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"THE INTEGRATED FOREST ECOSYSTEM MANAGEMENT PROJECT IN THE KYRGYZ REPUBLIC"  
(IFEMP)

Land Cover Classification (LCC) Scheme

2<sup>nd</sup> National Forest

## CONSULTING SERVICES

NATIONAL FOREST INVENTORY EXECUTION AND CAPACITY BUILDING

Contract № KG/IFEMP/QCBS/NFI/01/2018

Land Cover Classification (LCC) Scheme  
REPORT  
Delivery 2-1



UNIQUE



## Land Cover Classification (LCC) Scheme

2<sup>nd</sup> National Forest Inventory of Kyrgyzstan

# Land Cover Classification (LCC) Scheme

2<sup>nd</sup> National Forest Inventory of Kyrgyzstan

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# 1 BACKGROUND / GOALS

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The Objective 02 of the project “National Forestry Inventory Execution and Capacity Building” in Kyrgyzstan is related to the production of a Land Cover Classification of the country.

As an initial step towards the national Land Cover Classification, during the Kick-Off mission of the project (30.05.2019), the TGFI (Technical Group of Forest Inventory) together with the international and national consultants from the UNIQUE-CAREC team has elaborated a detailed scheme as base for the Land Cover Classification (LCC) Scheme in Kyrgyzstan.

This report contains the description of the LCC scheme that was proposed and adopted, and additionally describes the criteria followed during the elaboration of the scheme such as:

- Compatibility with international standards
- Connection with the established classification system in the country
- Technical possibilities and limitations.

Finally, the goal of the activity is to produce a wall-to-wall map of the country presenting the distribution of the main forest types and general land cover classes. The National Forest Inventory (NFI) will use this information in order to make a more efficient calculation of the results by forest type, at the same time improving the accuracy of the results on national level.

This report refers to task 2-1 and is the delivery 2-1 “Report on definitions and Land cover classification system”.

## 2 EXISTING SYSTEMS

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### 2.1 International standards

The current international standards in the field of forestry and land cover analysis, especially in connection to NFI, are set by international organizations such as FAO or IPCC. In this respect, as a member country of UN and different international organizations, Kyrgyzstan is required to provide information and reports about the state of the land cover, that fulfill certain standards. When designing the NFI and the LCC, these specific standards have to be taken into consideration.

The main bodies describing and using information on Land Cover are:

- FAO (Food and Agriculture Organization of the UN)
- IPCC (Intergovernmental Panel on Climate Change).

#### **FAO**

The FAO is probably the highest authority on issues related to forestry on international level. It reports annually about the status of the forest resources<sup>1</sup> in each country, and provides technical support in the fields of forestry and forest inventory. For the needs of the FRA (Forest Resource Assessment), the FAO has created a land use / land cover scheme for which the countries have to provide information.

The FAO also is setting the standard for a forest definition. The forest definition of FAO is used in many countries and is taken over locally in the forestry legislation. This definition in general describes the LCC scheme used by FAO.

FAO (FRA –Forest Resource Assessment) has the following classes:

- Forest
- Other wooded land
  - Other land Trees combined with other land uses
  - No trees present
- Inland water

#### **IPCC - Intergovernmental Panel on Climate Change**

The focus of the work of IPCC is climate change and its effects on the different ecosystems. In the reports that IPCC issues, it reflects on the effects of climate change on six major classes of land cover<sup>2</sup>:

- Forest land
- Crop land
- Grass land

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<sup>1</sup> <http://www.fao.org/forest-resources-assessment/en/>

<sup>2</sup> [https://www.ipcc-nggip.iges.or.jp/public/gpplulucf/gpplulucf\\_files/Chp2/Chp2\\_Land\\_Areas.pdf](https://www.ipcc-nggip.iges.or.jp/public/gpplulucf/gpplulucf_files/Chp2/Chp2_Land_Areas.pdf)

- Wetland
- Settlements
- Other land

## 2.2 Existing national experiences

Besides the standards on international level, the NFI and the LCC scheme have to provide link to the existing practices in the country. Those are:

- The first National Forest Inventory
- The land cover classification used by the cadastral agency
- The forest type categorization from the Forest Management Inventory.

