Integrated Biodiversity Management, South Caucasus

GIS and Remote Sensing Capacities for Integrated Land Use Management in Armenia, Georgia and Azerbaijan

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Report

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Executive summary

The recently started Integrated Biodiversity Management, South Caucasus programme aims to advise partners in integrated land use management based on precise (geo-spatial) data.

To develop a more comprehensive understanding of the institutional capacities and technical environment for handling geo-spatial data in Armenia, Azerbaijan, and Georgia relevant governmental, private, and scientific institutions were visited and assessed in 2015.

The most advanced approach towards a harmonized geo-spatial data infrastructure was found in Georgia, which currently implements a National Spatial Data Infrastructure in line with the EU framework for geo-data management, INSPIRE.

Armenia´s government has implemented IT-based systems for environmental data management like the National Forest Management Information System or an electronic cadastral system. These approaches of the government could be a stepping-stone for a more harmonized and comprehensive development towards geo-spatial data management and policy in Armenia.

Azerbaijan recently decided to develop more comprehensive geo-spatial data systems for agricultural and environmental management, which are absent at the moment. This development goes hand in hand with the acquisition of an earth observation satellite by a state controlled satellite provider in Azerbaijan.

The human and technical capacities of governmental institutions in GIS and remote sensing are in general low.

In all three countries comparable problems of data accuracy were found. Most of the data has thematic and/or geometric errors or is not provided in a common geo-spatial format. Access to data is in many cases difficult, because no open spatial data systems and policies exist. The cadastral systems are full of errors which result in unsecure property rights and biased statistical data.

Because of these challenging findings, integrated land use management should go hand in hand with the creation of baseline data, capacity development, and the implementation of a necessary technical environment.

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ACE	Acopian Center for the Environment
AUA	American University of Armenia
BPS	Biodiversity Protection Service
BSc	Bachelor of Sciences
CAD	Computer Aided Design
CARMAC	Community Agricultural Resource Management and Competitiveness
CBD	Convention on Biological Diversity
CENS	Center for Ecological Noosphere Studies
CRM	Center for Responsible Mining
DEM	Digital Elevation Model
EE	Environmental Education
EEN	Environmental Education Network
FMIS	Forest Management Information System
FPS	Forest Policy Service
GEO	Group on Earth Observation
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GIZ	Gesellschaft für Internationale Zusammenarbeit
IBiS	Integrated Biodiversity Management
ISO	International Organization for Standardization
LIDAR	Light Detection and Ranging
LPIS	Land Parcel Identification System
MENRP	Ministry of Environment and Natural Resources Protection
MoA	Ministry of Agriculture
MSc	Master of Science
NAPR	National Agency of Public Registry
NBMS	National Biodiversity Monitoring System
NFA	National Forest Agency
NDVI	Normalized Differenced Vegetation Index
NEA	National Environmental Agency
NFMIS	National Forest Management Information System
NSDI	National Spatial Data Infrastructure
OGC	Open Geospatial Consortium
PMIS	Pasture Management Information System
PMU	Pasture Management Unit
RA	Republic of Armenia
RGB	Red, Green, Blue
RS	Remote Sensing
RSS	Remote Sensing Solutions
RUSLE	Revised Universal Soil Loss Equation
SDI	Spatial Data Infrastructure
SESD	State Environmental Supervision Department
SFMC	State Forest Monitoring Center
SMB	Sustainable Management of Biodiversity
SMBP	Sustainable Management of Biodiversity Programme
SPM	Sustainable Pasture Management
WFS	Web Feature Service
WMS	Web Map Service
YSU	Yerevan State University

1. Introduction

The recently started Integrated Biodiversity Management, South Caucasus (IBiS) programme aims to advise partners in integrated land use management based on precise (geo-spatial) data.

To develop a more comprehensive understanding of the institutional capacities and technical environment for handling geo-spatial data in Armenia, Azerbaijan, and Georgia relevant governmental, private, and scientific institutions were visited and assessed in 2015.

Visits took place in Armenia from September – December 2015, in Azerbaijan from November, 10-13, and in Georgia from November, 2-4. Overall, 22 partners were visited.

Aside from a detailed understanding of partner’s capacities to work with Geographic Information Systems and remote sensing technologies, challenges like policy requirements, problems of data accuracy, or weak governmental institutions were also addressed.

In all three countries promising approaches for a more comprehensive development towards a harmonized geo-spatial data infrastructure were found. Partly, these are results from the predecessor programme of IBiS, SMBP. Under SMBP partners were supported by the creation of geo-spatial baseline data for forest management and monitoring, and biodiversity monitoring.

In all three countries natural resources and land use planning suffer from a lack of appropriate management approaches. A strong aspect of this problem is the lack of solid (geo-spatial) information. Decisions about the allocation of resources and the prioritization of environmental strategies and goals are being made with vast uncertainties, as reliable information is not being fully in place.

Therefore, integrated land use management should go hand in hand with the creation of baseline data, capacity development, and the implementation of a necessary technical environment. Additionally, a conceptualized approach for harmonized spatial data management and sharing should be developed which considers technical aspects like standards, data maintenance, and data creation.

2. The importance of geo-spatial data for a landscape approach

The landscape approach is a conceptual framework for integrated land use management became increasingly popular in the development community during the last years. On the forefront of the promotion of the approach there are well known institutions such as the World Bank Group, CIFOR/CGIAR or IUCN. During the COP 21 of the UNFCCC meeting in Paris last year (2015) a side event of the “Global Landscape Forum” was held addressing development issues related to the landscape approach (http://www.landscapes.org/glf-2015/).

The development of the landscape approach is strongly linked to the climate change and biodiversity debate. The rising awareness among experts on how land use activities are linked to climate change, and on how climate change imposes risks to environmental and production systems, demanded for a more integrated approach towards land use management. Additionally, the biodiversity debate shifted from an emphasis on protected areas towards a bigger consideration of the role of production and land use systems outside of protected areas for biodiversity conservation. Therefore, a demand for a more holistic consideration of land use management became also urgent for conservation specialists.

Conceptually the landscape approach aims to manage multifunctional land use in an integrated manner, considering the natural environment and the human systems that depend on it, by:

- integrating policies across sectors
- mitigating competing land uses (food, energy, conservation etc.)
- involving all relevant stakeholders
- managing across different spatial scales.

It is intended that a landscape approach improves resilience, adaptation, and mitigation of both natural and human systems (which face new challenges due to climate change) and that natural resources are managed from a cross-sectorial point of view. The institutionalization of “a landscape” is somewhat loose compared to other approaches addressing land use management (protected areas, property rights etc.).

The approach is conceptually appealing. However, its formalization is a challenge because institutionalization across sectors requires clarification of institutional roles and responsibilities in order to empower stakeholders to act as cross-sectorial players. Central pillars are therefore institutional and legal reforms, capacity development, involvement of stakeholders across sectors and institutional levels, and the creation of precise geo-spatial data. Usually, these prerequisites are not in place in developing countries (a roadmap for financing global landscapes: http://www.landscapes.org/wp-content/uploads/docs/GLFInvestmentRoadmap_web.pdf).

Geographic Information and remote sensing technologies are commonly applied as toolsets to support institutions in integrated landscape management (e.g. Childress et. al. 2014). The following list gives a basic idea how geo-spatial technologies and data are valuable for integrated landscape management:

- Integration of food production, hazard risks, water and natural resources management and conservation issues
- Monitoring of natural resources with independent and transparent information
- Modeling and understanding of complex ecological systems
- Analysis and quantification of material fluxes in ecosystems
- Safeguarding land tenure
- Precise land use information
- Landscape zoning
- Modeling of expected effects (e.g. climate change)
- Communication “maps tell more than thousand words”.

The landscape approach is more a conceptual framework than a readily applicable toolset. Hence, the geo-spatial data, which is required for a specific landscape approach is not defined in a fixed way. However, it is possible to identify geo-spatial data of major importance for operationalizing a landscape approach. Commonly, the following topics are linked to a landscape approach:

1. Administrative and infrastructure data
2. Production systems dependent on ecosystem services
3. Climate change
4. Biodiversity/conservation issues
5. Natural resources management
6. Socio-cultural aspects.

On the level of the required data, the topics mentioned above do partly overlap since the same land use types are considered from different perspectives. A Geographic Information System manages this overlapping information with “attributes”. Attributes are assigned to objects of an information layer (e.g. fields) and store different characteristics (e.g. crop type, drought vulnerability, soil type, taxation etc.) of an object.

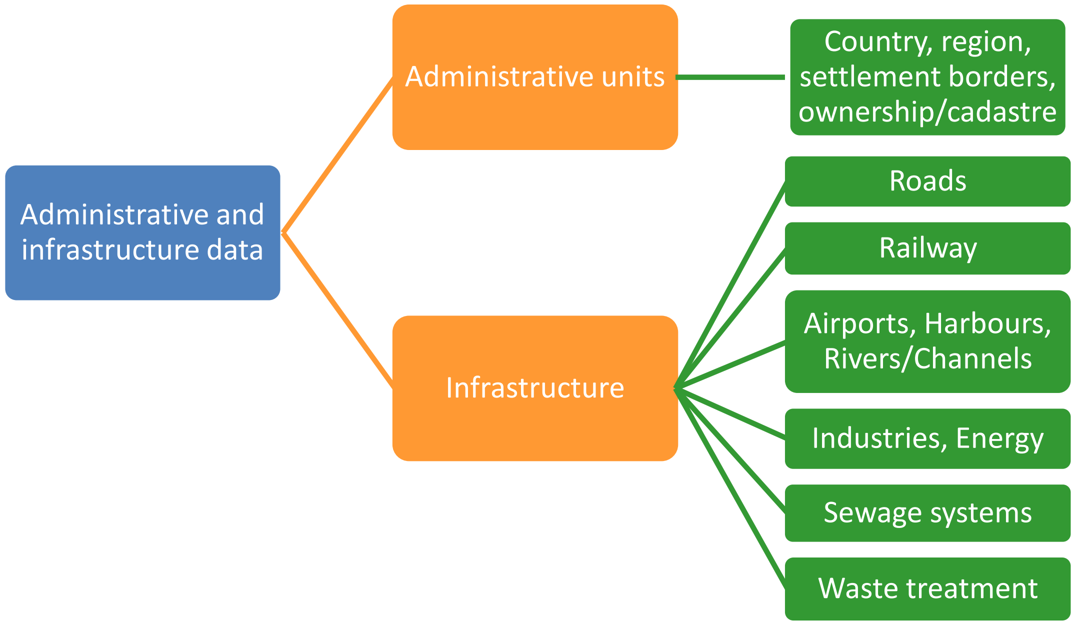

Figure 1: Overview of required geo-spatial data related to administrative and infrastructure data. Spatial scale of the data should be 1:10 000-1:25 000 (cadastre data has a resolution of 1:1000 or 1:2500)

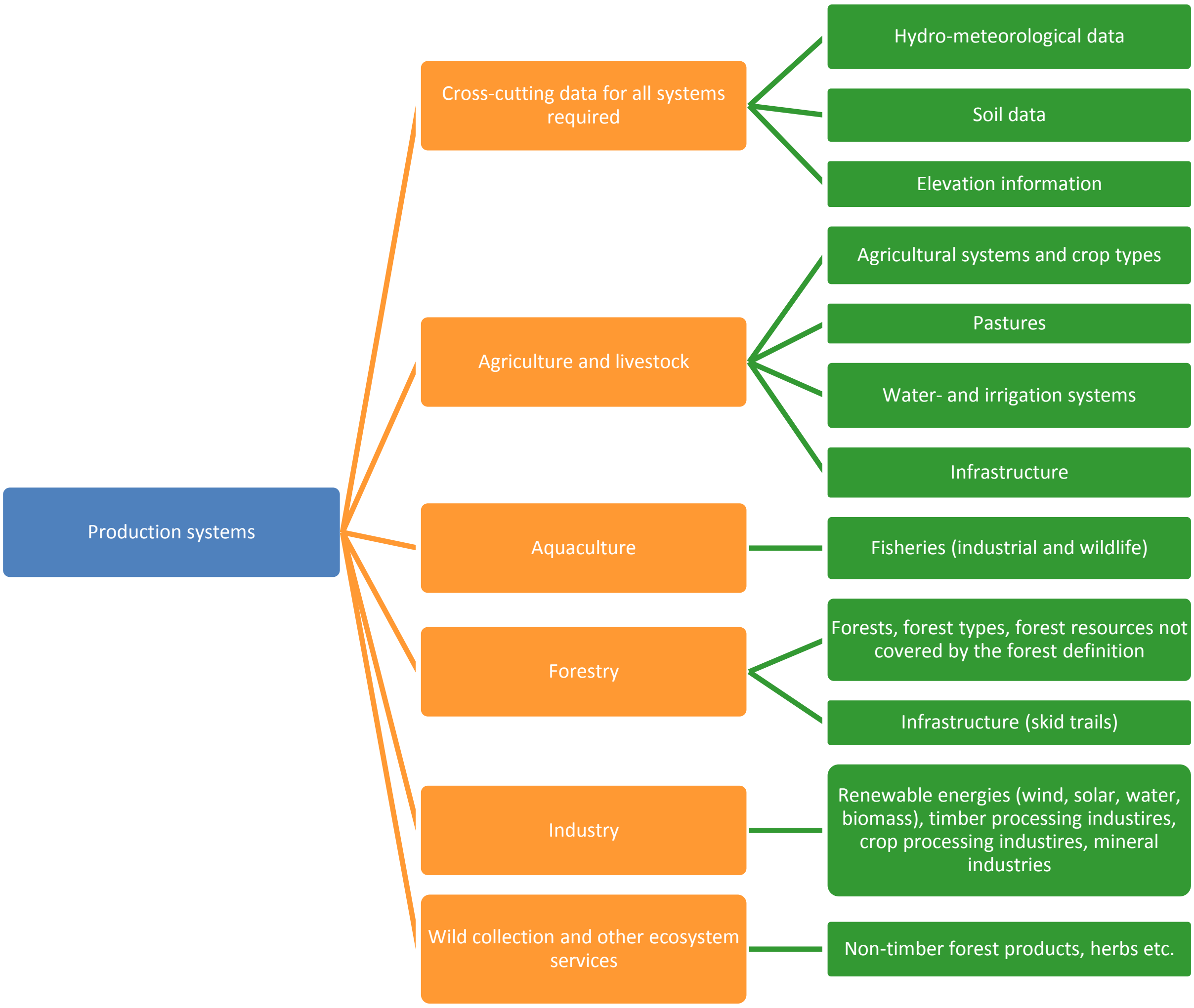

Figure 2: Overview of required geo-spatial data related to ecosystem service depending production systems. Spatial scale of the data should be 1:10 000-1:25 000 (soil data 1:50 000 or less)

