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CLIMATE CHANGE ADAPTATION IN ASIA'S HIGH MOUNTAIN COMMUNITIES

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COVER PHOTO: Ghandrung Nepal, a High Mountain Himalayan village. Photo By WWF-USA.

CLIMATE CHANGE ADAPTATION IN ASIA'S HIGH MOUNTAIN COMMUNITIES

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Prepared by
Jim Tarrant, PhD
Consultant to
Asia Regional Environmental
Field Support Task Order

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ACRONYMS

CAREC	Central Asia Regional Environmental Center
CBNRM	Community-based natural resource management
GLOF	glacial lake outburst flood
HKH	Hindu-Kush-Karakorum Himalaya, a mountainous sub-region of South Asia
ICIMOD	International Center for Integrated Mountain Development
IPCC	Inter-Governmental Panel on Climate Change
IWSM	Integrated Watershed Management
LAPA	local adaptation plans of action
NTFP	non-timber forest products
OECD	Organization for Economic Co-operation and Development
PES	payments for environmental services

1. INTRODUCTION TO THE PROBLEM

High mountain Asia consists mainly of three regions: the largely semi-arid mountainous sub-region of central Asia, the northern, Mongolian mountains and steppe, and the Hindu-Kush-Karakorum Himalaya (HKH) region. The HKH region has a very complex orography, which results in both a higher level of biodiversity and endemism and a more variable climate than the other two regions as well as supporting a denser human population. The western part of the HKH in Afghanistan and Pakistan, i.e. the Hindu-Kush-Karakorum ranges is mostly semi-arid but the center and eastern parts (northern India, Nepal, and Bhutan) are much wetter. The northern and eastern sections (Tibet and China) are again semi-arid since they are on the leeward side of the Himalayas. In general, the populations of Central Asia and the western parts of South Asia are much more dependent upon glacial and snow melt for their water supplies than the center and eastern parts of the HKH. Mongolia's rural population is heavily nomadic and their resource water management is different again from the other two regions.

Global climate change, represented by a steady increase in average yearly global temperatures threatens the water supply for millions of people in Central and South Asia due to rapidly melting glaciers and, in some parts, a decrease in annual precipitation (whether rain or snow). Precipitation is becoming quite variable in regularity and intensity. The overwhelming majority of those impacted by volatile water supply fluctuations (e.g. alternating drought and flood) reduced water supply will be populations in the middle and lower parts of the affected river basins. They are rightly the focus of most climate adaptation planning. However, sizeable populations of high mountain communities will also be affected by climate change. Impacts may include extreme storm events, wide temperature fluctuations that greatly raise the risks of agriculture, drought, and glacial lake outburst floods (GLOFs). The latter, in particular is a serious concern in the HKH sub-region.

The other significant category of impacts in the middle uplands and high mountain regions are changes in flora and fauna species populations and their distribution with consequent impacts on larger landscapes, including impacts to upper watersheds and whole river basins.

While residents, infrastructure, and businesses in the middle and lower parts of the affected river basins will clearly take top priority in climate adaptation planning and the required funding for climate adaptation measures, assessing the costs and benefits of these measures for high mountain communities is much less clear cut (Malone et al., 2010). Above all, climate change is an additional stress on existing resource management strategies and practices and their supporting ecosystems. This means that if those management strategies and practices were inefficient and unstable to begin with they will likely become more inefficient and unstable over time as climate change impacts increase. Hence, a primary focus of any climate adaptation planning is on achieving a more sustainable environmental management regime.

This study will present an overview of the impacts of climate change on Asia's upper watershed and high mountain regions, in particular, focusing on water security and landscape level impacts. Next, the study will describe the impacts of climate change on Asia's high mountain communities and the mitigation and adaptation responses that have emerged. Finally, the roles of state, civil society, and private sector institutions in adaptation planning and implementation will be reviewed.

1.1 SUMMARY OF WATERSHED MANAGEMENT ISSUES IN ASIA'S HIGH MOUNTAIN REGIONS

1.1.1 SCOPE OF WATERSHED MANAGEMENT IN ASIA'S HIGH MOUNTAIN REGIONS

River basins can be divided into upper and lower watersheds. Typically, precipitation falls on the upper slopes of hills and mountains and then drains down the watershed by way of streams and infiltrates the earth recharging groundwater aquifers. (This is not to imply that rain does not fall on lowlands, of course; the aim here is to describe the hydraulic relationship between upper and lower watersheds). Managing the drainage and use of water is a major objective of watershed management. Because of the dependent relationship of the lower parts of a river basin on the upper parts, it is essential to analyze the relationships and impacts of watershed management using a landscape approach. A landscape consists not only of interacting biological and geophysical elements, i.e. the complex of ecosystems found in the landscape but also of people, land uses, infrastructure, social organizations, institutional arrangements, and cultural, spiritual, and utility values.[1] A landscape approach factors in the impact of interventions and other activities from the largest scale, the river basin, in this case, down to impacts at the smallest scale, e.g. the household.

Ecosystems provide services that can be grouped into four broad categories: *provisioning*, such as the production of food and water; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational benefits.[2] The value and productivity of ecosystems can be overlooked. The provisioning and regulating functions of nature, including reducing risk of some natural disasters and increasing the natural resilience of ecosystems, have often been excluded in policy frameworks for economic development and poverty reduction. Conventional planning focuses more on resource extraction and physical infrastructure such as roads and bridges. But, in fact, investing in "natural" or "green" infrastructure may be the most cost-effective approach for providing sustainable support services for economic development, especially in the case of water and climate mitigation. In addition, careful design and location of physical infrastructure is essential. This is especially true for fragile upper watersheds and associated high mountain landscapes.

1.1.2 RATIONALE FOR MANAGING MOUNTAINOUS ENVIRONMENTS SUSTAINABLY

At this point in the study of climate change, a high level of certainty exists that climate change is accelerating and that it will definitely have significant negative impacts on most ecosystems and human communities. What is less certain is the severity of those impacts in any given location, due partly to the impacts of global temperature rise on wind circulation patterns, including the Indian Summer Monsoon, which affects the central and eastern HKH and the winter circulation patterns that affect the Pamir and Kunlun Mountains and the western parts of the HKH region. Climate change impacts also will be affected by both negative and positive feedback loops that accelerate carbon emissions or reduce them primarily by the nature of human responses to those impacts. While the level of uncertainty is still significant, most climate experts and policy makers have at least adopted a "no regrets" strategy. This posits that, even if the impacts of climate change are not as severe as predicted, the actions taken to reduce emissions and to adapt to and mitigate the impacts of climate change will still be worthwhile because they are all aimed at sustainable, environmentally sound development.

