also the decision about, for example, planting activities in the respective region. Additionally other leskhoz-capacities (e.g. available staff, financial resources, control capacity etc.) may be taken into account for the feedback of implementing the objectives on leskhoz-level.

3. Doubling of the productivity of forests (indicator could be forest products)

4. Ceasing of cattle grazing on 30 % of forest areas (designated areas)

5. Increasing the production of timber wood

6. Doubling of the profitability and efficiency of the leskhoz (indicator could be profit margin)

7. Increasing the number of households involved in the forestry sector within the frames of contracts on the joint forest management by (at the date of strategy preparation): $2779\ households * \frac{leskhoz\ area\ (ha)}{SFF\ land\ area\ of\ Tajikistan\ (ha)}$

Besides these operational goals that are provided from the government, the leskhoz has some more objectives. These include for example liquidity at all times, job security for the employees, etc. Further goals can be defined and the order of importance of the goals needs to be specified to know which goal has priority.

Local consultants: It is recommended that local experts, especially from the Forestry agency further develop approaches on how to integrate objectives of the forest strategy on the regional leskhoz-level (e.g. Madibron and Davaltali).

C6: Guidelines for the application of forest management measures – guarantee sustainability

Guidelines for the application of forest management measures shall provide a basis to develop standard forest management concepts for similar forests. These guidelines are a way to effectively plan forest management measures without the need of experts planning measures in the field. The overall goal of the guidelines is to ensure the sustainable utilization of the natural resources and protect the diverse other functions (e.g. protection against erosion etc.). In Tajikistan so far no objective/reasonable sustainability control with threshold values is implemented in practice yet. For example: In many forests close to settlements fuelwood is extensively collected without knowing how much increment the respective forest type has and how much annually can be extracted without depleting the resource. Threshold values can be elaborated in the future with help of monitoring results (e.g. forest inventory and reference plots) and structured management experience. Some of the information for facilitating the transition period from the current condition to an objective based sustainable forestry may be already existing in some form (e.g. certain yield tables). See table 8 for some general guidliens and a “to do” list in order to specify them. The specified guidelines will then provide measures for given forest types that are described by different quantitative forest parameters. Once the guidelines are ready-to-use, single stand planning is not necessary anymore because of the treatment concepts that were developed for every forest type.

Table 8: *Overview of some general guidelines for the application of management measures and "to do list" in order to specify the guidelines for the application in the field.*

Category of management measure (examples)	General guidelines for the application	To do (in order to specify)
Afforestation	- areas that shall become forested - site must be suitable for the planting activity - activity must be feasible - ensure sufficient availability of seedlings / saplings on regional level	- objective selection criteria for suitable areas - review and evaluation of planting techniques for the target tree species (e.g. Forest Research Institute) - review materials from Soviet-time and establish codes of practice for planting and tending measures
Enrichment planting	- no or too low number of regeneration - management objective is to transfer a forest to another development goal	- establish minimum values for regeneration per conditional class of forest formation (to be included in the codes of practice)
Timber harvest	- sustainability control: the extracted volume should not exceed the increment per ha. -regeneration should be sufficient	- define an annual allowable cut for the relevant forest type as basis for harvesting activities (can be facilitated by exact monitoring; e.g. inventory results on provincial level and reference plots)
Fuelwood collection	- sustainability control: see above and ensure distribution	- conceptualize how to manage distribution of fuelwood collection on the forest area (concentrations of over exploitation (e.g. typical near settlements) should be avoided)
NWFP collection (nuts and berries)	- sustainability control: ensure sufficient regeneration of resource species and do only harvest a certain amount - if feasible: replant / take care of certain resource species	- establish threshold values of maximum utilization per area (may be based on experience and simultaneous monitoring)

Similar forests can be summarized into forest condition classes. These classes represent the current state of the forest. For every forest condition class there should be a defined forest development goal. The forest management aims to transfer the current forest condition class (present forest) into the forest development goal (future forest) by applying forest management measures. These measures form part of the guidelines and are linked to the forest condition class and the forest development goal.

Example 1:

Forest condition class "Degraded Juniperus Open"

Forest stand with 10-30% tree crown cover composed mostly of *Juniperus* spp. with or without small parts (<10%) of *Acer* spp. and other broadleaved tree species. Tree regeneration is not abundant, thus the continuity of forest on this area is not assured. Ground vegetation consists of grass or ground vegetation is lost and erosion effects can be found.

Example 2:

Forest development goal "Juniperus Close"

Forest stand with 30-60% tree crown cover composed mostly of *Juniperus* spp. with small parts (<10%) of *Acer* spp. and other broadleaved tree species. Tree regeneration of *Juniperus* spp. is abundant and regeneration of other tree species (*Acer* spp., etc.) can be found. Ground vegetation consists of grass, herbs and a more or less dense understory – no effects of erosion can be found.

Example 3:

Forest management measures for the transition from forest condition class "Degraded Juniperus Open" to forest development goal "Juniperus Close"

- Fencing for stopping of livestock grazing and enabling of tree regeneration.
- Planting of *Juniperus* spp. for quick regeneration of the forest and boost of forest's density.
- If needed, planting of small shares of mixture tree species (e.g. *Acer* spp).
- Stop of the extraction of timber or fuel wood to enable adult trees for maximum regeneration ability.

Based on the stand characteristics and the level of degradation a system of forest conditions classes needs to be elaborated. This needs to be based on reference values of the respective forest condition classes. For an objective basis information from forest inventory, forest management planning and reference plots can be utilized. The objective should usually be to develop the respective forest stand towards a non-degraded forest condition or forest conditions with relatively lower level of degradation. For this also reference values will be needed. In this context the concept of reference stand and reference plot, including research plots with the option to study different impacts of management measures (e.g. harvesting, planting) on forest growth, regeneration and development will provide useful information for a more precise definition of management guidelines per forest condition class. This can help to optimize the management in the forest areas. Such work could be conducted in close collaboration with research institutes and universities.

In order to allow a financial estimation of each measure the unit costs of each measure need to be listed. Table 7 (C3) just gives examples of certain management activities and some financial aspects related to this. This need to be differentiated into single management measures, unit costs and norms related to each activity (e.g. how many working hours for activity x). In this context also social aspects need to be considered (e.g. working conditions).

Local consultants:

A preliminary classification of different forest condition classes of the most important forest types should be elaborated based on expert knowledge of local consultants. Criteria for this

classification should be elaborated with an international consultant. Additional preliminary norms for the management measures need to be elaborated. Reference stands of the defined forest condition classes need to be selected and reference plots established. Repeated measurements will provide threshold values for the respective forest condition class. This can only be done after the establishment of such plots (in cooperation with Forest Research Institute and the Agrarian University). Develop and structure the overviews presented in table 7 (management measures). The indicative table of management measures needs to be developed to a complete list with approximate unit costs and financial evaluation. This needs to be crosschecked by a local economic expert (possibly Ismoil?).
The final goal in terms of guidelines is to have a complete catalogue of measures, the approximate unit costs per management measure and to have guidelines that incorporate ecological, financial and social norms.

C7: Goals check

Following the first planning phase, the planned measures in the catalog of planned measures are summed up and compared to the operational goals on *leskhoz* level. Do the planned measures exceed the operational goals, the catalog of planned measures can be accepted (e.g. 200 ha afforestation goal; 220 ha afforestation planned). But are the planned measures inferior to the operational goals, the catalog of planned measures needs to be adapted (e.g. 30 % of forest livestock clear goal; 20 % of forest designated to be livestock clear). See also D5 for the financial feasability.

C8: Pasture, Cropland, Gardens

Areas of the SFF land that are currently under use as pasture, cropland or gardens shall be leased to herders, farmers or gardeners. The *leskhoz* shall not manage these areas itself but concentrate on the management of forested land. However, the leasing of these lands is highly important for the generation of income to enable the *leskhoz* to manage the remaining SFF land sustainably. Some of the croplands are managed in a collective cooperation system that also involves *leskhoz* employees. For these areas, especially the pasture land, a simplified assessment of the quality should be further developed in the frame of “лесоустройство”. Like on the forested area the preliminary delineation shall be based on satellite and GIS data. A short assessment via a simple description form of non-forest area can be utilized in order to estimate the quality of the non-forested subcompartments. According to the feedback during the workshops (Dushanbe, Sept. 2015) the non-forested land of the SFF shall be assessed only in its basic features. A simple assessment form is attached in the appendices A_7.

Local consultants: The assessment form for the non-forest land and it the evaluation need to be checked and tested.

C9: Development of leasing scheme

A leasing scheme shall support the sustainable use of pasture, cropland and gardens by providing a framework of guidelines for the leasing of these lands. The leaser is given some directions on how to use the area that was leased. Most important land use type in this context is pasture because of its extent and the high amount of income generated with leasing pasture to herders. People or communities that lease pasture on SFF land must follow these guidelines.

To enable a sustainable pasture use, some general principles need to be obeyed:

1. Pasture needs time to regenerate after livestock grazing. For a sustainable use of pasture, livestock grazing must be suspended for some time. Therefore a rotation system shall be applied and only a certain percentage per year (indicative for example 75%) of the pasture should be made available for leasing each year.
2. Pasture has a maximum capacity of feeding livestock. In general this capacity depends on the amount of fodder that grows on the pasture area. This amount can vary between years and should be reviewed and estimated each season.

After the assessments of the non-forest land that is implemented simultaneously with the forest assessment the area of degraded and non-degraded pastures is available. The management can decide to rehabilitate the respective pasture or to change the respective landuse class. The non-degraded pastures can be utilized for the leasing scheme. Income generated from the pasture leasing should be used for rehabilitation measures, especially on the forested land.

Figure 3 provides a simplified scheme of the pasture management.

