Document No.:
Receiving Date:
(For APFNet Secretariat)

Asia-Pacific Network for Sustainable Forest Management and Rehabilitation

PROJECT PROPOSAL

Monitoring forest cover change in Mongolia with participatory approach

NUM-ITC-UNESCO Space Science/Remote Sensing International Laboratory, National University of Mongolia

12 October 2014

Project title	**Monitoring forest cover change in Mongolia with participatory approach**	
Supervisory agency	Ministry of Environment, Green Development and Tourism of Mongolia	
Executing agency	NUM-ITC-UNESCO Space Science/Remote Sensing International Laboratory, National University of Mongolia Environmental Research, Information and Study Center	
Expected project duration: 01/Jan/2015 to 11/12/2015, 12 months		
Target area: "Khan Buyan", "Buural domuu" Forest Community of Bulgan province		
Total budget (USD) 98,772	**Expected APFNet grant** (USD) 73,372	**Conouterpart contribution** (USD) (in cash and in-kind) 25,400

Project summary:

Problem

Forest cover accounts 9.2 percent of total territory, out of which 70 percent is intensively deteriorated by ageing, fire and insect infestation. Generally, forest in Mongolia is highly disturbed with increased illegal logging, mining activities and fires by nut and fruit collectors. Climate warming in Mongolia is relatively high; in the country with extreme dry climate, and low precipitation the input of forest resources on the ecosystem functioning is relatively higher than in humid areas.

By forest law of Mongolia an inventory is to be completed once in 5 years. However due to lack of resources and capacity, the inventory can be accomplished for entire country only once in 15-18 years resulting in incorrect and inconsistent figure about the forest cover in our country. There is any single accounting on forest change detection in Mongolia, which is a major obstacle in the process of forest resources planning, use, and protection.

Thus, for vast country with scarce population the earth observation will save time and money, and contribute in effectiveness of improved management plans and policy (DeLeeuw *et al*., 2010).

Goal and objectives:

Main goal of the project is to make a quantitative assessment of forest cover in Mongolia, and assist in development of the strengthened local strategic document to manage forest resources.

Objectives:

- Monitoring of forest cover change over 15 years time;
- Determine forest cover of Mongolia, and assess the accuracy of the result;
- Forest cover mapping of selected two forest communities (pilot sites are in Bulgan province);
- Assist in strengthening of strategic management plans for pilot forest communities.

Expected outputs/deliverables:

a. Quantitative assessment of the forest cover change in Mongolia;

b. Forest cover maps of the selected two community forests with high resolution image;

c. Extension of a new method in forest cover assessment in Mongolia; Technical and human capacity is strengthened in two forest communities;

e. Strengthened management plan of two forest communities; An Extension of the new method for use in strengthening of forest inventory/ management.

Key activities:

1. Data procurement
2. Mapping, analysis and validation
3. Trainings (in class training and OJT)
4. Public awareness, dissemination (Workshop/seminars, Publications, and a short TV program)
5. Management (Correspondence, Internet, Paper, printer cartridge, pencils, etc)
6. Project progress Monitoring and Financial auditing

Target group (s):

Two forest communities in Bulgan/Darkhan uul provinces:

Potential beneficiaries and main stakeholders:

- Asia-Pacific Network for Sustainable Forest Management and Development (APFNet);
- Ministry of Environment and Green Development of Mongolia (MEGD);
- Environmental protection agency of Bulgan aimag
- Forest inventory companies/ organizations (FIC);
- Forest communities (FC) such as “Eco Khan Buyan” and “Buural Domuu”;
- Forest departments at the higher educational institutes;
- Scientists and researchers working in the forest field.

Methodology and approaches:

Use of medium resolution satellite data to be used for the forest cover change detection of the entire country; and high-resolution satellite data to be used for community forest mapping. The assignment shall employ vegetation indices and forest index calculation. For pilot sites, the forest types shall be determined. The results will be validated with field data that shall be collected with active participation of community members and relevant stakeholders. The outputs of the forest cover change will be used in development of the management plan, forest inventory, and is expected to contribute to the APFNet strategy to monitor the forest cover.

Human Capacity building will be obtained by both in-class trainings and on the job training courses. Classroom training will invite personnel from the selected pilot communities and forest entity in Bulgan province to attend classes for 7 days. Afterwards, upon needs and during the field data collection, an additional on the job trainings will be conducted on the sites. A special sessions on the use of RS data for forest cover change detection will be included into the training program of the graduate students of the department of forestry, National University of Mongolia.

Public awareness work will include workshops and seminars delivering progress and the final outputs of the project. It shall invite relevant organizations and stakeholders in order to discuss and engage in extension of the approach used in the forest cover change detection and its implications. A TV program is also intended to be prepared for increase of general public decision makers’ awareness. In addition, a guideline elaborating the use of the advanced technology for forest cover assessment shall be published, and disseminated.

Sustainability

To sustain further functioning of the project, the project team will utilize project outputs, e.g., documented training materials, TV program, and guideline to conduct the capacity building activities to the forest communities upon needs and requests.

Sustainable cooperation with APFNet shall be ensured with research and practical activities to support the APFNet and GoM policy in forestry sector.

Project Proponent(s):
Contact: Prof.Tsolmon Renchin and Dr Ya.Ariunzul
Organization/entity: NUM-ITC-UNESCO Space science and remote sensing lab and Environmental research, information and study centre of Mongolia (ERISC)
Tel: +976 99175014; +976-88013715
Email: erisc.mn@gmail.com; tzr112@psu.edu

Prepared and Submitted by	Reviewed and Nominated by
Team of ERISC and NUM-ITC-UNESCO Space Science/Remote Sensing International Laboratory	Chief of Bureau of Silviculture design Ministry of Environment and Green Development
Supervised by	**Dr. Batchuluun Tseveen**
Prof. Tsolmon Renchin, Head of the lab	
Dr. Ariunzul Yangiv, Director of ERISC	**(Printing name and title)**
	Focal Point Signature
	Date: 10 October 2014
(Printing name and title)	
Project Proponent Signature on behalf of EA Date: 10 October 2014	

Table of contents

Abbreviations and acronyms

APFNet	Asia-Pacific Network for Sustainable Forest Management and Development
MEGD	Ministry of Environment and Green Development
OJT	On-the-Job Training
RS	Remote Sensing
GIS	Geographic Information System
MODIS	Moderate Resolution Imaging Spectroradiometer
FIC	Forest inventory companies/ organizations
FC	Forest communities
NUM	National University of Mongolia
ERISC	Environmental Research, Information and Study Center
GoM	Government of Mongolia
PIU	Project Implementing Unit

GLOSSARY

Aimag	Administrative unit within of Mongolia. Mongolia is divided into 21 aimags
Soum	Administrative unit within Aimag. Each aimag is divided into several soums

Project details

1. Background and Rationale

Mongolia has an area of 1.565,000 km^2 and is located in Northwest Central Asia, between China and Russia, at the latitude 41.35-52.06^0 N and longitude 87.47-119.57 ^{0}E. The population is just over 2, 8 million, and has the population density of only 1.8 persons per sq.km. The terrain is wide and open, with Taiga pine and birch forest in the mountainous North, grassy steppe in the central part, the mountains in West and Southwest and the Gobi Desert in South-central Mongolia. The lowest point is Hoh Nuur at 518 m; the highest point is Nairamadliin Orgil at 4,374 m.