Mountains have historically been very central to human society. Mountains in humid areas contribute up to 60 percent of total runoff in watersheds. This proportion rises up to 95 percent in arid and semi-arid

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[1] Landscape-scale Approaches, p.30.
[2] See Millennium Ecosystem Assessment, Ecosystems and Human Well-being: Synthesis

zones. Mountains host approximately one-quarter of global biodiversity and are often rich in endemic species. Mountains' altitudinal gradients, differentiated topography, often over short distances and varying geology and soils offer a great diversity of habitats. Many of the world's major staple food crops, e.g. wheat, maize, and potatoes, and a large portion of domestic animals, originated in mountain areas.[3]

Over 10% of Central Asia's area is mountainous. Kyrgyzstan and Tajikistan, in particular, are almost entirely mountainous. The mountain systems of Pamir-Altai and Tien Shan that comprise the eastern edge of Central Asia are the most ancient on the planet. The mountains of Central Asia, due to their geographic location in the heart of Asia and because of their wide range of altitude zones, are characterized by great biological diversity at the ecosystem, community, population and species levels.[4] Not only is there a high level of biodiversity but also a high level of social and cultural diversity, with more than 50 ethnic groups found in these mountains and distinctive craft, agricultural and resource management traditions and practices that grew directly out of the often difficult landscape in which these people lived.

Central Asia's mountains are a critical source of fresh water. Runoff from high latitude glaciers and orographic rainfall is the source of the flow of the region's large rivers, i.e. the Ili, Shu, Talas, Syr Darya, Amu Darya, Zeravshan, Atrek, Karatal, Aksu and Lepsa (see Figure 1). A cascading series of water reservoirs has been built for irrigation and power generation to capture and utilize this flow in the semi-arid lowlands. Many small rivers start in the foothills as a result of underground runoff discharge that originated in the high mountain zone. This water is used to irrigate agricultural land in the piedmont valleys.

The HKH region is even more important since it is the source of some of the largest and most populous river basins in the world, including the Ganges, the Indus, the Brahmaputra, the Mekong, the Irrawaddy, the Salween, the Tarim, the Yangtze, and the Yellow River (see Figure 2). Approximately 1.3 billion people living in the basins of these rivers directly or indirectly depend on the water resources flowing from these 10 of the largest rivers in Asia for their livelihoods, mainly for irrigation, drinking, sanitation, and industrial uses.[5]

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[3] FAO, Why Invest in Sustainable Mountain Development, p.7.
[4] RECCA, Central Asia Mountain Ecosystems, p. 4
[5] Karki, et al., From Rio 1992 to 2012 and Beyond, p. 7

Figure 1. The High Mountains of Central Asia

Source: RECCA, Central Asia Mountains, p.20

The HKH sub-region includes all or part of four global biodiversity hotspots, 330 important bird areas, two mega-diversity countries (India and China), and 60 eco-regions of which 12 are global 200 eco-regions.[6] A total of 488 protected areas cover 39% of the total area. The region provides essential fresh water supply and ecosystem goods and services to more than 210 million upstream mountain people and close to 1.3 billion downstream populations.[7]

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[6] The "Global 200" is the list of ecoregions identified by WWF, the global conservation organization, as priorities for conservation. According to WWF, an ecoregion is defined as a "relatively large unit of land or water containing a characteristic set of natural communities that share a large majority of their species, dynamics, and environmental conditions (Olson & Dinerstein 1998, 2002; TNC 1997).

[7] Ibid., p. 6.

Figure 2. Area of the Hindu Kush – Himalaya Mountains and Drainage Area

Source: http://geoportal.icimod.org/Interactivemapping/Maps.aspx?thm=0&map=2

The HKH region also has many species unique to the mountains of this region including grains such as buckwheat, amaranth, and some varieties of millet, cashmere, a wide variety of medicinal plants, essential oils, and many other valuable products come from these mountains in addition to the full range of ecosystem services, most especially the provision of water.

1.1.3 DISTRIBUTION OF WATER RESOURCES OF HIGH MOUNTAIN ASIA

Of all of the HKH and Central Asian mountain goods and services, by far the most important is the provision of water – and it is also the one most imperiled by climate change. As noted above, the HKH region provides water to more than 1.3 billion people downstream as well as more than 200 million people in the mountainous regions themselves. Figure 3 describes the boundaries of the nine HKH and Central Asia river basins. It is clear that they comprise a substantial portion of mainland Asia. It is this entire region that will be affected by climate change and the consequent gradual reduction in water resources, especially from retreating glaciers as well as reduced rainfall in some regions. A number of studies show a wide range of change in the size of glaciers in this region. However, except for those glaciers in the Karakorum Range of the HKH, the majority of glaciers in this large region have already started to retreat and many small glaciers have disappeared completely. Glacial retreat rates have accelerated in the majority of the HKH region in the last few decades. Based on surveys of HKH glaciers over the past 40 years, retreat rates have varied greatly by glacier, from 2% to 20%, based partly

on glacier position, debris cover and other factors.[8] The International Center for Integrated Mountain Development (ICIMOD) has estimated that the amount of ice and snow in the HKH sub-region amounts to an enormous 60,000 km^2.[9]

In Central Asia, almost 90 per cent of the population relies on water that originates in mountain glaciers and snow packs before moving downstream to major population centers. Densely populated valleys, like the Ferghana and the oases of the vast drylands of Central Asia depend critically on mountain water transported by numerous rivers such as the Syr Darya River, which arises in the Tien Shan Mountains, and the Amu Darya, which arises in the Pamirs. Each flows more than 2,000 kilometers to ultimately trickle into the Aral Sea. The mountains also provide recharge for groundwater and springs.

Figure 3. Areal Extent of the Nine River Basins of the HKH and Pamir Mountain Regions

Source: Karki, et al., From Rio 1992 to 2012 and Beyond, p.8.

Overall, Tajikistan makes up 40% and Kyrgyzstan 30% of the water resources serving the five Central Asia countries. These water resources also supply parts of China and Russia. Uzbekistan, with the largest population in the region, is also the biggest water consumer, mainly because its economy is based largely on irrigated agriculture, especially cotton and wheat. With 90 per cent of their water resources

[8] WWF, Asia High Mountains, p.14.

[9] Ibid., p. 8

coming from mountains located outside their country borders, Uzbekistan and Turkmenistan are highly vulnerable to water shortages.[10]

The Altai-Sayan mountain range is an important source of water for Mongolia and parts of western China, though it is not as critical as the Pamirs or the HKH are to their downstream populations, especially since semi-nomadic pastoralism is much more important to the economies of this sub-region than it is to the other river basins discussed here.

1.1.4 GENERAL MANAGEMENT APPROACHES TO WATERSHED MANAGEMENT

As noted, an upper watershed that is under permanent vegetative cover provides the ideal "green infrastructure" for the provision of water to downstream users and is also the lowest cost solution, of course. Permanent vegetative cover can be grasslands, forest cover or a mix of both. However, it is often the case that many upper watershed areas – even high mountain regions – are not under permanent vegetative cover but are being exploited by humans for food, minerals, timber, and fiber or services such as tourism that end up exposing the soil and leading to the degradation of the watershed over time.