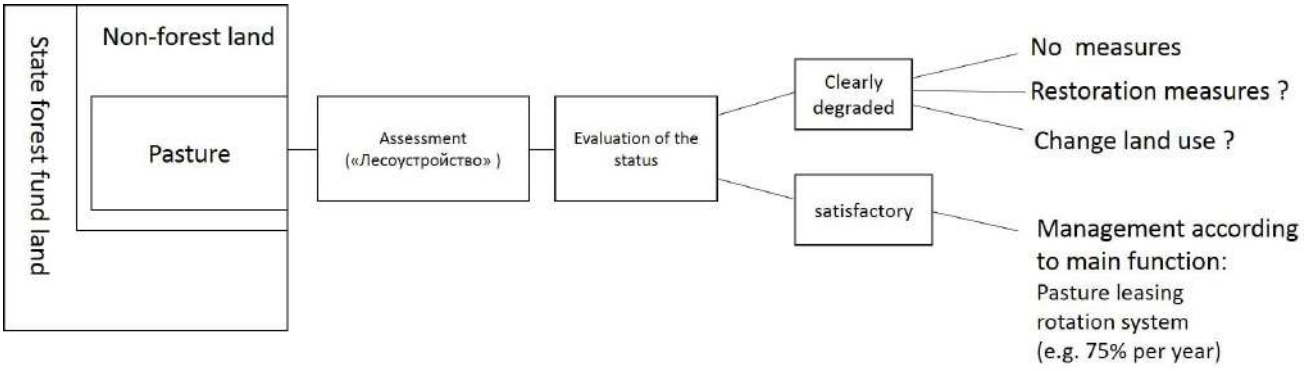


Figure 3: *Simplified scheme with respect to management of pastures of the SFF land.*

Local consultants: The leasing scheme should be further developed, including the development of treshold values (e.g. x livestock per hectare) and economic evaluation. A useful frame for the leasing scheme needs to be elaborated.

D: Business planning

D1: Budgetary funds

Budgetary funds are all funds allocated to the State Forestry Agency by the Government of Tajikistan (GoT) that can be used by the *leskhoz*.

D2: Planned income (incl. income from non-forest compartments)

The planned income of the *leskhoz* is based on the budgetary funds allocated by the GoT (D1) and on estimations for earnings from product selling, license selling or management of arable land (e.g. rice fields) and for example leasing of areas. The estimations are based on the catalog of planned measures per forest subcompartment on the planned area to be leased. All incomes are summed up to the leskhoz-level per hectare. The estimations for each stand or subcompartment can be adapted from previous years and experiences from the past, however should be calculated conservatively.

D3: Planned expenses

The planned expenses include costs for personnel, forest management measures and all other expenses that need to be paid by the *leskhoz*. The costs of the implementation of each task/measure appear at the leskhoz-level per hectare. All expenses are devided into cost units (e.g. costs for planting). The costs of each cost unit shall be devided into salary, non-personal costs and potential costs of contractors. The estimation of the costs will be based on reliable sources (e.g. from the Forest Research Institute). Finally the costs of all cost units per hectare are summed up to the leskhoz-level. Each cost unit is calculated for one hectare. With respect to forests it means the calculation to one hectare forest land and then to one hectare SFF-land. The relative portion of each cost unit with regard to the overall costs is calculated. It is important that the administrative costs form an own cost unit because these are fixed costs, that occur permanently. A buffer for unexpected expenses should be added to the estimation.

Calculation of one afforestation/planting example

The number of seedlings depends especially on the selected species and management. For poplar for example 5000/ha is a common number, whereas a Pistachio-plantation is afforested with approximately 330/ha. For Juniperus, depending on the planting scheme, less than 1000/ha are recommended. Table 9 shows a preliminary cost estimation for planting poplar. Based on this calculation the costs amount for 9750 TJS. However, according to other experts the costs can be clearly below 7000 TJS per hectare. It largely depends on the price of the seed stock and planting hole. Table 10 provides an overview of a cost calculation of Juniperus. Depending on costs per seedling the calculation may be result in much lower costs (table11).

Table 9: *Example of a calculation of poplar (vertical planting; numbers received from a local consultants); costs in Tajik Somoni (TJS).*

Working task	number	unit	TJS/unit	overall costs (1ha)
Preperation of the area	1	ha	400	400
Preperation of planting holes	5000	pieces	0,8	4000
Irrigation	3	worker	100	300
Plants (shoots)	5000	pieces	0,8	4000
Transport	1	car	50	50
Tending (especially irrigation, 1 year)	2	worker	500	1000

Table 10: *Example of a calculation for Juniperus (numbers received from a local consultants); costs in Tajik Somoni (TJS).*

	unit	price/unit in TJS	required amount per ha	sum	overall costs (1ha)
Collection of seeds	kg	150			
Price per seedling (form nursery)	1 piece (20-30cm)	20	625	12500	
Planting costs	piece	1,5	625	937,5	13437,5
Transport (car)	km	8	200	1600	**15037,5**
Transport (donkey with keeper)	day	30	5	150	**15187,5**

Table 11: *Same calculation as in table 10 only with changed unit costs (price per seedling: 10 TJS) and transportation costs (8% of overall costs) based on some general expert estimation); costs in Tajik Somoni (TJS).*

	unit	price/unit in TJS	required amount per ha	sum	overall costs (1ha)
Collection of seeds	kg	**150**			
Price per seedling (form nursery)	1 piece (20-30cm)	**10**	**625**	**6250**	
Planting costs	piece	**1,5**	**625**	**937,5**	**7187,5**
Transport (8% of overall costs)				**575**	**7762,5**

Currently there is no capacity in the nurseries for larger large scale afforestation. Only poplar plantations can be implemented fast (vegetative via shoots). Also concerning Juniperus the seed collection and germination is connected with some difficulties and requires special knowledge, preparation and time. Special attention needs to be paid to the species. Some of the nurseries breed especially plants for the greening of towns. These are often different species than the native ones in the higher mountains. Much cheaper than afforestation would be soil preparation onsite in order to facilitate seed germination (costs are estimated to account for about 10 % of the costs of planting).

Local consultants: An excel sheet should be developed that can be used as overview in terms of cost calculation, revenue and workload (e.g. hectare) of each activity, also with reference to the respective budget classes (implementation: Ismoil?).

D4: Balance

The final balance is calculated at the leskhoz-level. The costs of all cost units are summarized at the leskhoz-level and compared against planned income (all summarized income of the leskhoz). If this difference is positive, all planned expenses plus a security buffer can be paid by the expected income and the catalog of planned measures can be approved. If the difference is negative the catalog of planned measures has to be adapted for the expenses to meet the planned income (D5). An example of a final financial plan on leskhoz level is presented in the appendices (A_8).

D5: Adaption of catalog of planned measures

If the balance (D4) of planned income (D2) and planned expenses (D3) on leskhoz-level is negative, the catalog of planned measures cannot be realized due to insufficient funds. Therefore the management planning and consequentially the catalog of planned measures must be adapted. However, the adaption has to consider the objectives of management of the forest administration. The financial evaluation should be compared to the formulated goals. This means that important activities, which create no income, but high costs for the leskhoz in the current season (especially afforestation), should not necessarily be cancelled but financed by external sources (e.g. financial support in the frame of international cooperation). Measures that have a positive net marginal income should be planned in addition to the already planned measures to increase the planned income. The adaption of the catalog of planned measures due to business planning aspects needs to be done parallel to the actual planning of measures in forest compartments (C3).

A form of planning objectives on the leskhoz-level that includes ecological, economic and social performance indicators was developed by GIZ and a local consultant and is presented on the example of the leskhoz Penjikent in Appendices A_9. The indicators can also be used for controlling.

E: Application and controlling

E1: Application of planned measures (10 years)

After the planning period, the application of the planned measures takes place. Each land use plan is usually produced for 10 years. For the starting period, however, a shorter timeframe (e.g. 5 years) may be more useful. It is recommendable that the planned measures, however, are controlled earlier. This especially accounts for afforestation measures. We recommend to control afforestation at least 2 times: the first time directly after the planting and a second time after three years.

E2: Controlling

After the application of the planned measures (E1) the aim of controlling is to check whether all planned activities have been executed or not. Discrepancies between planned activities or quantities and realized activities need to be investigated to learn for coming planning periods. Often there is a difference between planned and realized amounts (e.g. exact m³ of extracted fuel wood), which is not necessarily a result of poor planning. Executed measures are noted in the catalog of planned measures and compared to the planned measure. This comparison can be implemented in a record book. Each afforestation should be controlled by an expert after the implementation and in the third year. The overall results of the record book, which provides an overview of the carried out activities are to be saved in the respective leskhoz and forwarded to the national forest agency.

Example of an entry in a record book:

Planned: 5 hectares afforestation in compartment x in stand y

Carried out: only 3.5 ha implemented; 1.5 ha were baren land and not suitable for afforestation

Controlling of certain management tasks:

The management tasks can be implemented by leskhoz-staff (e.g. foresters), contractors, private investors (in the frame of leasing contracts) or via JFM-schemes. But the control of a certain task (e.g. planting, timber harvest) needs to be carried out by external specialist. At least for larger or more important tasks this should be done by experts in the respective field, which belong to supervising institution (e.g. the Forest Agency or the Forest Research

Institute or a Forest Inspectorate). The control system also needs threshold values in order to define what are only minor or major mistakes or a complete failure. A strict control scheme, which enables a supervision during the process is especially recommended for planting and rehabilitation measures. Especially in the first years it is highly recommended to do the management control jointly with foreign specialists. This will not only guarantee success of certain implementation activities (e.g. planting). A good control system will also satisfy potential donors of financial assistance, ensure project evaluation and simultaneously provide capacity development of the respective staff involved, so that the national institutions of Tajikistan can step by step adopt the responsibility for the full supervision.

Local consultants: The integration of the presented approach into different management models (also including JFM) needs to be further elaborated. During the process of testing the methodology and directly afterwards the further involvement and responsibilities of institutions (data keeping, controlling etc.) need to be clarified. Threshold values for the controlling need to be elaborated and tested. A record book, which compares the planned and executed management measures on subcompartment level, should be designed and tested (see E2).

III GENERAL FINDINGS, RECOMMENDATIONS AND REMARKS (Wolfram Grüneklee and Alexander Gradel)

The national strategy on the forest sector development defines forest management. This definition focuses on the assessment in quantitative and qualitative terms and highlights data reliability as the planning basis of forest management and reforestation:

> "*The Forest management is a system of arrangements on accounting, assessment and forest management planning, aimed at improving the forest management and utilization of forest resources. Carrying out the forest surveying of forest husbandries and especially-protected natural areas in the Republic of Tajikistan will allow to do the quantitative and qualitative assessment of availability and conditions of forest resources and of the biodiversity of the country. Obtaining of the reliable data about the territory of forests, their entirety, stocks of the standing timber, their sanitary conditions will allow to correctly planning work on the forest management and reforestation" ("The Strategy on the Forest Sector Development for the period of 2016-2030"; chapter: Stocktaking, forestry management and monitoring*).

