

Instructions on Land Use Planning for *State Forestry Fund* Land in the Republic of Tajikistan

Guidelines for the Production of Management Plans for the SFF Land in Tajikistan



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1 Background

Instructions on land use planning for *State Forest Fund* (SFF) land in the Republic of Tajikistan aim to provide ready-to-use guidelines for the production of management plans for forest and non-forest areas. The main responsible authority for protection and management of the SFF land at local level are the *State Forest Enterprises (leskhoz)*. The *leskhoz* are responsible for the protection and management of all land use types present in the dedicated SFF land, including forested areas, pasture land, cropland, garden, non-usable lands, etc.

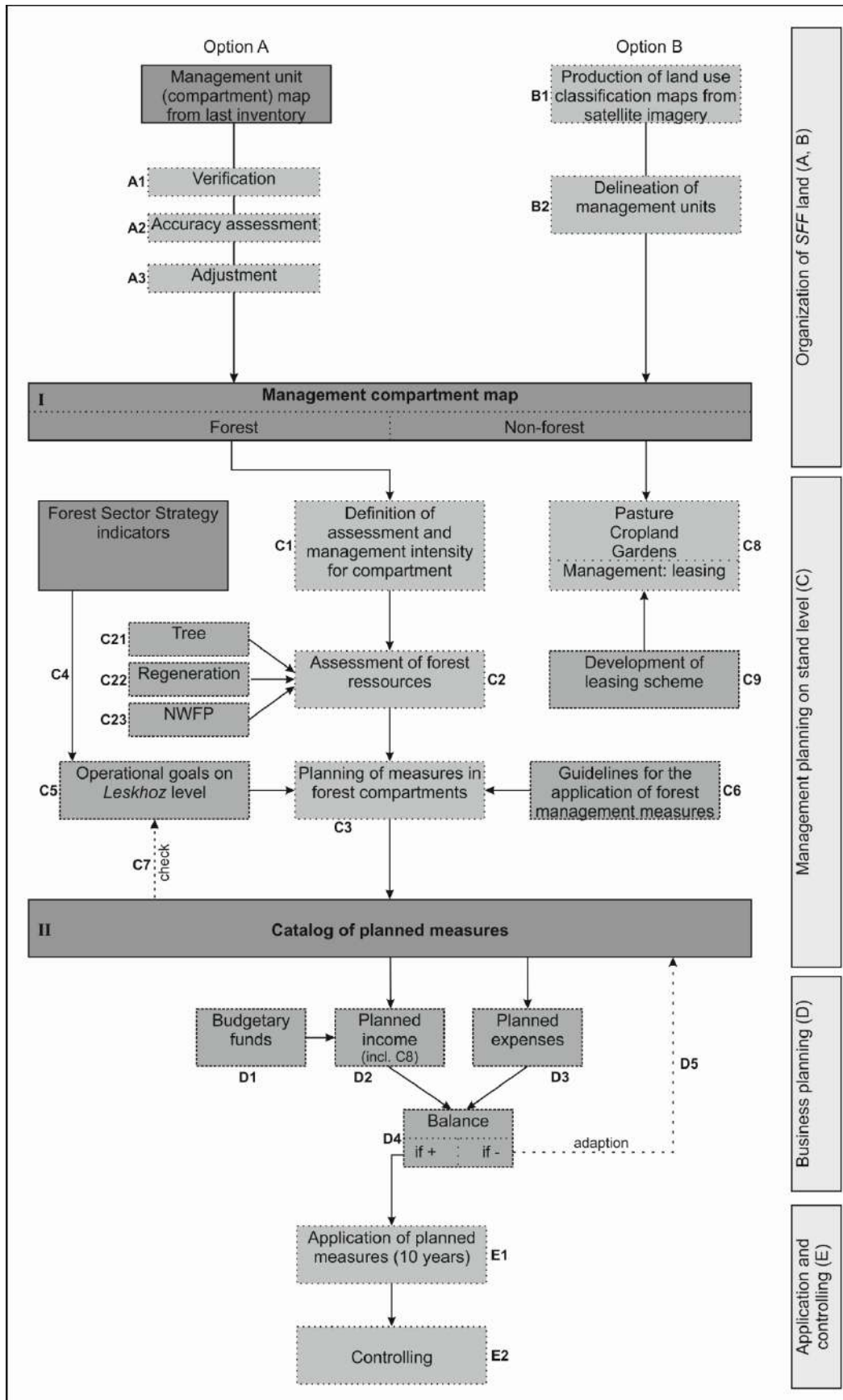
The present instructions focus on the management of forested areas of the SFF land. Due to the fact that forest management and pasture management are highly dependent in Tajikistan, the incorporation of pasture land management was taken into consideration. Furthermore the *leskhoz* as an institution is responsible for the management of all areas of SFF land and not only forest, thus needs management plans for other land use types too.