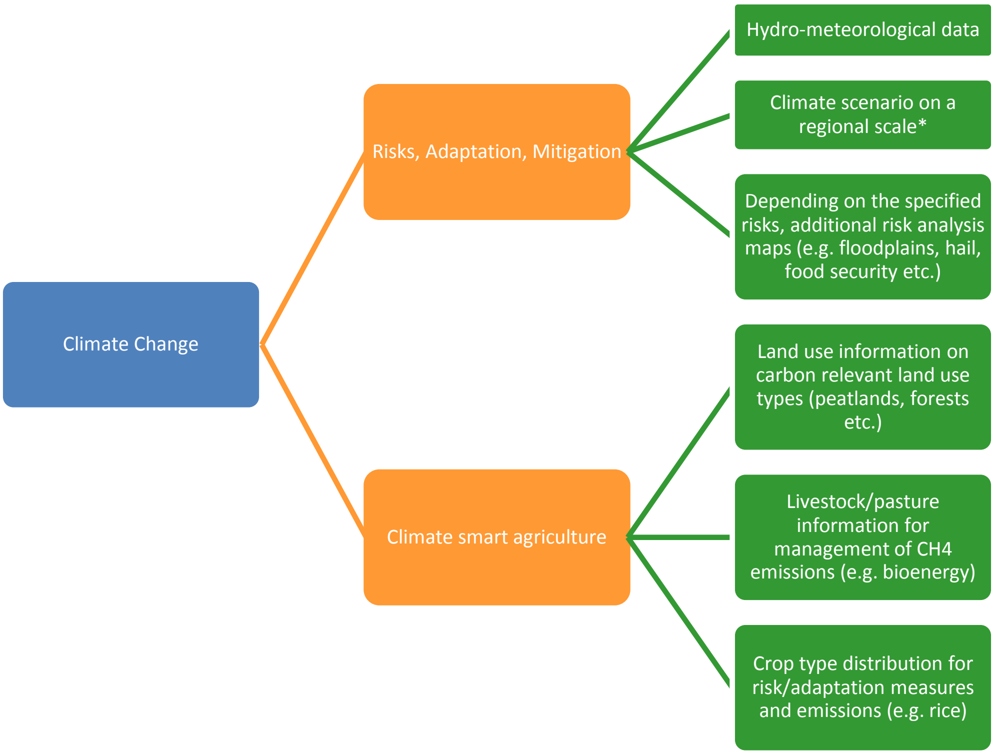

Figure 3: Overview of required geo-spatial data related to climate change. Spatial scale of the data should be 1:10 000-1:25 000

*Regional climate scenarios rely on high precision geo-spatial information of different types (temperature, rainfall etc.)

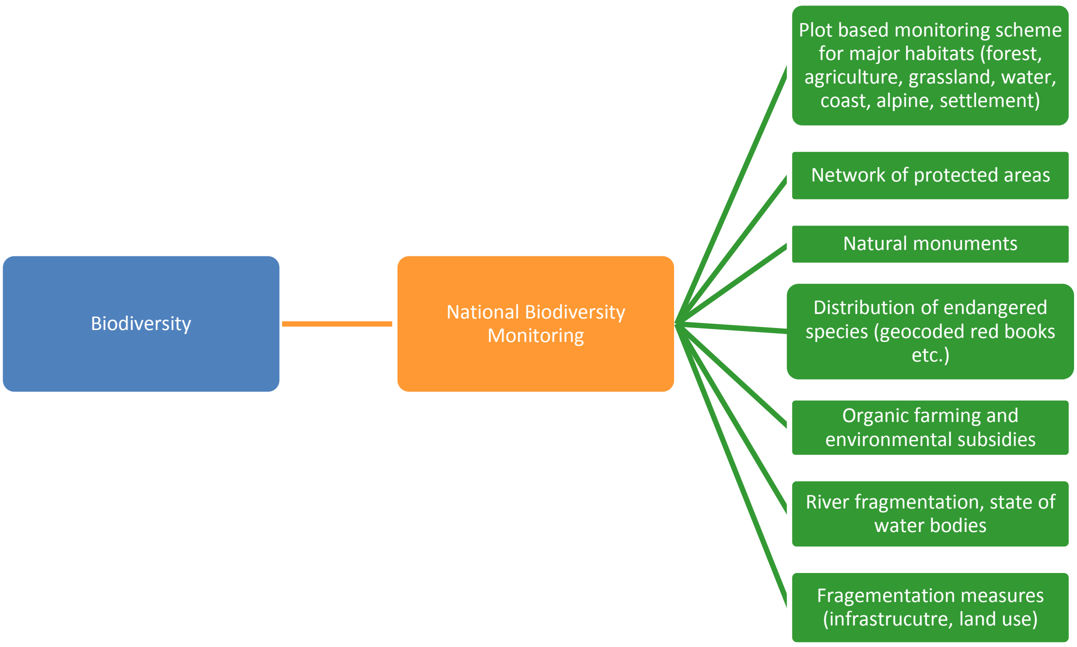

Figure 4: Overview of required geo-spatial data related to biodiversity. Spatial scale of the data should be 1:10 000-1:25 000 (plot based biodiversity monitoring systems have a resolution of 1:1000-1:5000)

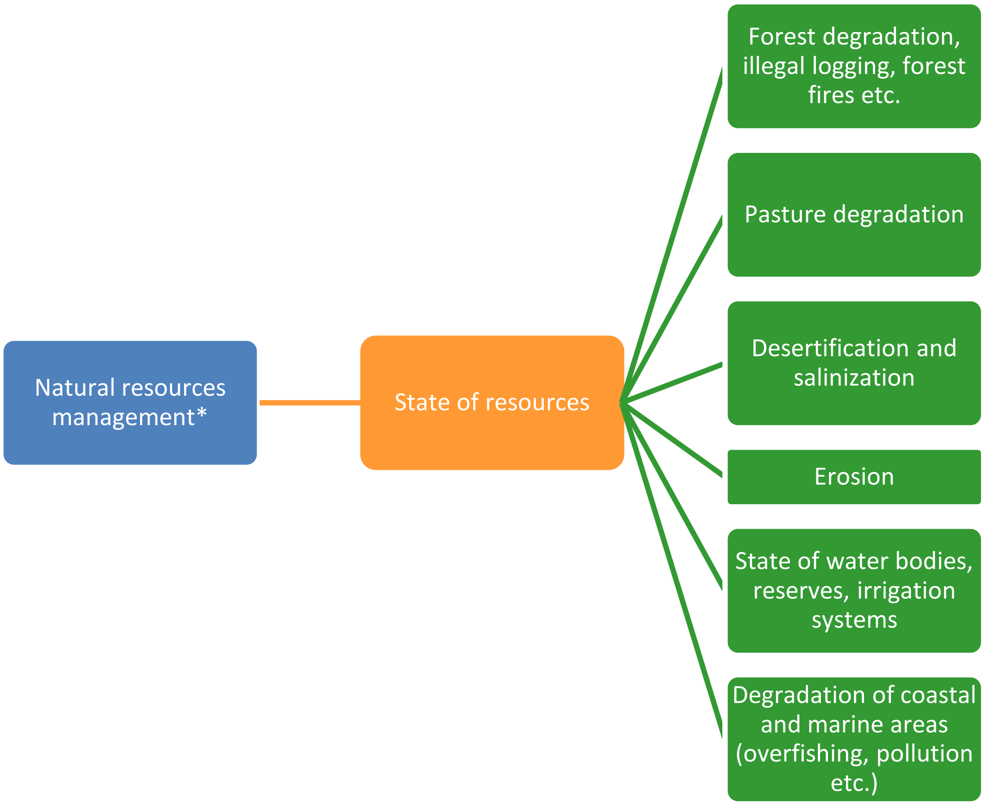

Figure 5: Overview of required geo-spatial data related to natural resources management. Spatial scale of the data should be 1:10 000-1:25 000

*This figure shows mainly degradation problems related to natural resources while the use is mainly covered by Fig.1.

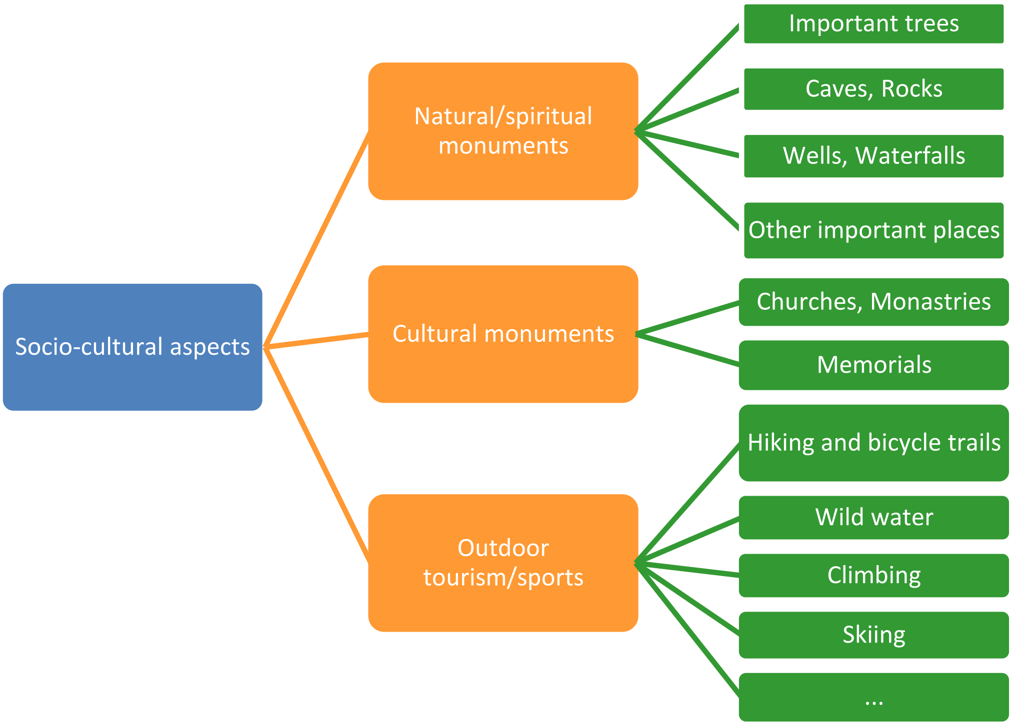

Figure 6: Overview of required geo-spatial data related to socio-cultural aspects. Spatial scale of the data should be 1:10 000-1:25 000

The above-presented collection of geo-spatial data can be linked to a landscape approach and represents a selection of possible data. Yet, when following a specific approach not all of them are obligatory, while other data, not mentioned here, could be more important.

Considering that most of the presented selection of data is not available in an appropriate manner (accuracy, up-to-dateness etc.) in all three countries, it clearly shows the challenges when applying a landscape approach. Moreover, it requires a spatial data infrastructure (SDI) to facilitate exchange of spatial data among different institutions because different government bodies usually maintain the data mentioned above. A SDI is a framework for handling geo-spatial data. Its infrastructure provides (IT-based) rules and standards for data exchange, processing and maintenance. Standards and rules are in compliance with international regulations (Open Geospatial Consortium (OGC), ISO 19139, 19115) and explain how data must be shared among government institutions and to end-users. The EU uses e.g. the so called INSPIRE framework (see also 4.1.1).

The data presented above represents (more or less) the set of so called “baseline layers”. Baseline layers are datasets, which are typically provided by government institutions and which have certain accuracy and reliability (e.g. border of the country). The maintenance of the data is costly because a mixture of field investigation and remote sensing technologies are used (depending on the required accuracy and thematic content). Cadastral information e.g. requires the highest accuracy with a positional error within centimeters. This accuracy requires field measurement with high precision instruments (tachymeter). Forest data for forest management does not have to meet such high positional accuracy but a high thematic resolution (forest stands, species composition), which makes intensive fieldwork or costly remote sensing technologies (Orthophotos, LIDAR), or a combination of both, mandatory.

The maintenance cycle of geo-spatial data is usually 1-5 years until the data needs to be updated.

This short overview shows that government bodies need comprehensive technical expertise (SDI, OGC/ISO, GIS, RS) and IT equipment. Furthermore, it requires institutional roles and responsibilities to be clarified. Data maintenance is costly because of the required fieldwork or remote sensing information and the technical expertise, which constantly needs to be in place.