This quotation highlights the need of a reliable data basis and a new frame of forest inventory and management in Tajikistan.

Important feedback of participants (see table1) during meetings and workshops

During the meetings and the workshops different forest inventory methods (e.g. sample plot inventory vs. inventory stand-by-stand) and the contents of the different methods and the data – storage of the collected data were explained and discussed with national authorities. The participants gave the following feedback:

- The inventory shall be carried out stand-by-stand, beside the forest area the non-forest area should be inventoried, too. There should be a planning for every area (forest or non-forest land). To get further and more exact information – especially about the increment – a fixed sample plot inventory should also be implemented.
- The data shall be entered in Excel or Access – software (e.g. Open foris) which can transfer the entered data in an Excel/Access format are also permitted.
- It should be the task of the Forestry Agency to safeguard and keep the data-files in a data base.
- The participants agreed on the contents of the inventory and agreed on the classification of the assessment intensity (see chapter II*).*

- The results of a forest inventory and planning (collected stand-by stand) shall be summarized in a final report (Forest Management Plan), of which a part represents the business planning. The business planning should assign the planned activities to costs and revenues; with that expenses and revenues can be assigned to different cost units (see Business/Financial Plan).
- The participants agreed that the executed activities must be checked. To this purpose all activities must be recorded in a record-book. The State Forest Inspectorate (not yet implemented) will perform the supervisory function.

Main findings from the field trip in the project area Penjikent

The area of SFF Penjikent is divided in about 13.000 -14.000 ha forest area, 33.000 ha pasture, 1.500 ha water, 113 ha arable land, 100 ha garden and 59.000 (!) without use, overall about 108.000 ha. Over 80% of the forests are stocked with more or less open Juniper-forests. The sample point inventory indicates a mean volume of about 10 m³ timber each ha (data: Sample plot inventory from B. Ilnazorow; see table 12).

Table 12: *Overview of some specific values of the* fixed *sample plot inventory in Penjikent (largely based on the presentation of B. Ilnazarov). *= forest cover estimation based on old data from Soviet-time.*

Forest area (ha)	N sample plots	Involved workers	Time frame (days)	Grid width	Time (1 sample plot)
13000-14000*	183	12	20	1 x 1 km; (in Tugai: 0.5 x 0.5 km)	45-50 min.

The staff the leskhoz Penjikent consists of 32 permanent employees and 12 temporary staff. The salary of the employees is very low, the management of the paddy-fields contributes most to the income besides the salary. The Juniper-forests almost exclusively has protection function, only on a small scale the use of fuelwood is permitted. Only in the Tugai (riparian area) of the SFF Penjikent, although these forests are identified predominantly as nature reserves, logging is allowed on a small scale. The income from the lease of the pastureland is also low, too. In the direct forest officer's and the ranger's opinion investments should be made in the afforestation of the protection forests for the income improvement: To get seedlings sufficiently, new tree nurseries should be established or old tree nurseries extended. For this purpose the enterprise needs new machines, e.g. a tractor and other tools. At present, no money is available for afforestation, the money should be provided by donors.

- Experiences from the field inventory in Penjikent:

- The standing volume (m^3) and the increment of the Juniperus forests are very low, the forests will be managed only as a protection forest in future as before. A low fuelwood-use as well as a low pasturing are possible.
- The slopes are very steep, partially covered with scree, it is often not possible to walk on these areas; many areas don't have access either.
- Juniperus trees are forming small groups (clumps) with about 6-10 stems, which have a common canopy. The clusters of trees lie scattered over the stand. Therefore it is not possible to deduce the basal area of a Juniperus stem from the crown projection, which could be withdrawn from an aero picture.
- It is possible to assess many stands visually via expert judgement.
- Due to the collected inventory data, statements concerning the degradation, suitability for an afforestation and statements concerning the pasture can be made.

- Further education of the inventory teams: During the field-visit the experts were accompanied by the inventory team of the sample plot inventory in Penjikent. The level of training was good, though they need a further training to be able to train other inventory teams.

Advantages of the proposed outline of forest management planning *(«лесоустройство»)*

We see the following advantages of the proposed methodology (see chapter II):

- There are different approaches included: On the one hand the division into compartments of the Soviet-FMP will be retained; on the other hand: with the modern methods of remote sensing (analysis of satellite pictures, GIS) many tasks can already be carried out in the office. Due to the difficult terrain conditions in Penjikent, the main field of inventory should be carried out in the office - particularly with regards to the classification of the forest area (division in forest land – non forest land, classification of forest land after percentage of the covering). However the field trip of the forest inventory teams is very important, for (I) a ***quantitative*** survey of the stands (site factors, e.g. slope, direction, information about the trees; e.g. number, height, basal area, volume, health, regeneration, other vegetation) and (II) a ***qualitative*** survey of the stands (e.g. endangering of erosion, degradation).
- The inventory teams should be accompanied by the forest rangers on the field trip. Due to the experiences of the inventory teams (especially the international expert), the tasks and objectives of an inventory will be understood and accepted by the forest rangers/forest staff much better if they are involved in inventory. By the exchange of

information with the inventory teams the forest rangers can also improve their forest knowledge.

- Another advantage of the method is that it is not rigid, but can be used “situation-related”, that means: dependent on the coverage of the stand, the steepness of the slopes, etc. the inventory can be carried out as an estimation, as an inventory with low or with high intensity. The intensity of the inventory will be assessed in the office.

General recommendations

Establish a forest inventory office in Tajikistan supported by international experts

Making Tajikistan independent of foreign experts, a national forest inventory office should be set up. To this purpose the local consultant TAJIKLES-service takes over this task for the time being. While the short time expert was in Tajikistan, there was already an office with a suitable equipment; there was a lack of trained employees, though. In the early stage of development, TAJIKLES-service will need help from international experts. We suggest to send besides short-term consultants also a foreign “long-term-expert” (e.g. CIM).

Besides forest management planning via the local stand by stand approach («лесоустройство»): Implementation of a national forest inventory

A national forest inventory is essential to get an overview of the status of the forests of Tajikistan. Such an inventory will provide baseline information, not only for future monitoring but especially also for the impact of large-scale rehabilitation projects. Using a National Forest inventory it can verify also, whether the goals and objectives of “The Strategy on the Forest Sector Development” are realistic or not. The base for an inventory design/for the inventory method already exists: Behrus Ilnazorow has modified an inventory method/inventory software and adapted to the conditions of the Tajikistan Forests in cooperation with the enterprise “Forest Eye” (University of Göttingen). The method is a “fixed sample plot inventory” based on a grid 1000mx1000m. The software “Open foris” was can be used for the data storage. A first inventory was carried out in SFF Penjikent. The inventory should be extended over the whole country as soon as possible. The collected data will be stored in a data-base and this will be managed by a respective national authority, for example the Forestry Agency. This inventory will allow a systematic monitoring of the overall forest conditions in Tajikistan.

If the two inventory forms (national level: fixed sample points, local level: *stand by stand approach («лесоустройство»))* are well implemented Tajikistan will have a reliable basis of specific data that can be used not only for forest management but also for more complicated

estimations (e.g. carbon sequestration). National Forest Inventories are carried out in many countries, e.g. in Germany.

Train and control the inventory teams

The inventory teams should be trained by skilled experts, also during the inventory the experts should advise and check the teams.

The ***national forest inventory*** will be carried out as a "fixed sample plot inventory", the methods are developed and already tested (s. above). The execution/implementation is carried out according to the regulations and shall not be further described here.

The ***local forest inventory*** (on oblast-level of SFF-land; *basis of forest management planning («лесоустройство»)*) will be carried out as an inventory stand-by-stand. The implementation measures and contents are described in detail in chapter II of this report.

Staff needs to be trained for both activities and each inventory needs to be controlled by supervising experts.

Support afforestation – support SFF and local population

It has already been described that the measures are limited in the forest sector of SFF Penjikent. The logging as well as the provision of fuelwood over the medium term cannot be increased. But there are other options, e.g. afforestation. But there are currently not enough tree nurseries for the production of seedlings. Therefore, the afforestation of the degraded forest is the main opportunity to increase the productivity of the SFF Penjikent: If the afforestation area is extended considerably, more seedlings will be provided.

On the one hand these measures will promote the SFF, because new tree nurseries must be established and the existing tree nurseries must be extended respectively. For this purpose the leskhozes and potential private companies will need new machines, e.g. a tractor and other tools.

On the other hand these measures will also promote the local population, because the planting and the tending of the seedlings can be carried out only with the help of the local population. How the local population can be involved into this concept, e.g. in the frame of "Joint Forest Management" or other projects, should be discussed with the stakeholders. The local population also should be informed about the great importance of the forest restoration.

Despite the great importance of the forests, the government of Tajikistan cannot provide sufficient finances for the restoration of the forests. At present the money should be provided by donors.

About the implementation of the Forest Management Plan (FMP)

The final FMP includes: the forest inventory, the activity plan, the business plan and the determination of work load, as well as maps to the subjects for land-use (forest land, kind of forest land (Juniperus, Tugai…; non-forest land, e.g. pasture, arable land), planned activities, site factors, digital terrain model etc.; the maps can be generated by GIS (different thematic layers for the different topics). The FMP should also contain an explanatory report, about the inventory, planning and measures being explained in writing; the soviet FMP, which was done in 1982, also included an explanatory report. The FMP should be approved by all authorities and other stakeholder like local NGOs and the local population. By the approval of the plan the forest district has a planning reliability for the next 10 years.

Implementation of a record book ("Kontrollbuch")

Each measure should be recorded in the record book. The measures carried out have to be notified to the Forest agency annual. In addition a check should be conducted by the Forest inspectorate regularly (in spite of existing legislative framework, the State Forestry Inspectorate has not been established yet). GIS-maps could help to illustrate the state of processing at implementation of the planned measures.