In general, river basin management faces a continuing challenge to balance different, often competing uses. Basin organizations and agencies must be able to provide a platform for stakeholders to cooperate and reach a common vision and approaches to river basin management that don't compromise one another's goals. However, river basin managers have often not understood the importance of treating ecosystems as natural infrastructure for water resource management. As a result, many river basins are now over-exploited, often at the expense of their supporting ecosystems. Furthermore, where ecosystems are addressed in policy or planning, the common focus is often on the maintenance of unique and special sites that support biodiversity. The wider role of ecosystems in supporting livelihoods and regulating the very rivers themselves is often not recognized and included in river basin strategy and planning. In other words, the management of ecosystems and the landscapes in which they are embedded becomes detached from the services they provide and therefore from the very development issues that river basin management seeks to resolve. This has implications for how high mountain parts of river basins should be managed especially under conditions of ongoing and rapid climate change.

Densely populated upper watersheds usually require active state intervention to assist localities in funding and training residents to build terraces, drains, check dams, and other watershed management infrastructure. Local governments also need assistance in reforestation and afforestation projects to reduce soil erosion and resultant downstream sedimentation and flooding and to stabilize the hydrological cycle. For particularly vulnerable watersheds, upland soil and water conservation projects normally require heavy state financing at least in the initial infrastructure/planting phase. Ideally, a self-financing structure or user charge scheme can be set up to compensate upland residents for maintaining or expanding conservation measures. In the last 20 years, in the developing and developed world, various kinds of payments for environmental services (PES) schemes have emerged as alternative sources of financing for upper watershed management infrastructure and maintenance. However, globally PES schemes have only been used in a relatively small number of watersheds to date.

In the usually more sparsely populated high mountain watersheds, the preferred management approach is usually to emphasize maintaining forest and other vegetative cover by gazetting these areas as protected in some fashion (watershed management area, national park, wildlife refuge, etc.). However, while the very highest parts of the Himalayas have very few or no people, there are a significant number of high mountain communities scattered across mountainous Central Asia and HKH regions and so it

[10] RECCA, op.cit., p.13

may not be practical or fair to prohibit these areas from being inhabited or developed; the question is how to do so in an environmentally sustainable way.

1.2 TYPES OF GOODS AND SERVICES FROM HIGH MOUNTAIN REGIONS

The goods and services provided by high mountain regions can be divided into those with long-standing, "natural" market values and those with "created" market values. The first category includes most goods and services from agriculture, forestry, freshwater fisheries, animal husbandry, mining, water supplies, tourism and recreation. These are a mix of tradable and non-tradable goods and services. The second category includes "regulatory" functions such as an ecosystem's contribution to climate stability (e.g. through carbon sequestration), aesthetic and cultural value, and biodiversity protection. These are all non-tradable services. The second category actually may provide important economic benefits but the market economy, as currently constructed, cannot readily capture and internalize these benefits in land use decision-making except through the use of shadow prices or option values (as is the case for bio-prospecting). Shadow prices, however, tend to be used mainly by public financial institutions like the multilateral banks for investment decisions and not by most private investors or governments.

In addition to tradable vs. non-tradable goods and services, markets for high mountain goods and services may be local or global in nature (and sometimes a mix of both).[11] For example, a PES agreement may involve payments to local upper watershed farmers for conservation agriculture or land set-asides, which offsets losses to local landowners from foregone production. The benefits for downstream residents may consist of water for irrigation, drinking water, and/or hydroelectricity. However, in some cases, global benefits in the form of conservation of biodiversity or carbon sequestration may also exist. As noted, though, these benefits are difficult to monetize and, in the case of carbon sequestration require a baseline of existing sequestered carbon against which benefits can be estimated over time. In practice, this has proven hard to do.

1.3 MANAGEMENT IMPACTS ON THE PROVISION OF HIGH MOUNTAIN GOODS AND SERVICES

Climate change, especially in the short and medium time frame, acts primarily as a stressor on existing environmental management systems. In fact, since the first Intergovernmental Panel on Climate Change (IPCC) report in the early 1990s, the emphasis has been on the managed adaptation to climate change, also called planned adaptation.[12] Evidence of good upper watershed management includes reliable and stable provision of water supplies, a stable land management system (e.g. minimal erosion, landslides, and other mass wasting). Good upper watershed management is evidenced by a diversity of sustainable production of goods and services rather than monocultures, subsistence agriculture or mining. Conversely, an unsustainable management regime is characterized by a destabilized hydrological regime; alternating droughts and destructive floods; increased mass wasting, including large landslides, soil erosion, and gullying. In addition, degraded provision of watershed goods and services, and declining economic diversification and growth, frequently also give rise to an increased likelihood of conflicts over resource control and use.

Increasingly, the importance of good management of upper watershed landscapes is recognized and is even being translated into practical actions on the ground in some parts of the world. In developed countries where often the loss and degradation of ecosystems in the past had been quite significant,

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[11] Mayrand, Karel and Marc Paquin. 2004, pp.13-15.

[12] http://www.ecologyandsociety.org/vol15/iss4/art33/main.html, Lesley C., et al., p.1

moves to restore ecosystems and integrate their role as natural infrastructure alongside engineered development solutions is beginning to gain momentum. For example, virtually all of the drinking water supply of New York City is pure and unfiltered because of careful ecosystem management of the watersheds in the Catskill Mountains that supply the city's drinking water; saving the billions of dollars that would be required in the building and operation of water treatment plants for the city – in other words, the use of a "green infrastructure" approach based on negotiated stewardship agreements with upland farmers and other residents. While this is a dramatic and oft-cited example, frequently ecosystems service solutions have been shown to be cost-effective and desirable solutions to water resource management problems. However, the use of natural infrastructure in water resource management even in developed countries is still not the default option and in developing countries this approach has not yet become widespread. Whether a PES or other approach is used in watershed-based services, the essential element for success is the governance regime and rule of law. Public participation and agreement on the rules and transparent and accountable payment regimes are essential. Too often, it is difficult to meet these requirements. However, examples do exist where the benefits from ecosystem maintenance and restoration have been balanced against those from traditional development solutions and a middle ground has been found.

Chun-Aksuu Upper Watershed Reforestation under a Pilot PES

One interesting example comes from Kyrgyzstan's Chun-Aksuu watershed in which a PES has been developed focusing on improving natural infrastructure in the mountains. This PES does not involve monetary payments. Downstream beneficiaries, which include mushroom pickers, farmers, and even tourists donate an agreed amount of annual labor in upland tree planting and pasture improvement and upland land users agree to improved land management practices that maintain or increase downstream water supplies. The state forest administration acts as the manager of the PES activities.[13] While this is a small-scale example, it shows the potential for planned adaptation and mitigation to a climate change sensitive landscape.

This example points to a larger issue in upper watershed management, which is public participation and co-management. The long history of state-owned and regulated resource management in this region, especially of forests and open pastures often accelerated resource degradation and compounding the effects of population growth and poverty in high mountain regions. This led to the gradual development of community-based natural resource management (CBNRM) schemes, especially in the area of forestry. In Nepal, over the past 30 years about 1.2 million ha of forests have been handed over to more than

[13] http://www.slideserve.com/camdyn/pilot-pes-scheme-in-the-chon-aksuu-watershed-kyrgyzstan

14,000 community forest user groups.[14] This approach was largely shepherded through the efforts of Nepali and foreign NGOs.