### **NFI 1**

The land cover classification system which was used for the first National Forest Inventory was based on the international standards set by the FAO. It included four levels of information, where “level 1” is synchronized with international standards and the level 2 – 4 have been developed to describe the natural conditions in the country.

Going from “level 1” to “level 4” the details of the land cover types are increasing, i.e. level 1 – category 1 is forests, which on level 4 is subdivided into 17 different forest types.

Similar level of detail is present on level 3.

A detailed scheme of the LCC scheme from NFI1 is given in the Annex.

### **Land cadastral agency**

The land cadastral agency is currently in the process of adopting a land cover scheme that is not forestry specific, but should be rather used by several sectors. In this respect, the LCC scheme is general and concentrates on land use change.

It includes three levels of information:

1. Land use categories – six in total (forest land, cropland, wetland, grassland, settlement, other land);
2. Land use sub-categories – in total 36, concentrating on the change between the land use categories
3. Land use sub-divisions – in total 37 different sub-division, describing in detail the six main land use categories.

A detailed scheme of the LCC scheme for this system is given in the Annex.

### **Forest Management Inventory**

The “State Institution Kyrgyz Forest Hunting Inventory and Planning (SIKFHIP)” is responsible for forest management in the country and has been performing forest stand inventories for more than 30 years. This experience is crucial for the NFI. One of the tasks of the NFI is to link with the information of the FMP and use the experiences.

For the LCC scheme, the FMP is using several attributes that are of interest. However, since the goal of the procedure is Forest Management Planning, it is describing only the existing forest type, and does not give information about land cover outside the forest.

In fact, there are three different attributes describing forests:

- Forest type
- Crown cover
- Main tree species.

The detailed description of these attributes is given in the Annex. The task of the LCC is to analyse the possibility and include if possible the categories from the Forest Management Planning related to forest types.



### 3 LCC FOR NFI2

Looking at the requirements on national and international level, the consulting team designed a proposal for a LCC to be used as part of NFI2 in Kyrgyzstan. This proposal was discussed together with the national experts from TGFI and accordingly adjusted, so that the outcome presents an approved scheme which will be used for the Land Cover Classification in Kyrgyzstan.

The following table contains the approved system.

Level 1 (basic level)	Level 2 (LC map)	Level 3 (field level)
Forest Canopy cover >10%	1 Spruce & fir forest	1 Spruce (>=60%)
		2 Fir (>=60%)
		3. Other (can be detailed further in the field manual)
	2 Juniper forest	1 Juniper turkestanica (>=60%)
		2 Juniper seravchanica (>=60%)
		3 Juniper semiglobosa (>=60%)
		Other (can be detailed further in the field manual)
	3 Walnut forest	1 Walnut dominating (>=60%)
		Other (can be detailed further in the field manual)
	4 Pistachio forest	Pistachio forest (>=60%)
Other (can be detailed further in the field manual)		
5 Other broadleaved and mixed forest	To be detailed further in the field manual	
Other wooded land	Shrubs	To be detailed further in the field manual (needs to reflect national & international definition)
3. Other land	Other land (Bare land, glaciers, rocks etc.)	
4. Agricultural land	Agricultural land (arable land, pasture / grassland)	
5 Settlement (including mines)	Villages and towns	
	Mines, quarries	
6 Inland water resources	Waterbodies (lakes, reservoirs, rivers)	

As it is possible to see from the table the system follows a similar approach as in the NFI1, as it is built up on different levels. These levels contain also different levels of information and have the task of linking the LCC with the established international and national standards.

#### Level 1 – main land cover types

The information presented in “Level 1” is more general type, describing main land cover types in Kyrgyzstan. In this case there are six main land cover types. “Level 1” presents also a direct

link to the established international standards. The land cover types described here correspond to the land cover types used by FAO and IPCC. This way a link to the international reporting standards is guaranteed.

From the six types presented in “Level 1”, the first two are of importance for the National Forest Inventory, as are directly related to forests and tree cover.