In the three countries Armenia, Georgia, and Azerbaijan the above-mentioned requirements are not fully developed. In Azerbaijan no approaches for the development of a harmonized spatial data infrastructure were found. In Armenia the Center for Ecological-Noosphere studies (CENS), a research institution, developed a spatial data infrastructure for the dissemination of environmental data and the participation in international initiatives such as GEO (Asmaryan et al. 2014). However, this approach is not linked to government initiatives. In Georgia the creation of a National Spatial Data Infrastructure in-line with INSPIRE is ongoing. Among the three countries this is the most advanced approach towards harmonized geo-spatial data handling.

Government bodies only provide baseline layers in a limited way. Those layers, which are available, suffer in many cases from accuracy problems (spatial and thematic), from being outdated, or from low spatial resolution. Data maintenance is mainly based on methodologies which do not allow an independent assessment of the accuracy of the data.

Additionally, open spatial data policies especially in Armenia and Azerbaijan are not developed, which makes it difficult to access and acquire information. What kind of information was produced in cooperation with government bodies and who has the information currently is mainly found in donor reports. For the access to data fees are common. From research institutions it has been stressed that personal contacts are in many cases helpful to access data.

3. Armenia

3.1 Institutional framework for geo-data management in Armenia

Geo-spatial data for environmental management is mainly used by the Ministry of Agriculture of the RA, the Ministry of Nature Protection of the RA, the Ministry of Territorial Administration and Emergency Situation of the RA, and the State Committee of the Real Property Cadastre of the Government of the RA.

The Ministry of Agriculture of the RA is responsible for data related to:

- Pastures (Department of Land Use and Melioration)
- Forests (Hayantar SNCO, State Forest Monitoring Center)
- Agricultural Lands (Department of Land Use and Melioration)
- Water (State Committee of Water Economy of the RA)

The ministry runs a central server, which hosts geo-spatial data. Forest data is distributed via a client-server based FMIS to the management authorities on the regional level (see 3.2).

The Department of Land Use and Melioration employs a GIS specialist. Hayantar has 2-3 employees with GIS knowledge and the Forest Monitoring Center has three people with GIS and RS knowledge and is equipped with eCognition and ArcGIS.

The Ministry of Nature Protection of the RA is responsible for data related to:

- Biodiversity (Bio-Resource Management Agency)
- Water (Water Resource Management Agency)
- Protected areas
- Protected forest areas

The Bio-Resource Management Agency employs one GIS and RS specialist and uses ArcGIS 8 and IDRISI-Kilimanjaro.

The Ministry of Territorial Administration and Emergency Situation of the RA is responsible for hydro-meteorological data (Hydrometeorology and Monitoring Service SNCO). The service employs a highly educated GIS specialist.

The State Committee of the Real Property Cadastre of the Government of the RA is responsible for cadastral data in Armenia. The cadastre data contains information about ownership and land use (according to the Land Code of the RA) and is stored in the AutoCAD format .dwg. Cadastral data is disseminated based on a client-server construction to regional cadastral authorities. Processing is based on Microstation with an additional plug-in (ArcPac 8) which enables certain GIS tasks.

The Armenian government has not implemented any spatial data infrastructure, so far. Yet, the implementation of FMIS is an advanced approach for environmental data handling.

Environmental data management is mainly based on the Law of the RA from May 25, 2001 of No. ZR-179, About Geodesy and Cartography and the Land Code of the RA. The regulatory framework does not contain any open spatial data policy.

3.2 Forest management and monitoring

Forest management and monitoring was a major focus of SMBP in Armenia. Forest related activities are well documented (see 3.2.1). Therefore, only a short description, mainly taken from a project publication at the XIV International Forestry Congress in Durban, South Africa in 2015, is given below.

The Armenian government in cooperation with GIZ developed a National Forest Management Information System (NFMIS). "Technically, it is a Geographic Information System client-server technology which links the 19 forest enterprises on the regional level to the Ministry of Agriculture, Hayantar SNCO, the responsible authority on the national level and the State Forest Monitoring Centre. It provides a common data base, facilitates processing and exchange of information and supports all processes of forest management and planning. Therefore, it allows transparent monitoring and control of forest lands and increases the efficiency of forest management and administration. From a technical point of view it is an IT-infrastructure with 7 modules of which are currently the following 4 developed: 1. GIS module, 2. Operational planning module, 3. Forest monitoring module, and 4. Forest land management module. […]".

For forest monitoring purposes eight indicators were developed addressing 1. Forest Cover, 2. Forest canopy density, 3. Intensity of logging, 4. Reforestation and afforestation, 5. Forest area differentiated by main tree species and 6. By age groups, 7. Area affected by fire and 8. Area of trees affected by insects or diseases. Baseline data for indicator 1, 3 and 7 was created based on remote sensing technologies from different sensors like RapidEye, Pleiades, Geoeye, and Landsat. Partly, these datasets are further used for an initial forest inventory. Precise inventory is based on in-situ measurements in pre-selected areas with high harvesting potential. The field data is collected by foresters on the local level with handheld GPS devices and traditional measurement methods. Field data is further fed into the NFMIS allowing for proper harvest planning and post-harvest assessment, as well as proper reporting and monitoring.

Aside from the collection of primary data, a classification system for forests was developed which allocates different zones based on environmental, economic and social functions (Fig. 7). The multi-functional zoning approach is a prerequisite for the planning process. The methodology considers 22 different forest functions (Table 1) and results in four management zones ranging from logging prohibition to unrestricted use with proper management methods." (Ghazaryan et al. 2015). The multi-functional zoning system was piloted in the area of Sevkar forest enterprise.

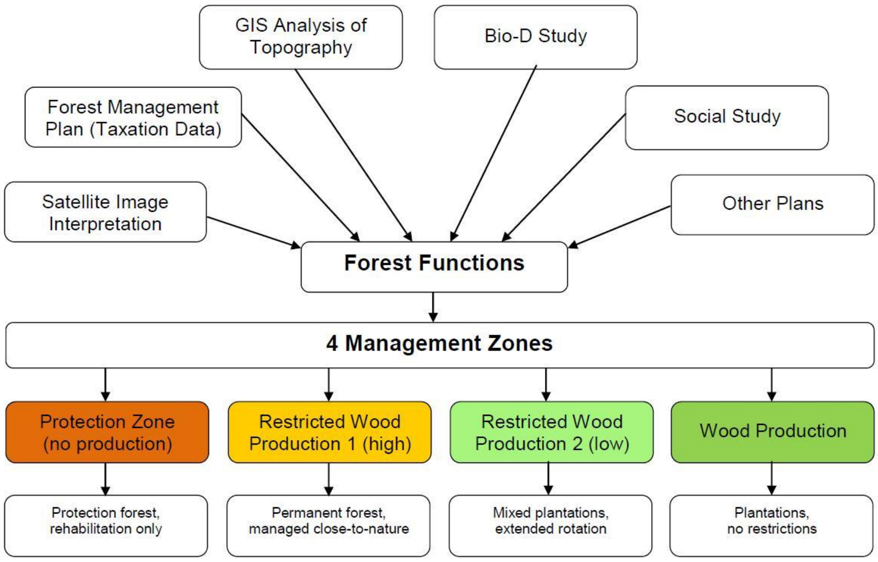

Figure 7: Multi-functional zoning approach for forest classification in Armenia.

Table 1: Forest functions considered in multi-functional zoning of forests.

Forest Function		**Code**
Type	**Name**	
Ecomonic Functions	Production of NWFP* only	ENWFP
	Non Productive areas	ENP
	Wood Production (unrestricted)	EWP
Soil Conservation	Soil Protection	SP
	Soil Conservation I	SCI
	Soil Conservation II	SCII
Water Conservation	Riparian Buffer Protection	WRP
	Water Catchment Conservation	WCC
	Water Supply Protection	WSP
Nature Conservation	Wildlife Protection	NWP
	Wildlife Habitat Conservation	NWC
	Rare Ecosystem Protection	NEP
	Reference Ecosystem Protection	NREP
	Biodiversity Conservation	NBC
Socio-economic	Cultural Sites Conservation	SocCC
	Recreation Forest Conservation	SocRC
	Arable Land Conservation	SocAC
	Special Site Protection	SocSP
	Local Use only	SocL
	Local cum Commercial use	SocLC
Others	Road and Infrastructure Conservation	ORC
	National Defense Protection	ONDP

*NWFP = Non Wood Forest Products

The Ministry of Agriculture hosts the server of the NFMIS. The State Forest Monitoring Center has the strongest GIS and RS capacities. For remote sensing analysis eCognition is used and GIS work is based on a licensed ArcGIS environment. The staff of SFMC has passed several GIS and RS trainings resulting in one worker with independent problem solving capacities (currently on maternity leave) and several workers with basic GIS and RS software and data understanding. Hayantar employs 2-3 people with GIS knowledge and runs an ArcGIS license which was financed by the World Bank.

3.2.1 GIS and RS expected development for forest management and monitoring under IBiS

GIZ support for forest management and monitoring under SMBP was a strong driver for a more systematic approach towards geo-spatial data management for forestry in Armenia. Especially the MoA was strongly supported in terms of technology and human capacity development. By following this systematic approach, the Armenian government and GIZ created a technical environment for state of the art sustainable forest management. Additionally, forest monitoring became independent due to the introduction of remote sensing technologies which allow a neutral assessment of harvest and reforestation/afforestation activities.

Up to now, not all of the indicators for forest monitoring are finalized. Hence, supporting the implementation of forest management and monitoring could be a continued activity for IBiS. Moreover, these indicators are also considered by the biodiversity monitoring approach of Armenia. Creating baseline data for all of the indicators would therefore not only support forest monitoring, but also biodiversity monitoring in Armenia.

Additionally, the upscaling of the multi-functional zoning approach could be a follow-up topic with a strong link to integrated land use management/sustainable forest management because the approach considers the three sustainability pillars and integrates ecosystem services into forest management. This fits strongly to the “solid data” aspect mentioned in the IBiS programme description and could be used as a best practice for the integration of ecosystem services into (agricultural) land use management.

3.2.2 Related documents and reports

- Ghazaryan, A., Schlager, P., Eberherr, T. (2015): Development and implementation of sustainable forest management and planning based on remote sensing and GIS technologies in Armenia. XIV World Forestry Congress, Durban, South Africa.
- Mann, S. (2009): Analysis of the Forest Policy of the Republic of Armenia. Unpublished project report.
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- Sahakyan, S. (2010): Concept for self-financing of forest enterprises and protected areas by sustainable use of Biodiversity. Unpublished project report.
- Schindele, W. (2012): Development of a National Forest Management Information System NFMIS for the Republic of Armenia Definition Study. Unpublished project report.
- Schindele W., Ghazaryan A., Nahapetyan S., Zakarian B. (2013): Guideline on Multifunctional Zoning for Forest Areas Managed by State Forest Enterprises in the RA. Unpublished project report.

3.3 Pasture management and monitoring

3.3.1 Sustainable pasture management activities under the Sustainable Management of Biodiversity in South Caucasus Program (SMBP).

In the framework of SMBP sustainable pasture management was mainly addressed by the following activities:

1. Pasture Management Information System (PMIS)
   PMIS is conceptualized based on the National Forest Management Information System (NFMIS) setup (Barth et al. 2013). It can be briefly described as an IT-infrastructure which involves relevant GIS and RS layers and links pasture management and monitoring on the regional and national level. PMIS is not implemented so far (Annex 1 PMIS).
2. Community based pasture management planning and monitoring
   Community based pasture management planning and monitoring was piloted in 19 communities in Syunik marz based on two technical guidelines (Tovmasyan 2015, GIZ 2015) and technical support with computer hard- and software. The guidelines are used by the communities to change their pasture management and monitoring regime. GIS and RS related activities are not fully developed because they are linked to the implementation of PMIS and to capacity development in the communities.
3. Development of an erosion sensitivity model
   An erosion sensitivity model based on a modified version of the Revised Universal Soil Loss Equation (RUSLE) model was developed and tested at Mt. Aragats and in Syunik marz, Sisian region (the data for Syunik was lost during a hardware crash). The model output delivers required GIS information for PMIS.

3.3.2 GIS and RS expected development for SPM under IBiS

The above-described framework for SPM shall be further developed into an interconnected PMIS which links the community based management approaches on the regional level to a (land monitoring) institution on the national level. The conceptual/technical setup of the system is described in the Annex 1 PMIS report.

By the implementation of the system, it is intended to concentrate GIS and RS analysis in one institution (on the national level). This shall reduce the requirements for the communities to develop GIS expertise beyond the command of some basic GIS features in PMIS. Furthermore, it is expected that PMIS would complement community based field monitoring through GIS/RS based pasture monitoring.

The implementation of PMIS requires the following geodata which partly still needs to be developed:

    - Base maps (road network, municipality boundaries, land cover, etc.)
    - Satellite images and image products (e.g. Landsat mosaics, NDVI)
    - Digital elevation model and related products
    - Pasture specific products:
        - Erosion sensitivity (prototype has been developed by SMB project)
        - Burned areas (to be derived from Landsat images by the State Forest Monitoring Centre)
    - Cadastral information where available (there is a need to clarify data availability)
    - Pasture management units: where available. Pasture management units should be an editable GIS layer to enable digitization of PMUs from sketch maps
    - Permanent sample plots: editable layer with a user interface to enter data and attributes for permanent sample plots
- Develop a module to manage leases on pastures: based on the leases and rents module of FMIS, a module for leases on pastures should be established. (Annex 1 PMIS).

3.3.3 Partners for SPM

The main partners for SPM on the regional level are the pilot communities in Sisan region, Syunik Marz. Upscaling has been accomplished in Berd region, Tavush Marz. Potential partners for further upscaling are communities in Tavush Marz which participated in the CARMAC project (World Bank Group, MoA RA) (Tovmasyan 2014).