However, simply decentralizing landscape management to communities is insufficient by itself. Crucial to successful CBNRM efforts is creating or strengthening local institutions and the governance principles and procedures underpinning them, especially those that promote wide participation, transparency, and accountability. Often good governance is lacking but a concrete program like well-designed CBNRM activities with clear targets and objectives can, in fact, promote good governance. Ultimately, local control over resources is a critical prerequisite for successful CBNRM and, as we discuss below, critical to planned adaptation at the local level though not sufficient without good governance.[15]

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[14] Lee, Don Koo (editor) 2008. **Keep Asia Green Volume III**, pp.12-13.

[15] See Anderson and Mehta, 2012 for a global assessment of CBNRM experience.

2. CLIMATE CHANGE IMPACTS ON UPPER WATERSHED MANAGEMENT

2.1 CLIMATE CHANGE IMPACTS IN AGRICULTURE

This section will not present a comprehensive discussion of climate change impacts in agriculture generally since much has been written on this subject elsewhere.[16] The focus of this section is on the impacts of climate change on agriculture on upper watershed and high mountain communities in Asia. "Agriculture" includes row crops, animal husbandry, agro-forestry, and related production processing. For the purposes of this report, "upper watershed" includes both high mountain landscapes and the middle slopes of river basins but not the lower main stem of the river or the floodplain.

Agriculture in Asia is already being affected by climate change through changes in rainfall and water availability for plants and animals, changes in temperature during the growing season, violent storm events, sea level rise, and the migration of disease vectors. Many but not all these factors affect high-mountain and upper watershed landscapes.

In addition to impacts on agricultural productivity across many landscapes, climate change is expected to bring both long-term structural changes to the hydrological cycle and increased variability and unpredictability in many river basins. Since temperature rise has been especially marked in high mountain Asia, impacts on the hydrology of the river basins originating from these mountainous regions will be especially acute. It is also likely to increase the vulnerability of communities in many watersheds through higher-intensity rainfall and greater frequency of floods, landslides, droughts and wildfires.

The impact of climate change on agricultural productivity is likely to stem not only from changes in water availability and quality, but also from temperature increase, which will cause some ecosystems to shift over space and will hence change the suitability of crops to the different latitudes. It is expected that mid- to high-latitude countries may benefit, at least in the short-term from the warming, while countries in the subtropical and tropical regions (low latitude) may experience negative impacts, and some marginal areas may go out of production altogether.[17]

However, for high mountain communities, the scope for expanding agriculture is not simply a function of temperature but also soils and slopes. Many of these high mountain areas are already marginal for row crop cultivation and are more suited to pastoral or agroforestry production. In the uplands, increased row crop cultivation without good soil and water management will cause runoff to increase and will exacerbate soil losses and land slips and slides. Increased downstream sedimentation is the likely result. Moreover, climate variability in the form of typhoons, floods, and droughts is expected to cause production losses.[18] The rural poor are the most vulnerable, since they bear the brunt of natural disasters and declining local agricultural productivity. Often lacking much in the way of assets, it is difficult for individual households to invest in more sustainable agricultural practices and they are often one natural disaster event from destitution.

In addition, climate change is expected to bring an increase in stream flows in high latitudes and in Southeast Asia and a decrease in stream flows in central Asia. In other parts of the world, the direction

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[16] Reviews of climate change impacts on agriculture can be found in Nelson, et al. (IFPRI), 2009 and IPCC Working Group III: Agriculture, among others.

[17] Robert Mendelsohn, Ariel Dinar and Larry Williams, 2006, pp. 159-178.

[18] Lee, Don Koo, op. cit., p.14.

of change is uncertain. Among scientists there is also "high confidence" that in many areas where snowfall is currently an important component of the water balance, peak stream flow will move from spring to winter and that water quality generally will be degraded by higher water temperatures. Flood magnitude and frequency are likely to increase in most regions, and low flows are likely to decrease in many regions.[19]

Furthermore, as a consequence of changing rainfall patterns, floods, landslides, and wildfires are expected to increase. Drought years already bring an increase in fire outbreaks and increased forest fires are likely to result in a change in vegetation structure, especially in unmanaged forested areas that in turn exacerbates the fire risk because of the greater likelihood of brush and other understory vegetation that is easy to burn.

2.1 HIGH MOUNTAIN IMPACTS

Increased temperatures, violent storms, accelerated glacial melting and the related increased risk of GLOFS are among the known risks of climate change in high mountain Asia. As noted, climate change acts as a stressor on existing management practices. There is a distinct likelihood of a decrease of biodiversity as warming climate alters ecosystem characteristics (e.g. vegetative changes), especially affecting those floral and faunal species with very narrow ecological niches, an inability to move quickly (or at all) and those which may see their prey or pollinator species disappear.

A few recent projects have specifically dealt with climate change in those watersheds at particularly high risk. The focus of these "dedicated climate change projects" has been on vulnerability and adaptation to climate change only. They have lacked the broader characteristics of the watershed management approach. In addition, "adaptation" often seems to mean the use of expensive engineered solutions (hard infrastructure) when a green infrastructure approach may actually be more effective especially over the medium and longer term.

In projects employing a watershed management approach, measures may include the revegetation of barren hillsides and promotion of farming practices to increase the soil organic matter content.

2.2 LOWER WATERSHED IMPACTS FROM CLIMATE CHANGE IMPACTS IN UPPER WATERSHEDS

The impacts of climate change in the upper parts of river basins on the lower parts of those same basins are analogous to the impacts of poor upper watershed management, historically only more intense. The main differences are the likely greater instability in river basin hydrology and greater likelihoods of natural disasters (GLOFs, large-scale flooding and longer and perhaps more frequent droughts). These impacts will cause significant changes in hydraulic regimes impacting irrigation, commerce and industry, and drinking water supplies for many millions of people. Secondary impacts from the changes in the hydrological regime include major impacts on the health and livelihoods of downstream populations, which are usually extremely dependent upon the rivers originating in the mountains. This may lead to increased internal and international migrations, which are often very destabilizing economically and politically. Instability of flows and declining water supplies in the downstream parts of watersheds also may lead to changes in lowland ecosystems, including forests and wetlands.

[19] WWF Asia High Mountains, op. cit., p. 30.

