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# ZEF Strategic Research Agenda for Central Asia

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# ZEF Strategic Research Agenda for Central Asia

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The Center for Development Research (ZEF) of the University of Bonn has a long-standing track record in conducting collaborative research and higher education projects in Central Asia. The distinctive strength of ZEF is in its extensive knowledge and experience in design and implementation of interdisciplinary research projects addressing economic, environmental, and social issues. Since 2001, for instance, ZEF has successfully implemented a large interdisciplinary project on “Economic and Ecological Restructuring of Land and Water Use in the Khorezm Region (Uzbekistan)” (<http://www.khorezm.zef.de>). There have also been many other ZEF projects in the areas of integrated water resource management, governance, migration etc. in Central Asia and its adjacent countries Afghanistan, Iran, and Western China. The long history of ZEF in the region has helped it to initiate and maintain an extensive network of local, European, and international researchers with outstanding experience and interest in issues related to Central Asia.

In January 2011, ZEF conducted a workshop to discuss and develop a future strategic research agenda for Central Asia. The workshop was attended by more than 30 experts, a large number of them from the region. This strategy paper provides a synthesis of the outcomes of that meeting and highlights the key research areas of ZEF in future collaborative development research projects in the region. Priority is given to research areas that address the fundamental drivers of regional cooperation and integration, water and energy, agricultural productivity, land degradation and ecosystem services, knowledge and innovation development and diffusion, migration and transnational networks, marginality, health, and social security.



Figure 1. The Central Asian region and the Aral Sea basin

## Central Asia - Regional characteristics

Central Asia covers an area of about 4 million square kilometres extending from the high mountain ranges of Tien Shan and Pamir to vast deserts in the interior and treeless, grassy steppes in Kazakhstan. The region, as defined by the EU and international donor community, encompasses the five land-locked independent republics, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan, with a total population of about 61 million as of 2009 (Figure 1).

Historically, the inhabitants of Central Asia have adapted to the predominantly arid conditions through the development of sustainable irrigation systems that date back several thousand years. But during the Soviet era (1924-1991), and particularly since the late 1950s, the rivers Amu Darya and Syr Darya were tapped excessively and used in immense irrigation systems to secure, among others, the production of cotton, the “White Gold”. The area of irrigated land in the Aral Sea basin almost doubled, from 4.5 million ha (Mha) in the fifties to almost 8.0 Mha today. This dramatic expansion of the irrigation system resulted in a substantial decrease in water inflow to the Aral Sea. Consequently, within decades the Aral Sea shrunk from being the fourth largest freshwater

lake in the world to less than 20% of its former surface.

One of the key characteristics of Central Asia is the upstream-downstream pattern of water and fossil fuel resources. The upstream countries Kyrgyzstan, Tajikistan and neighboring Afghanistan are rich in water, while the water-poor downstream nations Uzbekistan, Turkmenistan, and Kazakhstan are well-endowed with oil, gas, and mineral resources. During the Soviet Union period, a basin-wide management system was operated, i.e. the downstream states traded energy generated from fossil fuels during the winter time for water for irrigation during the summer period. With the breakdown of the Soviet Union this centrally-managed “water-energy nexus” ended. Higher post-Soviet market prices for oil and gas together with unreliable delivery from downstream states and the pursuit of energy security in the upstream countries increased the demand for hydropower. As a result, large quantities of water are released by upstream countries in winter to generate heat and electricity during the peak demand season, resulting in less water available during the summer irrigation season downstream.

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The water-energy nexus in Central Asia is less an issue of quantity but of distribution and efficient utilisation of resources. The region is actually rich in water and has substantial gas and oil reserves. Kazakhstan has the largest gas and oil resources. The natural gas reserves of Turkmenistan are the eleventh largest in the world. Uzbekistan has the largest population in the region with abundant natural gas reserves and mineral resources. The smaller but water-abundant upstream countries Tajikistan and Kyrgyzstan have significant potential for hydropower generation, with only about 8% of the hydropower potential being utilised so far.