Implementation of the concept of reference stand and reference plots ("Weiserflächen")

As many sites can be expected to have low forest cover or are hardly accessible an additional concept is recommended. The concept of reference stand and reference plots (see description C1 and Appendices A_1) is suitable for several reasons in Tajikistan:

-It provides base line information on forest structure and regeneration for larger areas (e.g. important in case of inaccessible, homogeneous stands).

-Long term monitoring will provide information the information on increment, which is needed for sustainable forestry.

- Reference plots in undisturbed forests allow for an evaluation of the level of degradation of other sites.

- Long term monitoring of forest structure change in the frame of climate change.

- On some of the plots certain management measures may be tested (for example fencing, selective cutting etc.). The impact of these measures (e.g. on regeneration) can be monitored. Results can be utilized for concrete management guidelines of certain forest types.

- The work on the plots can bring together different national and international institutions

Potential cooperation partners

Forest Research Institute

The Forest Research Institute expressed interest to cooperate with international partners to conduct relevant activities. This especially includes the following options:

- establishment and standardization of reference and research plots for many purposes: e.g. to provide baseline values of forest types under undisturbed conditions (the level of degradation of many forests in Tajikistan is unknown yet), to measure increment (there is no reliable information on this yet), or to study grazing impact;
- improving methodologies for growing different tree species (e.g. in nurseries)

For each cooperation topic always one employee of the Institute and an international partner should work together. Depending on the tasks partners may be: Universities, research institutes (e.g. NW-FVA), or forest administrations.

Forest inventories:

Domestic as well as international experts expressed the need and wish to carry out inventories in the nearer future. Tenders from respective donors usually demand a joint submission from a domestic partner (e.g. a domestic consultancy like TAJIKLES-service) and a foreign partner with the respective expertise (e.g. a forest administration like HESSEN-FORST). It is recommended to implement two types of inventory: a “fixed sample plot inventory”, which has already been tested in Penjikent shall provide a monitoring basis for assessment of the forest status. Recently a manual has been written and the method has been approved by the Forestry Agency. Secondly a local “stand-by-stand” inventory needs to be carried out as a stand-by-stand assessment. The implementation measures have been discussed and outlined in the flow chart description (Forest management planning («лесоустройство») on state forest fund land in the Republic of Tajikistan (outline).

Afforestation:

Domestic as well as international experts expressed the need and wish to carry out inventories in the nearer future. Afforestations can be conducted by local firms (e.g. a domestic consultancy like TAJIKLES-service as coordinator). However, the control will need to involve not only a domestic supervising authority (e.g. State Forest Inspectorate, Forestry Agency or Forest Research Institute), but also international experts. With regard to afforestations the control should be implemented directly after the implementation and then after a couple of years (e.g after three years). The success (e.g. survival rate and approximate growth) should be assessed. Based on this a bonus may be paid to the involved staff. The capacity of nurseries is not sufficient yet to provide enough seedlings for the larger afforestations.

IV CHRONOLOGICAL OVERVIEW OF THE MISSION (Alexander Gradel)

Week 1: 02.09.2015 - 06.09.2015

Travel to Dushanbe and meeting with the responsible GIZ-teamleader Kathrin Uhlemann and Behruz Ilnazarov (GIZ, national employee). I received a briefing about the conditions and objectives of the local consultancy TAJIKLES-service. TAJIKLES-service has been founded in 2015 and has the option to become the leading forest consultancy of the country. The foundation of a consultancy was also necessary in order to facilitate the cooperation between GIZ and state institutions.

TAJIKLES-SERVICE (October 2015):
- founded with support of GIZ;
- TLS has own office in Dushanbe;
- the name refers to the Tajik forests ("les" is the Russian word for forest);
- provides consultant services on issues related to forestry and environment;
- steering board is in development;
- current numbers of employees: 2 + one GIZ contact person.

forest management planning on the state forest fund land, as the last planning basis ("Forsteinrichtung") is from the beginning of the 1980ies, when Tajikistan was part of the Soviet Union. We reviewed the old technical maps and respective data from the last assessments in the province Penjikent. For the description of the main steps of a new forest management planning a flow chart was provided. During the first meeting and discussion with respective experts (including a GIS-expert) the flowchart and some first descriptions of a former GIZ-intern and student from Göttingen were adjusted. Based on this and the feedback discussions with national experts I drafted a first preliminary version of the flow chart description for translation into Russian. In order to get some reliable measurement data the potential usage and design of sample plots was discussed. I also got familiar with different other technical maps of the project region Penjikent and the distribution of the State Forest Fund (SFF)-land (see figure 4).

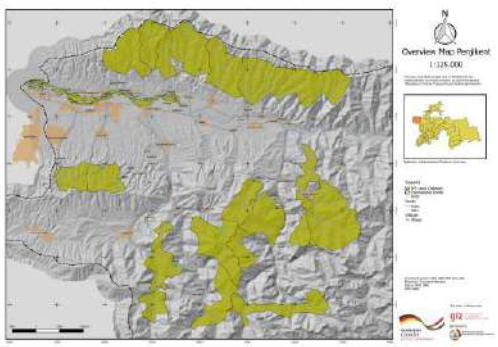


Figure 4: *Map of the project region Penjikent with SFF-land in green.*

Week 2: 07.09.2015 - 13.09.2015

The second week focused especially on the explanation and discussion of forest management planning with the help of the flow chart. This was largely implemented by every day single experts from different state organizations (Forestry Agency, Forest research Institute, Agrarian University Plant genetic Research institute, and free lancers who had special fieldwork experience). During these meetings I also collected feedback and impressions from the different experts. Every participant received a printed version (in Russian) of the preliminary flowchart description as well. I asked them to read this text until next week and to think in advance in what working group the respective specialist wished to attend (according to the themes in the flow chart). In the mean time I collected and compared information on NTWP-assessments. The information from Soviet-time seemed to be especially useful. We also planned workshops with different working groups for the next week. The different experts largely relied on the Soviet based system. This knowledge is theoretically still known but not fully practiced as the data basis for the planning is increasingly outdated and funds and capacity are low. For example even the salaries of the most employees are not sufficient to secure their livelihood. There exists basically no budget for larger operational or scientific work. It became clear that forestry in Tajikistan largely lives from the substance of the Soviet-time. Not only forest management planning but also all other related information and institutions are largely relying on the substance of the Soviet-time. There is actually only a very small number of forest experts left in the country. Apart from examples of German financed field work (inventory in Penjikent) field experience hardly exists. Forest management planning needs a “stand by stand” approach. Descriptive assessments (e.g. “Waldbegang”) however need well trained forestry experts. Such specialists are hardly available in Tajikistan. Therefore measurement activities that provide verifiable data are desirable, if the area is accessible.

The feedback made clear that updated information on the State Forest Fund (SFF)-land is needed and any kind of inventory is welcome. All experts recommended to include the available information of the assessments from Soviet-time. Also the feedback made clear that non-forest areas in some way also need to be included in the assessment.

Week 3: 14.09.2015 - 20.09.2015

An inventory with sample points (grid: 1x1km) was carried out during spring 2015 in the project region Penjikent. The sample point inventory was conducted based on a methodology from Forest Eye GmBH, Göttingen. After the arrival of the short term expert (Mr Grüneklee, HESSEN-FORST) the results of the fixed sample plot inventory were presented by Behruz Ilnazarov (GIZ and main contact to TLS) to various Tajik experts (see table 1). Preliminary results were presented and give a useful first overview of the forest conditions of the forested areas of the SFF-land in Penjikent. The preliminary results indicated rather low average stem numbers (about 60 stems/ha) and on average a very low basal area and volume. The very low number of the plots in the Tugai-forest resulted in an extremely high standard error. Also the number of sample plots compared to the area size is low. The province has a size of about 108000 ha. The area of the forest cover has only been estimated (see table 12). However, there was no control of the work of the inventory teams executed. Control needs to be improved in any assessment task in the future.

During the next days different methodological approaches were discussed with Mr Grüneklee, who provided very useful feedback on different topics. We conducted two workshops and invited Tajik experts for these meetings. According to the workshops the group were split up into two working groups: One group focusing on map preparation, field assessment and management measures (workshop I, 17th of Sept.) and a second group focusing on business planning and some issues related to non-forested land (especially pasture), and the integration of the objectives of the Forest Sector Strategy of Tajikistan onto the leskhoz-level (workshop II, 19th of Sept.). During the first workshop all participants voted for an approach to combine new technologies (satellite information and old information form Soviet-time). Especially the old compartment maps seem to be useful for the delineation of the administrative units. The feedback of both workshops was included into the final flow chart description. After workshop II Mr Grüneklee, I and several Tajik experts, especially from the Forestry Agency participated at a farewell gathering for Kathrin Uhlemann (GIZ- team leader). Every participant expressed his gratitude for the work and achievements of Kathrin Uhlemann. We prepared the field trip for the next week and worked on preliminary field forms.

Week 4: 21.09.2015 - 27.09.2015

Together with the field team Mr. Grüneklee, Mr. Ilnazariv and I drove to the project region Penjikent. Already on the way it became clear that Tajikistan is an extremely challenging country in terms of any field work related to forests. Forests in Penjikent especially consist of different Juniperus species and are situated on very high and steep slopes. Most of these areas are higher than 2000 metres above sea level. Before starting the field visits and training of the field crew we met with the representative of the local GIZ-funded NGO and then with the respective Director of the leskhoz. We explained him our objectives during the visit and asked questions about the leskhoz in order to get an overview. After this we met with the respective district forester, and a local forester, who presented his small nursery (including Juniperus), and his fruit and nut tree plantations. On the next day we drove with another local forester in the mountains and started our field work. We selected two forest stands with different density and together with the Tajik field team, Mr. Ilnazarov and the local forester conducted a field training. We used our prepared field forms and data sheets. As the Tajik members had already participated in the above mentioned inventory (1x1km grid) there was a good understanding of inventory issues, but the structuring of the field work was also important.

During the field visit it became clear that the previously formulated idea to differentiate the assessment intensity into different classes according to accessibility makes sense. It also became clear that inaccessible forest stands may be described via a distant description from another accessible position in the area. Such a description can be conducted with a good binocular. See figure 5-7.