3 IMPACTS OF CLIMATE CHANGE ON WATERSHED MANAGEMENT IN CENTRAL AND SOUTH ASIA

According to the IPCC, adaptation means adjustments to current or expected climate variability and changing average climate conditions, which can serve to moderate harm and exploit beneficial opportunities. It involves both disaster risk management focusing on preventing, mitigating, and preparing to deal with shocks and adaptive change management that aim to modify behaviors and practices over the medium to long term. Most ecological and social systems have some level of built-in adaptation capacity, but the current climate variability and rapid rate of climate change will impose new and potentially overwhelming pressures on existing capacity, i.e. the pressure exceeds the current coping range more frequently and more severely.[20]

The impact of climate change on watersheds depends not only on changes in the volume, timing, and quality of stream flow and recharge or on related rates of erosion and sedimentation, but also on management responses. Although all watersheds and their embedded hydrological systems may experience climate change impacts, institutional responses can mitigate these costs. It is unmanaged or poorly managed systems that are likely to be more vulnerable since, by definition, these systems have little or no management structures in place on which to build effective adaptation measures or to buffer the effects of hydrological variability.[21]

Although structural changes and increased variability and unpredictability resulting from climate change will have economic and social costs, an integrated set of management responses, within a broad integrated basin planning framework, which includes watershed management, can mitigate those costs. Watershed management can also help implement a risk management approach for disaster preparedness.

Recently, watershed management projects have begun to factor in climate change, and some "dedicated climate change adaptation projects" have been designed to deal with high-risk watersheds. Climate change risk analysis and adaptation options should now be factored in to all watershed management projects.

Sound agricultural **mitigation measures** to climate change impacts often have synergy with sustainable development policies, and many explicitly influence social, economic, and environmental aspects of sustainability. Many options also have co-benefits (improved efficiency, reduced cost, environmental co-benefits) as well as trade-offs (e.g., increasing other forms of pollution), and balancing these effects will be necessary for successful implementation.

3.1 PRINCIPLES OF INTEGRATED WATERSHED MANAGEMENT IN ASIA'S HIGH MOUNTAIN REGIONS

Integrated water resources management, which employs a landscape approach to watershed risk assessment, strategic planning and management activities has proven to be the only really sustainable approach to watershed management as well as disaster preparedness in watersheds. For this reason, integrated water resources management is likely to be a key part of any national strategy for addressing climate change adaptation and mitigation needs.

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[20] IPCC, 2007

[21] IPCC, 2001

With climate change, it is likely that the incidence of natural disasters will increase. Among the main policy lessons emerging from experience with disasters in recent years is the importance of integrating disaster prevention and natural disaster risk management into development plans.

Given the likely high incidence of these disasters in the fragile uplands and the causal connection between natural resource changes in the uplands and downstream disasters, such as flooding, preparing for natural hazards should be an important component of watershed management approaches. These preparations need not necessarily be highly elaborate. They may simply address current risks. For example, when landslides and floods have already been experienced in a watershed, plans and investments can be prepared that reduce the causes of the risk and set up institutional responses to future disasters of the same nature, such as flood emergency plans. Planning should ensure that key infrastructure, human settlements, and livestock are not placed along the most likely paths to be followed by floods or landslides.[22]

Watershed management can itself be a very effective set of adaptation measures, provided that these measures form part of an integrated approach throughout the watershed. The ideal is an integrated institutional response based on basin-wide planning that incorporates both integrated land and water resource management approaches and other components of spatial planning, such as planning for infrastructure and urban development. Within this overall planning framework, watershed management approaches can help provide the institutional and investment responses needed for the upstream areas as part of a coherent response to climate change. The range of adaptation responses in watersheds is illustrated in Table 1 below.

Table 1. Possible Measures to Adapt to Climate Change in Watersheds

Adaptation Option	***Purpose (both general and climate resilient)***
Productive Systems	
Crop diversification	Promoting farm-level risk management, increasing productivity, defending against pest/disease, and reducing vulnerability to high temperatures and water shortages.
Land and water conservation practices.	Conserving soil moisture, preventing erosion, increasing production per unit of land, reducing evapo-transpiration, reducing runoff, and assuring less variability in production during drought periods
Improvement of water management	Increasing water efficiency and productivity, improving irrigation water distribution, agricultural water and withstanding rainwater shortages.
Modernization of farm and development of extension services	Improving means, awareness, and knowledge of farmers to increase productivity, operations and save water, and cope with extreme weather events
Improving forecasting mechanisms	Assisting with farmers' ability to cope with droughts, floods, and so forth.
Water Resources	
Sound planning and inter-basin transfers to improve water use efficiency and to increase equity in water distribution.	Investing in water regulation and conservation through single and multipurpose investments in dams to regulate peak flows and provide water in drought periods. Investing in additional infrastructure.
Improved resource use	More efficient management of existing infrastructure facilities. Demand-side management and water-use efficiency.
Infrastructure	
Review of hydrological standards and design.	Updating technical construction standards for reservoirs, bridges, roads, and so forth—to account for higher climate variability and increase climate resiliency. criteria

[22] Salah Dargouth et al., 2008, p.91.

	for hydraulic structures
Extreme Weather Events	
Mainstream natural protection in disaster risk prone areas	Vegetative stabilization, for example, strategic location of tree buffers in landslide-prone areas. For non-extreme events (that is, lower return period events) the management (including establishment and/or conservation of vegetative cover (especially in combination emergency plans) with appropriate in-channel infrastructure) can reduce peak flows and thus localized

Source: Darghouth, et al., 2008, p. 92

Plainly, watershed management approaches have a major role to play in responding to climate change. In specific, very high-risk environments, dedicated "climate change adaptation projects" may be needed, which would incorporate watershed management approaches. In less dramatic situations, climate change risks in watersheds need to be analyzed for all watershed management projects as a matter of routine.

Globally, and certainly in the subject regions of this paper, adaptation and mitigation approaches to climate change that align with the country or community "ownership" principles laid out in the 2005 Paris Declaration on Aid Effectiveness by the Organization for Economic Co-operation and Development (OECD) have demonstrated the best performance. Methods that incorporate local stakeholders into adaptation planning and implementation, e.g. Nepal's local adaptation plans of action (LAPA) are more likely to create sustainable and effective resilience to climate change impacts in the long term.23

3.2 IMPACTS OF CLIMATE CHANGE IMPACTS ON WATERSHED MANAGEMENT AND AGRICULTURE

Adaptation activities can reduce the impacts of climate change and buffer their effects, reducing the negative impacts on humans and the environment. Adaptation is expected to reduce vulnerability and strengthen resilience of local food systems to floods, droughts and extreme weather events through the use of both ex-ante and ex-post measures.

Adaptation strategies encompass a wide range of activities including:

- Modifying planting times and changing to varieties resistant to heat and drought
- Development and adoption of new cultivars
- Changing the farm portfolio of crops and livestock
- Improved soil and water management
- Integrating the use of climate forecasts into cropping decisions
- Increased use of fertilizer and irrigation
- Increasing labor or livestock input per hectare
- Increased storage of food/feed or reliance on imports
- Increasing regional farm diversity and shifting to non-farm livelihoods[24]

[23] Asia High Mountains, op.cit., p. 39.

[24] Solomon Asfaw and Leslie Lipper, 2011, p.4.