The physical settings are the climate that ranges from semi-arid in the North to desert in the South; it is continental with large daily and seasonal temperature ranges, with large temperature differences between years; and availability of water that is the main determinant for flora and fauna.

There are 21 main administrative divisions - provinces (called *aimags*), the aimags are subdivided into *soums* (sub-provinces) and *Bags*. Mongolia is a country in transitional economy experiencing the shift from agriculture and animal husbandry economy to free market economy based on mining, agriculture and intensive animal husbandry in the past 20 years.

Climate warming in Mongolia is relatively high; in the country with extreme dry climate, and low precipitation the input of forest resources on the ecosystem functioning is relatively higher than in humid areas.

Forest cover accounts 9.2 percent of total territory, out of which 70 percent is intensively deteriorated by ageing, fire and insect infestation. Generally, forest in Mongolia is highly disturbed with increased illegal logging, mining activities and fires by nut and fruit collectors.

By forest law of Mongolia an inventory is to be completed once in 5 years. However due to lack of resources and capacity, the inventory can be accomplished for entire country only once in 15-18 years resulting in incorrect and inconsistent figure about the forest cover in our country. There is any single number defining the forest cover change detection, which hinders forest resources planning, use and protection processes. Therefore, with use of remote sensing data the change of forest cover increase and decrease will have significant contribution in adequate formulation of the forest policy of Mongolia.

Thus, for vast country with scarce population the earth observation will save time and money, and contribute in effectiveness of improved management plans and policy (DeLeeuw *et al*., 2010).

The proposed project is in relevance with the APFNet priorities. Forest cover change detection and assessment will be completed in the case of Mongolia. Two community forests will be selected for local forest type classification, and assessment with further implications in strengthening management plans of the pilot sites. Both monitoring of the forest cover change and strengthening of forest management to reduce deforestation with participation of local communities are in line with APFNet priorities and objectives.

The forest communities in Mongolia possess large sized areas, which supports the need on use of satellite data for development and formulation of the forest community management plan.at present there are 1062 communities with 21 thousand members possessing 2,310,663 ha area. These communities lack knowledge on use of earth observation data for planning. Thus, development of a method on formulation of management plans with use of satellite data, and training communities on the method, and extending it to the forestry personnel of

Mongolia will have a value addition to the country's forestry sector.

Effective management of forest and tree resources, in the broader context of regional and national policies and planning, requires a detailed analysis of those resources in relation to other sources of information. These other sources include, among others, information on biophysical parameters (e.g. DEM, soils, hydrology), socio-economic data (e.g. population, infrastructure), and development plans/economic policy (e.g. timber production, agriculture).

There are natural and human originated disturbances present in the forest resources of Mongolia e.g., logging, firewood collection, insect infestation etc. Until the recent past the forest resource management did not exist in action, it can be said as a relatively practice. Especially, supported with accurate spatial data and its analysis, the strengthened management planning is absolutely new action for the forest sector of Mongolia.

Forest cover change detection of the past 15 years will have tangible contribution to realistic planning of forest resources, and ecological and economic significance.

2. Goal and Objectives

In order to enable Mongolian decision makers to make educated decisions on forest management through the use of reliable spatial data, our team intends to make forest cover map for entire country, and resolve existing discrepancies on forest cover estimate. Provided with a single accurate figure both the local and national planners will be enabled to compare alternative management scenarios and to more effectively address the national forest policy. Forest type maps and forest change detection maps will inform related organizations on the current status of forest resources, and further study of the drives of the change for example.

Main goal of the project is to assist in development of the strengthened local strategic document to manage forest resources by making a quantitative assessment of forest cover in Mongolia.

The following objectives are set forth to achieve the main goal, that include:

- Monitoring of forest cover change over 15 years time;
- Determine forest cover of Mongolia, and assess the accuracy of the result;
- Forest cover/type mapping of selected two forest communities;
- Strengthening of strategic forest management plans for pilot communities.

3. Outputs and Strategic Activities

The deliverables of the project, the responsible party for each deliverable and milestones are indicated in the workplan (Annex D). The deliverables are also presented in the Logical Framework (Annex B).

Output 1. Quantified forest cover of Mongolia

Activity 1.1 Data retrieval

For the forest cover change detection at the national level, the medium resolution satellite imagery will be used. MODIS 250 m, and LANDSAT 30m

MODIS satellite images: The Moderate Resolution Imaging Spectroradiometer (MODIS) instrument is operating on both the Terra and Aqua spacecraft. It has a viewing swath width of 2,330 km and views the entire surface of the Earth every one to two days. Its detectors

measure 36 spectral bands and it acquires data at three spatial resolutions: 250-m, 500-m, and 1,000-m. Most standard MODIS Land products use this Sinusoidal grid tiling system. Tiles are 10 degrees by 10 degrees at the equator. The tile coordinate system starts at (0,0) (horizontal tile number, vertical tile number) in the upper left corner and proceeds right (horizontal) and downward (vertical). The tile in the bottom right corner is (35,17). Mongolia is located in horizontal from 24 to 26 and vertical from 4 to 5 (https://lpdaac.usgs.gov/). Our target site is including h25v4.

Landsat satellite images: Landsat represents the world's longest continuously acquired collection of space-based moderate-resolution land remote sensing data. Four decades of imagery provides a unique resource for agriculture, geology, forestry, regional planning, education, mapping, and global change research. Landsat images are also invaluable for emergency response and disaster relief (http://landsat.usgs.gov/). Mongolia is located in Path from 122 to 144 and Row from 24 to 31. Downloadable 60-70 scene of Landsat imagery /fully covering forest area of Mongolia/ kept in the USGS archives are available on**: Glovis** http://glovis.usgs.gov, **EarthExplorer** http://earthexplorer.usgs.gov, **LansdatLook Viewer** http://landsatlook.usgs.gov. Date available is from 1993.