Since the early 1990s, the region is undergoing diverse processes of rapid change, including socio-economic transformation and environmental change processes, with significant consequences for the countries' economic, political and social systems. There are strong indications that global warming is accelerating the melting of Central Asia's glaciers. By mid century, the water resources in the region are projected to fall by 20-40 percent. This climate change-related water scarcity will be aggravated by future increases in water demand and consumption due to population growth and economic development. In addition, climate change is also likely to increase the occurrence of extreme weather events such as frost, heat waves, droughts, floods, and windstorms. In response to these changes, the countries have, for instance, actively restructured their agricultural sector, although with different pace and intensity. The land and water reforms have had significant implications for rural life, including proliferation of poverty, concentration of land, and changing but unconsolidated institutional arrangements between market mechanisms and state control. The interplay of socio-economic and environmental processes of change is especially pressing for rural populations, located in the periphery of the nation-states and being especially exposed to change-induced uncertainties. These socio-economic uncertainties threaten systems of livelihood provision, long-term planning, (entrepreneurial) creativity and innovation development, and thus agricultural production.

The agricultural sector plays a significant role in the Central Asian economies, with cotton and wheat being dominant export commodities. Kazakhstan is among the world's top-eight grain producing countries and Uzbekistan among the five leading exporters of cotton fibre. The contribution of agriculture to GDP is less than 10% in Kazakhstan, about 20% in Uzbekistan, and between 25 and 35% in the other countries of the region. The productivity and input-use efficiency of agricultural production systems in the region are generally low. This is largely due to environmental mismanagement and under-investment in irrigation infrastructure, insufficient structural reforms towards market-oriented agriculture, limited knowledge of innovative and more productive management practices and cultivation techniques, and lack of incentives for the conservation of natural resources. While Kyrgyzstan, Tajikistan, and Kazakhstan introduced reforms to privatise and diversify the agricultural enterprises, Uzbekistan and Turkmenistan chose to maintain control over the major crops and their production, prices, input supplies, processing, and export.

Drawing on the development experiences of other Asian regions, a strategy for the future of the Central Asian region and its diverse countries should not mainly be based on natural resources in the long run, but needs to bring other forces of sustainable growth and development into the forefront, i.e. a strengthened human resource base, skills, science and technology, and conducive institutional frameworks that foster entrepreneurship. In spite of the region's vast natural resources, the Central Asian countries face currently significant challenges of poverty, stability, and security. The poverty level is high in the region, particularly in the upstream countries. Poverty, inequality, and social exclusion threaten social and political stability, which may increase migration and tensions. Addressing these challenges requires substantial improvements in regional cooperation supported by regional infrastructure networks and institutional arrangements.

These challenges together with the region's vast economic potential and geostrategic significance have made Central Asia one of the key Eurasian regions of great strategic importance. The European Union, for instance, has adopted a strategy "The EU and Central Asia: Strategy for a New Partnership" during the German EU presidency in 2007 to strengthen the cooperation with the Central Asian states in the areas of economic development, energy and transport, water use and hydropower, environment, development of transparent and democratic political structure, respect for the rule of law and human rights, and modernisation of education and research systems.

The ZEF Strategic Research Agenda for Central Asia to be pursued with partners in the region – as outlined in the following – comprises seven priority areas for basic and applied research, based on their scientific relevance in and for the region.



## Research concept & rationale

The United Nations World Summit on Sustainable Development in 2002 in Johannesburg recognized that poverty eradication, changing consumption and production patterns, and protecting and managing the natural resource base for economic and social development are overarching objectives and essential requirements for sustainable development.

Given the high importance of the agricultural sector to most countries in Central Asia in terms of employment, rural livelihoods, food security, and government earnings, it is acknowledged that this sector is highly sensitive to environmental degradation including climate change. For example, the predicted changes in temperatures and water availability as well as in the increasing occurrence of extreme weather events are certain to aggravate the present income inequalities, particularly in rural areas with the highest share of vulnerable poor. Therefore, the Central Asian republics need to find climate-resilient growth strategies (i.e. strategies achievable despite impacts of climate change). Given that poverty alleviation and good governance are major challenges in the region, combating the threat of environmental degradation and climate change must go hand in hand with boosting efforts to reduce poverty and improve institutional and political frameworks.