3.3 CLIMATE CHANGE IMPACTS, WATERSHED MANAGEMENT AND OTHER ECONOMIC SECTORS

3.3.1. CLIMATE CHANGE IMPACTS ON TOURISM IN ASIAN UPLANDS AND MOUNTAIN ENVIRONMENTS

The two most important forms of tourism in upland and mountainous Asia are nature-focused tourism, including ecotourism, mountain climbing, bird watching, etc. and cultural tourism, which includes antiquities tourism, religious tourism, and interactions with indigenous cultures and their communities. All of these forms of tourism are climate-dependent – that is, their availability may be affected in the short and long term by climate variability, extremes, and shifts, which can cause significant changes in ecosystems and affect the physical and social infrastructure supporting tourism. Impacts of climate change on tourism in mountain areas may be divided into two types: direct and indirect. The former would result from changes in the atmospheric conditions required for specific activities (e.g., clean air, snow). Indirect impacts from climate change and from the resultant wider-scale socioeconomic changes include changes in fuel prices and patterns of demand for specific activities or destinations. They may also include changes in mountain landscapes, which is the "capital" of much ecotourism and sports tourism in this region. These landscape changes might cause potential tourists to regard them as less attractive, and consequently to seek out new locations. There also may face new competition from other tourist locations as climates change, particularly on seasonal timeframes, e.g. in relation to vacation periods.[25]

3.3.2. CLIMATE CHANGE IMPACTS ON FORESTRY, MINING, AND OTHER EXTRACTIVE INDUSTRIES IN ASIAN UPLANDS AND MOUNTAIN ENVIRONMENTS

Climate change is already having impacts on commercial forestry all over the world. Rising temperatures and reduced rainfall in some places are stressing trees and their supporting ecosystems. Rising temperatures are also making some species non-viable in their current locations. Climate change is affecting protection forests, commercial forests, and wood plantations. The direct effects include loss of viability of commercial species, including problems in regeneration and lower seedling survival. Indirect effects relate to disturbances such as fire, insect, and disease losses. These indirect effects depend on the influence of climate on the disturbance agents themselves. Hence, as stressed trees become weaker, they become more vulnerable to disease and pests. In addition, some disease vectors are moving into areas where they previously did not exist because of warming temperatures. This is happening in both temperate and tropical forests.

Many commercially viable mineral deposits in the world are located in mountain regions. While climate has only a minor direct influence on exploitation of these resources, it may exert a significant indirect influence. Mining causes surface disruption and requires roads and other infrastructure. Changes in climate that lead to increases in precipitation frequency and/or intensity exacerbate the potential for mass wasting and erosion associated with these developments, especially where there are mine tailings and other wastes that are not contained adequately. Furthermore, the economics of mineral exploitation often requires in situ processing of the extracted ore – for example, aluminum smeltering and hydro-chemical processing. In the latter case, climate, especially precipitation and temperature, is a critical factor in process design. For some activities, a high demand for process water can compete with other water users and also cause serious local and downstream water pollution.[26]

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[25] Beniston and Fox, 2007, IPCC Working Group II, pp. 205-206.

[26] Ibid., p. 205.

The collection of wild nuts and fruits, leaves, bark, resin, and roots, included in the category of non-timber forest products (NTFP), affects the structure and function of forests much less than other uses, e.g. timber cutting and forest conversion. Under favorable circumstances, NTFP extraction is capable of achieving the overarching goal of sustainable development. In Tibet's "Medicine Mountains," the overharvest of medicinal species combined with temperature increases (5-6°C by the end of the century) threatens the ethno-botanical foundation of Tibetan culture and religion. In addition, the degradation of forest structures through timber cutting the impact of which is magnified by climate change can lead to the disappearance or non-viable harvesting of NTFPs.

4. COMMUNITY BASED CLIMATE ADAPTATION AND MITIGATION IN HIGH MOUNTAIN ASIA

4.1 EXISTING ADAPTATION PRACTICE IN UPPER WATERSHEDS AND MOUNTAINS IN ASIA.

The hilly and rugged geography of many upland and high mountain communities has resulted in a mosaic of relatively small communities and economies based strongly on their surrounding ecosystems and their natural resources. This is certainly the case for much of high mountain Asia. This means that efforts to mitigate and adapt to the impacts of climate change will require the strong involvement of the affected communities in all stages of planning and implementation.

Adaptation to environmental variability and change is not a new concept in Asia's mountainous regions. In fact, it is the age-old approach used by mountain communities to survive. Mountain people have a long record of adapting to extreme environmental conditions through multiple livelihood strategies, including approaches such as trade, on and off-farm labor, crop diversification, and development of traditional resource management systems for water, irrigation, and soil conservation. Recently, international labor migration (as in Nepal) has also been an adaptation strategy. However, in the Himalaya region, progressive warming at higher altitudes has been three times greater than the global average, and future predictions indicate a continuation of this trend of disproportionate warming. The existing strategies, which are mostly highly dependent on the exploitation of natural resources, may not be sufficient to respond to the magnitude of future change.

Hence, adaptation to climate change is local and highly context specific; it is not independent of, or isolated from, the influence of other factors including social, political, environmental and economic variables. Adaptation efforts therefore need to take local conditions into consideration. Generally, adaptation is facilitated by reducing vulnerability, and vulnerability in turn is mainly determined by poverty and marginalization. Mountain communities in the HKH, for example, generally have disproportionate rates of poverty and are usually marginalized with respect to political influence and economic opportunities. Thus, in a mountain context, adaptation to change needs to focus on reducing poverty and marginalization, and is thus actually closely related to the traditional rural development and poverty reduction agenda. The most important task is to gain a better understanding of the risks related to climate change and to mainstream this knowledge into development planning. [27]

4.2. APPROACHES TO COMMUNITY LEVEL CLIMATE CHANGE ADAPTATION IN HIGH MOUNTAIN ASIA

A community-based approach to management of the environment and economic development was clearly apparent even before climate change emerged as an urgent policy matter. Typically, 20-30 years ago, government development programs often were designed and implemented by individual sectoral agencies. So, government interventions in agriculture, forestry, public works, education, industry, and other sectors tended to develop programs in isolation from each other. However, their impacts were experienced all in one place, which sometimes led to counterproductive and wasteful outcomes. The lack of consultation and participation by the nominal beneficiaries of sectoral programs often made these interventions even less successful and sustainable. As a result, over time, alternatives emerged that have tried to rectify sector-driven interventions. These included decentralization of government

[27] See also, 2011. Maatchi, et al. Climate variability and change in the Himalayas: Community perceptions and responses

authorities and strengthening development planning and integration at the provincial/state or even lower levels of government. In addition, a performance and results-based approach for assessing what works and has gained ground in recent years. For upland and watershed management and economic development, utilizing a landscape approach to spatial planning and assessment of interventions has been very important.

However, participation is not automatically beneficial. Project interventions have to actively cultivate participation and the benefits must be apparent to local people. In addition, participation is not a neutral concept. It involves shifts in decision-making power not just between higher levels of government and local communities but also between different segments of the local community, especially where local elites do not represent all of the community. In one study of participatory approaches to watershed management in India, while the study found that the more participatory projects were, the more they were successful in protecting upper catchments. On the other hand, the study found that "too often protection of upper catchments came at the expense of landless people whose livelihoods relied heavily on them."[28] The conclusion is that participatory processes in development project design and watershed management in particular, need equitable rules – specifically including the poor, women, youths, and ethnic minorities and these rules have to be designed for the specific development and distributional outcomes intended.

