FEATURES OF METHODOLOGY A MULTI-SCALE ASSESSMENT OF CENTRAL ASIAN MOUNTAIN ECOSYSTEMS

Bogachev V.P.
The Regional Environmental Centre for Central Asia

Progressive growth of population on Earth is coupled with a steady growth of human demand for natural resources. Increasing man-made pressure threatens regular functioning of natural ecosystems and entails the development of global adverse effects. In this connection, in June 2001 UN Secretary-General Kofi Annan launched the international program "Millennium Ecosystem Assessment" (MA). The MA Program is primarily focused on assessing the status of the system «human being-biosphere» and addresses the following issues:

a) how changes in ecosystem services affect human well-being;
b) what changes may affect people in future decades;
c) what response should be provided locally, nationally and globally to improve the system of nature management to promote conservation and restoration of ecosystems and to ensure their sustainable contribution to human well-being and poverty alleviation.

Following the initiative of the Regional Environmental Center for Central Asia (CAREC), the Millennium Ecosystem Assessment Secretariat included the Central Asia sub-region (CAR) as a Sub-Global Millenium Ecosystem Assessment candidate. As mountains play an important role in ensuring CAR's vital functions and as there is a need to develop a relevant chapter for the Millennium Assessment Overview, the CAREC with support from the Millennium Assessment Secretariat and in cooperation with the World Fish Center developed this Program "Assessment of Central Asia Mountainous Ecosystems" (ACAME). The main objective of the Programme is sustainable development of mountain territories. It corresponds to the priority purpose of development CAR: " Preservation of water basins ecosystems. Combat to necessary for vital activity ecosystems degradation ". This purpose has been approved by the 55th European ministers at 5-th Pun-European conference in Kiev in May, 2003.

Over 10% of the area in Central Asia area covered with mountains. Kyrgyzstan and Tajikistan are fully located in the mountains. The mountain systems of Pamirs-Altai and Tien Shan are the most ancient and highest on the planet. The population approximately 0.53 mln people (10% of the CA area) live there. Population is represented by over 50 ethnic groups belonging to various religious confessions.

The mountains of Central Asia are a unique source of fresh water. Runoff of the large rivers in the regions, such as the Ili, Shu, Talas, Syrdarya, Amudarya, Zeravshan, Atrek, Karatal, Aksu, Lepsa, etc., is formed in the high altitude mountains. The mountains of Central Asia, due to their geographic location in the heart of the sub-region and a comprehensive range of altitude belts, are characterized by extreme biological diversity at the ecosystem, cenosis, population and species levels. The main forestry resources of the region are concentrated in the mountains of Central Asia. They are the source of timber and fuel wood, fruits, berries, medicinal plants and a habitat of various wild animals. Mountainous forests play an important role in water saving, landscape control, oxygen production and carbon dioxide absorption.

One of the basic objectives of the Program is to modify ecosystem assessment methodology based on the specific features of the sub-region. Mountainous ecosystem assessment methodology in the Central Asian sub-region is based on the approaches and principles developed and used in the MA Program.

Its core element is the multi-scale assessment, which will be conducted in accordance with the objectives identified at sub-global, national and local levels. We attach a great importance to the

Basin Scale, which connects other scales of assessment. This scale is very important for CA. It is necessary for understanding of the processes of formation and supply of the main environmental good - water resources. Mean annual water flow of Amu Darya river is about 79.3 km3 per year, and water flow of Syr Darya river is about 37.2 km3 per year.

Content-wise, the ME Sub-Global Assessment methodology approaches comply with the Global Assessment Methodology; however, they are seen through the prism of natural, social and economic conditions of the sub-region. The specific features of the CA mountainous areas are their vertical belts, transboundary sub-global mountain ecosystems, considerable gradients and lateral («horizontal») migration of substance and energy. Sub-global mountain ecosystems CA have extension of hundred kilometers and across borders of the several countries. This fact demands development following transboundary aspects of assessment:

- Negotiation of the methodological approaches of ACAME with national experts (classification of mountain ecosystems, a format of the analysis, etc.)
- Criterias of selection of the main research objects - priority mountain ecosistems
- Adoption of common indicators of ME state, impacts, consequences and response (DPSIR).

The mountains form cascade systems, consisting of dynamically connected and directed flows of ecosystem substance and energy. Each ecosystem presents definite set of goods and services (nival - regulating a climate, glaciers - accumulating and provisioning water, forests – regulation of the hydrological regime, etc.) As the sub-global CA mountain ecosystems provide varied contributions to human well-being and varied responses to man-caused pressures, there is a need to select the main mountain ecosystems (MMEs) for the purposes of research. We could propose following criteria:

(A) Scope and range of environmental goods and services provided – role of the mountain ecosistems in the population life support

(B) Capacity and effectiveness of the regulative service (climate change, flow forming, etc) – role of the mountain ecosystems in the nature autoregulation;

(C) Magnitude of disturbance life support mountainous ecosystems and threat of loss of its potential.