The State Forest Monitoring Center (SFMC) of Armenia could be a potential candidate for the development of a land monitoring service on the national level. SFMC is currently responsible for forest monitoring based on NFMIS. Other suggestions from the MoA are also discussed.

3.3.4 Capacity development for GIZ and partners

The implementation of PMIS requires training for the participating communities. PMIS is a standalone IT solution which contains basic GIS capabilities such as data editing and data entry. Therefore, no extensive GIS training is necessary. Instead, training could focus on how to use and command PMIS.

For the implementation of PMIS the eGovernance system which was developed by the Local Governance Program of GIZ could serve as an installation platform. Yet, not all communities are equipped with PCs.

The involvement of communities in Tavush will probably require more capacity development with a focus on computer systems because many communities are digital illiterates. The training in community based pasture management planning and monitoring was already organized within the framework of CARMAC.

Capacities of the SFMC were built during the setup of NFMIS. The main task of the SFMC is forest monitoring based on independent and reliable information. This is carried out by a combination of GIS /RS and field verification. Therefore, the institution has already experience in handling geodata. If the MoA is in favour of another institution, capacity development can be expected to be more comprehensive.

If SFMC responsibilities will grow into land monitoring, additional capacity development in remote sensing applications for land use monitoring is necessary.

3.3.5 Related documents and reports

- Annex 1 (PMIS): Technical Specification of the Pasture Management Information System prototype and detailed description of development tasks. Unpublished project report.
- Barth, H., Ruecker, G. & Schindele, W. (2013): Development of a National Forest Management Information System NFMIS for the Republic of Armenia. Unpublished project report.
- Eberherr, T. (2014): Institutionalising Developed Approaches for a National Forest Management and Information System (NFMIS) for the Republic of Armenia. Unpublished project report.
- GIZ (2015): Manual for Monitoring of Pastures, Armenia (printed).
- Ruecker G. (2014): Development of a National Forest Management Information System NFMIS for the Republic of Armenia. Finalisation of 1st Development Phase and Preparation of Second Phase. Unpublished project report.
- Tovmasyan, G.A. (2015): National Monitoring Report on “Total Surface Area of Sustainably Managed Pastures” Indicator. Unpublished project report.
- Tovmasyan, G.A. (2015): Guidelines for Development and Implementation of Sustainable Management Plans for Pastures and Grasslands (printed).
- RUSLE report.

3.4 Environmental Education and GIS

Within the SMB programme GIS technology has not yet been applied as a tool to promote environmental education. As the new IBiS programme is now widening the scope of EE towards the wider society, GIS could also play a bigger role in this respect.

3.4.1 Environmental Education Network – thematic maps for education

The recently (2014) initiated Environmental Education Network (EEN) is a joint initiative of relevant stakeholders from the civil society, governmental, educational and international organizations in the field of EE in Armenia. It is contributing to the efforts by the government of Armenia in promoting and ensuring environmental education at all school levels and at communities.

Currently, the website for the EEN is being developed with major support of GIZ. One focus here is the set-up of an online map, which shows the location of all existing EcoClubs, EE Centers, and relevant NGOs of Armenia. The purpose of this is to ensure better flow of information on existing EE institutions to the wider public. The EEN website is expected to become a broadly used communication platform for its active network members, but also for the wider public.

Hence, the platform and especially the planned online map can also be used to promote other relevant environmental information. Institutions who are already mapping environmental information could share their data on the EEN website to reach a wide group of people.

The Acopian Center for Environment under the American University of Armenia (AUA), for example, is already in the process of mapping information on mining activities, distribution of red book species, protected areas, and natural monuments. In the frame of the new IBiS programme also other environmental information could be mapped and shared on the EEN website.

3.4.2 Community-Based Mapping

Another entry point to promote environmental awareness to communities supported by GIS technology could be approached by community-based mapping activities. Mapping environmental information together with members of communities can be a powerful tool to record and utilize local knowledge, for example on the location of medical plants, raise awareness about areas of concern in their environmental and social landscape, and to empower communities to communicate their concerns to government officials.

Community based mapping could be combined with sharing of information on the value of ecosystems through various means and activities, like public film screenings or sharing relevant environmental information materials. To reach also remote communities with mapping activities and environmental awareness raising campaigns, the idea of a mobile information platform, inspired by the “e-bilim” mobile library of Kirghizstan a joint initiative by the University of Central Asia and GIZ, could be picked up, and adjusted to the Armenian context (www.ebilimproject.wordpress.com, contact person: aline.rosset@ucentralasia.org).

E-bilim is conducting “information in action” tours to remote villages of Kirghizstan with a mini-bus equipped with relevant information material. The aim is to provide knowledge on relevant environmental topics, as well as also to deliver farmer field courses and innovative agricultural extension services.

A mobile EE-mini-bus in Armenia, equipped with necessary hard- and software and supportive staff, could serve as a mobile “mapping service” for remote communities. Final results, e.g. in form of printed maps of local landscapes or ecosystems, could then also be handed over to community offices or other relevant institutions.

Developed community maps could also be shared on the EEN website for promotion of communities and their specific landscapes.

3.5 Private companies

3.5.1 GeoRisk

GeoRisk was established in 1997 as a spinoff from the Institute of Geological Sciences, National Academy of Sciences of the Republic of Armenia. It employs three permanent staff and additional contract based freelancer. The company works mainly in national and international mining projects (Turkey, Haiti, Iran, Egypt, Kazakhstan etc.).

GIS and RS processing is based on ArcGIS 10. A comprehensive geodatabase (mainly geology, seismology, landslides, geophysics, urban infrastructure, topography) was built up by the company during their 18 years of working in different projects.

For Armenia, it was stated, that projects could be implemented more efficient and professional if the responsible ministries had the technical and institutional capacities to cope with the results provided by GeoRisk.

3.5.2 GeoCom

GeoCom is a spinoff from the Institute of Geological Sciences, National Academy of Sciences of the Republic of Armenia. It employs 4 permanent staff and one student. Additional staff is temporary hired for particular projects. The company is specialized in GIS activities related to ecology, hydrology, nature protection, and mining topics. Accomplished projects are mainly in the field of environmental risk assessment. The company runs a geo-server (currently not operating) that hosts environmental and administrative data (see Kirchmeir, no date).

3.5.3 Related documents and reports

- Kirchmeir, Hans. (no date): Socio-Economic and Environmental Baseline Study including the Elaboration of a Monitoring System. Annex1. Geodata. Unpublished project report.

3.6 Research Institutions

3.6.1 Acopian Center for the Environment, Center for Responsible Mining, American University of Armenia

The Acopian Center for the Environment (ACE) and the Center for Responsible Mining (CRM) are two research centers at the American University of Armenia focusing on nature conservation (ACE) and mining (CRM). Both centers are under the directorate of Alen Amirkhanian. ACE and CRM work with ArcGIS 10 in research. Additionally, the center organizes GIS (QGIS, ArcGIS) and remote sensing courses for different MSc programmes (public health, informatics, engineering). The university has two computer labs with 60 workstations and 40 ArcGIS 10 licenses (ArcView).

From the website of the ACE, geospatial data can be downloaded (administrative and environmental data). Only ACE and the Center for Ecological-Noosphere Studies offer open spatial data access in Armenia in an operational manner.

ACE and CRM have several ongoing projects which might be interesting for IBiS. Recently ACE geocoded the Red Book of Armenia. That means the center offers GIS ready information about the distribution of endangered species. In another ongoing projects the center collects, in cooperation with communities, information about the natural monuments of Armenia and distributes this information by an online platform (see also chapter 3.4).

3.6.2 Yerevan State University, Faculty of Biology - Department of Zoology, and Department of Ecology and Nature Protection

The department of Zoology of the Faculty of Biology of the Yerevan State University is applying GIS for specific research activities in the frame of PhD theses, or small research projects. No practical RS techniques are being applied. Spatial data, for example of the distribution of specific plant and animal species, is being obtained during field trips by using relevant GPS-equipment. Collected data is then being mapped and analyzed using ArcGIS software.

At present time, the department of Zoology has one ArcGIS 10.1 license ready to use for research projects. Three staff members have advanced knowledge in AcGIS. In the field of GIS the department also works in close cooperation with the department of ecology and nature protection.

The department of Ecology and Nature protection of the Faculty of Biology is applying GIS software for research purposes. Also, one GIS master course (lecturer: Aram Gevorgyan) is being offered, where basic GIS theory and practice is being taught. The master course usually consists of 10 – 15 students yearly, out of which approximately 2-3 students show a high potential in GIS application. A GIS lab with 7 computers with an installed ArcGIS 10.1 license is available. GIS courses are not being offered for Bachelor students.

No practical RS techniques are being applied.

3.6.3 Yerevan State University, Faculty of Geography and Geology

The Faculty of Geography and Geology provides basic GIS introduction to all of its BSc students (approximately 100/year). During the different MSc programs GIS courses are offered more comprehensively with the biggest emphasize in Cartography. Remote sensing is taught with Erdas Imagine.

The university is equipped with 30 ArcGIS 10 licenses and 5 Erdas Imagine licenses. For the classification of images, Landsat and one Ikonos scene for Yerevan are used. Four people are responsible for GIS and RS education. The university would also like to offer Web GIS and GIS programming courses but does not have the capacities to do so.

3.6.4 Center for Ecological Noosphere Studies (CENS), National Academy of Science

The Center for Ecological-Noosphere Studies is part of the National Academy of Science of Armenia and was founded in 1989. The institution is split into and educational part with an “Environmental Protection and Nature Management” MSc program and a scientific/research part with four departments and one analytical laboratory (Fig. 8). Currently, the institute has 70 employees, out of which 51 are researchers. The “GIS and Remote Sensing Department” permanently employs six researchers and hires additional staff contract based. All permanent staff uses ArcGIS. Five staff members have knowledge in remote sensing.

Compared to other GIS/RS related actors in Armenia, the scientific knowledge, strategic perspective, international cooperation, and technical environment of the department has been perceived as very good.

GIS processing builds on ArcGIS and remote sensing on Erdas Imagine and ENVI. During a cooperation project with the University of Geneva (Switzerland) the department developed a spatial data infrastructure upon international standards (OGC, ISO). This allows to share data with other web based (geo-)databases and opens free web based access of data for users with Web Map or Web Feature Services (WMS, WFS). Data which is published via these services have a scale of 1:100 000 or less. This is due to the lack of an appropriate data sharing policy in Armenia that addresses high-resolution data. The development can be seen as a driver for geo-spatial development in Armenia because it addresses international standards, geo-spatial data policy, and technical requirements which are usually provided by government institutions (see also the NSDI development of Georgia 4.1) and is not in place in Armenia so far. The development of a spatial data infrastructure allowed CENS to become a member of the Group on Earth Observation (GEO).

According to GEOs website it “is a voluntary partnership of governments and organizations that envisions “a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information.” GEO Member governments include 99 nations and the European Commission, and 92 Participating Organizations comprised of international bodies with a mandate in Earth observations. Together, the GEO community is creating a Global Earth Observation System of Systems (GEOSS) that will link Earth observation resources world-wide across multiple Societal Benefit Areas - Biodiversity and Ecosystem Sustainability, Disaster Resilience, Energy and Mineral Resources Management, Food Security and Sustainable Agriculture, Infrastructure & Transportation Management, Public Health Surveillance, Sustainable Urban Development, Water Resources Management - and make those resources available for better informed decision-making.” (http://www.earthobservations.org/wigeo.php).

Building on the spatial data infrastructure project, CENS can now feed their data into GEOSS.

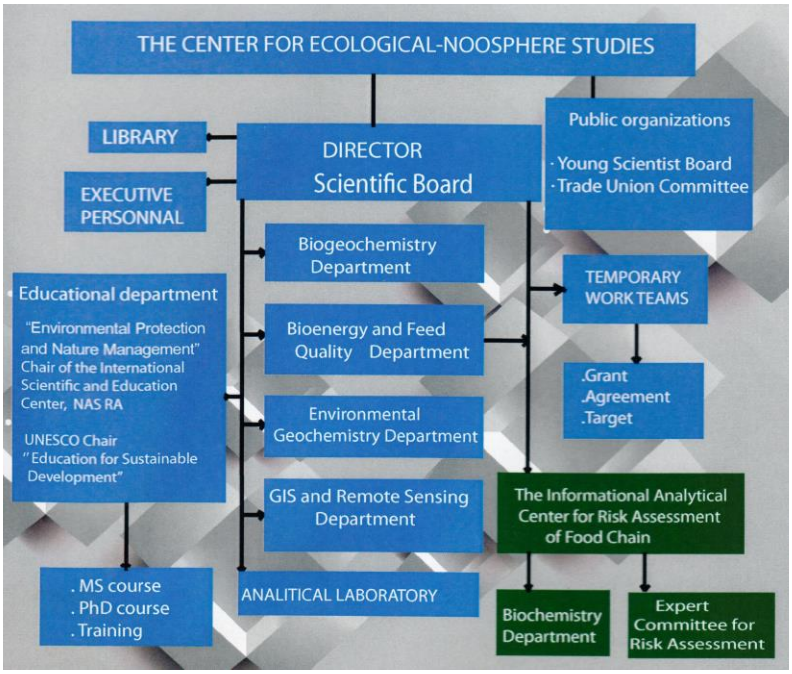

Figure 8: Organisational diagram of the Center for Ecological-Noosphere Studies

CENS was involved in the CARMAC project (World Bank Group, MoA) which aimed to improve pasture and livestock management in eight regions of Armenia. CENS was responsible for pasture monitoring and assessment based on RS and GIS.