A number of conditions are necessary for people to actually participate in watershed management programs. First, the watershed program must include demand-driven activities. Then, people must be aware of the advantages of collective action in conserving and managing natural resources, which puts an emphasis on public awareness and education as key parts of the planning process and local people must be empowered to plan, implement, and manage the programs. Finally, people should expect private economic benefits. [29] As noted above, in Nepal and a few other places, bottom-up and top-down planning in the form of LAPAs are being introduced, acknowledging the significant variation in exposure, sensitivity and adaptive capacity of local systems and human communities.

In watershed management programs, the principal application and output from the participatory approach is the establishment of micro-catchment management plans to which LAPAs may link for those countries using this approach. In all watershed management projects reviewed in the World Bank study, the principal participatory activity was the preparation, implementation, and monitoring of community micro-watershed management plans. The objective of these plans was to integrate the concerns and interests of the stakeholders, and to come to an agreement within the community and then between the community and the government's watershed management program on a set of interventions that aim at both sustainable natural resource management and livelihoods improvements. The micro-catchment management plan is also the instrument by which the watershed management program tries to consider program objectives beyond the micro-watershed, mainly downstream benefits and externalities (pollution, sediment, etc.).[30]

In most projects, the community sets up a committee to design plans with the assistance of a multidisciplinary team of technicians. These teams may come from local government, an NGO or university, foreign technical assistance or, frequently, a combination of these. Once agreed to, the plan becomes the basis of a contractual or stewardship agreement between the community and the program, with assignment of responsibilities and cost sharing. Micro-catchment management plans (or LAPAs) can

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[28]Dargouth, Salah, et al., Watershed Experience Scaling Up, World Bank, .p.38

[29] Ibid., p. 38.

[30] Ibid., p.39.

be done at various levels from farm level upwards, although the complexities and risks tend to increase with scale.

As noted above, the success of participation also depends strongly on the design and management of the participatory process itself. In successful cases, sufficient time was provided at the beginning of the project for initiating the participatory processes. A preliminary phase is generally needed in which community capacity building and institutional development takes place before participatory planning started. In the process, stakeholder empowerment was a factor critical to success: local people's priorities and needs were taken as the point of departure, and communities were able to become active partners and gain ownership in the development process. Where this process is carried out well, communities are likely more willing to invest in the long term and to operate and maintain their investments properly. The community forest movement in Nepal is a good example of this.

As in all participatory processes, considerable time has proven to be necessary, for capacity building, institutional development, stakeholder dialogue, and inclusion of the poor and of women. In India's Karnataka state, the process from first contact to approved micro-watershed plan initially took a year or more. However, with experience, the time taken for establishing new micro watershed plans has fallen to nine months.[31]

Even in a challenging context, an innovative multi-stakeholder approach to project implementation that brings together government, international agencies, NGOs, scientists, and local community groups can both increase respect for different stakeholder strengths, including for villager capacities and traditional knowledge, and provide new learning opportunities for all participants. With multi-stakeholder support, local groups can manage investments transparently and with accountability.

Interestingly, fixed budgets are an effective way for villagers to allocate resources in LAPAs or micro-watershed climate adaptation plans. Setting a limit on funds available for each type of rural production investment is a mechanism that fosters prioritization by cost effectiveness and risk. Combined with participatory planning, this approach contributed to a wider distribution and better targeting of project financing than was expected.

[31] Ibid., p.40.

5. CONCLUSIONS

Asia's high mountains are undergoing rapid increases in annual average temperatures, which are having a disruptive impact on mountain communities, their surrounding ecosystems, and their use of natural resources for basic livelihoods as well as economic growth. The vast area of central and south Asia that constitutes "high mountain Asia" is highly variable with respect to ecosystem types, climate, population density and levels, and kinds of economic development.

Climate change is having an increasingly disruptive impact on high mountain communities and will have an even greater impact on cities and economic cities downstream. Adaptation and mitigation to climate change will require integrated watershed management approaches that incorporate "green infrastructure" and, especially in the high mountain regions, will require the development of local adaptation plans of action involving high levels of participation from the communities themselves.

High mountain communities have had to adapt to harsh and unpredictable environmental conditions for centuries and so have become generally highly adaptable with multiple on-farm and off-farm coping strategies. But many are poor and marginalized and so have little political or economic power. Because geographical conditions are so variable from site to sit in high mountain Asia, it is nevertheless essential to tap into the local knowledge base about the environment and changing climate to develop effective adaptation plans which will support watershed integrity and services like sustainable water supplies for the future.

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ANNEX 1: SELECTED EXAMPLES OF HIGH MOUNTAIN COMMUNITY ADAPTATION PROJECTS

1. TAJIKISTAN, COMMUNITY AGRICULTURE AND WATERSHED MANAGEMENT PROJECT

2004 (US$15 million total, US$10.8 million IDA, US$4.5 million GEF grant). The project objective was to build the productive assets of rural communities in selected mountain watersheds in ways that sustainably increased productivity and curtailed degradation of fragile lands and ecosystems. The GEF's Objective was to: entail protection of globally significant mountain ecosystems by mainstreaming sustainable land use and biodiversity conservation considerations within agricultural and associated rural investment decisions.

2. INTEGRATED WATERSHED MANAGEMENT IN CENTRAL ASIA - IMPLEMENTING AN EDUCATIONAL AND RESEARCH CONCEPT FOR CAPACITY BUILDING IN KYRGYZSTAN

Project Duration: 2010-2014

Sustainable resource utilization as well as sustainable societal development was the objective of this project as part of a larger effort to improve living conditions for local communities. These living conditions were determined by the existing environmental conditions and the regeneration capacity of the supporting ecosystems and productive resources. During the previous decade, the concept of Integrated Watershed Management (IWSM) gained importance as an interdisciplinary and integrated approach to support regional sustainable land management and development. Integrated Watershed Management is a system and process-oriented integrative approach to assess landscape sensitivity and as a basis for designing management strategies. It implies that the available natural, agricultural and human resources within a defined ecological system – in this case the system of a watershed - should be sustainably utilized for the benefit of the local population.

As noted above, local population benefit was the target of the project on IWSM in Kyrgyzstan. This project was a German-Kyrgyz cooperative project aimed at capacity building in IWSM, including education and training of experts. This included establishing a MSc.-programme on IWSM. To achieve this, a project-oriented partnership was established with the Kyrgyz National University (KNU) in Bishkek. To ensure sustainability and acceptance by the local population young Kyrgyz postgraduate students carried out the base assessment of landscape sensitivity and the configuration of management approaches. In this way, these students honed their scientific and technical skills. Additionally, as future lecturers, regional planners, or consultants they were in a position to disseminate and apply the knowledge they gained.

