Annex 2. 2. Mapping of LUS using the LADA/WOCAT tools and SOC mapping

REPORT OF THE DLDD AND SLM ASSESSMENT AND MAPPING OF LUS USING THE LADA/WOCAT TOOLS AND DPSIR AHALYSIS AT NATIONAL AND SUBNATIONAL LEVEL

PART II: MAPPING OF LUS USING THE LADA/WOCAT TOOLS AND SOC MAPPING

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Content

Preface		2
1. Baseline	e Information on Land Use System in the Country	2
2. Mapping	g of Land Use System	2
2.1.]	Methodology and Characteristics	2
2.2.	National Map of Land Use System	3
2.3.	Mapping of Land Use System at sub-national level	7

Preface

This report is Part II of the DLDD and SLM assessment and mapping of LUS based on FAO LADA (2009) Guideline on «Mapping of Land Use System at global and national scales for Land Degradation Assessment Analysis» and using DPSIR analysis at national and subnational level, as well as SOC mapping report. The Report had been prepared in accordance with the Methodological Logframe and Workplan of DS-SLM Project.

1. Baseline Information on Land Use System in the Country

Land use categories

Total land resources of the country are 44,4 million ha, 25,68 ha million ha from that are agricultural lands, 21, 2 million ha from that are low productive pastures, and 4, 295 million ha are irrigated lands (**Table 1.1**).

Area		Arable lands		Perennial plantings		Fallow lands		Pastures and hayfields		Agricultural lands			
Total	Irrigat.	Total	Irrigat.	rainfed	Total	Irrigat.	Total	Irrigat.	rainfed	Total	Irrigat.	Total	Irrigat.
44410.3	4295.3	4057.2	3303.6	746.0	335.8	322.7	83.6	48.4	35.2	21207.4	43.4	25683.9	3718.1

Table 1.1. Distribution of the agricultural lands, thousand ha

Source: Goskomzemgeodezkadastre, 2015

Irrigated agriculture lands

Irrigated agricultural lands are concentrated in plain and piedmont part of the republic that defines the character of soil formation processes development, agricultural practices, their intensity and identification of agricultural land quality. This category of lands is divided into 6 sub-categories, depending on soil type, degrees of amelioration and production capacity, expressed in potential level of crop yield.

Rainfed agriculture lands

The lands used for rainfed agriculture in Uzbekistan, are located in foothill plain, piedmonts and low hills of Tien Shan and Pamir-Alay. The total area of arable rainfed area is 753,6 thousand ha. More than 80% of the rainfed area is classified as poor with precipitation rate in total 250-350 mm. Only 15% of dry land area in mountains and piedmonts are provided with natural soil moistening (450-750 mm).

Pasture

The pasture area of the country is based in the regions with low natural resources potential; its technological cycle is extensive and entirely depends on natural forage conditions. It is multicultural by structure and occupies 21.2 million ha, 81% of which are arid areas, 12% are sub-mountainous and semi-arid areas, 5% are mountainous pastures and 2% are alpine pastures.

2. Mapping of Land Use System

2.1. Methodology and Characteristics

FAO LADA (2009) Guideline on «Mapping of Land Use System at global and national scales for Land Degradation Assessment Analysis», as well as global products - FAO LADA, GLC-2000, AgroMaps, SRTM data and the others served as methodological basis for development of land use system at the national and subnational level.

For mapping of subnational land use system (LUS), compilation of information (climate, soils, landscapes, land use categories) and updating of digital thematic maps (boundaries of agricultural rainfed and irrigated lands, change of vegetation cover and lakes/open water surfaces) was carried out using

MOD13Q1 and Google. In accordance with the above guidance of FAO LADA, two subnational land use system (FAO LUS) maps have been prepared.

2.2. National Map of Land Use System

National LUS Map developed in the framework of multicountry CACILM SLM-Information System project (SLM-IS, 2009) has been used for design of DS-SLM subnational LUS maps (Figure 2.1).

National LUS Map consists of 25 classes of land use, each of them is divided into 3-4 sub-classes depending on biophysical characteristics of ecosystem, land use characteristics and social economic characteristics:

- Biophysical characteristics is the class of temperature regime, growing duration of crops, dominating soil units and landscapes
- o Characteristics of land use dominant cattle type, cattle density, dominant crops
- Socio-economic characteristics: population density, poverty.

CACILM LU and National FAO LUS map in GRID format and attributive maps of FAO LUS are presented below.