There is an emerging consensus that low-carbon growth strategies are more likely to provide a sustainable route to overcome poverty and manage climate change. This

alternative growth path may be particularly relevant for the Central Asian republics because of their strong economic dependence on non-renewable natural resources and their CO<sup>2</sup> emissions per unit of GDP, which rank among highest in the world. The low-carbon and climate-resilient growth strategies will enable the states to not only receive international (financial) support for mitigation and adaptation measures but also take advantage of new economic opportunities that will arise from the adoption of low-carbon technologies and management concepts.

The design and implementation of sustainable low-carbon strategies to achieve economic growth while combating climate change and alleviating poverty require appropriate policies and active participation of all involved stakeholders. Scientific analysis of policies in terms of their intended effects as well as unintended side effects or consequences is a crucial step in the policy making process. The successful implementation of such policies will also require a thorough analysis of governance, socio-cultural, and bio-physical settings. In fact, Agenda 21 recognizes scientific understanding, long-term scientific assessments, and building up scientific capacity and capability as essential components in the search for feasible pathways towards sustainable development. The Central Asian states are particularly challenged to increase scientific research and capacity development by investing in scientific infrastructures.

## Key research areas

The ZEF Strategic Research Agenda for Central Asia aims to provide scientific knowledge and advice for a sustainable development trajectory of the region taking into account the key challenges of governance and institutions, poverty and food security, and climate risk and adaptation (Figure 2). This interdisciplinary research program comprises seven interrelated research clusters, with each cluster consisting of a set of specific research topics.

We note upfront, however, that the ZEF Strategic Research Agenda does not claim to be all comprehensive, but merely aims to address selected key issues where ZEF can make a useful contribution in partnership with research organizations in the region. Moreover, the identification of this Agenda is to stimulate discussions and initiatives by other research actors and investors from within and outside the region and not just ZEF itself.