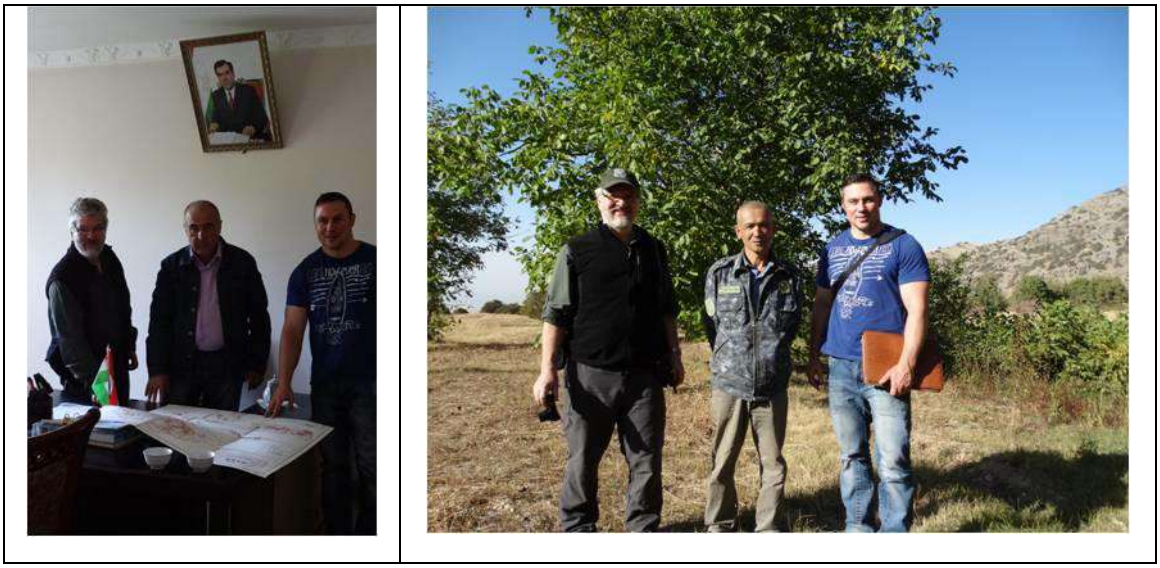


Figure 5: *Discussion with the Director of the leskhoz Penjikent (left) and a local ranger (right). Photos by B. Ilnazarov and H. Qadamshoev.*


Figure 6: *Juniper-forests in the project region. Photos by W. Grüneklee*



Figure 7: *Photos taken during the field training and test of the descriptive forms and data sheets in the northern part of the Penjikent province; Kolkhoshonskoe lesnitchestvo (Photos by W. Grüneklee and U. Nazarov).*

Week 5: 28.09.2015 - 05.10.2015

Members of the field crew invited me to the Forest Research Institute. I had a long discussion with the Director of the institute (*Nurali Khisainov*) and we especially talked about different inventory approaches and what especially might be necessary for the development of the forests in Tajikistan (figure 8). In the following days I had final meetings with K. Uhlemann and B. Ibele on issues related to TAJIKLES-service. Besides writing on the final version of the flow chart description I used the time for additional meetings with specialists from the Agrarian University where we discussed potential management measures, especially related to the project region Penjikent and issues related to the Juniperus forests. For afforestation or enrichment planting sufficient seedling material is needed. This is currently hardly available. A seed breeding center needs to be established for the seed collection and preparation (e.g. stratification etc.). It is important to know where and when to gather the seeds and to organize this. Further the quality of the seeds needs to be checked. From this centre nurseries should receive seeds. Nurseries need to be established. Currently there are no nurseries with young Juniperus trees larger than 0.5 ha. The main species in the mountains is Persian Juniper (*Juniperus seravschanica*). In the nurseries mostly other species are breeded. Nurseries with sizes larger than 1 ha are needed to provide sufficient material for the planting activities.

I finally included the feedback from Tajik and German experts, sent the last draft version of the flow chart description to the mentioned coauthors for acceptance and for comments and finalized the descriptions: Forest management planning («лесоустройство») on state forest fund land in the Republic of Tajikistan (outline); *Gradel A, Ilnazarov B, Mahnken M, Grüneklee W*). This document is part of this final report. The Tajik partners expressed their interest to test and elaborate a final methodology.

V APPENDICES:

A_1: THE CONCEPT OF REFERENCE STANDS AND REFERENCE PLOTS

The concept of reference stands with a core area (reference plot) that is representative for common stands is applicable for the objective of continuous cover forestry, especially in remote areas. Reference stands and plots allow forest specific analyses and evaluations. A main purpose of the concept is that the measurements provide reference values for larger forest areas. One or several reference plots are established on representative sites of the reference stand and should have a rectangular shape as the systematic distribution of regeneration sample points is then eased. The minimum size should be of 2500 m² (50 by 50 metres). In order to facilitate re-assessments and the analysis of scientific questions all tree positions are to be mapped. Based on practical considerations the plot should be established on a subjective representative site, although this may not be correct from a statistical point of view. But the random installation of plots can easily conclude into senseless assessments of uninteresting areas for forestry. The selection of the site is easier if ordinary measures of the forest are already known (e.g. approximately species and age class distribution; in Penjikent this information is now available based on the inventory). The number of plots depends on the financial resources. In scientific literature one reference plot per 1000 ha forest is recommended. The monitoring of the core area in the reference stand (the reference plot) allows for the controlling and assessment of small and large scale changes, dynamics and trends or the assessment of a forest conversion. The comparison between reference stands in unmanaged and managed forests of the same forest type also allows adjustment of management towards more natural conditions. For example: In Tajikistan the level of degradation and the potential of Juniperus-forests can only be assessed if the values of managed forests are compared against reference values of undisturbed sites. The closeness to naturalness of a managed forest could be assessed and controlled through such comparison methods; if natural defined forest stands are still available.[1] Based on this realistic target values for the degraded stands can be formulated and increment and other variables that are important for the management can be obtained. Increment is a main criteria for the planning of a sustainable forest management.

[1] A basic problem nowadays, especially in areas with potentially largely degraded forests as in Tajikistan, is the definition of the natural reference conditions. The closeness to nature may be described through the assessment of anthropogenic impact or through the comparison with natural reference sites. These values provide then a baseline for the estimation of the level of degradation.

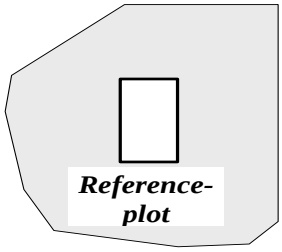
		Purpose	Assessment
Reference stand 	***Reference plot***	- orientation for impacts - utilisation planning - assessment of degradation	- tree species - tree positioning - BHD, height - crown onset height - price assessment - regeneration inventory
	Reference stand	- education - view object - silvicultural concepts	(an inventory of the reference stand is not necessary)

Figure A1_1: *Reference stand and reference plot. Forest spatial structure should only be assessed in the reference plot (species, tree positioning, DBH, height).*

Figure A1_2: *Example of reference stands and reference plots; the design depends on the management and monitoring objectives. (left: larch stand Mongolia; partly with different management treatments: unthinned, low and medium thinning intensity; established in the frame of the FAO-project GCP /MON/ 002/NET; right: during field work in Southern Siberia, Russia; established with the Buryat State Academy of Agriculture in Ulan-Ude).*

A_2: COMPARSION BETWEEN FIELD ASSESSMENT AND SIMPLE YIELD TABLE FROM TSSR-TIME (Juniperus forest, Penjikent)

Table A_2: *Comparsion between our measured values on the 0,1 ha plots and respective values from a simplified yield table from the TSSR-time. The comparison indicates that the table is usable for satisfactory estimation of stocking volume, if tree height is known.*

	Measured and calculated values; field training Sept. 2015			**Simple yield table from TSSR-time**		
	average tree height measured (m)	basal area "G" (m^2) / ha	volume (m^3) with general ff 0.5	tree height class	basal area (G) / ha	volume (m^3)
plot 1	5,8	13,7	43.1	6	11,9	38
plot 2	3,34	6,2	10,9	3	4,3	9

Photo by Umed Nazarov (Tajik Forest Research Institute, Dushanbe)

Photo by Wolfram Grüneklee (HESSEN FORST)

Figure A_2: *During the field training in the Juniperus forests in the province Penjikent.*

A_3: DESIGN OF SAMPLE PLOTS

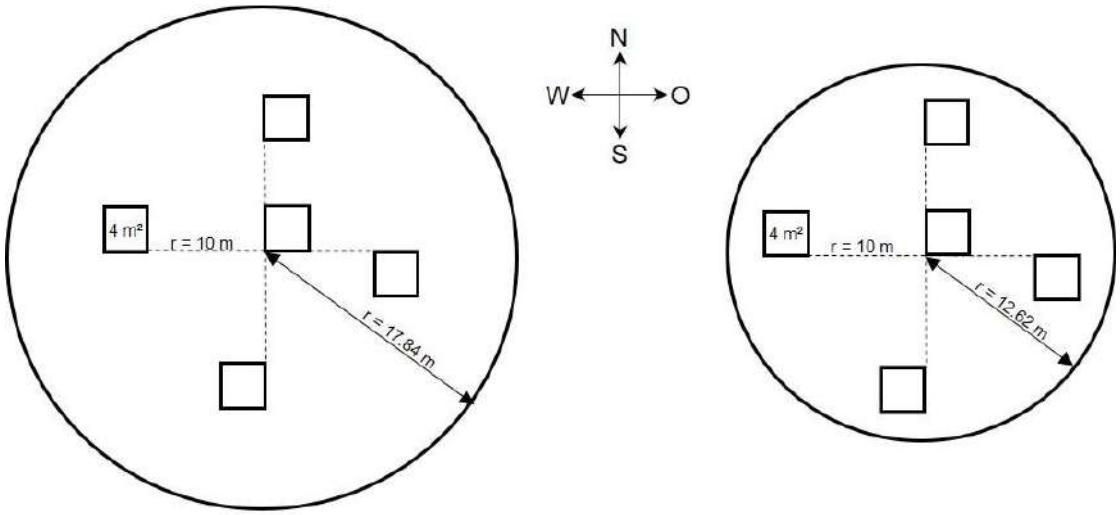


Figure A_3: *Sample plot design for the stand assessment (with r=17,84 m; 0.1 ha, and r=12,62 m; 0.05 ha.). Regeneration class 1 and 2 are assessed in the 5 square plots.*

A_4: LIST OF EQUIPMENT

Table A_4: *List of technical equipment.*

Overview/road map of the region
Copy of old technical map (1980ies)
basic measures/values of the single subcompartments of the last inventory
new preliminary technical map (based on old compartment borders and GIS-based delineation)
Description / manual of the assessment
5 pens and field froms (Stand description form, data sheets of the sample points, non-forest description form)
GPS
Diameter tape or calipper
VERTEX measuerment system (Ultrasonic height and distance measurement instrument including stative)
2 m wooden pole with colored marks at 50cm, 100 cm, 130 cm and 150 cm height (overall 3 poles)
binocular
Compass (Suunto-bussol)
Teleskopmesslatte / -stange
Oil pastel / roll to mark trees
Tape 10 m
4 batteries for replacement
first-aid kit

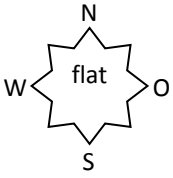
Every worker will carry a pole (2.00 m), which can also be used as walking stick. This is especially useful in mountainous terrain. The pole contains clearly visible marks in different colours for certain measurements: the heights for the regeneration classes and DBH. The poles can also be used to frame the regeneration squares.