Figure 2.1. FAO LUS Map of Uzbekistan, CACILM SLM-IS, 2009

Source: NSIU Team, 2009 based on FAO LADA Guidance on Mapping LUS at global and regional scales for LADA, (F. Nachtergaele, M. Petri), 2009



Figure 2.2. CACILM Land Use (LU) of Uzbekistan

Source: CACILM SLM-IS NSIU Final Report, 2009

Table 2.1. Description of completed attributes of LUS database in GRID form

N	Description	Scale		Covered area, source and date of data	
1	Temperatu re regime of the Ecosystem	1: 200 000		Temperature regime	
				Moderate, subtropical (southern part of Surkhandarya region). Arctic and Boreal (limited area – two glaciers)	Uzb vector map of location meteorolo- gical (62) stations. Uzhydromet)
			FAO CODE	Land Use Systems	
			2	2 Forest Protected	
		1: 2 500 000	3	3 Forest Managed	Atlas of Land
			4	4 Forest Pastoralism	Resources of
			8	8 Grasslands – Protected	Uzbekistan, 2001;
			9	9 Grasslands Extensive pastoralism	Uzbekistan Atlas,
	I and Use		10	10 Grasslands – Mod. intensive pastoralism	1982;
2	Systems		11	11 Grasslands – Intensive pastoralism	Vector shape files
			14	14 Shrubs Protected	prepared on the base
			15	15 Shrubs Extensive pastoralism	of national land use,
			16	16 Shrubs Mod. intensive pastoralism	forests, irrigated and
			17	17 Shrubs Intensive pastoralism	rain fed, bare areas
			19	19 Agricultural Lands – Rainfed agriculture	layers, etc
			22	22 Agricultural land and Agro pastoralism- mod intensive, plantations with large-scale irrigation	

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N	Description	Scale		Covered area, source and date of data		
			23	23 Agricultural Lands Large-scale irrigation		
			25	25 Urban land		
			27	27 Wetlands protected		
			29	29 Wetlands Agro-pastoralism		
			31	31 Sparsely vegetated areas - Protected		
			32	32 Sparsely vegetated areas Extensive pastoralism		
			34	34 Bare areas No use (takyrs, sand-dunes)		
			35	35 Bare areas protected		
			38	38 Open water No use		
			39	39 Open water – Protected		
			40	40 Open water – Inland Fisheries		
			41			
			LGP days	Moisture regime		
3			<60	Deserts	Length of growing	
	Climatic	1: 200 000	60-180	Drylands Sub-humid	period in Central	
	Ecosystem		180-270	Sub-numia	Asia. ICARDA	
			> 220	Par humid		
			CODE	Irrigation		
4	Irrigation	1:200 000	1	Large-scale irrigation	-	
5	Urban areas			Single class	MODIS-2000, Basic map	
	Protected areas	1:200 000	CODE	Protected areas (ha)		
6			1	<10 000	Reserves and national	
U			2	10 000 - 50 000	UNDP 2005	
			3	>50 000		
	Dominant Livestock Types	1:200 000	CODE	Livestock Types		
			9	Cattle, Poultry	GLC and State Statistical Committee	
7		Livestock	1.200 000	10	Cattle, sheeps	data for 2005-2007
			13	Sheeps, goats,	-	
			16	Sheeps, Poultry		
		TLU/1	TLU/κm ²	Livestock		
	Livestock Density		0	Non pastoral area		
8		2 k 1:200 000	0,01-0,1	Extensive pastoralism	GLC and State	
			0,11-0,8	Mod.Intensive Pastoralism	data for 2005-2007	
			0,8-1,0	Intensive Pastoralism	per region/oblast	
			> 1,1	Intensive Pastoralism	level	
	Terrain		CODE			
		1.	1	Plain and plateau		
9		1:	2	Mountain 800-1500 m. slope >5%	1	
9			2	Mountain 1500-2500 m slone >2%	SRTM	
				Mountain > 2500	-	
			4	wountain >2500 m		

N	Description	Scale		Covered area, source and date of data	
			CODE	Soil Type	uuu
			4	AR	
			5		
			5	AI	
			/	UL UL	
			8	СМ	
10	Dominant	1:1 500 000	9	FL	FAO Uzbekistan Soil
10	Soil Unit		11	GL	Мар
			16	LP	M 1:1 500 000
			17	LV	
			25	PC	
			25	RO RO	
			26	SC	
			27	SN	
			CODE	Dominant Crops	
			36	Barley	
			84	Barley, Sunflower	
			85	Barley, Sunflower, Wheate	Goscomzemgeodez-
			272	Grapes (Fruit), Potatoes, Grapes (Fruit), Potatoes, Wheat	cadastre, 2007
	Dominant		275	Grapes (Fruit), Polatoes, wheat	Digital administrative
11	Crops	1:200 000	510	Supflower	division layer of
	-		511	Sunflower Wheat	basic country vector
			516	Wheat	шар
			535	Cotton-Fibres, Wheat	
			536	Cotton-Fibres Wheat Rice	
				Cotton-Fibres, Wheat, Vegetable	
10	D		537		
12	Dominant		CODE	Dominant crop groups	-
	groups		1	Cereals and sereal products	C
	groups		2	Cereals and sereal products, Fruits	Goscomzemgeodezca
		1:200 000	3	bearing crops	Digital administrative
				Cereals and sereal products Fruits	division layer of
			8	Vegetables	basic country vector
			10	Creals and sereal products, Oil-bearing crops	map
			16	Cereals and sereal products, Oil-bearing	
			10	crops, Vegetables	
			50	Fruits, Vegetables	
			CODE	Population density, inhabitants/ km ²	
	Populatio		3	2 to 10	State Statistical
13	n	1.200.000	4	10 to 50	2005-2007 per
	density ^{**)}	1.200 000	5	50 10 250	province/oblast
			6	above 250	province, const
			CODE	Infant mortality / poverty	
					State Statistical
			4	10 to 20	Committee data for
	· **)				2005-2007; CACILM
14	Poverty '	1:200 000			NPF Uzbekistan, 2006: Evaluation of
			5	20 to 30	Living Standards.
					World Bank, 2003.
					Part 2, Table 2