- **Forest** includes natural forests and forest plantations. It is used to refer to land with a tree canopy cover of more than 10 percent and area of more than 0.2 ha. Forests are determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 m with DBH  $\geq$  8 cm. Young stands that have not yet but are expected to reach a crown density of 10 percent and tree height of 5 m are included under forest, as are temporarily un-stocked areas.
- **Other Wooded Land** is land that has either a crown cover (or equivalent stocking level) of 5 to 10 percent of trees able to reach a height of 5 m at maturity; or a crown cover (or equivalent stocking level) of more than 10 percent of trees not able to reach a height of 5 m at maturity; or with shrub or bush cover of more than 10 percent. Other wooded land is considered by the national definition in Kyrgyzstan to be forest, it is in this case however separated so that the land cover statistics can correspond to the international requirements.

## Level 2 – main forest formations

Level 2 is giving more details to the main land cover types and specifically divides **Forests** into 6 main forest formations:

- Spruce and fir forests
- Juniper
- Walnut
- Pistachio
- Other broadleaved and mixed forests.

For the first four main forest formations, the decision if one forest stand belongs to a certain formation of forest is dependent on the percentage of the main tree species in the stand. This percentage is set to 60% i.e. if a forest stand has more than 60% spruce, it belongs to the main forest formation “Spruce forest”, similarly if it has more than 60% walnut, it belongs to the main forest formation “Walnut forest”. If the percentage of the main tree species is below 60%, the stand belongs to the “Other broadleaved and mixed forests”.

From technical aspect, it is important to note, that “Level 2” is the furthest level of information that will be provided by the Land Cover Classification using satellite imagery. Any more level of details will increase the uncertainty of the information and will drastically increase the time input needed for analysis and collection of reference data.

## Level 3 – field level (forest species)

At this level, the information is most detailed. This level of information will be assessed on the ground by the teams doing the measurements of the sample plots.

It presents a direct link with the LCC and gives more detail by adding information that cannot be assessed from satellite imagery, but only by visual assessment in the field.

Since it is a visual assessment, the different forest types can be further differentiated.

“Level 3” presents a direct link to the information gathered during the Forest Management Inventory. This is of importance since part of the FMP plots will be revisited during the NFI2 and a direct comparison of the data is needed. With this, the LCC complies directly with the requirement of linking the LCC system with existing national standards.

Level 3, will also be further detailed in the field manual for the NFI.

## 4 ANNEX

### 4.1 Land Cover Classification System used by NFI 1

The land cover classification system which was used for the 1<sup>st</sup> National Forest Inventory was based on the international standards set by the FAO. It included 4 levels of information, where the level 1 was synchronized with international standards and the level 2 – 4 have been developed to describe the natural conditions in the country.

Going from level 1 where the forest to level 4 the details of the land cover types is increasing, i.e. level 1 – category 1 is forests, which on level 4 is subdivided into 17 different forest types.

Similar level of detail is present on level 3.

International classes	National classes		
Level 1	Level 2	Level 3	Level 4
1. Forest	1. Natural forests	1. Coniferous natural forests	1. Spruce forest
			2. Juniper forest
			3. Flood plain forest
			4. Other coniferous forests
		2. Broadleaved natural forests	1. Walnut forest
			2. Apple forest
			3. Maple forest
			4. Hawthorn forests (Crataegus)
			5. Flood plain forest
			6. Other broadleaved forests
		3. Mixed coniferous-broad leaved natural forests	
		4. Natural «Forests» with small area	
	2, Homogeneous forests	1. Coniferous homogeneous forests	1. Spruce homogeneous forest
			2. Juniper homogeneous forest
			3. Other coniferous homogeneous forests
		2. Broadleaved homogeneous forests	1. Walnut homogeneous stands
2. Pistachio homogeneous stands			
3. Poplar homogeneous stands			
4. Other homogeneous stands			
	3. Mixed homogeneous forests		
	4. Homogeneous «Forests» with small area (shelterbelts)		
2. Other wooded land	1. Open stand		
	2. Shrubland	1. Coniferous shrubland	
		2. Broadleaved shrubland	
		3. Mixed shrubland	
3. Other land		1. Rocks, glaciers and rockslide	