Activity 1.2 Data correction

Digital Image preprocessing includes

Geometric correction: conversion of data to ground coordinates by removal of distortions from sensor geometry, and

Radiometric Correction: removal of sensor or atmospheric 'noise', to more accurately represent ground conditions:

to correct data loss, remove haze, enable mosaicking and comparison

Radiometric correction is used to modify DN (digital number) values to account for **noise,** i.e. contributions to the DN that are a result of the intervening atmosphere; the sun-sensor geometry; and the sensor itself *(Landsat 7 Science Data Users Handbook).*

Activity 1.3 Forest cover change detection

Change Detection Method for employment:

Unsupervised change detection plays an important role in many application domains related to the exploitation of multitemporal remote sensing images. The availability of images acquired on the same geographical area by satellite sensors at different times makes it possible to identify and label possible changes that have occurred on the ground.

Change vector analysis first computes a multispectral difference image (**X**D) subtracting the spectral feature vectors associated with each corresponding spatial position in the two considered images **X**1 and **X**2 . Letting *X*D be the multidimensional random variable representing the spectral change vectors in the difference image obtained as follows

$$\mathbf{X}D = \mathbf{X}2 - \mathbf{X}1$$

(Francesca Bovolo, and Lorenzo Bruzzone, University of Trento)

Activity 1.4 Forest cover mapping – DIP

This is MSc student' topic. S/he will be in charge for entire process of image processing, and will be guided whenever required.

Mapping method shall employ supervised classification (Maximum Likelihood) Based on a probability function derived from a statistical distribution of reflectance values.

In order to make land cover legends, we used the baseline legends definitions from NELDA research. The assessment for 7 aggregated land cover classes included (APN report, 2010)

Activity 1.5 Forest inventory data collection, validation

For data needed to validate the output maps, we shall approach the forest inventory companies. Validation work is a part of MSc students research. An MSc student will compile

collected data, and prepare for validation analysis. Out of total available data, random number of data shall be selected for accuracy assessment to see the reliability of produced forest map.

Output 2. Mapped forest type of pilot community forests

Activity 2.1 Data retrieval/ procurement
IKONOS images: The IKONOS Satellite was launched in 1999. IKONOS is owned and operated by DigitalGlobe, which collects image data of a pixel resolution of 0.82 m. Onboard sensors can point both along and across track, providing a revisit capability of 1-3 days depending on latitude. The satellite simultaneously captures 0.82 m panchromatic (black & white) and 3.28 m multispectral (colour) digital imagery. The panchromatic and multispectral datasets are available separately or can be purchased as combined (pan-sharpened) 0.82 m multispectral imagery (http://www.geoimage.com.au/satellite/ikonos). IKONOS image will be used for forest type mapping of the pilot forest communities.

Activity 2.2 Data correction/ processing
The data will be checked for external values such as clouds, and prepared for processing. Visual interpretation is also an applicable metho to delineate forest resources by wood types, health etc.

Activity 2.3 Field data collection
Field data should be sufficient enough to cover data for classification/ mapping and for validation purpose. For field data collection, a releve sheet shall be prepared that shall include information on biophysical, environmental and social aspects. Random data sampling strategy will be employed.

Activity 2.4 Validation
Out of set of data collected in the field, half will be used for accuracy assessment. Conventional method of validation is a Confusion matrix. It provides information on both– the accuracy of the amount mapped against the accuracy of geographic distribution
Validation sample selection, an example /from NELDA project/:

- Minimum of 300 randomly selected points across the image with proportional representation of classes (adjusted to 30 min per class)

Class	*Pixels*	*Prop S*	*Sample*	
–	TNDC	5%	15	30
–	TNO	7%	21	30
–	TMC	26%	78	78
–	TMO	17%	51	51

Output 3. Extension and Application of the new method

Activity 3.1 Human capacity strengthening
There will be one time in class room training of a week long duration on use of 3S technology for forestry. This activity shall focus on training of the relevant members of the selected communities, forest officers at soums and aimag Environmental offices, undergraduate and

graduate students, and representatives from private entities. The training shall be conducted at the NUM-ITC-UNESCO lab and shall be organized by PIU.
It is also planned to conduct two on the job trainings at the pilot communities. One of the OJT shall be combined with field data collection activity for cost-effectiveness purpose, and the other one on the requirement of the community. For field data collection work, all PIU together with community members shall go for data collection.
Research studies involving 2 Bachelor and two Master level and 2 PhD students from NUM and Mongolian University of science and technology (MUST) are to be supervised by PIU senior personnel and Consultants.

Activity 3.2 Technical capacity strengthening
Considering poor technical capacity of the pilot communities, within the project it has been budgeted to procure 6 Personal Computers, and 4 GPS. Each community shall be allocated two PCs and a GPS. Computers are to be installed with required software packages. Remaining two computers will be used at the PIU for data processing and training purposes, and two GPS's shall also be used for training purposes and field data collection.

Activity 3.3 Review and improvement of the forest management plans of the pilot communities
The project resources are to be input into the development of the method that shall be applicable for community based forest management plan for the period stated in the law. Successful accomplishment of the task shall reveal method/ technique that is extendable in other forest communities. Accordingly strengthening of the capacity of the local communities in use of products produced with use of advanced tools for long and short term planning to manage the forest resources.

Activity 3.4 Guideline preparation
Teaching materials, handouts are to be used for teaching purpose. Based on the documented materials a guideline shall be prepared clearly indicating steps to follow for the users/community staff/ forest officers etc.

Output 4. Increased public awareness
Activity 4.1 Stakeholder workshop x3
During the project lifetime three stakeholders' workshops shall be organized. The workshop shall present outputs delivered, achievements made in each 6 months, and bring into discussion further detailed planning with incorporated lessons learnt. It also will welcome comments, remarks, and critical review on the project approach (draft program of the workshop is in part 8).

Activity 4.2 Preparation of TV program
A short TV program highlighting importance of having high accuracy spatial information for better management of forest resources will be produced. It will depict parts of the project implementation process as for examples. TV program last for 5-10 minutes, and depending on the budget availability it will be broadcasted once on an environmental channel.

Activity 4.3 Monitoring and auditing
Monitoring and auditing is described in details in part 8.