The concept of land use planning incorporates 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.

Before planning specific measures on respective areas of the SFF land, a system of management compartments needs to be established. Knowledge about the spatial organization of the area to be planned is essential for the management planning. Therefore, the first step is the mapping of the whole SFF land for land use types, then subdivision of these areas into management units (compartments). Once this is done, the established system of compartments will not be changed in the future. Only marginal changes in the organization system will take place and can be integrated easily. The second step is the planning of measures, which must then be conducted for each and every planning period. Because of budget limitations the management planning and application of management measures must be restricted to most important areas.

The flowchart below gives an overview about the steps proposed to produce a land use plan. The present guidelines are drafted to be enhanced and refined after testing the described methods and indications in a trial phase. It must be noted that all of the proposed methodologies and concepts are drafts and can - should - be adapted after testing.

2 Flowchart for land use planning in *SFF* land



3 Description of flowchart process steps

3.1 A, B: Spatial organization of SFF land

3.1.1 A1: Compartment map – verification

Compartment maps are depicting the management units (=compartments) in the area of concern. These maps are used to spatially organize the area into management units. All land use types that are generally managed (e.g. forest, pasture, cropland, etc.) are divided into management compartments. Each compartment is assigned to one land use class. Since these maps date back to before the independence of Tajikistan and were produced by soviet specialists, they have to be checked. The main question in the context of the verification is if the compartments mapped in the old maps are still corresponding to the assigned land type classes.

For that reason the printed or drawn maps need to be digitized and georeferenced. 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 is usually realized by collecting ground control points (GCPs) with a GPS device in the area of the map. The GCPs should be placed at easily distinguishable places that can be found without difficulty in the map and in the field or respectively on georeferenced satellite/aerial imagery.

After preparatory work, the map can be viewed on a computer. Comparison of the information of the land use types of the compartments with very high resolution satellite imagery (e.g. Google, Bing) should give a first impression on the quality of the map.

3.1.2 A2: Compartment 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 map land use information associated with the randomly selected point to real land use information, the overall map accuracy can be estimated. The collection of real point information can be done in the field or using freely available very high resolution satellite imagery. It should be noted that collecting information in the field is always more costly but also provides better results because not all relevant aspects can be seen from above.

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 1:

Of 20 randomly generated points on the map's area, 10 fall into the map's land use type 'pasture'. By assessing these 10 points on Google imagery one determines that only 8 of these 10 points are located in 'pasture' according to the satellite imagery. Assuming that Google imagery gives correct information on land use types we can say that the map accuracy for 'pasture' is 80 %. By multiplying map accuracies from all land use types the overall map accuracy can be calculated.

3.1.3 A3: **Compartment map – adjustment**

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 very high resolution satellite imagery (e.g. Google, Bing).

A second option for adjustment of compartments is a field visit. GPS devices and printed compartment maps are the tools that are needed for this field work. Manual adjustment of the management compartments is timely and does not have always major benefits. Therefore it is not recommended to adjust the management compartments all by hand with field visits. It is, however, recommended to adjust compartments when experts are in the field anyway. While assessing forest resources the experts can also check the management compartment borders and do changes by hand on prepared and printed out maps or taking GPS points with a GPS device.

The adjustment of the old management compartment 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.



Fig. 1: Management compartments (white borders) from last inventory (1981) in the *leskhoz* of Penjikent compared to current very high resolution satellite imagery (*Google Earth, 2015*).

Figure 1 shows the management units (compartments) that were defined in soviet times. Even though the borders are not located correctly on ridges, rivers or forest borders, one can see that the compartments were not delineated randomly but follow specific criteria. Adjustment of the compartment 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.

3.1.4 B1: **Production of land use classification maps from satellite imagery**

Option B is only applied if the necessary management unit 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 inventory to save time and funds.

The SFF land that is managed by *leskhoz*es 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.

It is recommended to use L3A RapidEye data. This satellite imagery needs to be pre-processed before the classification algorithm is able to produce meaningful results. Besides topographic correction and atmospheric correction the imagery needs to be prepared for further processing steps.

On training data plots information is collected that afterwards will be linked to the satellite imagery to predict the land use class outside the training 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 training 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 1 shows a possible land use classification with a focus on the classification of forest.