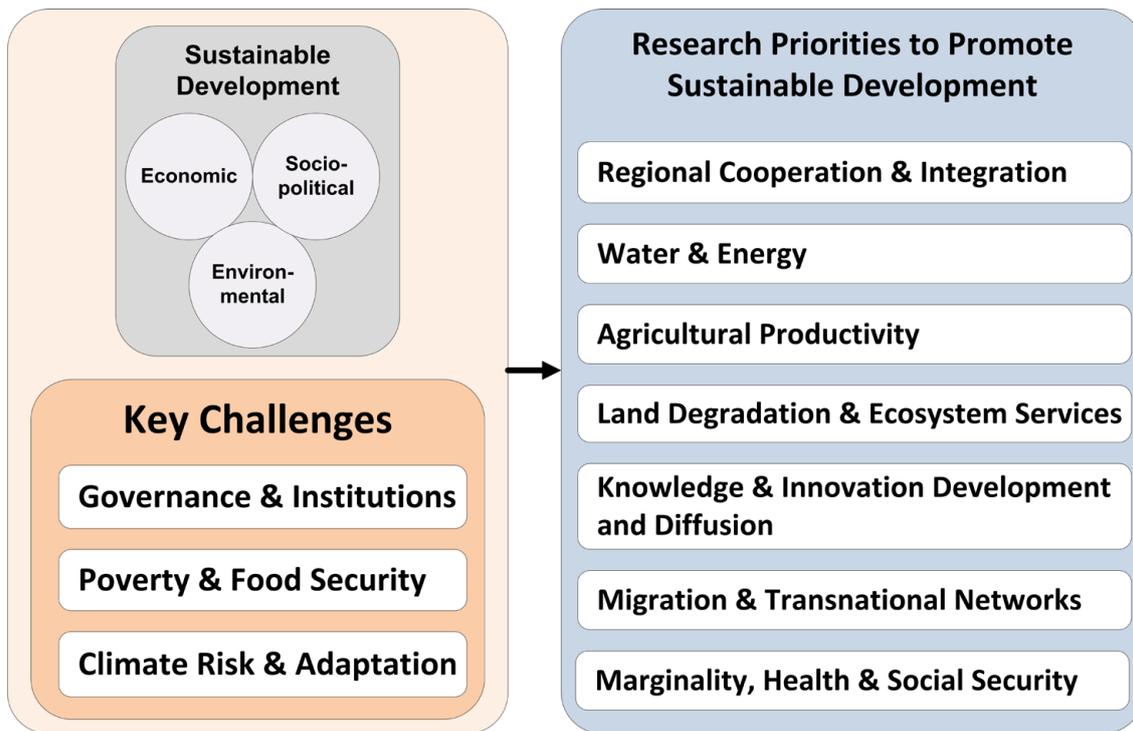


Figure 2: Key challenges facing Central Asia on the path to sustainable development and ZEF's research priorities

## Research cluster: Regional cooperation & integration

The economic development of Central Asia depends heavily on economic integration policies, as the region is characterized by distance from world markets and lack of economic density. The five “bottom billion” countries in the region share similar languages and cultures. However,



they differ in market sizes, natural resource endowments, income levels, and consumer preferences. Such differences in resource (natural and human) endowment and their respective comparative advantages can form the basis for regional cooperation in trade, policies, and regional infrastructure. In the post Soviet Union era, the economic linkages between these countries have been inadequately sustained resulting in collective losses. The present interdependence of common trading corridors, energy networks and systems, and the existing water-energy nexus still underlines their transboundary character. These can be addressed effectively only through cooperative efforts between the countries. Furthermore, the economic integration of the countries in the framework of a larger market will make the regional economies individually and collectively more competitive in today's globalized world.

The integration can be achieved in the long run via harmonized innovation and science policies, coordination of infrastructure and trade policies, development of a



regional power market, and coherence in institutional arrangements. However, the concept of regional integration in Central Asia, as perceived in the usual policy debate, has been far away from proper scientific and research analysis. It is a complex subject, as the resulting changes may differ across the countries depending on their level of internal integration and integration with larger developed markets surrounding the region. Hence, research is needed for a systematic analysis of the myriad web of factors influencing trade and economic integration of the region.

The following research topics have been identified:

- Exploring the potential for improving intra-regional trade and coordinated transboundary infrastructure;
- Exploring the opportunities for coordinated institutional arrangements in trade, energy and infrastructure;
- Analyzing externalities (e.g. carbon emissions) and resource mobility (e.g. water and labor) resulting from regional integration;
- Analyzing spatial distribution of gains and losses within and across the research countries from regional cooperation and integration;
- Identifying options for harmonizing the innovation and science policies towards regional integration and sustainable growth;
- Identifying opportunities for forward and backward linkages in the industries and associated infrastructure for regional cooperation and integration.

### Research cluster: Water & energy

The strategic resource water plays a key role in economic growth, food and fibre production, environmental sustainability, social development, and human security in Central Asia. Considering that over 90% of the surface water flow is used for irrigation, enhancing the efficiency of irrigation schemes is of paramount importance. ZEF and its partners have carried out extensive research on integrated water resource management (IWRM) and improving the water productivity of irrigation systems in the region. Rehabilitation and modernisation of irrigation and drainage infrastructure will improve the efficiency of water use. Technical improvements are, however, costly and the benefits may not be significant. In addition, the lack of clearly-defined responsibilities for operation, maintenance, and rehabilitation of irrigation systems at local, national, and regional scales makes significant technical investments less likely. Strengthening and empowering the institutions involved in water distribution and allocation are equally if not more important to improving water productivity in Central Asia.