Activity 4.4 Reporting and publishing
The PIU is responsible for the project management reporting and the technical reporting of the project implementation. All project management reporting will be in English while technical reporting can be in English language, and Mongolian if there is the intended use of

the reports. The following management reports are foreseen in the project implementation period that include:

Project document	due 15 October 2014
Inception report	20 January 2015
Progress report	15 July 2015
Final report	31 December 2015
Financial report	15 April/15 July/ 15 Oct/ 31 Dec 2015
Monitoring report	15 April/15 July/ 15 Oct 2015
Audit report	June/ December 2015
Guideline	June- November 2015
Publications (x2)	June – December 2015

4. Risks and assumptions

The project achievement is subject on availability and willingness of the forest inventory companies to share their data. The latter is essential part for validation of produced forest cover data for entire country. The project team shall utilize its resources to sign MoU of cooperation with the inventory companies.

We assume that the community staff is knowledgeable about forest resources, on use of computers, and have ability to work on computer, and understand the advanced techniques.

5. Human Resources and capacity assessment

Under overall guidance of Prof.R.Tsolmon, Dr Ya.Ariunzul shall lead a project team comprising of 11 people, of which 2 undergraduate students, and 4 postgraduate students and two national consultants.

№	Name	Organization	Field	Duty
1.	Tsolmon.R	NUM-ITC-UNESCO Space Science/Remote Sensing Lab	Overall guidance, image processing, training	Lab Project Director; coordination of DIP, training components
2.	Ariunzul Ya.	Environmental Research, Information and Study Centre /ERISC/	NGO	Team leader overall management of the project
3.	Kh.Narangerel	Environmental Research, Information and Study Centre /ERISC/	NGO	Project Staff, financial responsibility; image processing, data collection
4.	Tungalag.A	NUM-ITC-UNESCO Space Science/Remote Sensing Lab	/PhD student/	Involved in the project implementation process
5.	Enkhjargal.N	NUM-ITC-UNESCO Space Science/Remote Sensing Lab	/PhD student/	
6.	Master students	National University of Mongolia	Research student	
7.	Saruultuya.L	National University of Mongolia	Master students	
8.	Ariuntungalag.S	National University of Mongolia	Bachelor	
9.	Bachelor	National University of Mongolia	Bachelor	
10.	Ganbandi.Sh	“Khan buyan”-Forest communities of Bulgan province	Forest communities	Main stakeholders
11.	Erdenebileg. G	“Buural Domuu”-Forest communities of Bulgan province	Forest communities	Main stakeholders

In the project implementation the role of the **MEGD** is defined as support, extension unit of the methods developed within the project to the national level, in advertising and outreach program the Environmental protection agency of Bulgan aimag shall play its input, and extend the method at the aimeg level.
APFNet signs the contract, provides grant for project implementation, and together/or through APFNet focal point is expected to be a coordinating point with the GoM.
APFNet focal point shall support, advise, coordinate the project activities.
NUM-ITC-UNESCO Lab as part of implementing unit shall focus on educational training of 6 students involved into the project, and conduct the planned trainings, and publish scientific article(s).
ERISC as a part of the PIU shall develop the project proposal, and project document, will be responsible for project implementation, print and publish guidelines, and responsible for financial management of the project and financial reporting in accordance with APFNet rules.
Six **students** engaged into the project shall become trainers for further trainings on formulation of the management plans at the community level under the overall supervision of ERISC.
Two **pilot communities** shall be strengthened in human capacity by learning utilization of advanced data and technology for development of the management plans at the community level.
National consultants shall be accountable for monitoring and evaluation of the project progress to ensure qualitative outputs of the project, and provide required advice and guidance in forest management planning looking at the strategic scenario development with use of 3S technology.
Project Board (PB) is to be in charge for the project implementation in terms of effectiveness and timeliness of inputs and in terms of success of project activities and to oversee and provide guidance to project activities; also it will have right to hear the liquidity to ensure transparent financial management of the project.)

6. Budget, funding resources and financial management

Financial management of the project is subject to funding sources, most of which is to be sponsored by APFNet, and 20 + percent is to be sourced from the implementing agency as in kind contribution of renting office premises, office rooms and in terms of fee payment.
In order to secure cost-effectiveness of the project resources, the project will collaborate with inventory companies to get their field data, that shall be used for accuracy assessment of the forest cover for entire Mongolia. In return, our team will involve the inventory company to the relevant trainings, and make our data available for them. In addition, whenever required, e.g., on the job training shall be combined with the field survey period in order to save project resources.

The financial management is the responsibility of the PIU precisely of the Project team leader.

A bank account of the Environmental Research, Information and Study Center of Mongolia will be available for project fund allocation. There will be a special US dollar account opened to ease the financial management. It will be used for transactions abiding the existing financial rules

in Mongolia, and if any by APFNet. And it is for PIU to assure that any interest gained on the proceeds of the project, will benefit the project only, and included into the financial report.
Quarterly or semi annual financial reports will be produced and submitted to the APFNet. After approval of the reports by the APFNet, the next installment is to be made by APFNet.
Twice during the project implementation period an external audit will be carried out, applying national auditing rules such as calling for open bid.
Financial management of the project resources is subject to disbursement according to secured categories of activities only.
Project budget is detailed in both by activities (Annex D) and by categories (Annex E).

7. Monitoring and evaluation

Monitoring: Monitoring of the project progress shall be done against milestones to check whether the work is on track. Monitoring and evaluation shall be conducted three times in the project lifetime. An independent consultant will conduct monitoring and evaluation of the project progress. All related documents e.g., progress reports, random datasets, workplan and project document shall be used as reference.

On day-to-day basis, monitoring and coordination is a duty of the project coordinator who shall keep the project work on track according to a workplan. It will be an ongoing process including data collection, and assessment of the project's field implementation, and also will involve key project staff meeting reviewing operations, and implementation.

Evaluation: A midterm evaluation is to be scheduled during the project's lifetime. This will enhance the project quality outputs.

Each monitoring and evaluation of the project will document lessons learned, identify problems and gaps, and provide recommendations to improve performance.

In addition, an official audit shall be called to assess and document the financial management of the project. As per requirement, there two auditing services are planned for a year-long project. Audit reports shall be sent to APFNet consideration on timely basis.