3.6.5 Faculty of Land Management, Cadastre and Melioration, Armenian National Agrarian University

The faculty of Land Management, Cadastre and Melioration of the Armenian National Agrarian University is equipped with a computer lab with 15 workstations running ArcGIS 10 and eCognition (trial). Additionally, the faculty has a small research lab with 6 PCs and equipped with ArcGIS 10, ENVI and eCognition. During the BSc two GIS modules are taught. One addresses land management the other cadastre. For the MSc the university offers an optional module in remote sensing. In cooperation with GIZ vineyards in Vayots Dzor were mapped based on high-resolution satellite images. The faculty is supported since December 1, 2013 by an integrated expert (CIM).

The technical equipment of the university is very good because of the strong support by CIM and GIZ.

3.7 Conclusion

Several donor programmes support geo-spatial development in Armenia. GIZ supported the MoA during the successful implementation of a client-server based NFMIS technology. A comparable development can be found in cadastre data management. Cadastre data is disseminated through a client-server construction to the regional cadastre offices; any changes on the regional level automatically update the national database. Therefore, parts of the Armenian government gained experience in distributed geo-spatial data handling. Nevertheless, a comprehensive and state of the art approach towards spatial data provision and maintenance is neither technically nor institutionally or legally developed. The Center for Ecological-Noosphere Studies developed a spatial data infrastructure for dissemination of geo-spatial data. Therefore, a certain local experience regarding spatial data standards etc. is already in place. Furthermore, NFMIS and a Microstation plugin for cadastre data management was programmed by a local company which reflects the rather strong IT-sector in Armenia. Compared to Georgia the GIS/RS market in Armenia is underdeveloped but promising developments driven by selected institutions can be identified.

IBiS can build on the successful cooperation with the Ministry of Agriculture. The NFMIS could be used as a best practice to extend geo-spatial services into other land use systems which are under the administrative control of the Ministry (pasture, agricultural land etc.). On the one hand this would allow to advise the government on a more systematic approach towards geo-spatial data handling (e.g. establishment of a spatial data infrastructure) and open data policy, and on the other hand it would open the opportunity to integrate biodiversity and ecosystem service issues into agricultural policy and management. This facilitates mainstreaming because of the importance of agricultural land as a main target area for biodiversity conservation.

The interest and understanding of the importance of GIS/RS technologies of the Ministry of Agriculture is also reflected in a research project of the MoA in cooperation with the Private Sector Development South Caucasus programme of GIZ and the Armenian National Agrarian University. The project aimed to map vineyards with remote sensing technologies in Vayoc Dzor in order to create independent and reliable spatial data about the development of vineyards in the region.

The development of other land use related geo-services requires capacity development. As stated above, HCD depends on the institution appointed to host an IT based land management service. The State Forest Monitoring Center could build upon the already existing capacity and experience and would be in need for a better understanding of technical requirements for land monitoring. The Department of Land Use and Melioration would need a more comprehensive capacity development because of nearly absent expertise.

The technical environment is partly developed. The MoA hosts already a server for NFMIS. Either this is sufficient for additional data or could be extended. Software is mainly in place in forest related institutions while the Department of Land Use and Melioration would need additional software depending on tasks to be conducted.

4. Georgia

4.1 National Spatial Data Infrastructure of Georgia

Spatial information created by means of Geographic Information Systems found one´s way into every public sector, nowadays. This development requires the existence of technologies, institutional agreements, standards and rules which facilitate exchange, search, processing, use, storage and renewal of spatial data. A Spatial Data Infrastructure (SDI) is a framework for this standards.

"In other words, National Spatial Data Infrastructure is a system with geographic data and related electronic services in its centre, which are documented by metadata. Production of geographic data, electronic services and metadata is regulated by relevant Legal Acts, standards, regulations and methodologies in accordance with the principles of harmonization and interoperability." (http://nsdi.gov.ge/en/about-nsdi).

4.1.1 The link of Georgia´s spatial data infrastructure to EU regulations

The Georgian Government decided in 2013 to setup a State Commission for the development of a National Spatial Data Infrastructure (NSDI) which follows the Infrastructure for Spatial Information in Europe (INSPIRE). INSPIRE is based upon the EU Directive 2007/2/EC and should find its way into national legislation of EU member states. INSPIRE defines 34 spatial data themes which are listed in Annex I to III (Fig. 9). The themes cover all relevant geo-spatial information which public authorities provide.

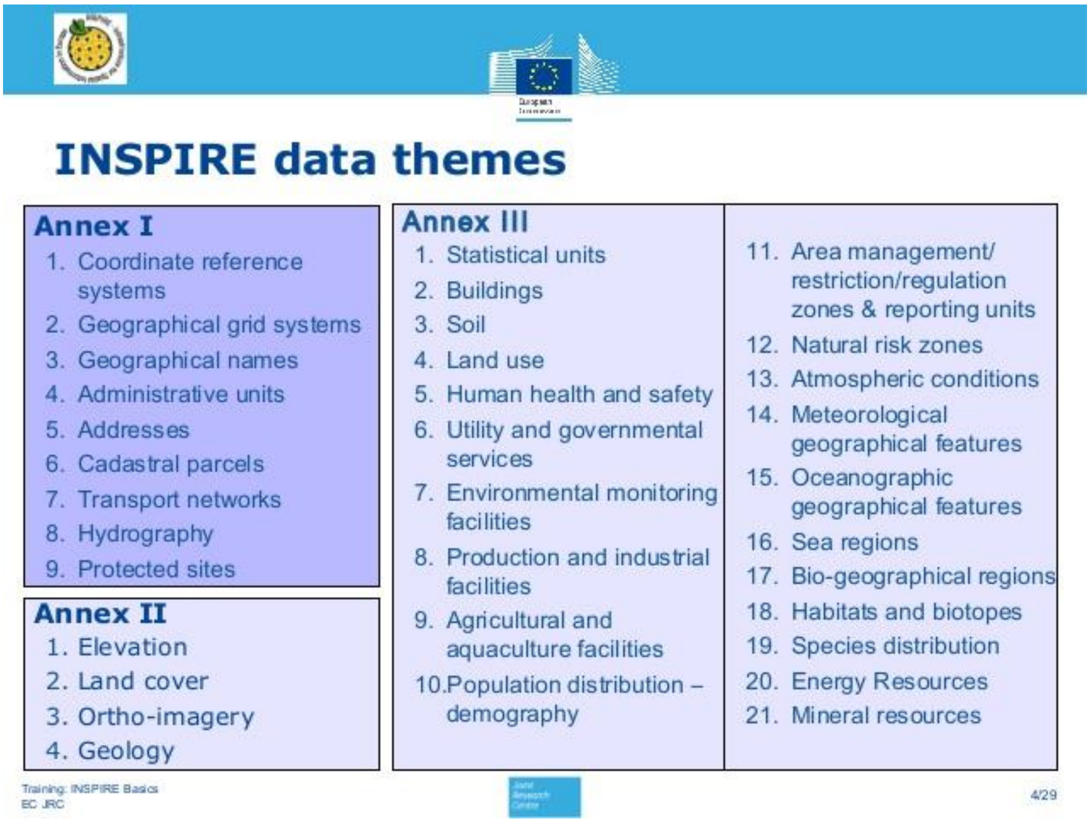

Figure 9: 34 spatial data themes of INSPIRE (http://www.slideshare.net/inspireeu/inspire-data-scope)

To read more about the technical specifications of INSPIRE, please follow this link:

http://www.slideshare.net/inspireeu/inspire-data-scope

The attempt of Georgia`s government to create a NSDI aims to implement:

1. a long term strategy for spatial information handling
2. clarification of responsibilities of government institutions
3. enforcement of the implementation and revision of relevant legal acts and procedures.

4.1.2 Implementation of Georgia´s National Spatial Data Infrastructure

The National Agency of Public Registry (NAPR) (Ministry of Justice) was appointed as the coordinating agency for the implementation of the NSDI in Georgia (Fig. 10). It oversees the activities of the 1. State Commission, 2. Secretariat and 3. Thematic Work Groups.

- The State Commission is responsible for preparation of proposals and recommendations regarding the establishment of NSDI for the Georgian government.
- The Secretariat coordinates and facilitates the Thematic Work Groups and is responsible for PR.
- The Thematic Work Groups are responsible for the technical, conceptual and procedural framework in-line with the INSPIRE concept.

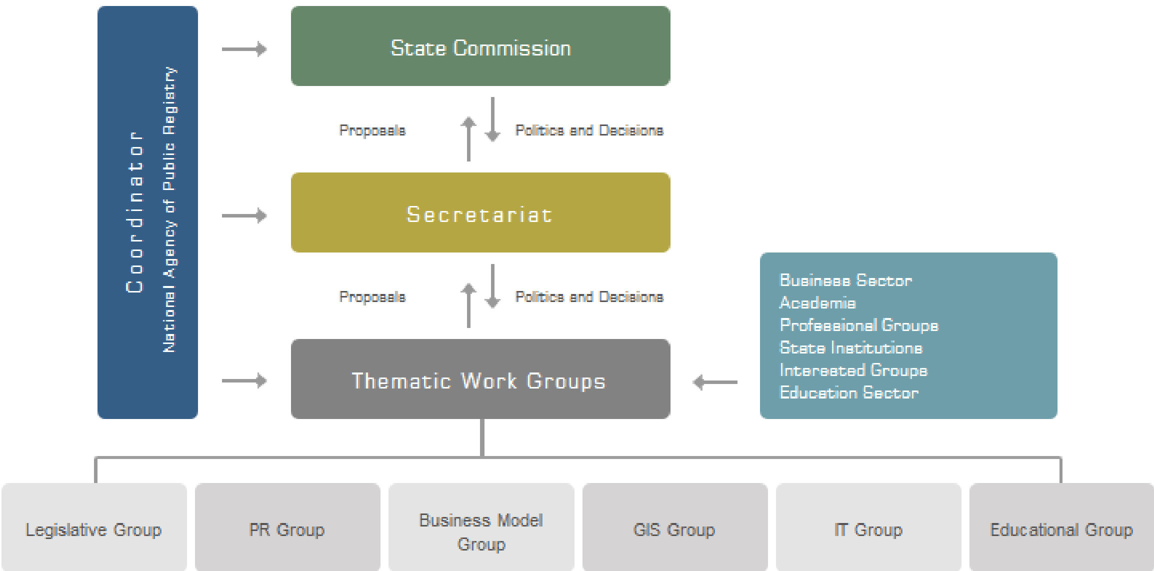

Figure 10: Implementation structure for NSDI in Georgia (http://nsdi.gov.ge/en/structure)

The implementation of NSDI will change geo-spatial data handling and access for the participating institutions fundamentally. In the future a network will connect them (probably with access restrictions) to a central server where the data is located. Data access and exchange will be based on international standards (Open Geospatial Consortium (OGC), ISO) such as Web Map Services (WMS), Web Feature Services (WFS) etc. which requires a running GIS software and technical staff. Data creation and maintenance will be more standardized and has to follow rules and documentation (metadata). From this professionalization process it can be expected that the role of geo-spatial data becomes more important and useful for governmental procedures.

4.1.3 National Agency of Public Registry

During the mission to Georgia it was not possible to meet the National Agency of Public Registry. However, because of their key role in the facilitation of NSDI and their current experience handling geo-spatial information we strongly suggest a meeting with NAPR.

4.1.4 Spatial Planning and Construction Policy Department, Ministry of Economy and Sustainable Development of Georgia

The Spatial Planning and Construction Policy Department of the Ministry of Economy and Sustainable Development of Georgia is responsible for policy development in spatial planning and construction from the local to the national scale (including transboundary initiatives). This covers the following aspects:

- Implementation and monitoring of legal and technical frameworks.
- Development of short, medium and long-term strategies.
- Cooperation with Autonomous Republics and local self-governments.

The department consists of two divisions with 12 employees. They work equally distributed in the Urban Planning and the Construction division. None of the employees works with or is educated in GIS. Some of the employed architects use AutoCAD (a computer aided design (CAD) software is mainly used in engineering and architecture to build 3D models. In some cases CAD systems are also used for GIS tasks which is not appropriate due to their disability to handle geographic coordinate systems).

During the interview Mr. Kakha Potskhishvili (Deputy Head of the department) explained mainly the National Spatial Data Infrastructure project and stressed the role of the Spatial Planning Department in becoming the physical hub (server, maintenance etc.) of NSDI. Yet, considering the website of the project (and other interviewer´s opinion) the National Agency of Public Registry seems to be in charge of this role.

In case the Spatial Planning and Construction Policy Department will become the mentioned hub there will be a need for technical infrastructure (server, software etc.) and strong human capacity development due to the complete absence of any GIS knowledge.

For a more detailed understanding of the spatial planning framework of Georgia, please consider Annex 4 of the Project Evaluation Report of SMBP and the currently ongoing consultancy regarding spatial planning in Georgia.

4.1.5 National Environmental Agency, Ministry of Environment and Natural Resources Protection of Georgia

The National Environmental Agency (NEA) is a legal entity of public law in the organizational structure of the MEPNR of Georgia. NEA is responsible for environmental monitoring, environmental impact assessment and risk assessment in hydro-meteorology, geodynamics and environmental pollution. The responsibilities are distributed among the Department of

Hydro-meteorology, of Environment Pollution Monitoring, and of Geological Hazards and Geological Environment Management.