Thus, modernisation of the region's dilapidated irrigation and drainage systems and institutional improvements



have to go hand in hand to achieve an efficient, equitable, and sustainable irrigation system. Similar to water, energy efficiency in the region is also very low. Given that the Central Asian republics, in particular the downstream countries, rely heavily on carbon-intensive energy sources, research on the feasibility and transfer of innovative "green technologies" to generate power, while at the same time reducing emission of greenhouse gases, is urgently needed.

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The following research topics will contribute to improving water and energy security in the region while mitigating climate change:

- Identifying “bottlenecks” in the irrigation systems at local and regional scales to maximize water and land productivity gains from limited investments in the infrastructure;
- Exploring technical (e.g. storage reservoirs, sprinkler and drip irrigation methods), financial (e.g. water pricing), and management-oriented (e.g. mobilization of social capital, strengthening

of Water Users Associations and Main Irrigation Canal Organizations) options to improve the reliability and use-efficiency of irrigation water; Developing regional and local irrigation monitoring systems based on GIS and remote-sensing technologies;

- Assessing the socio-economic feasibility of small-scale run-of-river hydro and solar power systems and decentralized electricity grid in upstream countries;
- Analyzing the potential of renewable energy sources (solar and biomass) for electricity generation in rural areas.

## Research cluster: Agricultural productivity

The agricultural sector in Central Asia is particularly vulnerable to climate change and variability due to its reliance on variable rain-fed agriculture and limited water for irrigation. Crop yields in the region are estimated to decrease by 30% by mid century. This will have significant implications for food security and poverty. Central Asia is already vulnerable to climate variability and occurrence of extreme weather events. In 2008, for instance, a severe drought combined with an extremely cold winter resulted in a compound “water-energy-food crisis” and serious political tensions in the region. Therefore, the adverse impacts of climate change are a very serious concern.

The success of the region in implementing a sustainable development path depends on restructuring of the agricultural sector from a carbon-intensive, inefficient, and low-productive system to one which is climate-resilient, diversified, and highly productive. In addition to enhancing food production, such a system will provide increased income and employment opportunities for the rural population,

which is fundamental to reducing food insecurity in the region. For a sound science-based restructuring of the agricultural sector in Central Asia, research on the following topics is suggested in order to proactively identify opportunities, risks,

and vulnerabilities related to climate change and develop site-specific adaptation measures at various management scales:

- Assessing the site-specific impact of climate change on crop yields;
- Developing alternative, climate-resilient cropping systems considering the local socio-economic and cultural settings;
- Exploring agricultural management practices for more efficient use of inputs (e.g. conservation tillage, integrated nutrients and pest management);
- Investigating the biophysical and economic potential of organic farming (e.g. cotton, fruits, and cash crops);
- Improving pasture management, livestock production, and crop-livestock integration;
- Assessing future food security in the region, based on projected agricultural production, population growth, food demands, and food prices;
- Developing an integrated systems modelling framework for assessing life cycle sustainability as a decision support tool for decision and policy makers in pursuit of climate-resilient systems.



## Research cluster: Land degradation & ecosystem services

Declining soil fertility and degradation of irrigated land due to soil salinisation are major threats to food security, environmental sustainability, and socio-economic development in Central Asia. ZEF has extensively researched the concept of setting aside degraded cropland for remedial practices via afforestation with well-adapted multi-purpose tree species and alternative annual crops. Long-term field studies in Province Khorezm of Uzbekistan demonstrated the potential of afforestation to generate an array of ecosystem services that can lead to land rehabilitation and, if monetized, improve rural incomes. In particular, revenues from forest carbon sequestration may accrue in the form of payments via, for instance, the Clean Development Mechanism (CDM).



To assess alternative land-use options at different spatial scales and to evaluate their out-scaling possibilities in Central Asia, the following research priorities are identified:

- Multi-scale identification and suitability assessment of degraded lands for afforestation and cultivation of alternative annual crops using remote sensing and GIS technologies;
- Regional analysis of hydrological dimensions of mitigating climate change impacts via re- and afforestation and cultivation of alternative annual crops;
- Scenario analyses of carbon sequestration trajectories following conversion to multi-species tree plantations;
- Evaluation of potential economic benefits from participation in carbon markets;
- Evaluation of the potential for enhancing biodiversity via the alternative land-uses;
- Impact assessment of land-use related policies and incentives to promote forestry practices, alternative annual crops, and pasture on degraded croplands.