8. Dissemination and sustainability

The project progress and outputs is planned to be delivered for the public awareness by means of the following activities:
Workshops: inception, progress, and final stakeholder workshop. All workshops will invite relevant stakeholders like officers from governmental and non-governmental forest organizations, companies, forest communities and forestry students. All participants are to be engaged into discussion works on the progress, and final evaluation on the results and in extension of the approach used in the forest cover change detection and its implications (draft agenda of the workshop).
Seminars and trainings: It is planned to convene a week long class room training engaging the pilot community members, forest department officers at soum, and aimag level, for students engaged into the project activities. It will be further supported with the on-the-job training (*OJT)* where trainees will have opportunity to execute learnt knowledge and skills into practice (Below is the draft in classroom training program).
For general audience, *a TV program* is planned to be prepared that shall depict the use of advanced technology and data for development of the community forest management plans,

value of use of satellite data and terms of saving money and time, and producing reliable and accurate user friendly outputs.
In addition, *a guideline* elaborating the use of the advanced technology for forest cover assessment, and use of the outputs for development of community management plan shall be published, and disseminated.

There is indispensable need to increase awareness and educate people of all forest communities in Mongolia. This is achievable number as long as communities are willing to gain such knowledge in application of advanced 3S technology in their forest management planning.
Having experience and equipped with made available with APFNet project training packages, guidelines, our lab will be able to ensure further sustainability of knowledge dissemination for targeted audience that may include newly established communities, students, officers from governmental organizations, and private entities.

Draft program for in classroom training:
The overall focus of the course will be on forest cover quantification that is beneficial and relevant for forest resource management, and improving forest management plans. In this respect operational methods and advanced tools of remote sensing and GIS combined with field data verification will be an important part of the course.

Below is an outline of the tentative programme of course.
Day 1. Introduction about the project; Government priorities in forestry sector; Forest resource mangament: forest policy, forest inventory status, and current status of the foest management plan formulation. Role of GIS and RS; Use of softwares, start of ArcGIS software (ArcCatalog, ArcMap, Edit legend), practical exercise
Day 2. Introduction about satellite data, maps; Forest cover mapping exercise;
Day 3. Assessing deforestation, lecture and exercise. Lecture and exercise: Biomass assessment of forest and other vegetation, spatial modeling of biomass using Remote Sensing
Day 4. Lecture and exercise: Mapping and quantifying forest; forest cover change;
Day 5. Lecture and exercise: use of Geo-information GPS; fieldwork preparation
Day 6. Fieldwork: navigation skills, data collection for forest mapping, interviews
Day 7. Lecture and exercise: why management plan, how to prepare, interactive exercise to review forest management plan of a pilot site

Draft agenda of the stakeholder kick off workshop (one day event):
The purpose of the kick off workshop will be to introduce to the audience about the Government policy related to the forestry sector; APFNet strategy, and activities; APFNet funded project goal and objectives; the target group of the project, method and approach, and means of dissemination. Participants are welcomed to comment and critically review the project method and approach, make recommendations.

8:00	Registration
9:00	Opening remarks (by APFNet focal point)
9:30	Current environmental/ forestry policy
10:00	APFNet activities, strategy
10:30	About APFnet project

11:00-11:30	Tea/ Coffee break
11:30	Forest cover activities, researches conducted in Mongolia, existing discrepancies in quantification. Advantage of the method to be used in the project
12:00	Questions/remarks
12:30	Availability of ground data by various inventory companies, reliability, availability
13:00 – 14:30	Lunch break
14:30	Use of high resolution data for studies in Mongolia, its proposed use in the project case
15:00	Discussion, questions, comments, remarks
15:30	Forest communities formation, functions, management plan development, implementation
16:00	Proposed possibility to strengthen the management plans of the pilot sites
16:30 – 17:00	Questions, remarks
17:00	Concluding remark

9. Duplicability and sustainability

There are 1,062 communities with over 21 thousand members exist in Mongolia, that possess 2,310,663 ha of forest area. These communities have not used any satellite data in development of their community forest management plans. Thus, the project team shall make input in conducing capacity strengthening programs to train community staff on use of 3S (GIS, GPS, and RS) technology for mapping and development of their plans. The methods developed and applied in case of two pilot communities shall be used for preparation of a guideline in order to expand the method to other 97 communities of Bulgan aimag in collaboration with EPA of Bulgan aimag.

Staff of the local forest units shall be trained on use of satellite data to assess the forest status. Besides, in collaboration with the MEGD to introduce means of forest inventory annually with employment of RS data. Annual update of forest inventory data of Mongolia will keep the APFNet database system updated with new data on Mongolian forest resources.

“Khan Buyan community” of Khangal soum, Bulgan aimag was established on 28 November 2011 withh 15 members. It posseses 5000 ha forest area. Khangal soum belongs to the central region of Mongolia, and it is located in Khangai mountain range. The soum covers 165,6 thousand ha area.

It is located in 110 km distance from the aimag centre, and in 420 km from Ulaanbaatar city, from Orkhon aimag in 45 km distance. To the east it borders with Baruun buren soum of Selenge aimag, in the south with Jargalant and Bayanundur soums of Orkhon aimag, in the north with Selenge soum of Bulgan aimag. Timber preparation industry, tourism, and resort places are operational in the soum. Over 1100 children attend 9 years, and 11 years secondary schools in Khangal soum, and pre-school children make around 200. Medical service is performed with 2 medical care units. Two farming industries, 8 communities, a timber industry, four resorts and tourism sites, two children’s camps, and many other small enterprises are operational in the soum.

“Buural domuu community” of Bugat soum, Bilgan aimag. The community was established with 11 members on 16 July 2012. It possesses 1172 ha of forest resource area.

Bugat soum is in the north-east to Aimag centre in 55 km distance. It is located between Erdenet city and Bulgan city. From Erdenet city it is in 30 km to the north-west. In the north it border with Bulgan and Orkhon soums of Bulgan aimag, and in the north-east it borders with Selenge soums of Orkhon aimag, and in the north-west it borders with Saikhan, Khutagt-Undur soums. Agricultural area covers 79572.7 ha area or 26.5% of total land, forest area is 214619.59 ha or 71.4%, and water body is 1120 ha or 0.37%, land for special purposes make 3500 ha or 1.16%.

At the soum level, total number of operational enterprises is 36 contributing 41484.9 mln tug at local budget, and at the state budget 141768.9 million tugrik, totalling in 183253.8 million tugrik’s paid as tax. At the soum level, out of total 69772 head stock there is null camel, 6142. horses, 9092 cows, 31689 sheep, and 22849 goats. At the soum, 3014 thousand ha of agricultural land is used. Of which 11 percent is used for vegetables, 98 % for wheat, and other crops. There are 5 private companies dealing with crop production on 1910 ha land, and about 1104 ha of land is used for potato and other vegetable growth by individuals.