The Department of Hydro-meteorology manages hydro-meteorological data and is responsible for risk assessment and early warning (floods, hail etc.). For this purpose the department runs a hydrological model (BSMEFFG). Hazard risk maps for settlements are published on their website (could not be proved because the website is Georgian).

The Department of Environment Pollution Monitoring is responsible for soil, air, and surface/groundwater pollution monitoring. Air pollution is only monitored in Tbilisi by one permanent and three mobile stations. Soil monitoring is carried out based on an annual plan in different land use categories (settlement, industry, garden, forest etc.).

The Department of Geological Hazards and Geological Environment Management is responsible for licensing the use of natural resources (e.g. forests, mining etc.).

The staff of NEA which deals with GIS (3 employees) can be described as a group of young, motivated employees with good technical knowledge in GIS (ArcGIS), experience in hydrological modeling, and database management (SQL, Oracle). They were able to assess shortcomings of the data for better model results and could provide a clear technical understanding of the challenges of the implementation of the National Spatial Data Infrastructure (metadata management, accuracy of the data, user sharing etc.). Deeper training in GIS and database management was requested because it was understood that geo-spatial technologies could be used for environmental monitoring and risk assessment beyond the scope of current NEA activities. It was also mentioned that an improvement of the technical facilities must come along with capacity development. Currently NEA has no GIS licenses and no powerful computers that are able to handle intensive computing of environmental models.

4.1.6 Environmental Information and Education Centre, Ministry of Environment and Natural Resources Protection of Georgia

The Environmental Information and Education Centre was not visited by us. We did not receive any information by other interview partners beyond the information provided by GIZ about their role or intended role in geo-data management.

4.1.7 Consequences of the implementation of NSDI for environmental data management in Georgia

From the implementation of NSDI several consequences for the implementation of a FMIS, NBMS, and other environmental data can be expected and should be considered during project implementation. The National Agency of Public Registry should be consulted prior to the technical design of FMIS to follow the technical requirements of NSDI. The following questions need to be answered during this consultancy:

1. What file types should be provided?
2. What kind of (geo-)databases are used?
3. Where will the data be hosted (server?)?
4. What are the rules for metadata documentation?
5. What are the technical requirements for data exchange?

6. Are there accuracy requirements and how are they fulfilled?
7. How often needs the data to be updated?

Because we did not meet the National Agency of Public Registry, we can´t inform about the detailed technical setup of NSDI.

4.1.8 Related documents and reports

- Annex 4: PEV report. Unpublished project report.
- Consultancy report about spatial planning in Georgia.

4.2 Forest Management in Georgia

4.2.1 Forest Policy Service, Ministry of Environment and Natural Resources Protection of Georgia

The Forest Policy Service (FPS) is responsible for forest policy development. All major developments such as FMIS, legal revisions, forest zoning etc. are coordinated and supervised by FPS. Currently, FPS employs one person with basic GIS knowledge who is mainly controlling management plans based on ArcGIS 10 (not licensed). FPS expects requirements for more GIS capacities and an updated technical equipment in the future due the development of FMIS in cooperation with GIZ and Global Forest Watch. FPS' use of GIS will be more for controlling purposes while the main tasks of data entry, editing etc. is seen to be at the National Forest Agency.

4.2.2 National Forest Agency, Ministry of Environment and Natural Resources Protection of Georgia

The National Forest Agency (NFA) is a legal entity of public law in the organizational structure of the MEPNR. NFA is responsible for forest inventory and is expected to be the main user of FMIS. Currently, NFA has one ArcGIS 10 license and four employees with basic GIS knowledge.

NFA has experience with manual stand mapping based on three channel (red, green, blue, (RGB)) orthophotos with 50 cm resolution from 2007/2008 and 2010 provided by the National Agency of Public Registry. Other common GIS tasks in forest management such as the delineation of terrain parameters (slope, azimuth etc.) from a digital elevation model are not used so far. Digital forest information is very limited. Aside from a national forest map, NFA has digital inventory information only for some forest stands ("litter"). Skid trails and water bodies are not available.

NFA has a need for more capacity development in GIS and for technical equipment. Capacity development in remote sensing technologies will be required if forest inventory will (partly) be based on remote sensing data.

4.2.3 State Environmental Supervision Department, Ministry of Environment and Natural Resources Protection of Georgia

The State Environmental Supervision Department (SESD) is in charge of forest monitoring. Currently, this is mainly done by 407 urgent response teams who are activated when SESD receives a call via a hotline about illegal forest activities. SESD expressed a need for comprehensive geosystem development and capacity building to improve forest monitoring with independent and reliable information. It was also expressed that SESD should have access to FMIS.

Forest fires are currently monitored by the Ministry of Internal Affairs.

4.2.4 Caucasus Environmental NGO Network

Caucasus Environmental NGO Network (CENN) is a NGO which supports several forest related activities.

- CENN created in the framework of FLEGT a web portal about forests which serves a public monitoring function (http://w3.cenn.org/wssl/).
- Currently, the forest map of Georgia is updated based on the information which was provided by GIZ/RSS, a forest map created from ASTER satellite data and the forest map of the National Agency of Public Registry.
- CENN works in cooperation with MENRP and GeoLab on the development of a forest zoning directive which contributes to the currently revised forest code.

The zoning directive rests upon sustainable forest management principles. It defines three main forest functions (production, protection, socio-economic) with several sub-functions such as erosion control, water courses, recreation etc. The directive advises to translate the importance of each function into a value scheme ranging from 1-4. This value is then being assigned to a spatial object which represents the function in order to map and combine the different functions and their associated values (Forest zoning directive).

4.2.5 Recommendations for GIS/RS developments related to forest management

The institutional setup for forest management and monitoring in Georgia under the MENRP is divided into policy development (FPS), forest planning and management (NFA) and forest monitoring (SESD). Institutional changes are ongoing which probably will strengthen FPS. FPS and NFA have basic capacities in GIS and no capacities in remote sensing. SESD has no capacities at all. The technical environment is weak with only one license of ArcGIS 10 in NFA.

As stated above (4.1.7), any GIS related development in forestry should consider the requirements of NSDI.

For the setup of FMIS capacity development for all three institutions will be necessary. Following the current institutional roles, NFA will become the main user of FMIS with responsibilities for entry and editing of inventory data and management planning. Depending on the technical design of FMIS (what kind of GIS tools will be implemented) this will require additional GIS capacities, software and hardware. The requirement of additional backup systems can be expected in general, but depends on the specific design of NSDI. During the design of FMIS it should be considered that users on the regional level (forest offices) can conduct all required tasks with FMIS without additional GIS processing. By this, GIS capacity development and technical systems can be concentrated on the national level which will also facilitate and streamline management and planning procedures in NFA/NPS.

If NPS needs additional GIS capacities depends on the design of FMIS. In case FMIS will deliver compiled information for policy development GIS becomes superfluous. Therefore, the needs of NPS should be taken into account during the design phase of FMIS.

SESD has strong operational field teams which is an asset in terms of urgent response to illegal logging. Nevertheless, SESD lacks a state of the art independent control mechanism of forest activities. Remote sensing technologies are a cost efficient and independent source of data for forest monitoring which can be expected to become increasingly important in the future. Mainly three developments will change remote sensing based environmental monitoring:

1. The fast development of drone technologies.
2. The open spatial data policy of the EU Copernicus programme which will make multispectral images from Sentinel 2 satellite with 10/20 m resolution freely available from June 2016.
3. A new satellite approach from Planet Labs (http://www.planet.com). Planet Labs operates currently 87 very small multispectral satellites in space. It is planned to grow the fleet until summer 2016 to 150 satellites. Probably this will change the availability of remote sensing data dramatically. Recently Planet Labs bought the RapidEye system.

SESD could be substantially strengthened in carrying out forest monitoring with remote sensing technologies. Yet, this will require intensive capacity development and setup of technical equipment because of the complete absence of GIS/RS knowledge.

4.2.6 Related documents and reports

- Forest zoning directive (the document was received from CENN and has no other editorial information).

4.3 National Biodiversity Monitoring System (NBMS)

In Georgia the National Biodiversity Monitoring System (NBMS) has been established as one important step to achieve the 2011-2020 Aichi Biodiversity Targets under the Convention on Biological Diversity (CBD). It is a governmental initiative under the guidance of the Ministry of Environment and Natural Resources Protection. The process began in 2007 and until now the Biodiversity Protection Service (BPS) under the MEPNR has the coordinating role and is responsible for reporting on the results of the NBMS.

4.3.1 NBMS under SMBP

GIZ-SMB Programme is advising BPS in fulfilling their coordinating role. Dating December 2015, the cooperation between GIZ and BPS has led to the result that already 12 indicators are published. 10 indicators, out of which 3 have already been published, are currently under revision (see table 1).

Although there has been quit a success and some indicators have already been published there remain factors that hinder the development of an effective process of biodiversity monitoring within Georgia.

The major obstacle identified is the lack of a clear legal and institutional basis of NBMS. BPS has the mandate to coordinate and manage the monitoring process. However, it is not defined on a clear legal basis which institutions are responsible for data delivery, processing, storage, and management. Several memorandum of Understanding have been signed with different institutions, to push this process, but these do not seem to be sufficiently binding. Additionally, there is a clear lack of human, technical, and financial resources within the main coordinating institution, BPS, to follow up on these processes and agreements. Responsibilities remain unclear. BPS is not capable to fulfill their role as the main coordinator in an efficient and effective way.

Another obstacle is the deficiency of data availability and reliability. Governmental institutions do not yet ensure the collection of comprehensive data relevant for the calculation of biodiversity indicators on a regular basis. Hence, the availability of data is a major bottleneck of the NBMS process. Moreover, secondary data that is being published by government institutions so far is perceived as not reliable. By the Head of BPS, Mr. Ioseb Kartsivadze it was stated that data quality and accuracy remains questionable,. Independent quality-checks that would confirm accuracy and reliability of data are not yet being undertaken in a standardized way.

Until now, BPS relies on the support of international organization, like GIZ, to obtain primary data, in order to ensure quality of data used for NBMS.

What kind of data the National Agency of Public Registry has that could be used for some of the NBMS indicators was not proved , as we had no meeting with the National Agency of Public Registry. Also, the Kirchmeir report does not contain any information about the data hosted by the National Agency of Public Registry.

4.3.2 Relevance of RS and GIS for biodiversity indicators

The following chapter shall give an overview of the NBMS indicators and relevance of RS and GIS capacities for the collection of data.

For the indicators that are marked in red the application of RS and GIS application is decisive for collecting objective and reliable primary data (RS), and for conducting further analyses (GIS). For institutions responsible for data collection and processing advanced knowledge in both, RS and GIS application is critical.

For the indicators that are marked in green GIS and RS application is favorable and supports collection (RS), as well as analyses and visualization processes (GIS). Application is not decisive. For institutions responsible for data collection and processing advanced knowledge in GIS, and basic knowledge in RS application is supportive.

For the indicators that are left blank, GIS and RS application does not play a role other than for visualization of results. For institutions responsible for data collection, basic knowledge in GIS is a surplus value.

Table 2: Published indicators and indicators under revision, NBMS Georgia, December 2015.

Published Indicators		Indicators under revision	
P1	Fragmentation of landscape	P2	Forest area with timber harvesting
P4	Intensity of Marine fishery	P3	Sustainability of wood production
P9	Number and distribution of invasive species	P5	Intensity of agricultural land use
P11	Forest diseases and forest fires (part of fires)	P7	Intensity of pasture land use
S1	Forest area	P11	Forest diseases and forest fires (part of diseases)
S3	Population sizes of selected species (rare plants	S2	Agro-biodiversity
S7	Public awareness on biodiversity	S3	Population sizes of selected species
R1	Total area of protected areas	S5	Area of habitats of special conservation value
R2	Protected areas with management plans and qualified personnel	R2	Protected areas with management plans and qualified personnel
R5	Reforestation within the State Forest Fund of Georgia	R8	Hunting farms with management plans
R6	Area under organic farming		

4.3.3 GIS and RS capacities of Biodiversity Protection Service

There is little (GIS) to no (RS) in-house capacity within the Biodiversity Protection Service. The collection of primary data for indicators cannot be conducted through BPS by any means. BPS employs one young and motivated staff member, who has worked with ArcGIS in the frame of his PhD. He has basic GIS knowledge, but is missing practical experience. There is no RS capacity within BPS. Also, sufficient equipment for the application of RS and GIS techniques (hard- and software) is lacking within BPS. There are no financial resources allocated to BPS to build up neither GIS nor RS capacities themselves. Also, further governmental obligations of BPS combined with a limited number of human capacities hinder the development towards advanced in-house GIS and RS knowledge.

4.3.4 Capacity development under IBiS

Biodiversity Protection Service

BPS does not have in-house capacities to collect primary data itself. Building-up advanced GIS and RS capacity within BPS by providing intensive training and necessary hard- and software, is likely to not be effective. Due to other main obligation, and the clear mandate as a coordinator of the process rather than a data provider, staff of BPS will continue to have limited time and human capacities to obtain primary data themselves. However, basic RS and GIS knowledge and equipment can help BPS to improve in-house processing, management and storing of secondary data. It can strengthen BPS to fulfill their role as the coordinator of the biodiversity monitoring system, by enabling the staff to control and monitor the process of NBMS more efficiently.

National Environmental Agency

The National Environmental Agency (NEA) is a legal entity of public law in the system of MEPNR of Georgia. NEA is mainly assessing hydro-meteorological and geodynamic processes, as well as environment pollution conditions, and hence not yet collecting and processing data relevant for NBMS. However, NEA has high potential to develop capacities and for obtaining primary data relevant for NBMS in the future. NEA employs well-educated and motivated personal, with advanced knowledge in the field of GIS.