The question needs further consideration. There is examples of selection of main mountain ecosystems at a national level presented in the table on the base of these criteria and a degree of priority with the offered goods and services. Experts of CA countries used three degrees of priority: insignificant (1), significant (2) and primary (3).

Selection of priority ecosystems (fragment)

Central Asia															
Mountain ecosystems	Kazakhstan			Kyrgyzstan			Tajikistan			Turkmenistan			Uzbekistan		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Glaciers	3*	3	3	3	3	3	3	3	3	2	1	2	2	1	2
Forests ecosystems	2	3	1	2	3	2	2	3	2	1	1	2	2	1	3
Steppe ecosystems	3	2	3	3	2	3	3	2	2	3	1	2	3	2	3

* Expert assesments

We can see from the example, that different mountain ecosystems are in a various condition in the different countries and they play different role in providing the goods and services at national level. At summarizing of national assessment for sub-global assessment there are certain difficulties because the importance of the various ecosystems goods and services changes along with changing of scale.

The importance of different ecosystem goods and services varies with change of scale, and elementary summation is not acceptable. At the local scale, for example a forest provides by food, fuel wood and timber. At national level, supporting services of forests have the first role and at sub-global scale the forests provide regulating services - climate regulation (reduction of carbon, etc.), water regime and runoff formation. Therefore, extrapolation of the ecosystem assessment results, obtained at the local level is not always possible at national and subglobal levels for mountains conditions. It is necessary to develop tools of the integrated assessments of mountain ecosystems on the basis of the "weighed" points and the system analysis.

Bridging multi-scale assessments are especially important when the effectiveness of decisions related to ecosystem resource use and human response to their changes are considered. Mountains are open ecosystems. Powerful solar energy flows and considerable rainfall provide for the great productivity of mountain ecosystems and their goods and services provision capacity. However, the volume of product withdrawal in the mountains is limited by ecosystem instability caused by fast top-bottom substance and energy transfer.

The high vulnerability of ecosystems in mountains provokes the danger of occurrence natural and man-caused catastrophes. Increasing exploitation of mountain ecosystems and degradation of biota result in disruption of ecosystem linkages and, as a consequence, reduction of their self-regulating function. The negative effects of human activities in the mountains at the threshold of millenniums are demonstrated by an increased occurrence of natural disasters (mudflows, landslides, floods), extremely fast biodiversity losses, water resource reduction and soil degradation. There is a necessity of adoption of the reciprocal actions based on scientific understanding of cause-and-effect relations system between mountain ecosystems of different scales, and, also, between mountains and plains.Direct interactions between humans and ecosystems, for example, forest throw occurs at local scales, but consequences (natural disasters, reduction of productivity, increase of morbidity) are shown in downstream ecosystems at national and sub-regional levels.

Response action will be the most effective if they direct it on elimination of original cause. It is necessary to raise the understanding of mountains role in providing of services to valleys and plains. Mountains provide population by means of subsistence in the downstream of plains/valleys. However, the countries located in the mountains (Kyrghyzstan, Tadjikistan) still do not receive compensation for preparation of water from the downstream countries. In our opinion, the effective decision-making on resource-saving activity in mountains will promote clear idea of interaction system of social and environment components of ecosystems at all scales. The present system has structural and functional complexity. Structural complexity is caused by cooperating blocks " Natures ", "Technosphere", "Society" and "Management". Each block consists of components that have different properties and carry out concrete functions. Character of functions changes by scale. And as it was mentioned above the ecosystems produce goods and services different on volume and a set at various scales,. Such heterogeneity of functions demands development of the existing ecosystems control system, which has the central value in system of interaction of social and ecological components of ecosystems.

Administrative-territorial borders of management do not coincide with ecosystem borders in CA. The structure of interaction of decision making bodies is inefficient and undeveloped for management of mountain territories for the decision of development problems at local, national and sub-global levels. The integrated ecosystem management starts to develop in CA countries. We suppose, it is necessary to develop the strategies of the population survival, Local Agenda

–21, LEAP on the local level, integrated management of ecosystems and preservation Mes – at the national level, and to develop and ratify the regional and interstate agreements, Conventions - at the regional level. Considerable assistance in development of a ecosystem control system at different levels renders development of models « Impact - State - Answer » (DPSIR).

Development of Mountain Ecosystems Assessment methodology is necessary to integrate it with methodology of Millennium Ecosystems Assessment, to modify the methods of multi-scale assessment Mountain Ecosystems along with development of transboundary aspects, to coordinate criteria of priority mountain ecosystems choice at sub-global and regional levels. Approbation of methodology on the pilot project will be conducted at the national level. Experience exchange and information dissemination are important at the local level. High Educational Institutions could train the specialists, which are able to implement theoretical knowledge on practice.