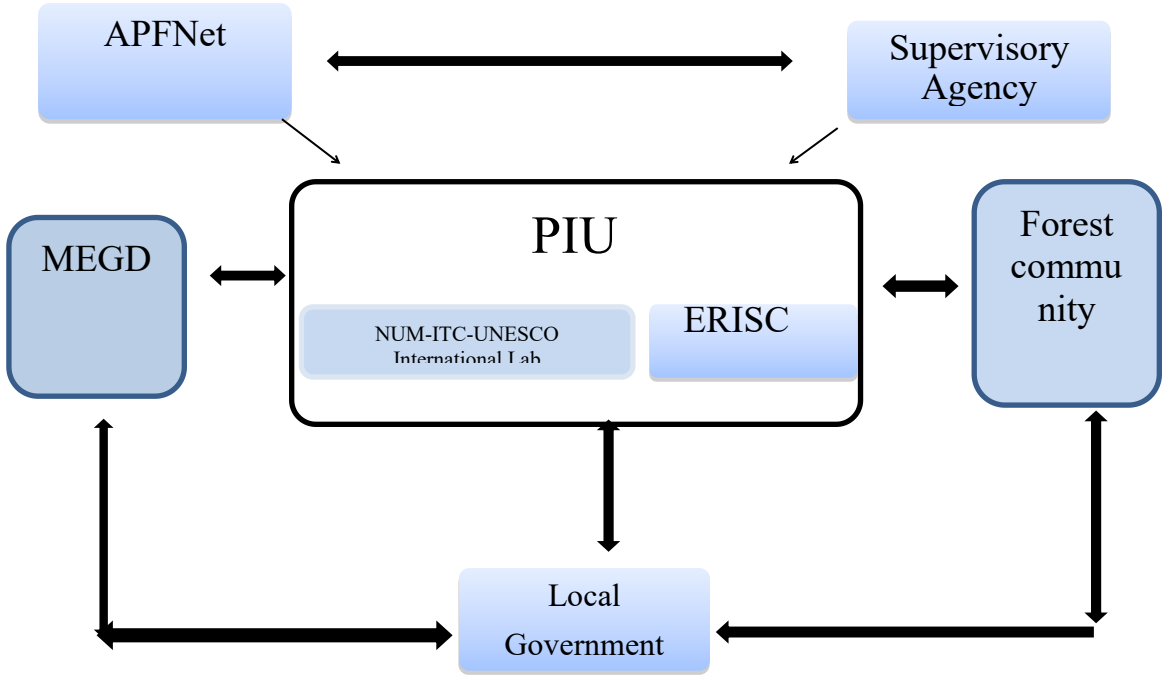
Annex B: Project logical framework

Items	Intervention logic	Objectively verifiable indicators of achievement[5]	Sources of information and means of verification[6]	Assumptions[7]
Goal(s)[1]	- To contribute to development and implementation of forest policy of GoM providing accurate and high quality data on quantification of forest cover in Mongolia	-Accurate and up-to-date data on forest cover is available for further management and policy implications; - Availability of guidelines for extension of the method	- Strengthened management plan of the selected forest communities; - Use of guidelines on use of the approach	- Local offices and communities have educated people to work with advanced technology; - Local community staff are aware about forest resources
Objectives[2]	Updated and accurate forest cover of Mongolia Monitored forest cover change over past 15 years span Demo pilot area forest cover assessed, and utilized in strengthening of the strategic plan of the community	Available updated and verified for accuracy forest cover map of Mongolia An estimate of forest cover change detection is used for research and policy works; High resolution data utilized in pilot sites to create up to species level forest map; and used for management plan development; Strengthened human capacity of communities; and students	Demand for the APFNet products Web availability of the updated map, and publication of relevance	Recognition and acceptance of the work by stakeholder organisations, especially by the forest inventory companies; Willingness to collaborate
Expected outputs[3] Output 1	Quantitative assessment of forest cover of Mongolia: NUM-ITC-UNESCO lab and ERISC are responsible for implementation	Change detection of forest cover of Mongolia is quantified Quantified and validated forest cover of Mongolia	Satellite data will be downloaded from three sources for Landsat since 1993 and from 1998 for MODIS Validated at acceptable level forest cover map of Mongolia Available size of an area under the change occurred in forest cover	Sufficient number of high capacity computers are available
Activities Activity 1.1 Activity 1.2	1.1 Data retrieval 1.2 Data correction 1.3 Forest cover change detection 1.4 Forest cover mapping – DIP 1.5 Forest inventory data collection, validation	Landsat and Modis data are downloaded and corrected Forest cover change is detected over 15 years Forest cover is quantified and validated for accuracy MSc students research on change detection is completed	http://landsat.usgs.gov/, https://lpdaac.usgs.gov,	Capable staff are available
Output 2	Mapped forest type of pilot community forests	Forest type map produced and validated	(http://www.geoimage.com.au/satellite/ikonos)	Cost for satellite data remains stable

Annex B: Project logical framework

Activity 2.1 Activity 2.2	2.1 Data retrieval/ procurement 2.2 Data correction/ processing 2.3 Field data collection 2.4 Validation	IKONOS data for pilot sites are procured and corrected Forest type mapping is completed Validated forest type map Sufficient number of field data 2/3 of a PhD student' research is completed Draft paper is available	Forest type mapping will include methods used in studies of Ariunzul and Tsolmon Forest type map validated and of acceptable accuracy (>70%) Min 250 points/ community forest is available in datasheet Draft research paper is available	Cost for satellite data remains steady
Output 3	Extension and Application of the new method	Strengthened forest management plan with RS produced forest type map	Developed method to strengthen and develop forest management plan based on forest type map Upgraded forest management plan of the pilot community forest	Qualified human resources is available
Activities	3.1 Human capacity strengthening 3.2 Technical capacity strengthening 3.3 Review and improvement of the forest management plans of the pilot communities 3.4 Guideline preparation	Training program Procured and installed computer and software at the target destinations in pilot communities On the job training Guideline is prepared Draft manual for use of user friendly maps for management plan development	Feedback received from 30 participants of the training Operational computers on sites Reports re On the job trainings in the communities on use of GPS, computers and processing etc. Results of tests are available Available guideline describing method of mapping, and use of maps for management plan development	Qualified personnel are available at the pilot communities
Output 4	Increased public awareness	TV footage Publications	TV program/Footage is broadcasted	No inflation Rates remain steady
Activities	4.1 Stakeholder workshopx3 4.2 Preparation of TV program 4.3 Monitoring and auditing 4.4 Reporting and publishing	Minutes of meetings TV program is available and broadcasted Monitoring reports are delivered and available Audit report is available and delivered All reports including progress, financial are available Article published	Workshop minutes of meeting is available Kick off workshop report Short TV program is available Project progress and financial reports Final report Audit reports Monitoring and evaluation reports Article submitted for publishing	No inflation takes place Sufficient resources