A_5: DATA SHEETS FOR THE ASSESSMENT ON THE SAMPLE POINTS

Field Form stand description– based on Draft from - ForestEye Reserach GmbH, Goettingen (adapted)

STAND				
TEAM		**Intensity of assessment**		
DATE		☐ high ☐ medium ☐ only descriptive		
Forest district (leskhoz)				
Compartment		XGPS		PDOD / Error:
Stand		YGPS		
Stand area (ha)		HSL		

Site factor

ASPECT	**SLOPE**	**POSITION (SLOPE)**	**TERRAIN**	**SOIL**	**EROSION**
	☐ 0 - 10 ° ☐ 10 - 20° ☐ 20 - 30° ☐ 30 - 45° ☐ 45 – 60° ☐ > 60°	☐ Top ☐ Upper slope ☐ lower slope ☐ lower slope ☐ valley ☐ plain	☐ very concave ∪ ☐ concave ⌣ ☐ flat -------- ☐ convex ⌢ ☐ very convex ∩	☐ sand/stone ☐ bare soil ☐ humus layer ☐ grass _____ ☐ < 10cm soil depth ☐ >10 cm soil depth	☐ no ☐ slightly ☐ serious ☐ heavy

STAND

FORST TYPE	**ORIGIN**	**VERTICAL STRUCTURE**	**CROWN CLOSURE**	**MANAGED**	**MATURITY**
☐ Pistachio ☐ Riparian/Tugai ☐ Juniperus ☐ Broad-leafed ☐ Xerophytic	☐ **natural** ☐ **planted** ☐ **both**	☐ one layer, same height ☐ one layer, var. height ☐ multiple layers ☐ var. structure in gaps ☐ complete variable	☐ dense ☐ close ☐ loose ☐ open ☐ very open	☐ managed ☐ unmanaged _____ ☐ no grazing ☐ fair grazing ☐ intensive grazing	☐ < 15 cm DBH ☐ 15 – 20 cm DBH ☐ 20 – 35 cm DBH ☐ 35 – 50 cm DBH ☐ > 50 cm DBH

MAIN TREE SPECIES (with age (pot. updated from old data) and yield class):
If available (e.g. Juniperus): estimated height; see yield table for basal area, volume:
REGENERATION

☐ secured
☐ unsufficient

COMMENTS	

Field Form data sheets – based on Draft from - ForestEye Research GmbH, Goettingen and GIZ; (adapted)

	STAND:							**PLOT NO:**			
TREE ID	STEM ID	SPECIES CODE	SPECIES	SPECIES LOCAL	DBH	DHDEV	HEIGHT	VITALITY	Layer (1-3)	DISTANCE	GENDER

	ID		**COMMENTS**

Regeneration

REG (<50cm and 50-150cm) in regeneration subplots					
RPLOT	SPEC	HCLASS 1	HCLASS 2	BROWSED	Height class 1=0-50 см 2=50-150 см

REG (> 150cm) in the whol plot and <7см DBH					
REG_DCLASS	SPEC	SPCODE	SPEC	COUNT	Height class 3=>150 см and <7см DBH

Bushes I (small bushes, coverage)

BUSHES (<100 cm)	<10%	10-30%	30-70%	>70%

Bushes II (larger bushes, number per circle)

BUSHES (> 100 cm)	number

Which usable herbs (in terms of NWFP) exist in this stand?

What is the utilization potential? (please discuss also with the local forester and comment on this)

Management recommendations:

Main management objectives should focus on? (if possible with estimation of quantity)

- Protection forest_____
- NWFP _____
- Fuelwood _____
- Timber_____
- Other (please specify): _____
- Are there any additional limitations (e.g. fuelwood extraction is limited to dead trees?):

_____

Expert estimation on degradation and options for afforestation/rehabilitation:

- Not degraded
- Degraded; soil preparation for facilitation of seed germination is recommended
- Degraded; afforestation/enrichment planting possible
- Degraded; no afforestation/enrichment planting/ soil preparation recommended

Other recommendation of measures:

Accessibility of the stand:

- low slope, accessibility by motorized vehicle possible
- low slope, not accessible by motorized vehicle, but with donkey
- not accessible by motorized vehicle or donkey
- Slope > 45 °

Checklist

- POINT_ID on every sheet?
- Tree heights measured?
- Time recorder (TEND)?
- All devices complete?

Table A_5: *Correction factors of the slope (e.g. for the adjustment of the* regeneration plots). Ilnazarov B, Fehrmann L, Magdon P (2015) Руководство по полевым измерениям. (English version: Field manual)

Склон		Корректировка $\left(\frac{1}{\sqrt{\cos(\alpha)}}\right)$
∠°	∠%	
10	18	1,01
15	27	1,02
20	36	1,03
25	47	1,05
30	58	1,07
35	70	1,10
40	84	1,14
45	100	1,19

A_6: EXAMPLES OF ASSESSMENT TABLES, MAP LEGENDS AND REFERENCE TABLES FOR THE ESTIMATION OF HARVEST OF NWFPs OF WOODEN SPECIES (the local consultant received full versions)

***Бочарав и др. 1987* (МЕТОДИКА ВЫЯВЛЕНИЯ ДИКОРАСТУЩИХ СЫРЬЕВЫХ РЕСУРСОВ ПРИ ЛЕСОУСТРОЙСТВЕ:**

Окончание приложения 10

1	2
Шалфей эфиопский	трава
Шиповник майский и др. виды	"плоды"
Шавель конский	корневища
Щитовник мужской (мужской папоротник)	корневища
Эвкалипт шариковый и др. виды	листья
Эфедра хвощевая, э. промежуточная	неодревеснев-шие побеги
Якорцы стелющиеся	трава

Приложение 11

Сводная ведомость

недревесного сырья: ягодников, технического сырья и др.

Область_____

Лесхоз_____

Составляется по каждому виду сырья с указанием используемой его части

№ квартала	№ выдела	Площадь выдела, га: доступная	Площадь выдела, га: труднодоступная	% проективного покрытия, полнота, шт/га	Средняя многолетняя биологическая урожайность, кг/га	Средняя многолетняя хозяйственная урожайность, кг/га	Категория пригодности (промысловая (+), непромысловая, (–)), га	Ресурсы по категориям пригодности, кг
Лесничество_____								
Пример:								
Клюква обыкновенная (ягоды):								
2	11	15	–	30	120	60	+15	+630
3	3	–	5	5	80	40	– 5	–200
Итого по лесничеству:		15	5	–	–	–	+15 га – 5 га	+0,63 т –0,20 т
Итого в пределах лесхоза_____								

Приложение 12

Сводная ведомость

размещения и встречаемости
лекарственных растений

Область _____

Лесхоз _____

Составляется по каждому виду сырья с указанием используемой части.

№ квартала	№ выдела	Площадь выдела, га		Встречаемость, %	Категория пригодности (промысловая (+), непромысловая (–), га
		доступная	труднодоступная		

Лесничество _____

Пример:

Ландыш майский (трава)

1	10	2	–	80	+2
3	2	–	5	40	–5
5	4	3	–	40	–3
7	6	–	4	70	–4
Итого по лесничеству:					
	–	5	9	–	+2 га –12 га

Итого в пределах лесхоза _____

Приложение 13

Шкала

для определения балла плодоношения плодовых, ягодных и орехоносных растений

Количество плодоносящих растений, % от общего количества растений на площади выдела	Балл плодоношения
0 – 19	1
20 – 39	2
40 – 59	3
60 – 79	4
80 – 100	5

Примечание. Применяется при исследовательских работах, а также при ежегодной глазомерной оценке плодоношения. Балл плодоношения устанавливается за 10–15 дней до созревания плодов, ягод, орехов.

Приложение 14

Характеристика

выборочно-измерительной таксации учетного выдела по определению урожайности . . .

(вид сырьевого растения)

1. Область . . .
2. Лесхоз . . .
3. Лесничество . . .
4. Квартал . . .
5. Выдел. . .
6. Площадь выдела . . .
7. Состав . . .
8. Возраст . . .
9. Полнота . . .
10. Количество растений (деревьев, кустов) плодовых, орехоносных и сырьевых пород в насаждении или подлеске (шт/га) . . .
11. Встречаемость (для лекарственного сырья), % . . .
12. Проективное покрытие (для травяно-кустарничковых сырьевых растений), % . . .
13. Группа типов леса . . .
14. Условия произрастания сырьевого растения (B_1, B_2, B_3) . . .
15. Биологическая урожайность в год инвентаризации, кг/га . . .
16. Хозяйственная урожайность в год инвентаризации, кг/га . . .
17. Методика определения урожайности (источник) . . . . .
18. Балл урожайности в год инвентаризации . . .
19. Средний многолетний балл урожайности . . .
20. Средняя многолетняя хозяйственная урожайность, кг/га . . .
21. Средняя многолетняя биологическая урожайность, кг/га . . .
22. Используемая часть сырьевого растения . . .
23. Порядковый номер учетного выдела . . .
24. Назначаемые хозмероприятия и рекомендации . . .
25. Дата учета (год) . . .