Tab. 1: Land use classes for the classification of SFF land.

	ID	Label	Description
Forest (1)	11	Juniperus	Land with > 10 % tree crown cover of mostly <i>Juniperus</i> spp.
	12	Tugai	Land with > 10 % tree crown cover of mostly <i>Salix</i> spp., <i>Populus</i> spp. and <i>Hippophae rhamnoides</i>
	13	Broadleaved	Land with > 10 % tree crown cover of mostly <i>Juglans regia</i> , <i>Malus</i> sp., <i>Acer</i> spp. and <i>Platanus orientalis</i>
	14	Shibliak	Land with > 10 % tree crown cover of mostly <i>Amygdalus bucharia</i> , <i>Pistacia vera</i> , <i>Calophaca grandiflora</i> , <i>Cercis griffithii</i> and <i>Rhus coriaria</i>
	15	Small leaved	Land with > 10 % tree crown cover of mostly <i>Betulae</i> , <i>Populus</i> spp., <i>Salix</i> spp., <i>Hippophae rhamnoides</i> and <i>Fraxinus</i> 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

3.1.5 B2: Delineation of management units

Management units are established for the spatial organization of the SFF land. Measures are planned on management unit level. Forested areas and non-forest areas are divided 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 land use map produced with satellite imagery and additional topographic information from supplementary maps can be used to delineate management units following precise criteria for the delimitation of management units. Borders for management unit delineation should be objectively detectable. Borders can be mountain ridges, rivers, land use types, etc. The maximum management unit area 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 a goal of the testing phase.

3.2 C: Management planning on stand/compartment level

3.2.1 C1: Definition of assessment and management intensity (AMI)

Assessment intensity and management intensity need to be defined for every compartment for the reason that the undertaken effort should correspond with the expected benefit due to limited resources in the planning and the management phase.

Every forest compartment that is defined by the management compartment map is given an assessment and management intensity corresponding to the numbers 1-4, being 1 highest assessment and management intensity and 4 no assessment and no management. The intensity is defined by the parameters

1. accessibility (distance from road/next village, slope),
2. expected economic potential (soil type, grazing pressure, tree condition, stock, etc.)
3. importance for erosion security (location, slope, etc.) and
4. availability of management personnel (near the compartment).

Tab. 2: Assessment and management intensity (AMI) classes.

AMI class	Description	AMI points	Example
1	High AMI	9 - 10	highly productive pistachio plantations
2	Medium AMI	7 - 8	productive Tugai forest
3	Low AMI	4 - 6	productive Tugai forest with high river dynamics
4	No AMI	0 - 3	very remote sparse juniperus forests

The AMI is a measure to divide the SFF land into focus areas and areas of less concern. This is done in the light of restricted funds. Focus areas are segregated from the rest of the SFF land by applying the AMI classes to each part of the SFF land. This way there will be class 4 compartments that form the focus areas with high management intensity, whereas the lower AMI class compartments can be included into the focus of land management if sufficient funds are available.

Tab. 3: Criteria for the classification of compartments into AMI classes.

Parameter	AMI points	Criteria	
1	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 > 50 %
2	economic potential	3	high expected return-on-investments
		2	moderate return-on-investments expected
		1	return-on-investments expected
		0	no economic benefit expected
3	erosion security	3	high risk of erosion events threatening settlements, roads or other infrastructure
		2	erosion threatening forest persistence
		1	risk of erosion in future
		0	no erosion and no risk of erosion
4	management personnel	1	sufficient and well-trained management personnel available nearby
		0	no management personnel available nearby

By evaluating the compartment regarding the parameters depicted in table 3 and summing up the AMI points of the respective parameters the AMI class is defined (see table 2). This evaluation must be finished before field visit to obtain information which compartment has the highest AMI class and, therefore, should be assessed in the field. Thus, information on accessibility, expected economic potential, erosion security and management personnel needs to be available before field work.

3.2.2 C2: Assessment of forest resources

Forest resources are assessed in the field. An assessment in the field is only required in compartments that contain forest since non-forest areas are not managed directly by the *leskhoz* but leased to tenants. Also compartments that have a low assessment and management intensity are not assessed or only parts of the assessment methodology are applied. If sufficient funds are available, also lower AMI class compartments can be assessed and managed.

3.2.2.1 C21: Assessment of trees

The assessment of tree resources aims to provide information about 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. Information to gather in the field for adequate description of tree resources is depicted in table 3. A field form can be crafted out of the parameters mentioned below.