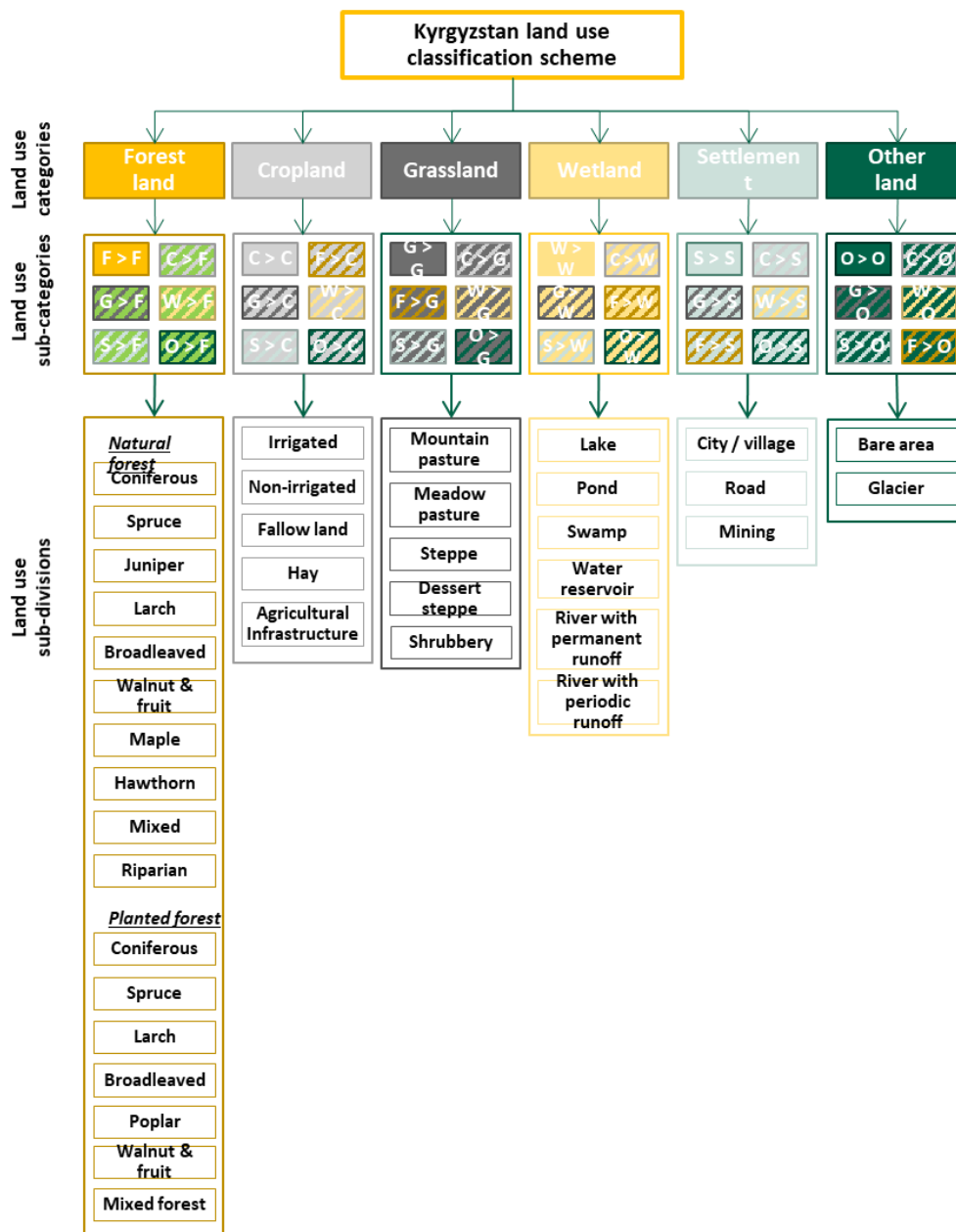
<b>International classes</b>	<b>National classes</b>		
<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Level 4</b>
	1. Natural non-forest land	2. Pastures - grassland	
	2. Agricultural land	1. Hay-making	
		2. Plough-land	
		3. Vineyards and orchards, city parks - (Perennial crop)	
		4. Gardens and crops under the canopy	
	3. Small wooded land		
	4. Houses and roads		
5. Mines, quarries			
4. Inland water resources	1. Lake		
	2. Pond		
	3. Reservoir		
	4. Perennial river		
	5. Intermittent stream (non-perennial)		

## 4.2 Current classification system based on FAO categories

Parallel with the process of NFI2, there is an ongoing activity lead by the land cadastral committee on establishing a Land Use Classification Scheme for Kyrgyzstan.