Source: CACILM SLM-IS (2009) Second Annual National Report on the Status of Land Degradation, 2009

2.3. Mapping of Land Use System at Sub-national Level

Mapping of land use system at the sub-national level is executed on the basis of National LUS Map. Maps are made for two various landscapes (Figure 2.3-2.4)

- 1. Rainfed landscapes in the upper reaches of the Kashkadarya river basins Kashkadarya region
- 2. Irrigated landscapes of the Hunger steppe in the east of Jizzakh region

LUS Map of Kashkadarya region include 20 land-use classes. The largest area is occupied by 4 land-use classes: (i) Shrubs – Extensive pastoralism (21%), (ii) Grasslands - moderate intensive pastoralism (17%), (iii) Agricultural land-Agro-pastoralism moderate intensive with large-scale irrigation (14%) and (iv) Agricultural land-Rainfed agriculture (13%).

LUS Map of Jizzakh region include 16 land-use classes. Three classes of land use prevail:

(i) Grasslands-Moderate intensive pastoralism (23%), (ii) Agricultural land-Rainfed agriculture (21%) and (iv) Agricultural land-Large scale Irrigation (15%).



Figure 2.3. CACILM Landuse Map of Kashkadarya Region





2.4. Soil Organic Carbon Mapping

Country Report on Digital Soil Organic Carbon Mapping Training Uzbekistan

(06-23 June 2017, ISRIC, Wageningen).

The severe problem of salinization in arid and semiarid regions is attributed to land use conversion involving deforestation, excessive irrigation, poor drainage and re-use of drainage water for irrigation. Adoption of scientifically proven and reliable SLM technologies can increase net primary productivity (NPP) and enhance ecosystem C pool as humus in soils and woody/ perennial material as above ground biomass.

Under support of FAO/GEF DS-SLM Project and in collaboration with the Global Soil Partnership of FAO UN and World Soil Information (ISRIC), a soil organic carbon mapping has been performed to evaluate soil carbon of the whole territory of Uzbekistan.

1. Input Data

National Soil maps of Uzbekistan (traditional paper format), in the scale 1: 100 000, have been used as a source of information for digital soil mapping. These maps have been created by the State Design and Research "UZGIP" (Uzgipromeliovodkhoz) Institute with using soil survey and soil monitoring data of the national institutions for the period 1998-2008. Among the other property information, these soil maps include soil organic matter (SOM) content in percent for 30 cm soil depth and soil bulk density (BD) for the same depth in g/cm³.

These soil maps have been scanned, geo-referenced and digitized into polygon shapes and attributed with corresponding soil characteristics.

For the purpose of simulation of soil carbon stock, digital point data set have been created from the above mentioned polygons using ArcGIS. In total, **roughly 5000 points** have been derived from the soil polygons **covering entire territory of Uzbekistan**. Each point in the dataset includes spatial information (x and y coordinates in UTM coordinate system), soil organic matter and bulk density for the 30 cm depth.

2. Methods (The method used for producing your national SOC Map)

A random forest simulation have been used to simulate the soil organic carbon stock and 1 km grid covariate data of Uzbekistan. The number of trees for simulation were taken as 1000.

3. Calculation of SOC Stocks and associated uncertainties

The simulation resulted the residual (r^2) as = 0.617, The RMSE was estimated as 0.33.

Internal validation of random forest model has given almost same results r^2=0.655. RMSE=0.33.

In addition, we have performed independent validation for the 15 field measurements that were available for relatively small area in the east of Uzbekistan. The R square for simulated and observed scatterplot was equal to 0.681, which is in line with internal validation of the model.

4. Output Maps

In our opinion, the model gave quite a good and reasonable results. From the map it can be seen that former bed of dried Aral sea, in the western part of Uzbekistan has a lowest value of carbon stock and this is logical. The irrigated agricultural lands in the Amu Darya river delta and at the other part of Uzbekistan are definitely highlighted with higher level of carbon stock compared to surrounding deserts. The highest levels are observed in the pre-mountain and mountain meadows in the eastern part of Uzbekistan.