This existing potential could be further developed by offering advanced technical training courses for NEA staff, specified on the collection and processing of primary data which is necessary for NBMS. In this way, new service opportunities for NEA could be combined with the demand of processed primary data for NBMS.

Moreover, it could also be a potential option to completely shift the NBMS data management hub to NEA, relieving BPS from data management and storage responsibilities. Like this, BPS could concentrate capacities on process coordination, and data publication. As a matter of course, establishing a clear institutional and legal framework, which defines responsibilities and ensures quality of data, shall be analyzed and addressed in-line.

Agency of Protected Areas

The Agency of Protected Areas could not be visited during our mission in November 2015.

4.3.5 Related documents and reports

- Kirchmeir, Hans: Socio-Economic and Environmental Baseline Study including the Elaboration of a Monitoring System. Annex1. Geodata.

4.4 Emerald Network

The Emerald Network is based on the Convention on the Conservation of European Wildlife and Natural Habitats, also known as the Bern Convention. The convention served in 1998 as a backbone for the creation of the Emerald Network of Areas of Special Conservation Interest (ASCIs). The network is the *de facto* extension of the NATURA 2000 concept to countries which signed the convention or have an observer status. Habitats and species which should be protected by the convention are listed respectively in Resolution No. 4 (1996) and Resolution No. 6 (1998) of the Standing Committee to the Bern Convention. Georgia is currently in the process of habitat identification.

4.4.1 NACRES

NACRES is a local NGO with a focus on biodiversity conservation activities. NACRES' main client is MEPNR, but the NGO is also working for international organisations such as UNDP, USAID, or GIZ.

NACRES is technically responsible for the identification of potential Emerald habitat sites in Georgia. During the interview it was stressed that NACRES faces challenges with adapting the habitats listed in Resolution No. 4 to Georgia because many habitats in Georgia do not fit the characteristics mentioned in Resolution No. 4 (especially forest habitats are difficult in this respect). Furthermore, it was mentioned that specialists with sound botanical knowledge are rare in Georgia which makes the process even more complicated.

NACRES employs two people who have good knowledge in ArcGIS but mainly apply it for map displaying purposes. For certain projects for which deeper GIS knowledge is necessary NACRES is additionally contracting external GIS experts from companies/institutions such as GISLab or WWF.

Website: www.nacres.org (under construction)

4.4.2 Potential of RS for the identification of Emerald sites in Georgia

The scientific interest in using remote sensing technologies for habitat mapping dates back into 1990s. Starting with visual orthophoto interpretation of habitats (Biotoptypen), more and more semi-automatic classification techniques were developed by the scientific community. Yet, the following challenges remain:

- The NATURA 2000/Emerald habitats, listed by the habitat directive/resolution, appear in many cases too similar in remote sensing images. Therefore, huge challenges in separating spectrally similar habitats (e.g. dry or calcareous grasslands) remain.
- Large areas are often not sufficiently covered by remote sensing images from the same period. This causes problems in applying algorithms which have been developed for a specific remote sensing scene with a specific character (season, position of the sun etc.) to another scene with other characteristics.
- Because of the above-mentioned challenges, policy demand such as identification and change detection of habitats are still not met based on standardized procedures and services.

Promising approaches during the last years were developed due to technology development of sensors and data availability. An increasing amount of studies uses multi-sensor approaches (combination of orthophotos, LIDAR, radar, multispectral satellite data) and/or multi-temporal approaches (e.g. RapidEye).

For Georgia a visual orthophoto interpretation technique can be advised to prioritize sites for detailed field investigation.

4.5 Private Companies

4.5.1 GeoGraphic GIS & RS Consulting Center

GeoGrapic is one of the leading private companies and offers high-quality GIS and RS services on a range of topics. Geographic consists of 40 staff member, with different backgrounds such as geography, landscape engineering, urban planning or cartography.

Activities of GeoGraphic include the following:

- Spatial Information Collection and Processing
- Integrated Aerial Photograph and Satellite Image Processing
- Topogeodetic and Cadastral Works
- Photogrammetry and Orthophoto Production
- ESRI Software Distribution, Training and Certification
- Customized Software Development
- Sectoral Geoinformation Systems Development
- High-End Cartographic Production
- Environmental Survey and Analysis
- Geomonitoring Surveys
- Information Technologies Development

GeoGraphic is working with the following software ArcGIS (GIS) and ERDAS (RS). A countrywide Digital Elevation Model (DEM) has been produced by GeoGraphic with 5m spatial resolution (West Georgia), 15m spatial resolution in East Georgia, and 1m spatial resolution (in big cities). The company has sound technical experience in orthophoto production.

Mr. Niki Kaishauri, director of GeoGraphic, has a wide network within the field of GIS and RS in Georgia and is very supportive to his graduates to find employment in their field of interest. He could be a good resource and contact person when developing an internship program to improve employability for young graduate in the field of GIS and RS in Georgia.

Website: www.geographic.ge

4.5.2 GeoLab

GeoLab is a small Georgian Company consisting of 3 GIS and RS specialists, and one accountant. GeoLab offers GIS and RS services focusing on topics such as pasture monitoring, forest zoning, sensitivity mapping of forests, or geo-statistical analysis of carbon stocks. On the topic of forest zoning GeoLab is closely collaborating with CENN NGO. GeoLab stated that the main source from which they purchase raw data is NEA. Here, the problem is that there is no standardized way of data sharing yet defined in Georgia and data is being provided in various formats, which makes efficient work difficult, as much time has to be spend on organizing and managing data.

4.6 Research Institutions

In Georgia no research institutions were visited.

4.7 Conclusion

Georgia´s efforts to develop a National Spatial Data Infrastructure is a promising development which will make geo-spatial data handling more professional, user friendly, and standardized. Any geo-spatial system or dataset created in the future should be in-line with NSDI to ensure its compatibility. Because we did not meet the National Agency of Public Registry, which will be in charge of NSDI, a meeting with them is strongly advised to understand the technical requirements more comprehensively.

The institutional framework for geo-spatial data management is to a certain extend developed and probably will become more professional with the implementation of NSDI. Yet, the government has already structures (NAPR, NEA etc.) which provide geo-spatial services and data. This structure could be used especially in the case of biodiversity monitoring because the in-house capacity and mandate of the Biodiversity Policy Service is absent.

Local private companies are strong with experiences ranging from standard GIS analysis, to photogrammetric tasks and programming. Remote sensing analysis is not fully comparable to international competitors.

All institutions we met in Georgia were using ArcGIS (often not licensed versions). Therefore, existing capacities build upon ESRI standards. Because of missing licenses, no software maintenance concept could be found. It does also remain unclear if the NSDI project offers any solution here. To avoid extensive ArcGIS investments for forest management, basic GIS functions should be integrated into FMIS to concentrate more advanced GIS tasks in NFA/NPS.

Private companies stressed that (geo-spatial) datasets from government institutions are often of low quality and require intensive post-processing, and data cleaning. Because we did not meet the National Agency of Public Registry a more detailed investigation of this issue was not possible.

It remains also unclear if a local server for forest and other environmental data will be needed. Most probably, the National Spatial Data Infrastructure will provide a central server and backup system and distribute data by an intranet to the ministries.

5. Azerbaijan

5.1 State Programme on the Socio-economic Development of Regions

The State Programmes on socio-economic development of Regions, resolved by the president of Azerbaijan and firstly initiated in 2004, have the general aim of ensuring diversification of the economy, sustainability of the development of non-oil sector and regions, as well as the improvement of infrastructure and social services. There has been a first State Programme on socio-economic Development of Regions of the Republic of Azerbaijan (2004 -2008), a second Programme beween 2009 and 2013, and the third programme for the years 2014 – 2018, which is ongoing. The coordination and reporting role for all programmes is with the Ministry of Economy and Industry. The Cabinet of Ministry, constituting of representatives from relevant state ministries, is responsible to take necessary measures for the implementation of the state program along with the corresponding implementing center and local executive authorities.

All programmes have been or are being financed through the following sources:

- The State Budget of Azerbaijan Republic;
- Non-budgetary state funds;
- Funds of enterprises, entities and organizations regardless of their property type;
- Funds of “The National Fund for Entrepreneurship Support” and “The Azerbaijan Investment Company” OJSC;
- Funds of local and foreign businessmen;
- Financial resources of international organizations and foreign states.

Other sources are not prohibited by the legislation.

Based on a formulated action plan, implemented activities have to be reported among all ministries. The coordinating ministry has to report to the president of Azerbaijan on a yearly basis.

5.1.1 The 10 Economic Development Regions

There are 10 economic development regions, which have been defined based the following key factors:

- Economic and geographical position
- Natural conditions and resources
- Population density
- Sectorial and territorial structure of the region
- Historical development characteristics.

The regions are:

- **Nakhchivan economic region** (Nakhchivan city, Babek, Julfa, Ordubad, Sederek, Shahbuz, Kengerli, Sherur rayons);
- **Absheron economic region** (Absheron, Xizi rayons, Sumgait city);

- **Aran economic region** (Aghjabedi, Aghdash, Beylagan, Berde, Bilesuvar, Goychay, Hajigabul, Imishli, Kurdemir, Neftchala, Saatli, Sabirabad, Salyan, Ujar, Zerdab rayons, Shirvan, Mingechevir, Yevlakh cities);
- **Upper Shirvan economic region** (Aghsu, Ismayilli, Gobustan, Shamakhi rayons);
- **Ganja-Gazakh economic region** (Aghstafa, Dashkesen, Gedebey, Goranboy, Goygol, Gazakh, Samukh, Shemkir, Tovuz rayons, Ganja and Naftalan cities);
- **Guba-Khachmaz economic region** (Devechi, Khachmaz, Guba, Gusar, Siyezen rayons);
- **Lenkeran economic region** (Astara, Jelilabad, Lerik, Masalli, Yardimli, Lenkeran rayons);
- **Kelbejer-Lachin economic region** (Kelbejer, Lachin, Zengilan, Gubadli rayons);
- **Sheki-Zagatala economic region** (Balaken, Gakh, Gebele, Oghuz, Zagatala, Sheki rayons);
- **Upper Garabagh economic region** (Aghdam, Terter, Khojavend, Khojali, Shusha, Jebrayil, Fuzuli rayons, Khankendi city).

5.1.2 Action plan

For each development region an action plan shall be formulated for the rayons/city level, stating the name of the action, the implementing period and the main implementing agencies. Here, the action plan is divided into actions, which are of national importance, measures to be implemented in Baku city and settlement areas, and actions to be implemented on economic regions level, which is then again divided into activities on rayon level.

The following sections taken out of the state programme for the years 2009-2013 shall give an example for each level.

Actions of national importance within the environmental sector, implementing agency MoENR, 2009-2013

- To raise different types of plants for implementation of greening work in cities and urban settlements
- To carry out forest rehabilitation and forest planting works in arid areas
- To plant forests of fast-growing tress
- To continue forest-reinforcing measures in regions subject to flood threats
- To define forests of recreation importance and ensure service infrastructure for development of eco-tourism
- To carry out measures on reintroduction of extinct and rare flora and fauna types
- To develop Earlier Warning System (EWS) of dangerous hydro-meteorological events
- To improve the State Hydro-meteorological observation network
- To improve hydrological-monitoring works in Kur, Araz and other rivers
- To install modular water-treatment systems in order to provide population with quality waters.

Actions for Absheron economic region within the environmental sector, implementing agency MoENR, 2009-2013

- To continue search and exploration works for new construction materials deposits
- To install modular water treatment facilities in coastal areas of the Caspian Sea.

Actions for Khizi rayon (environmental sector), implementing agency MoENR, 2009-2013

- To carry out exploration and search works on deposits of construction materials and table-waters in the rayon.

The proposed actions for regional and rayon level are in general relatively similar, with a strong focus on the exploration of construction material. Only few actions focus on afforestation activities or introduction of extinct and rare flora and fauna types (compare related documents).

Activities promoted in the state programme 2014 – 2018 in the environmental sector include for example the following:

- Continue afforestation and reforestation activities in regions
- Increase plant areas in regions
- Develop specially protected natural areas and ensure sustainability of biodiversity
- Management of solid household and industrial wastes generated in regions
- Expand use of alternative and renewable sources of energy.

5.1.3 Potential for IBiS

For the integrated management of biodiversity approach of the new GIZ-IBiS programme one major challenge is the sectoral structure of governments. Units or departments responsible for environment and biodiversity related issues, are separated from finance, planning, and sectoral departments, which control the majority of investments.

The existing structure under the programme on socio-economic development of regions might be one possible entry point for the promotion of an integrated biodiversity management. Through the cabinet of ministries, a potential communication platform between relevant ministries (horizontal integration) already exists.

It is also claimed that the classification process of the economic regions did reflect on the natural conditions of the areas and how they influence the economic value of the respective region. The quality of the baseline data on which the natural conditions have been analyzed is questionable, considering spatial data is almost absent or has numerous geometric and thematic errors and statistical data is biased. Here, GIS and RS technologies can be promoted as tools for obtaining and processing objective primary data on the environmental condition of economic regions on the rayons level. Yet, the technical and institutional framework is challenging since no spatial data policy exists, no approach for harmonized spatial data handling could be found, and the technical and human capacities of partner institutions is basically absent.

As the state programme is expecting actions on all levels - national level, economic regions level, and rayons level - the existing structure might also be supportive for a vertical integration of biodiversity management into mainstream development structures.