## Research cluster: Knowledge & innovation development

The rapidly ongoing processes of change, including socio-economic transformation and environmental changes, foster a high level of knowledge uncertainty: the not knowing of what will be tomorrow, whether and how access to land, water and agricultural advice (knowledge) will cease, who will be affected, to what degree, and how to cope with it as well as adapt to the changed conditions.

This is further exacerbated by the erosion of the former (Soviet) system of research and development and the disintegration and increasing out-datedness of this expertise, so far not substituted by renewed local (i.e. Central Asian) research and development, as well as agricultural service provision system. With the aim of filling this increased knowledge gap under decreasing local capacities, ZEF has



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collected extensive expertise in the field of participatory agricultural innovation development for further diffusion together with local stakeholders.

Building on this experience, while additionally focusing on national and regional science policy-making, the following research topics move into the center of ZEF's attention:

- Regional and national level assessment of the systems of scientific knowledge production (research and development for the construction of knowledge societies);
- Regional and national level assessment of the institutions, actors and processes of science policy-making with special interest also in country and sector specific impact pathways of science policy;
- National and local level of conceptualisations

of knowledge, including every-day, local forms of knowledge production and the attaching of meaning to different interpretations of life as well as scientific, expert knowledge and to be fostered, result-oriented knowledge production for i.e. economic growth, national identity-building or regional stability;

- National and local level assessment of epistemic cultures, institutions, actors and channels of knowledge production and dissemination;
- Transdisciplinary and participatory processes of high- and low-tech innovation development;
- Identification of suitable channels of scientific knowledge and innovation diffusion and outscaling, i.e. system of science policy-making, agricultural service provision systems, water users associations and farmers associations.

## Research cluster: Migration & transnational networks

Since gaining independence from the Soviet Union in 1991, labor migration has emerged as a decisive livelihood strategy in Central Asian republics, especially in the economically less-developed upstream countries. The impact of labor migration abroad, both economically and socially, is tremendous. Especially Tajikistan and Kyrgyzstan heavily depend on the economic growth of Russia. Accordingly, the global economic depression in 2009 strongly affected the income and livelihood situation of many people in Central Asia. Moreover, labor migration triggers social dynamics in local communities. Due to the fact that mostly men

are going abroad, women increasingly take over typically male workloads. Thus, in local decision-making processes female voices become more decisive. This often leads to social conflicts, when male labor migrants return home and aim to revitalize the status quo ante of the social order. The migration abroad furthermore affects cultural life. Especially due to Russia being the dominant destination of labor migration, often migrants are the ones who are upholding Russian culture and language in Central Asia. In addition, domestic migration from rural areas to the cities is a significant issue in Central Asian countries.

Taking the extensive ZEF research experiences in the areas of migration, conflict, and governance in Central Asia and its neighboring countries into consideration, the following research themes have been identified:

- What is the impact of labor migration patterns on the social fabric and the systems of livelihood provision of local communities?
- How is the gender balance in work, decision-making etc. changing during the phase of migration and afterwards?



- What kind of knowledge and worldviews are transferred to Central Asia via labor migration?

- To what extent can labor migration be regarded as a short-term valve or a long-term strategy combating unemployment and poverty in Central Asia?

## Research cluster: Marginality, health & social security

A range of covariate risks (e.g. weather shocks, food price, and other economic shocks) to which the poor in Central Asia are exposed are increasing and idiosyncratic risks, such as health shocks. These risks remain especially high for the poor. A broad concept to address these issues is needed – a concept of marginality. Marginality describes people and communities, in situations affected by circumstances and in places at the edge of economic, ecological, social and political systems. Most of the poor are marginalized, but not all marginalized are extremely poor. Marginality is most prevalent in rural areas and often relates to agricultural conditions in small farms and pastoralists. When development investors understand marginality better, poverty reducing investments will be more successful.