Приложение 15

Сводная ведомость

глазомерной оценки баллов плодоношения дикорастущих пищевых растений

Область_____

Лесхоз_____

Лесничество_____

Вид сырьевого растения	№ квартала	№ выдела	Балл плодоношения по годам										
			1	2	3	4	5	6	7	8	9	10	средний балл

Главный лесничий_____ (подпись)

Приложение 16

Оформление картографического материала

На основании сводных ведомостей недревесного сырья составляется обзорный план размещения ягодников, лекарственного и технического сырья с окраской всех имеющих промысловое значение выделов, в которых произрастают подлежащие учету виды дикорастущих сырьевых растений.

Обзорный план размещения ягодников, лекарственного и технического сырья окрашивается в соответствии со шкалой цветов красок, применяемых для окраски лесных карт.

Окраска производится в четыре тона, в зависимости от концентрации сырьевых ресурсов (проективного покрытия, количества экземпляров на 1 га, полноты насаждения, урожайности на 1 га грибов и встречаемости травянистых лекарственных растений). Если на одном выделе встречаются несколько видов сырьевых растений, то окраска производится по преобладающему виду учитываемых растений. При этом условный знак преобладающего на данном участке вида обводится кружком.

Таблица 1

Экспликация

Вид растения	Показатель количественной оценки	Тон окраски в зависимости от показателя количественной оценки, %				Цвет окраски x)	Условный знак
		25	50	75	100		
1	2	3	4	5	6	7	8
I. Кустарничковые растения (для сбора ягод и плодов)							
Брусника	проективное покрытие, %	21–40	41–60	61–80	81–100	2513–10–100%	
Голубика	– " –	21–40	41–60	61–80	81–100	2513–61–95% +2513–32–5%	
Земляника	– " –	21–40	41–60	61–80	81–100	2513–42–100%	
Клюква	– " –	21–40	41–60	61–80	81–100	2513–24–100%	
Морошка	– " –	21–40	41–60	61–80	81–100	2513–51–100%	
Черника	– " –	21–40	41–60	61–80	81–100	2513–32–100%	
II. Кустарниковые и древесные растения нижних ярусов (для сбора ягод, плодов, орехов)							
Алыча	к-во экз.	5–20	21–40	41–60	61 и выше	–	
Боярышники	– " –	5–20	21–40	41–60	61 и выше	2513–71–90% +2513–61–10%	
Груша	полнота	0,5	0,4	0,3	0,2	2513–51–95% +2513–24–5%	

x) Номер цвета окраски указан по шкале цветов красок, применяемых для печати и окраски лесных карт.

EXAMPLES REFERENCE TABLES (PROVIDED BY THE AGRARIAN UNIVERSITY)

Приложение № 7

Таблица урожайности ореха грецкого Таджикской ССР

Возраст лет	Диаметры крон в м																	
	3	4	4,5	5	5,5	6	6,5	7	7,5	8	8,5	9	I0	II	I2	I3	I4
	урожайность в кг																	
30	0,3	0,35	0,35	0,5	0,7	0,9	-	-	-	I,I	-	-	-	-	-	-	-	
50	-	0,35	0,35	0,5	0,9	I,35	I,38	I,4	I,5	I,6	I,75	2,0	2,5	3,0	-	-	-	
70	-	-	-	-	-	2,5	3,0	3,I	3,2	3,5	-	3,7	3,9	4,0	4,2	-	-	
90	-	-	-	-	-	-	3,I	3,2	3,5	3,7	3,9	4,0	4,I	4,I	4,3	4,4	4,5	
II0	-	-	-	-	-	-	-	2,9	-	3,0	-	-	3,6	3,8	4,0	-	-	
I30	-	-	-	-	-	-	-	-	-	-	-	-	-	3,5	3,5	-	-	
I50	-	-	-	-	-	-	-	-	-	-	-	-	-	3,0	3,0	-	-	

Верно: Лист

Продолж.

Высота дерева в м	Диаметр кроны в м						
	0,5	I	I,5	2	2,5	3	3,5
	урожайность в кг						
	Возраст кустарника I5 лет						
I,5	-	I,05	I,09	I,I3	I,I7	-	-
2,0	-	I,20	I,24	I,28	I,33	I,37	-
2,5	-	-	I,39	I,43	I,47	I,50	I,53
3,0	-	-	I,54	I,58	I,62	I,66	I,70

Верно

A_7: DESCRIPTIVE ASSESSMENT FORM FOR NON-FOREST AREA ON THE SFF LAND

Field Form non-forest area description – partly based on a Draft from - ForestEye Research GmbH, Goettingen; **Ilnazarov B, Fehrmann L, Magdon P (2015)** Руководство по полевым измерениям. (English version: Field manual) (adapted for the description of non-forest subcompartments)

NON-FOREST AREA					
TEAM		**land use class of this subcompartment**			
DATE		☐ Pasture ☐ Cropland ☐ Garden		☐ Water ☐ Bare rock ☐ Other, specify:_____	
Forest district (leskhoz)					
Compartment		XGPS		PDOD / Error:	
Subcompartment		YGPS			
Subcompartment area (ha)		HSL			

Site factor					
ASPECT	**SLOPE**	**POSITION (SLOPE)**	**TERRAIN**	**SOIL**	**EROSION**
N W flat O S	☐ 0 - 10 ° ☐ 10 - 20° ☐ 20 - 30° ☐ 30 - 45° ☐ 45 – 60° ☐ > 60°	☐ Top ☐ Upper slope ☐ lower slope ☐ lower slope ☐ valley ☐ plain	☐ very concave ∪ ☐ concave ⌣ ☐ flat -------- ☐ convex ⌢ ☐ very convex ∩	☐ sand/stone ☐ bare soil ☐ humus layer ☐ grass ☐ < 10cm soil depth ☐ >10 cm soil depth	☐ no ☐ slightly ☐ serious ☐ heavy

How do you estimate the quality of the area compared to average conditions?

☐ Over average
☐ Average
☐ Below average

How do you evaluate the condition of this area?

☐ Degraded
(comments:_____)
☐ Satisfactory
(comments:_____)

Is the area suitable for afforestation?

☐ Yes
(comments:_____)
☐ No
(comments:_____)

COMMENTS

A_8: FINAL FINANCIALPLAN ON LESKHOZ-LEVEL (EXAMPLE)

Additional financial support / subsidies may be added in the field “other operational areas” of the revenues if they are available for the timeframe of the planning period (e.g. 10 years). (example based on plan provided by W. Grüneklee, HESSEN-FORST)

Financial plan								
Forest district	**Penjikent**							
Company	**SFF**							
Variante:								
Costs	**salary**	**non-personnel costs**	**contractor**	**Sum**	**TJS/ha FA**	**TJS/ha SFF**	**% of costs**	
Planting activities								
Forest protection								
against livestock								
others								
opening of forest/ infrastructure								
fuel-wood/timber harvesting								
Tending								
add different work task (?)								
Administration								
Sum costs								
Revenue					**TJS/ha Forestarea**	**TJS/ha SFF**	**% of revenue**	**TJS/m³**
from harvesting (fuel wood)								
from harvesting NTFP								
from harvesting (timber)								
from leasing pasture								
from leasing arable land								
from leasing areas for herbs, gardens								
other operational areas (Betriebsbereich) ?								
Sum revenue								
operating results								
sum revenue								
sum costs								
result								

FA= Forested area SFF: State forest fund

A_9: EXAMPLES OF PERFORMANCE INDICATORS OF THE LESKHOZ PENJIKENT (SOURCE: GIZ-TAJIKISTAN)

ЦЕЛЕВЫЕ ПОКАЗАТЕЛИ ГУ ЛХ ПЕНДЖИКЕНТСКОГО РАЙОНА НА 2015 ГОД

1	ЭКОЛОГИЧЕСКИЕ ПОКАЗАТЕЛИ	Ед-ца измерения	Показатель 2014 (факт)	Показатель 2015
1,1	**Отношение площади покрытых лесом земель к общей площади лесного фонда**	**%**	**13,57**	**13,59**
	Площадь земель лесного фонда	*га*	108083	108083
	Покрытая лесом площадь	*га*	14670	14693
1.1.1	***Перевод лесных культур и молодняков в покрытую лесом площадь***		**20**	**23**
	Перевод лесных культур и молодняков в покрытую лесом площадь	*га*	20	23
1,2	**Отношение площади введенных молодняков к площади посева, посадки и содействию леса**	**%**		
	Площадь введенных молодняков	*га*		
	Общая площадь посева, посадки и содействию леса	*га*	43	45
1,3	**Среднегодовой прирост на 1 га**	**м^3/га**		
	Среднегодовой прирост в арчовных лесах	м^3/га	учет не ведется	
	Среднегодовой прирост в тугайных лесах	м^3/га	учет не ведется	
	Среднегодовой прирост в других лесах	м^3/га	учет не ведется	
1,4	**Объем санитарной рубки, заготовка древисины от форс мажоров**	**м^3/га**	**0,027**	**0,028**
	Объем санитарной рубки на землях лесного фонда	*м^3*	134	135
	Объем заготовки древисины от форс-мажоров на землях лесного фонда	*м^3*	266	270
	Покрытая лесом площадь	*га*	14670	14693
1,5	**Площадь лесных насаждений, пострадавшей от вредителей, болезней и антропогенных факторов**			
	Площадь лесных насаждений, пострадавшей от вредителей, болезней и антропогенных факторов	*га*	0	по факту
	Наличие очагов вредителей и болезней леса на конец года	*га*	1500	по факту
1.5.1	***Площадь лесных насаждений, погибшей от лесных пожаров***	**%**		
	Площадь лесных насаждений, погибшей от лесных пожаров	*га*	0	по факту
1,6	**Площадь и объем незаконных рубок**			
	Кол-во случаев, по которым составлен акт(ы) о незаконный рубке	*кол-во*	119	по факту
	Объем незаконных рубок, на который составлен акт(ы)	*м^3*	4,55	по факту
	Оценка потери лесных ресурсов от незаконных рубок	*сомони*	37231	по факту
1,7	**Площадь леса, пострадавшей от выпаса скота**	**%**		
	Площадь леса, пострадавшей от выпаса скота	*га*	учет не ведется	