5.1.4 Related documents

- State Program on socio-economic development of regions of the Republic of Azerbaijan for 2004-2008
- State Program on socio-economic development of regions of the Republic of Azerbaijan for 2009-2013
- State Program on socio-economic development of regions of the Republic of Azerbaijan for 2014-2018
- Action Plan for “The State Program on socio-economic development of regions of the Republic of Azerbaijan for 2004-2008 years”
- Action Plan for “The State Program on socio-economic development of regions of the Republic of Azerbaijan for 2009-2013 years”
- Action Plan for “The State Program on socio-economic development of regions of the Republic of Azerbaijan for 2014-2018 years”

5.2 Land Parcel Identification System

The Ministry of Agriculture of the Republic of Azerbaijan has recently started to create a Land Parcel Identification System (LPIS) for agricultural areas in Azerbaijan. The system shall provide accurate land use data and borders of parcels. This information is currently found in the cadastre system, yet this data has shortcomings in terms of geometric and thematic accuracy and land tenure. Later the system shall help to allocate set aside lands and degradation problems (salinization, erosion, diseases etc.).

The ministry intends to derive the information from newly created Orthophotos which cover currently 70% of the country. Storage and maintenance of the data shall be carried out by a newly created GIS laboratory in the ministry based on the data from Azersky, a satellite which Azerbaijan has recently bought from Airbus Defence and Space (see 5.3).

Aside from the creation of precise geo-spatial information about land use in Azerbaijan, LPIS is intended to become an electronic agriculture system (e-Agriculture) which supports farm management. Therefore, existing agricultural offices on the regional level (“rayon”) shall be equipped with GIS systems and experts.

During the interview it was stressed, that the ministry would be grateful if GIZ supports this process with the provision of baseline data, training, and software.

5.3 State Air-geodesy Center of State Agency on Geodesy and Cartography under the Ministry of Ecology and Natural Resources of the Republic of Azerbaijan

The State Air-geodesy Center of State Agency on Geodesy and Cartography is a newly created unit under the Ministry of Ecology and Natural Resources. The unit could not be visited during the country visit.

Yet, according to the following website, the unit will become responsible for an Identification System of Terrestrial Areas (ISTA) which is part of the above presented e-Agriculture system.

http://azercosmos.az/en/azercosmos-held-a-workshop-on-use-of-azersky-satellite-imagery-for-natural-resources-management-purposes-in-azerbaijan

In October, 2015, Azercosmos signed a contract with the unit to deliver the required images from the Azersky satellite.

5.3.1 Potential for IBiS

The recently started IBiS programme aims to advise partners in integrated land use management based on precise (geo-spatial) data. In Azerbaijan the institutional and technical environment for integrated land use management is weak. Yet, the currently ongoing approaches to create a Land Parcel Identification System and an Identification System of Terrestrial Areas are promising and could be used as entry points to support the creation of precise information for integrated land use management and human capacities in key institutions.

Beyond the creation of solid data, LPIS and ISTA can also be seen as instruments for sustainable natural resources management (salinization, erosion, diseases control etc.). This might serve as a basis for a more comprehensive integration of environmental aspects (ecosystem services, biodiversity) in agricultural policy and management through policy development, technical support and HCD which goes in-line with integrated land use management/landscape approach. Additionally, this could feature the IBiS “mainstreaming of biodiversity” aspect since agricultural land is a target area for biodiversity and ecosystem services management.

5.4 Azercosmos

“Azercosmos” Open Joint Stock Company (OJSCo) is a satellite operator owned by the government of the Azerbaijan Republic which was established in 2010. The company offers mainly services in telecommunication and extended its services in 2014 with the acquisition of the Earth observation satellite “Azersky” from Airbus Defence and Space. Azersky was launched in June 2014 and initially named Spot 7 since it is (together with Spot 6) the successor of the Spot 4 and 5 satellites. With the acquisition of Azersky, Azercosmos has also access to Spot 6, Pléiades-HR 1 and 2 (multispectral), and Terra-SAR X/TanDEM-X (radar) data.

Azersky is a high resolution multispectral state of the art Earth observation satellite with the following technical specifications:

- Four multispectral bands (blue, green, red, near-infrared) with 6 m resolution
- Panchromatic band with a resolution of 1.5 m
- Imaging swath 60 km at Nadir (means 60 km width of the image when the camera points directly to the Earth (is not panned in any direction))
- Altitude of the satellite 694 km.

5.5 Private Companies

5.5.1 Integris LLC

The private company Integris was founded in 2006, employs 45 office staff workers and more than 70 field workers. Integris is mainly involved in the following fields of work

- GIS Programming and Development
- Online cadastre systems
- RS applications
- Terrestrial laser scanning
- Photogrammetry
- Cartography
- Regional planning
- Conduction of trainings
- ESRI distributor.

The Ministry of Agriculture of the Republic of Azerbaijan is one of the main clients of Integris. Other clients are private oil-companies, urban planning institutions, etc..

Integris is using the GIS software ArcGIS 10.3.1 and Erdas Imagine for remote sensing purposes.

One major challenge in their daily work is the availability of high-quality spatial data. Since most of the data provided by governmental institutions is of insufficient quality, Therefore, Integris is constantly developing and extending the company's database of geo-spatial data.

Integris collaborates closely with the MoA in the frame of the "e-Agriculture" project

Website: www.integris.az

5.6 Research Institutions

5.6.1 Department of Erosion & Irrigation Systems, National Academy of Science

The Department of Erosion and Irrigation Systems is a research body under the National Academy of Science. The institution has weak GIS (ArcGIS 10.1) and no remote sensing capacities. Due to a lack of finance from state budget, the department works contract based for ministries and other clients. Compared to the private companies, the department is less competitive and needs capacity building in both GIS and remote sensing.

5.6.2 Department of Land Management and Cadastre, Faculty of Ecology and Soil Science, Baku State University,

The Department of Land Management and Cadastre is responsible for higher education in cadastral systems and land management. Both subjects are taught theoretically, because the chair has no technical equipment (no computers, no software etc.). This shortcoming was formerly buffered by a collaboration with the Property Committee, which was responsible for cadastre management. Recently the committee has been closed by the government, which ended the collaboration. The chair needs technical equipment and intensive capacity building to provide state of the art education.

5.7 Conclusion

The human, technical and legal framework for geo-spatial data management is weak in Azerbaijan. The Ministry of Agriculture and the Ministry of Ecology and Natural Resources don´t provide state of the art geo-services, spatial data infrastructure and data. The socio-economic development plans are only partly linked to geo-spatial technologies (one plan was exemplary developed by Integris). Thus, the prerequisites for integrated land use management or a landscape approach are challenging.

Promising developments are the implementation of the Land Parcel Identification System and the Identification System of Terrestrial Areas. Since the latter will be developed by the Ministry of Ecology and Natural Resources (one of the main partners of the SMBP programme) this could be an entry point for IBiS to support the government with technical expertise and human capacity development.

Because data for the above mentioned systems will be provided by a state owned satellite institution, data maintenance without donor cooperation is less vulnerable. This is clearly an advantage for sustainable environmental monitoring approaches with geo-spatial technologies which is usually expensive.

Mapping in the framework of LPIS and ISTA is still in the development phase. This might be an opportunity to integrate ecosystem services and biodiversity measures into policy and data/system development. Because the above mentioned approaches will cover large areas relevant for integrated land use and biodiversity management, a successful implementation of such measures will have a huge impact on the landscape level.

6. GIS and RS Capacities within GIZ SMBP Team

6.1 Existing Capacities

Among the regional GIZ-IBIS team (excluding administrative staff members) there is limited GIS and RS capacity. Few staff members have advanced GIS and RS knowledge, allowing them to independently develop GIS and RS based solutions for complex environmental problems:

- IBiS AM: Ayser Ghazaryan
- IBiS AZ: Oliver Kögler.

Most team members have **basic GIS and RS knowledge**, allowing them to open, view, and manage (shape)-files. However, refreshment training is necessary in order to ensure confidently use of the systems, since knowledge is not always based on professional training, is out of practice, or outdated.

- IBiS GE: Giorgi Kolbin, Giorgi Lebanidze, Olga Weigel, Erich Mies, Jürgen Geldbach, Natia Kobakhidze, Christian Gönner, Hans-Joachim Lipp, Peter Sass;
- IBiS AZ: Serdar Hajiyev, Tomris Bayramova, Alexandra Joseph, Elmaddin Namazov (only RS);
- IBiS AM: Astghik Danielyan, Alla Berberyan, Kathrin Winterscheid.

Few team members have **no GIS and RS knowledge**.

- IBiS GE: Bachana Khachidze; Mariam Urdia;
- GIZ AZ: Aydin Inciyev; Elmaddin Namazov
- IBiS AM: Lusine Gharajyan, Arthur Hayrapetyan.

In Armenia one ArcGIS licence (1 user), one eCognition licence and one ENVI licence is available. No ArcGIS licenses are available in the Georgian and Azerbaijani IBiS Teams. Q-GIS open source software is used within the Azerbaijani team. A central GIS and RS data management system, which is being maintained regularly and accessible to all team members, is neither existent in Armenia nor Georgia. Azerbaijan developed a first folder structure with relevant data. However, regular maintenance is missing. Regular information exchange on state-of the art GIS and RS methodology and viability assessments for the specific country context do not yet commonly take place within IBiS teams and external research institutions. Also, regular exchange of experience on advising on GIS and RS applications does not yet take place between the country IBiS teams in a sufficient way.

6.2 Required capacities

The recently started IBiS Programme is advising governmental partners on how to improve biodiversity and ecosystem services across sectors and administration levels based on solid data. Yet, in all three countries relevant governmental institutions are not yet providing solid data in a sufficient way. One factor that is hindering the provision of solid data is the lack of sufficient capacities for collecting reliable data based on modern technologies. Hence, one focus during the IBiS programme will be put on advising the partners on the application of state-of the art GIS and RS methodologies for obtaining primary data.

For this, the in-house capacities, which are available within GIZ-IBiS team, might not be sufficient in order to confidently offer consultancy service on RS and GIS technologies to relevant partners.

Main activities which are supportive to the advisory services offered by GIZ-IBiS in the field of GIS and RS, but cannot yet be solely provided by GIZ-IBiS staff, are:

- the development of concepts for activities based on GIS and RS methodologies
- the development of GIS and RS rulesets for partners
- the collection of lessons learnt and best-practices from the three countries, as well as sharing of experiences among all team members;
- the revision and quality-check of GIS and RS working results submitted by external consultants;
- the conduction of research on international state of the art RS and GIS methodologies, development of new approaches or activities;
- the conduction of research and regular reporting to IBiS on GIS and RS activities conducted by other institutions within the three countries;
- the management of GIS and RS database within GIZ-IBiS (control of shapefile naming, setup and maintain geodatabase structure, development of label templates, server backup, etc.);
- the conduction of Training of Trainers (internal and external);
- the communication with relevant departments of GIZ headquarter on relevant updates of “GIS and RS in the development world”.

Depending on if and how regular this tasks shall be completed, a decision can be made on how the capacity is being brought into the IBiS team, internally or externally. An internal GIS- and RS-coordinator has the following main advantages:

- being able to work regionally on a long-term basis
- “dive-deep” into the conceptualization of relevant activities
- representing a contact person for GIS and RS related inquiries by partners
- support IBiS staff in their communication and conceptualization regarding GIS and RS
- creation of synergies among the approaches within the three countries (best practice, transfer of rulesets etc.)

External consultants have the following advantages:

- can be appointed (and paid) only on demand, e.g. for quality checks, conduction of internal and external trainings
- consultants with different fields of expertise can be contracted

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8. Appendices

8.1 Time Schedule

Time Schedule, Azerbaijan	

Time Schedule, Georgia	
Date	**Visited Institution**
Monday, 02.11.15	
9:30 – 11:30	GIZ SMBP
11:30 – 12:30	Presentation Round GIZ, Mission, and Partners
14:00 - 15:30	National Forest Agency, MoEPNR
15:30 – 16:00	WWF
16:00 - 17:30	State Environmental Supervision Department
Tuesday, 03.11.15	
9:30 – 11:00	GIZ SMBP
12:00 – 13:00	National Environmental Agency, MoEPNR
14:00 – 15:00	Geographic GIS & RS Consulting Center
16:45 – 18:30	Forest Policy Service, MoEPNR
Wednesday, 04.11.15	
9:30 – 10:30	Spatial Department, Ministry of Economy
11:00 – 12:000	CENN NGO
14:30 -15:30	Biodiversity Protection Service
16:00 – 17:30	NACRES NGO
Wednesday, 11.11.15	
12:00 – 13:00	Chief of Staff, MoA, Mr. Ilham Bayramov
13:00 -14:00	Deputy Director, Agriculture Projects Department, MoA, Mr. Orkhan Mikayil
15:00 -17:30	Integris LLC
Thursday, 12.11.15	
11:30 – 12:30	Institute for Irrigation and Erosion, National Academy of Science
15:00 – 15:30	Dean of Faculty of Ecology and Soil Science, and Chair of Department of Land Management and Cadastre, Baku State University

Time Schedule, Armenia	
Monday 28.09.15	
12:00-13:00	Acopian Center of the Environment, Center for Responsible Mining, American University of Armenia
Monday 14.12.15	
14.00 – 15.00	Jinj Ltd., Armenia
Wednesday, 16.12.15	
11:00 -12:30	GeoRisk CJSC, Institute of Geological Sciences, National Academy of Science
12:30 – 14:00	GeoCom LLC
Thursday, 17.12.15	
10:00 – 11:00	Center for Ecological Noosphere Studies (CENS)
12:00 – 13:00	Faculty of Biology, Yerevan State University
Friday, 18.12.15	
12.00 – 13.00	Faculty of Geography and Geology, Yerevan State University

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