Tab. 4: Assessment of tree parameters for stand description. (Adapted from *Institute of Silviculture, 2004*)

Feature	Description	Characterization	
1	Main tree species	Tree species of primary importance	
		1. Botanical tree species name	
2	Stand age		
		1. Mean tree age / range of age	
3	Natural stage of age	(tick)	
		1. Young stands: < 15 cm DBH 2. Pole wood: 15 – 20 cm DBH 3. Minor treewood: 20 – 35 cm DBH 4. Medium treewood: 35 – 50 cm DBH 5. Major treewood: > 50 cm DBH	
4	Origin	(tick)	
		1. Natural 2. Planted 3. Both	
5	Vigor	(tick)	
		1. Full 2. Medium 3. Low	
6	Special tree features of prevailing trees	Bole quality	
		Crown	
		1. Straight / bent 2. Branched 3. Damages (grazing, cuttings, etc.)	
		1. Shape (large, small) 2. Damages (insects, broken, etc.)	
7	Tree species mixture (> 10 %)	Tree species	
		Same description as main tree species (1 – 6)	
		Portion of mixture	
		Relation to main species (tick)	
		1. Botanical tree species name	
		1. Main tree species 2. Stand age 3. Natural stage of age 4. Origin 5. Vigor 6. Special tree features	
		1. Percentage of mixture	
		1. Catching up 2. Equally growing 3. Lagging	
8	Other tree species (< 10 %)		
		1. Botanical tree species name	
9	Stand closure	(tick)	
		1. Dense (crowns interlace) 2. Close (crowns touch) 3. Loose (one crown size between crowns) 4. Open (more than one crown size between crowns)	
10	Other Characteristics / miscellaneous		
		1. Regeneration (secured) 2. Afforestation 3. General management condition of the stand	

Basal area estimation based on Bitterlich dendrometer count for each tree species (> 10 %) is recommended for volume estimates. The sampling can be done on subjectively chosen spots in the compartment that appear to represent the average condition of the forest in the stand. The number of Bitterlich counts needs to be adjusted to the degree of heterogeneity in the stand and size of the compartment – more variable stand, more Bitterlich counts.

Additionally an assessment of the state of erosion in the stand is reasonable. Therefore the predominant ground vegetation and the degree of erosion are assessed in the field (see table 4 for parameters to assess in the compartment).

Tab. 5: Assessment of the state of erosion.

Feature	Characterization
1 Ground vegetation (tick)	<ol style="list-style-type: none"> 1. Sand / stone 2. Bare soil 3. Humus 4. Grass 5. Herbaceous
2 Degree of erosion (tick)	<ol style="list-style-type: none"> 1. None (vegetation / top soil undisturbed) 2. Slightly (vegetation / top soil partly lost) 3. Serious (vegetation / top soil lost) 4. Heavy (bare soil affected by water / wind erosion / land slides)

3.2.2.2 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. Regeneration can be regarded as secured if the terminal bud is not anymore reachable for livestock. In case of areas with grazing cattle this is about 2-3 m. After this height the plants are not anymore regarded as regeneration in the context of this methodology.

For the assessment of tree regeneration the expert estimates the percentage of ground covered by regeneration for each tree species. In addition the percentage of regeneration plants that is browsed is recorded. The age span of the regeneration per species should be estimated and noted.

3.2.2.3 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.

Special attention should be given to the methodology for NWFPs assessment that has existed in former soviet times.

Tab. 6: Relevant NWFPs in Tajikistan.

NWFPs
1 <i>Rheum</i> sp.
2 mushrooms
3 <i>Allium</i> sp.
4 <i>Lonicera</i> sp.
5 <i>Carum carvi</i>
6 <i>Berberis</i> sp.
7 <i>Rosa canina</i>

3.2.3 C3: Planning of measures in forest compartments

The planning of forest management measures is conducted in the field while assessing the forest resources (C2). Experts assess the current status of forest resources and propose a management concept and the respective measures. These prescriptions are initially based on the expert's knowledge of silviculture and experience. After the first planning period of 10 years and gaining experiences in silviculture in the *leskhoz*, the previous management plans can be analyzed to develop guidelines for the application of forest management measures (C6).

The planning includes the prescription of forest management measures (e.g. fencing, harvesting, planting), quantities (e.g. 400 m of fence, 50 m³ of fuel wood, 1000 plants) and the time of measure realization (e.g. in the next 5 years, 2017 - 2020, 2020).