The expected outcome was a methodology which facilitates sustainable development of a growing society in an environmentally sensitive mountain area under the influence of global climate change and associated impacts. It is also intended that the strategies and measures developed in this project would be evaluated for their transferability to the larger Central Asia region.

Contact:

Prof. Dr. Tilman Rost

Free University Berlin
Institute of Geographical Sciences
Malteserstrasse 74-100

12249 Berlin – Germany

Email: tilman.rost@fu-berlin.de

3. PILOT PES SCHEME IN THE CHON-AKSUU WATERSHED, KYRGYZSTAN

31st January 2012 by mashutka1225

Issues and challenges

The quality of irrigation water in the Chon Aksuu watershed represents one of the major challenges for the population in the area. In particular, a high level of suspended sediments in the watershed's river is a big problem in the summer. Consequently, irrigation pipes often get blocked quickly, while the adjacent fields get covered by a non-fertile layer of hard sediment.

After extensive scientific research on the pastures and forests of the upper Chon-Aksuu, several problems were identified: some pastures and forests in the upstream parts of the watershed were overused; in turn, overgrazing led to erosion of the pastures; at the same time, downstream mushroom collection and weak forest regeneration throughout the river basin led to a decrease in land cover in forests.

Payments for Environmental Services Scheme

The water issue in the Chon-Aksuu watershed clearly shows the interdependence between upstream and downstream nature use activities. To link them and address this problem, the Central Asia Regional Environmental Center (CAREC), based in Almaty, Kazakhstan set out to devise a Payments for Environmental Services **(**PES) scheme where upstream pasture and forest users act as "sellers" of ecosystem services (by improving their land use, they can provide additional water-related ecosystems services, including reduced erosion and sediment loading) while downstream water users and mushroom pickers act as "buyers" (as they benefit from the services provided by the upstream ecosystems).

Payment

Unlike a lot of PES schemes, this PES does not involve money but rather labor exchange

1. The Water Users Association pays in labor

– The Forest Administration: 10 man-days a year to help them in tree planting, fencing, etc;

– The Pasture Committee: 20 man-days a year for pasture quality improvement.

2. The Mushroom Pickers Association pays in labor working with the Forest Administration: 30 man-days a year to help in soil preparation, tree planting, etc.

3. Tourists pay in cash to the Forest Administration the entrance fee into the valley: 20 soms/person and 50 soms/car.

To date, activities in support of the PES scheme carried out include:

Detailed scientific assessments on grazing, forest management and landslides in the Chon Aksuu watershed have been undertaken and published;

Public awareness levels about the PES operation have been increased significantly;

A Multi-stakeholder Coordination Committee of 20 members was established;

The contract on the PES scheme was signed on the 5th of December 2011;

A basic contract monitoring and evaluation plan was prepared.

Future steps:

Organizing a study tour to Vietnam;

Implementation, monitoring and evaluation of the PES scheme;

Development of REDD+ schemes;

Replication of the Chon Aksuu experience and new pilot projects in Kyrgyzstan.

Positive Lessons:

Plan to spend sufficient time on raising awareness on PES and negotiations with

stakeholders;

2) Involve all relevant stakeholders in the negotiation and decision-making process;

3) Demonstrate lessons learned from the international experience in a similar context;

4) Careful scientific assessments add credibility.

Negative Lessons:

1) Do not speed up the process of preliminary negotiation and awareness raising;

2) Do not impose your own vision on how to solve the problem; give stakeholders freedom to decide and time to understand their interest and benefits from the PES scheme.

Main factors of success for the project:

1) Existence of a strong intermediary organization;

2) Clear scientific data on the status and necessary activities to improve ecosystem services;

3) ES 'buyers' are willing to pay for the delivery of a particular ES;

4) The size and form of payment is accessible to the 'buyers' and is interesting for 'sellers';

5) A monitoring plan, reconciled with all the stakeholders, will ensure the sustainability of the scheme.

Source: Authors, and Kurukulasuriya and Rosenthal 2003.

4. CONSERVATION AND ADAPTATION IN ASIA'S HIGH MOUNTAIN LANDSCAPES AND COMMUNITIES

World Wildlife Fund 2012-2017 from their website: http://www.worldwildlife.org/initiatives/asia-high-mountains

In October 2012, WWF launched the USAID-funded Conservation and Adaptation in Asia's High Mountain Landscapes and Communities project to promote conservation of snow leopards and their habitat; improve water security, design and implement of community climate change adaptation strategies; and foster sustainable natural resource management and development at local, national, and regional levels in snow leopard range areas.

CLIMATE ADAPTATION

WWF is assessing climate vulnerability across the high mountain landscapes of Asia and identifying opportunities to increase the resiliency of mountain ecosystems. Site-specific interventions, we promote climate-smart actions integrate sustainable development, water security, and snow leopard conservation. Activities emphasize building capacity of local governments, increasing public understanding, and providing incentives for climate change adaptation work.

WATER SECURITY

Increasing the resiliency of these Asia's high mountain ecosystems will help safeguard the headwaters of rivers upon which millions of people depend. Activities range from local interventions—such as conducting springshed restorations, building water storage ponds, embracing water-efficient irrigation, and incentivizing communities to keep freshwater resources clean—to capacity building for government workers.

FOOD SECURITY

Unreliable water availability and weather patterns are already changing the viability of traditional high mountain agricultural activities. WWF is assessing the impact for climate change on food security, helping local communities understand the issues, and training farmers and herders to embrace more sustainable and alternative practices. Activities range form addressing how food is grown (e.g. encouraging greenhouse gardening, bee-keeping and planting different crops or varietals) as well as how livestock is maintained (e.g. adopting sustainable pasture management practices and growing fodder crops on marginal or degraded lands). Such activities not only increase food security, but they also protect grassland ecosystems.

SUSTAINABLE LIVELIHOODS

Climate change is severely impacting livelihoods in Asia's high mountains and threatens communities with deep cultural ties to landscape. WWF aims to help diversify rural livelihoods and empower sustainable development that benefits both people and nature. These activities have significant benefits for women, as they are empowered to generate income through production of handicrafts, community-based ecotourism, marketing of yak and horse milk, poultry raising and egg production, and sewing, among other activities.

EDUCATION, AWARENESS AND ENGAGEMENT

WWF strives to raise awareness of the issues threatening Asia's high mountain communities and encourage local participation in solutions. Activities include school programs, door-to-door education campaigning, creative events like snow leopard festivals, community-based biodiversity monitoring and anti-poaching patrols, and integrating biodiversity conservation into livelihood activities.

TRANSNATIONAL COLLABORATION

WWF promotes transboundary cooperation on mountain conservation among snow leopard range countries. By increasing the availability of data, sharing lessons learned rangewide, and supporting

climate-smart conservation activities, the project will strengthen existing linkages and form new channels for cooperation among existing regional conservation networks.

Email: john.farrington@wwfus.org

U.S. Agency for International Development

1300 Pennsylvania Avenue, NW

Washington, DC 20523

Tel: (202) 712-0000

Fax: (202) 216-3524

www.usaid.gov