The proposed scheme is presented in the illustration below.

The general land use categories do correspond with the categories proposed for NFI2, with some differences. It is obvious that this classification scheme is designed with the intent of visual interpretation where a trained professional is analyzing aerial images. In this way it is possible to distinguish for example “Grassland” from “Cropland”. Such differentiation is also not the goal of the LCC scheme for NFI2 and additionally cannot be efficiently achieved by an automatic classification procedure.



### 4.3 FMP Classification system

The forest inventory which is part of the process for creating a Forest Management Plans for the forestry ranges in Kyrgyzstan does not have specific attributes that refer to land cover. Instead, it is concentrated only on forests and gives detailed information on forest types.

The following three attributes are example for that:

- Forest type
- Crown cover
- Main tree species.

#### Forest types

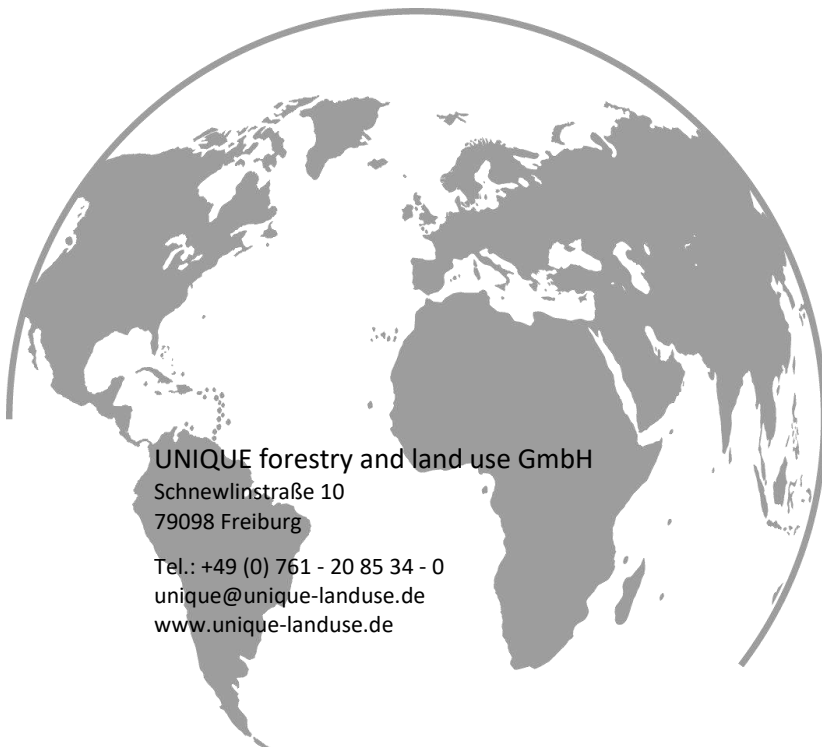
1. Coniferous
2. Broadleaved
3. Mixed
4. Volumetric shrubs
5. Small shrubs

#### Crown coverage with trees

1. Thick	81 – 100 %
2. Free	51 - 80 %
3. Rare	10 – 50 %

#### Percent dominating tree species

- 0 - juniper procumbence, shrub formation;
- 1 - more 61 % walnut trees on strata;
- 2 - 21-60 % walnut trees on strata;
- 3 - 0-20 % walnut trees or absence on strata
- 4 - pistachio forest;
- 5 - predominance of turkestanica;
- 6 - predominance of juniper semiqlobosa;
- 7 - predominance of seravchanica;
- 8 – mixed types of juniper on strata



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