Annex C: Project organizational chart



APFNet provides grant, the project output dissemination and input into APForest network database
MEGD supports the project at policy level, facilitates extension of the project methods to the national level application
Supervisory Agency advises, coordinates and keeps in line with the APFNet strategy
Project Board comprising of MEGD, APFNet focal point, Head of the international Lab, and ERISC leader and a consultant shall exchange information on project progress, and coordinate synergy with other relevant activities
"NUM-ITC-UNESCO" International Lab represented by Prof.R.Tsolmon, Enkhjargal and Tungalag shall be responsible for image processing, prepare maps, conduct training, and write reports on the executed tasks.
ERISC represented by Dr.Ya.Ariunzul, Kh.Narangerel, L.Saruultuya, S.Ariuntungalag and 2 other students shall be responsible for project implementation on day to day basis, project implementation, reporting, and informing stakeholders with relevant info.
Local Government shall support the project at local level, and support extension of the developed methods at the local level.
Forest Community represented by G.Erdenebileg, Sh.Ganbandi will facilitate project implementation at community level, and provide support in extension of the project outputs at local communities

Annex D: Overall Project Work Plan with budget by activity

Output/Activity line	Responsible Party	Project year 1												Cost (USD)		Total
		Months with milestones														
		1	2	3	4	5	6	7	8	9	10	11	12	APFNet	Counterpart	TOTAL
Output 1. Quantified forest cover of Mongolia																
Activity 1.1 Data retrieval	Lab															
Activity 1.2 Data correction	Lab, students														700.00	
Activity 1.3 Forest cover change detection	Lab, students			20%			90%	100%							4,200.00	
Activity 1.4 Forest cover mapping DIP	Lab, students			10%				85%							4,200.00	
Activity 1.5 Forest inventory data collection, compilation, Accuracy assessment	Lab, ERISC													6,000.00	1,400.00	
Subtotal														6,000.00	10,500.00	16,500.00
Output 2 Mapped forest type of pilot communities																
Activity 2.1 Data retrieval/ procurement	Lab, ERISC															
Activity 2.2 Data correction, processing	Lab, ERISC			60%		100%									2,800.00	
Activity 2.3 Field data collection	Lab, ERISC, community													6,781.00	1,400.00	
Activity 2.3 Validation	Lab, ERISC													2,000.00	700.00	
Subtotal														8,781.00	4,900.00	13,681.00
Output 3 Extension and application of new method																
Activity 3.1 Human capacity strengthening	Lab, ERISC, community			in class		OJT		OJT						7,800.00		
Activity 3.2 Technical capacity strengthening	Lab, ERISC, community													11,840.00		
Activity 3.3 Review and upgrade of the forest management plan	ERISC, Community													8,781.00		
Activity 3.4 Guideline preparation, publishing	Lab, ERISC													5,000.00		
Subtotal														33,421.00	-	33,421.00
Output 4 Increased public awareness																
Activity 4.1 Stakeholder workshop	all													10,170.00		
Activity 4.2 Preparation of TV program	all													3,000.00		
Activity 4.3 Monitoring and auditing	NC, Audit comp													10,000.00		
Activity 4.4 Reporting and publishing, management	ERISC, Lab													2,000.00	10,000.00	
Subtotal														25,170.00	10,000.00	35,170.00
Total														73,372.00	25,400.00	98,772.00

Annex E: Project budget by category

Costs category	Rate (USD)	Unit	Project Year 1		Project Year 2		TOTAL (USD)
			APFNet Grant	Counterpart Contribution	APFNet Grant	Counterpart Contribution	
Project staff cost (salary for project staff and management personnel; team leader and a staff salary)	700	11 months		15,400			
Subtotal				**15,400**			
Consultancy cost[2] (2 local consultants' cost: in developing community management plan, monitoring the project progress, preparing content and TV program, publications)	2,000	2 x 6 months	24,000				
Subtotal			**24,000**				
Travel and related cost[3] (car rent, local travel, per-diem and etc:)			9,562				
Meeting and training cost[4] (venue, facility, hospitality, speakers/experts' fees , participants accommodation, meeting material, etc)			17,970				
Field activities cost[5]							
Publication &Dissemination cost[6] (formulation, editing, publishing of articles, reports, and TV program products and organization of outreach activities, media activities)			6,000				
Office Operation cost[7] (project administrative management fee, lease/rental of office premises, office and facility maintenance, etc)				10,000			
Procurement [8] (purchase of 2GPS, 6PC, and satellite images)			11,840				
Monitoring, evaluation and audit cost[9]			4,000				
Miscellaneous[10]							
Subtotal							
TOTAL			73,372	25,400			

Annex E: Project budget by category

Notes for budget completion (for each category clarification):

1. **Project staff cost** (in-kind from the Counterpart organisation). (project staff) Full Job description is below this notes
2. **Consultancy cost**: Subline 1.1 national consultants. Terms of reference for each consultant is attached below this texts.
3. **Travel and related cost**: Subline 2.0. This includes vehicle rent cost, cost for gasoline, and per diem. Estimate is made for 6 persons x 7 days x twice.
4. **Meeting and training cost**: Subline 3.0 includes expenses related to in-classroom training, 2 on the job trainings, and stakeholder workshops. The stakeholder workshop is estimated for approximately 50 participants, which will be national level workshop. The in classroom training is designed for maximum 30 participants from target pilot area. Tentative agenda for kick off workshop and in classroom training is attached.
5. **Dissemination & publication cost:** Subline 4.1. includes expenses on editing, printing and publishing; Subline 4.2 is on media and outreach broadcasting
6. Office Operation cost: is to be borne as in kind from the Counterpart. Job description is attached for
7. **Procurement of equipment**: Subline 5.0 is purchase of 6 computers, 2 GPSs and satellite data for pilot area
8. **Monitoring, evaluation and audit cost:** Subline 6.1 is internal monitoring of the project progress; and Subline 6.2 is financial auditing cost,

"NUM-ITC-UNESCO" International laboratory
for Space Science and Remote Sensing
Nationall University of Mongolia

The laboratory was established in 2003 with the name "Remote sensing study of the environmental monitoring and Geographic Information System" with the Department of Geophysics of the School of Physics & Electronics at National University of Mongolia (NUM). Its role includes research, education and technology transfer. From 1 December 2005, the laboratory became the "NUM-ITC-UNESCO" international laboratory of Remote Sensing/GIS by the School of Physics & Electronics, NUM. The new laboratory has given a good opportunity to study remote sensing and GIS subjects for both national and international students in Ecology, Geography, Hydrology, Biology, Anthropology, and Archeology. The subjects cover principles of remote sensing and GIS, general concepts, data acquisition procedures, data analysis and role of remote sensing in terrain investigations for land management, urban land planning, land cover changes, monitoring for agricultural, meteorological and climate changes, forest map and wild fire,

environmental engineering practices. Data collection from airborne and satellite platforms are emphasized.