It is desirable to include local population into planning and management if the management compartment is near settlements and the involvement is possible.

3.2.4 C4: *Forest Sector Strategy (FSS)* 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 current 721 households to 3,500 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.

3.2.5 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. National goals for the forest development and forestry sector development in Tajikistan can be found in the *Forest Code*, the main legal basis for forest protection and management, and 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 smaller parts in the forestry sector, namely the *leskhoz*es. 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. Planting of: $10000 \text{ ha} * \frac{\text{leskhoz area (ha)}}{\text{SFF land area of Tajikistan (ha)}}$ new forests adapted to the region in conditions of the climate change
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:
 $2779 \text{ households} * \frac{\text{leskhoz area (ha)}}{\text{SFF land area of Tajikistan (ha)}}$

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 before which.

3.2.6 C6: Guidelines for the application of forest management measures

Guidelines for the application of forest management measures are an instrument 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 guidelines 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.

Similar forests can be summarized into forest condition classes. These classes represent the current state of the forest. For every forest condition class there is a 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.

3.2.7 C7: Goals check

Following the first planning phase, the planned measures in the catalog of planned measures (II) 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).

3.2.8 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.

3.2.9 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.
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.

3.3 D: Business planning

3.3.1 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*.

3.3.2 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 leasing of areas. The estimations are based on the catalog of planned measures per forest compartment and on the planned area to be leased. These estimations can be adapted from previous years and experiences from the past, however should be calculated conservatively.

3.3.3 D3: Planned expenses

The planned expenses include costs for personnel, leasing, forest management measures and all other expenses that need to be paid by the *leskhoz*. Estimations are based on the catalog of planned measures per forest compartment and on experiences from the last years. A buffer for unexpected expenses should be added to the estimation.

3.3.4 D4: Balance

The balance is the subtraction of the planned expenses (D3) from the planned income (D2). 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).

3.3.5 D5: Adaption of catalog of planned measures

If the balance (D4) of planned income (D2) and planned expenses (D3) is negative, the catalog of planned measures cannot be realized due insufficient funds. Therefore the management planning and consequentially the catalog of planned measures must be adapted. Measures that have a negative net marginal income and can be shifted to a later implementation period should be cancelled to reduce the planned expenses. 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).

3.4 E: Application and controlling

3.4.1 E1: Application of planned measures (10 years)

After the planning period, the application of the planned measures takes place. Since each land use plan is produced for 10 years, this is also the timeframe for the application of planned measures. Executed measures are noted in the catalog of planned measures (II) and compared to the planned measure. Often there is a difference between planned and realized amounts (e.g. exact m³ of extracted fuel wood), which is not a result of poor planning.

3.4.2 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.

4 Structure of land use plan

This chapter provides a draft structure for the land use plan (LUP). The parts of the LUP are described in the following.

4.1 General information on the LUP

In this section explanatory notes on the land use plan itself are located. All administrative, official and legal information is stated.

- Author
- Addresser (*leskhoz*)
- Planning period
- Note of approval by inspectorate

4.2 General information of the *leskhoz*

This section contains some general information of the land that is managed with the present land use plan. It includes only written descriptions of the information, no maps, even though some information is spatially explicit.

- Geographical position and demarcation of managed SFF land
- Soil types and soil type distribution
- Topography
- Infrastructure

4.3 Business goals and indicators

This section consists of the operational business goals of the state forest enterprise with respective indicators.

- Business goals
- Indicators

4.4 Catalog of planned measures (II)

The catalog of planned measures is the most important part of the land use plan. This section consists of one page per compartment. Each management compartment in the SFF land is represented by one page in this catalog and any of the compartments has all of the following elements in this catalog.

- Name (number) of the compartment
- Area size
- Land use type
- Assessment and management intensity
- Assessed resources (if assessed)
- Planned measures
- Realized activities and quantities

4.5 Summary tables of prescribed measures

This section consists of a summary of all measures planned in the LUP. The summary table serves for controlling and business planning by giving an overview of all prescribed measures in one place.

- Summary of planting activities
- Summary of felling/harvesting activities for wood products
- Summary of harvesting activities for NWFPs
- Summary of other forest management activities (e.g. fencing)
- Summary of leased areas

4.6 Business planning

The business planning section includes calculation estimations based on experiences from previous planning periods and the planned measures.

- Income
- Expenses
- Balance

4.7 Cartographic material (I)

Maps are important instruments for land use planning and management. They are a product of the management planning.

- Overview map of land use types
- Overview map of management compartments
- Detail maps of management compartments

5 Literature

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