2	ЭКОНОМИЧЕСКИЕ ПОКАЗАТЕЛИ	Ед-ца	Показатель	Показатель

		измерения	2014 (факт)	2015
2,1	**Объем платежей в государственный и местный бюджеты РТ в расчете на 1 га земель лесного фонда**	**сомони/га**	**0,95**	**1,05**
	Объем платежей в государственный бюджет Республики Таджикистан	*сомони*	*40.388*	*45.500*
	Объем платежей в местный бюджет	*сомони*	*62.306*	*67.700*
	Площадь земель лесного фонда	*га*	108083	108083
2,2	**Бюджетная эффективность (соотношение поступлений в бюджет к финансированию лесхоза)**	**%**	**14,08**	**15,51**
	Объем поступлений в государственный бюджет РТ (кроме местных налогов)	*сомони*	*40.388*	*45.500*
	Финансирование ГУ ЛХ Пенджикентского района за счет государственного бюджета	*сомони*	*286.750*	*293.408*
2,3	**Отношение бюджетного финансирования сохранения и восстановление лесов к финансированию, требуемому по нормативу**	**%**	**36,80**	**33,05**
	Объем финансирования из государственного бюджета для сохранения и восстановления лесов	*сомони*	*55.200*	*50.064*
	Объем финансирования для сохранения и восстановления лесов, требуемой по нормативу	*сомони*	*150.000*	*151.500*
2,4	**Доход лесхоза, приходящегося на 1 га лесных земель**	**сомони/га**	**4,21**	**4,38**
	Доход лесхоза из всех источников	*сомони*	*455.481*	*473.500*
	Площадь земель лесного фонда	*га*	108083	108083
2.4.1	***Доход лесхоза от реализации лесной продукции, приходящегося на 1 га покрытую лесом площадь***	**сомони/га**	**3,21**	**4,47**
	Доход лесхоза от реализации лесной продукции на землях, в котором собраны лесные продукты	*сомони*	*47.066*	*65.700*
	Покрытая лесом площадь	*га*	14670	14693
2.4.2	***Доход лесхоза от пастьбы скота, приходящегося на 1 га пастбищных земель***	**сомони/га**	**6,97**	**7,37**
	Доход лесхоза от пастьбы скота на пастбищах, входящие в лесной фонд	*сомони*	*231.539*	*245.000*
	Площадь пастбищ, входящий в лесной фонд	*га*	33225	33225
2.4.3	***Доход лесхоза от аренды земель лесного фонда, приходящегося на 1 га арендованных земель***	**сомони/га**	**825,49**	**895,52**
	Доход лесхоза от аренды земель лесного фонда	*сомони*	*108.965*	*120.000*
	Площадь арендованных земель, входящий в лесной фонд	*га*	132	134
2,5	**Доход лесхоза, приходящегося на 1 работника аппарата управления**	**сомони**	**30365,40**	**29593,75**
	Доход лесхоза из всех источников	*сомони*	*455.481*	*473.500*
	Кол-во работников аппарата управления	*чел.*	15	16
2,6	**Фактические затраты на ведение лесного хозяйства в расчете на 1 га лесных земель**	**сомони/га**	**6,79**	**7,10**
	Сумма затрат на ведение лесного хозяйства за счет государственного бюджета	*сомони*	*287.909*	*293.408*
	Сумма затрат на ведение лесного хозяйства за счет собственных средств	*сомони*	*445.481*	*473.500*
	Площадь земель лесного фонда	*га*	108083	108083

2,7	**Удельный вес финансирования собственных средств к общей сумме финансирования ведения лесного хозяйства**	**%**	**60,74**	**61,74**
	Сумма собственных средств, израсходованных на ведение лесного хозяйства	*сомони*	*445.481*	*473.500*
	Общая сумма затрат на ведение лесного хозяйства (гос.бюджет и собственные средства)	*сомони*	*733.390*	*766.908*
2,8	**Удельный вес расходов на содержание сотрудников лесхоза в общих затратах на ведение лесного хозяйства**	**%**	**49,10**	**49,23**
	Сумма затрат на содержание сотрудников лесхоза за счет гос.бюджета	*сомони*	*210.060*	*220.020*
	Сумма затрат на содержание сотрудников лесхоза за счет собственных средств	*сомони*	*150.000*	*157.500*
	Общие затраты на ведение лесного хозяйства	*сомони*	*733.390*	*766.908*
2,9	**Кол-во договоров аренды**	**кол-во**	**1081**	**1086**
	Кол-во краткосрочных договоров аренды (сроком до 3 лет)	*кол-во*	187	192
	в т.ч. договоров в рамках СУЛ	*кол-во*	*0*	0
	Кол-во долгосрочных договоров аренды (сроком свыше 3 лет)	*кол-во*	894	894
	в т.ч. договоров в рамках СУЛ	*кол-во*	0	0
2,10	**Кол-во договоров аренды, заключенных в течении года**	**кол-во**	**17,00**	**56,00**
	Кол-во договоров аренды (включая договоров СУЛ), заключенных в течении года	*кол-во*	*17*	*56*
2,11	**Инвестиционная привлекательность**	**кол-во**		
	Кол-во инвестиционных проектов с участием частного сектора и иностранных инвесторов	*кол-во*	0	1
	Сумма инвестиционных проектов с участием частного сектора и иностранных инвесторов	*сомони*	0	*150.000*
2,12	**Возмещение ущерба от нарушений лесного законодательства**	**сомони**		
	Кол-во выявленных административных нарушений лесного законодательства	*кол-во*	*187*	*по факту*
	Оцененная сумма ущерба от административных нарушений лесного законодательства	*сомони*	*22.820*	*по факту*
	Фактически оплаченная сумма в государственный бюджет от административных нарушений	*сомони*	*16.440*	*по факту*
	% возмещенного ущерба от оцененной суммы ущерба от административных нарушений	*%*	***72,04***	
	Кол-во выявленных нарушений лесного законодательства	*кол-во*	*188*	*по факту*
	Оцененная сумма ущерба от нарушений лесного законодательства	*сомони*	*48.076*	*по факту*
	Возмещенная сумма ущерба от нарушений лесного законодательства в ГУ ЛХ Пенджикентского района	*сомони*	*38.830*	*по факту*
	% возмещенного ущерба от оцененной суммы ущерба от нарушений лесного законодательства	*%*	***80,77***	

3	**СОЦИАЛЬНЫЕ ПОКАЗАТЕЛИ**	**Ед-ца измерения**	**Показатель 2014 (факт)**	**Показатель 2015**
3,1	**Отношение среднемесячной зарплаты работника лесхоза к среднемесячной зарплате работника по всем отраслям региона**	**%**	**80,76**	

	Среднемесячная зарплата работника лесхоза	*сомони*	*529*	*по факту*
	Среднемесячная зарплата работника по всем отраслям региона (Согдийская область)	*сомони*	*655*	*по факту*
3,2	**Отношение среднемесячной зарплаты работника лесхоза к среднемесячной зарплате работника по всем отраслям страны**		**81,37**	
	Среднемесячная зарплата работника лесхоза	*сомони*	*659*	*по факту*
	Среднемесячная зарплата работника по всем отраслям страны	*сомони*	*809,85*	*по факту*
3,3	**Темп роста номинальной заработной платы работников лесхоза**	**%**	**24,47**	**6,24**
	Средняя заработная плата, оплаченная работникам лесхоза из всех источников в предыдущем году	*сомони*	*425*	*529*
	Средняя заработная плата, оплаченная работникам лесхоза из всех источников в отчетном году	*сомони*	*529*	*562*
3,4	**Доля бюджетной составляющей в фактической номинальной заработной плате работников лесхоза**	**%**	**65,30**	**58,28**
	Общая сумма зарплаты, оплаченной за счет государственного бюджета	*сомони*	*211.848*	*220.020*
	Общая сумма зарплаты, оплаченной из всех источников (госбюджет+собственные средства)	*сомони*	*324.432*	*377.520*
3,5	**Доля внебюджетной составляющей в фактической номинальной заработной плате работников лесхоза**	**%**	**34,70**	**41,72**
	Общая сумма зарплаты, оплаченной за счет собственных средств	*сомони*	*112.584*	*157.500*
	Общая сумма зарплаты, оплаченной из всех источников (госбюджет+собственные средства)	*сомони*	*324.432*	*377.520*
3,6	**Обеспеченность сотрудников необходимыми средствами**			
	Кол-во столов	*кол-во*	*26*	*26*
	Кол-во компьютеров (стационарные + ноутбуки)	*кол-во*	*5*	*5*
	Кол-во принтеров	*кол-во*	*2*	*2*
	Кол-во множительной техники	*кол-во*	*1*	*1*
	Кол-во автостранспорта для передвижения сотрудников (легковой автомобиль и автобус)	*кол-во*	*2*	*2*
	Кол-во телефонов	*кол-во*	*3*	*3*
	Кол-во штатных единиц, работающих в главном административном здании	*кол-во*	*13*	*13*
3,7	**Коэффициент текучести кадров**	**%**	**3,85**	
	Общее число уволенных по собственному желанию за отчетный период	*кол-во*	*2*	*по факту*
	Общее число уволенных за нарушение трудовой дисциплины, прогулы, по судимости за отчетный период	*кол-во*	*0*	*по факту*
	Среднесписочная численность персонала за отчетный период	*кол-во*	*52*	*по факту*
3,8	**Средний возраст сотрудников**	**%**		
	Совокупный показатель возраста сотрудников	*кол-во*		
	Общее кол-во штатных единиц	*кол-во*	*52*	*56*
3,9	**Кол-во дней обучения и переобучения на 1 сотрудника**	**%**	**0**	**1,87**
	Общее кол-во дней обучения и переобучения сотрудников в течении года	*кол-во*	*0*	*30*
	Общее кол-во штатных единиц	*кол-во*	*52*	*56*

3,10	**Доля работников аппарата управления с высшим специальным образованием**	**%**	**46,67**	**50,00**
	Кол-во работников аппарата управления с высшим специальным образованием	*кол-во*	*7*	*8*
	Общее кол-во работников аппарата управления	*кол-во*	*15*	*16*

VI RELEVANT LITERATURE AND SOURCES

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