Activities

Education

- For undergraduate students from Ecology, Hydrology, Meteorology, Geophysics.
- For master student studying same as elective and special source.
- For PhD students advanced course and research.

We are actively working on three kind topics which are Space Science, Remote Sensing and Geographic Information System. We organize International and National annual workshops mainly on remote sensing and GIS for Environmental application since 2004.

The titles of workshops held:

1st"International land use, land cover change"

2ndInternational land use, land cover change

3d National workshop on "Land exploitations, land cover changes of Mongolia"

4thNational workshop on "Land exploitations, land cover changes of Mongolia

5th international workshop of Remote Sensing and Space science in Mongolia

6th International Workshop on Remote Sensing and Environmental Innovations in Mongolia.

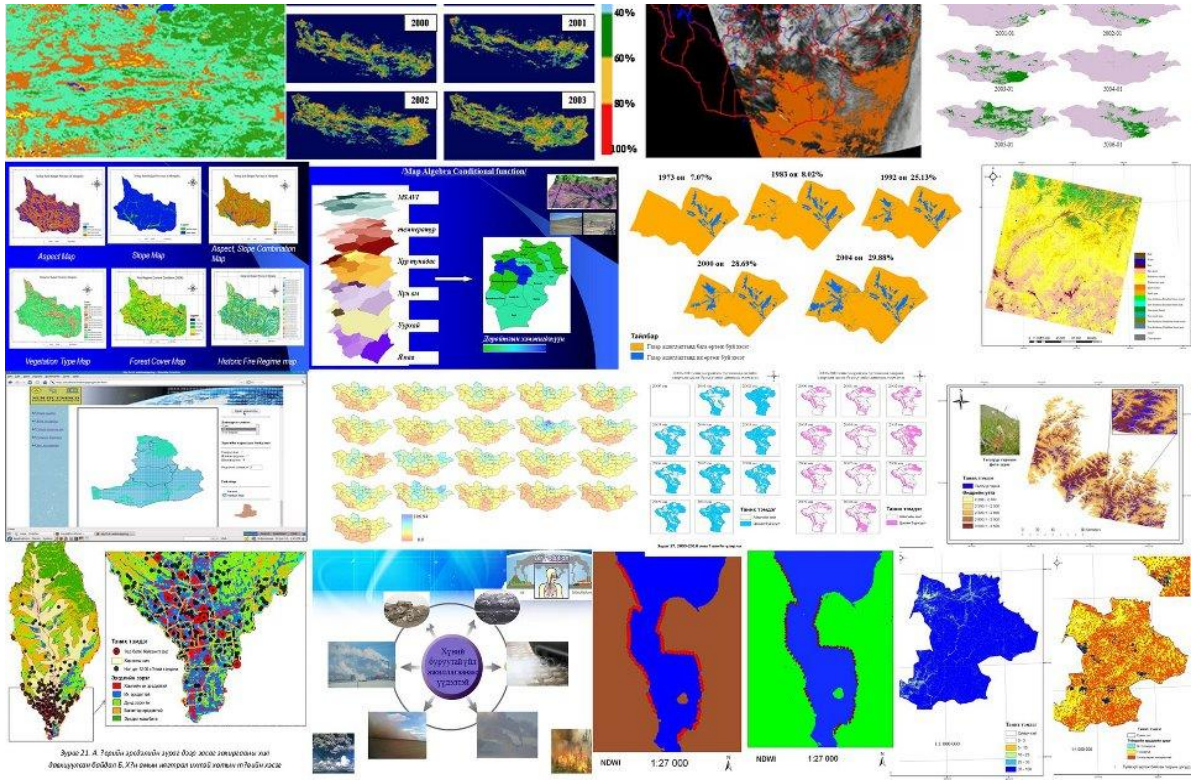
Annex E: Project budget by category

Proceedings of the organized workshops

Topics of the current research at "NUM-ITC-UNESCO" lab:

- Surveying on snow cover of Mongolia
- Research study on Surface water of Mongolia
- Forest Bio mass and vegetation index
- Research study of saxaul forest cover
- Vegetation and land cover study of Mongolia
- Calculation of wheat crops.
- The development and movements of Ulaanbaatar
- Natural disaster risk reduction
- Using the GIS application for Natural protection
- To compute air pollution
- Establish the forest information base of Mongolia
- Environmental Monitoring of Mongolia

Annex E: Project budget by category



Resaerch results

Training courses

- Remote sensing and GIS analysis for Land managers
- International course for advanced RS and database
- Advanced course for environmentalist on protected areas
- Wildlife World Foundation (WWF)- RS/GIS course for land management and environmental specialists

NUM-ITC-UNESCO lab resources:

Server: 1

Dell vostro computer – 3

Annex E: Project budget by category

Processor : Dual Core CPU-3.0GHz
Memory: 2 GB RAM
Operating System: Windows 7, Ubuntu
HDD: 1TB
Display monitors 17”

Samsung computers -13
Processor : Intel(R) Pentium (R) 4 CPU-2.66GHz
Memory: 2GB RAM
Operating System: Microsoft Windows XP Pro
HDD: 2TB
Displays monitor 17”

One of the high priorities is international cooperation, which is an integral part both educational and research. At present we have co-operation with the following foreign universities and organizations:
University of England
Ginsburg University of Austria
ITC, The Netherlands
Clark University, USA
Chiba University, Japan
COFC-GOLD, USA
ITC the Netherlands
JAXA
NAOJ

National partner institutions and organizations:
Ministry of Nature and Environment of Mongolia
NAMHEM
Institute of Botany of Mongolia Academy of Sciences