Research needs that can contribute to overcome marginality relate to several of the above mentioned research themes in a cross-cutting way, and shall focus on:

- Assessing, analyzing, and mapping the different dimensions, complexities and dynamics of the marginality in Central Asia and thereby enable identification and location of priority actions;
- Supporting decision-making by marginalized people and selecting policies and development interventions by development investors;
- Testing investment options, including for land use, to overcome marginality of the poor in Central Asia.

Furthermore there are strong linkages between environmental degradation, marginality and health. Poor health infrastructures, inadequate social security for the marginalized, and lack of staff trained in modern environmental health science are common characteristics of rural areas in Central Asia. While indentifying the mechanisms of exposure to environmental factors and their impact on human health is an important scientific question, equally important is introducing strategies to reduce environmental risks and enhance human health. Striking a balance requires bringing together different scientific

disciplines and policy makers for a collaborative research and capacity building initiative.

Such a collaborative initiative should focus on the following research issues:

- Identifying different forms of environmental exposure affecting human health, in particular the marginalized population;
- Analyzing the distribution of environment-related diseases affecting human population, and the reasons for spatial and social differentiation;
- Foreseeing potential threats of environment-related diseases among the neighboring countries and continents;
- Enhancing public health education and training for rapid skill improvement in epidemiology, statistics and environmental toxicology;
- Developing government agencies' capacities to improve the monitoring and evaluation of diseases, maintenance of health databases, develop social security systems, and risk management strategies for public health care.



# ZEF Strategic Research Agenda

In sum, the ZEF Strategic Research Agenda aims to be supportive of sustainable growth and development in the Central Asia Region in cooperation with partners from the region. The seven research clusters sketched above are not to be viewed in isolation but are linked. It is ZEF's position that the actual definition of research agendas needs to be done in consultation with partners and not single-handedly by ZEF or others. An important aspect of the Strategic

Agenda is not only the definition of "what" might be appropriately high on a research agenda in Central Asia, but also "how" such agenda might best be pursued and what role data and methods should play in the context. ZEF sees its role very much in the domains of "how" and in relation to data and methods, as here the ZEF experiences, also from other world regions, can usefully come into play in support of research for development in Central Asia.

## ZEF research programs in Central Asia

### Ongoing projects

#### **Economic and ecological restructuring of land and water use in the Khorezm Region (Uzbekistan)**

Project duration: 2001 – 2011

Donor: Federal Ministry of Education and Research (BMBF), Germany

Homepage: <http://www.khorezm.zef.de/>

#### **Local governance in the Amu Darya Borderlands**

Project duration: 2005 -2011

Donor: by the Volkswagen Foundation

Homepage: <http://www.zef.de/353.html>

#### **Crossroads Asia: Conflict, migration, development**

Project duration: 2011 - 2014

Donor: Federal Ministry of Education and Research (BMBF), Germany

Homepage: <http://crossroads-asia.de>

#### **Opportunities for climate change mitigation and adaptation through afforestation of degraded lands in Central Asia**

Project duration: 2009 – 2014

Donor: Robert Bosch Foundation

Homepage: <http://www.zef.de/1631.html>

### Further activities

#### **Workshop on global environmental change and water-related diseases in Tashkent, Uzbekistan, May 2-6, 2011.**

Donors: Volkswagen Foundation, the World Health Organization and the Ministry of Health of the Government of Uzbekistan

### Selected doctoral research

#### **Climate change in Central Asia: Economic impacts and adaptation options in irrigated agriculture**

(in cooperation with ICARDA and funded by BMBF/IPSWaT)

#### **Efficient water allocation and water conservation policy modeling in the Aral Sea Basin**

(funded by BMBF/IPSWaT)

#### **Institutional performance and comparative advantage of the Kazakh economy in Central Asia with special reference to the energy and wheat sectors**

(funded by DAAD)

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