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Tajikistan
Country Environmental Analysis

May 15, 2008

Environment Department (ENV)
And
Poverty Reduction and Economic Management Unit (ECSPE)
Europe and Central Asia Region

Abbreviations and Acronyms

REPUBLIC OF TAJIKISTAN

Government Fiscal Year: January-December

Currency Equivalents
(Exchange Rate Effective as of April 10, 2008)

Currency Unit	Tajikistan Somoni
US$1.00	TJS 3.44
TJS 1.00	US$ 0.29

Weights and Measures: Metric System

ACS	American Cancer Society
BLL	Blood Lead Concentration
CB	Chronic Bronchitis
CEA	Country Environmental Analyses
COI	Cost-Of-Illness
DALY	Disability Adjusted Life Years
DBCP	Dashtidzhum Biodiversity Conservation Project
DNP	Department of Nature Protection
DPL	Development Policy Lending
EA	Environmental Assessment
EIA	Environmental Impact Assessment
HadCM2	The second Hadley Centre coupled ocean-atmosphere general circulation models
HCA	Human Capital Approach
LRI	Lower Respiratory Illness
MAC	Maximum Allowable Concentration
MANP	Ministry of Agriculture and Nature Protection
MMR	Mild Mental Retardation
NDS	National Development Strategy
NEAP	National Environmental Action Plan
ORT	Oral Rehydration Therapy
PDPC	Programmatic Development Policy Credit
PEE	Public Ecological Expertise
PRS	Poverty Reduction Strategy
RAD	Restricted Activity Days
SEA	Strategic Environmental Assessment
SCSNUEP	State Control Service on Nature Use and Environmental Protection
SEE	State Ecological Expertise
TaAZ	Tajikistan Aluminum Plant
VSL	Value of Statistical Life
WHO	World Health Organization

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EXECUTIVE SUMMARY

1. Tajikistan is a small mountainous land-locked Central Asian country with an economy that heavily depends, as a legacy of the soviet economy, on exports of cotton, aluminum and hydroelectricity that are three rather environmentally sensitive sectors, as well as on remittances from migrants living abroad[1]. The macroeconomic performance has been impressive since the end of the recent civil war; the Gross Domestic Product (GDP) has been growing at an average rate of 8.7 %[2] in the last five years. The country has a population of about 7 million in 2007, with about 75% living in rural areas. It has a GDP per capita of $390, which is the lowest among the 15 former Soviet republics. The population has been growing at about 1.3% during 2002-2006 and the per capita income -- at 5.9%.

2. Environmental degradation and unsustainable use of natural resources are constraints to sustainable economic growth and poverty reduction. With more than half of its territory situated above 3,000 meters, the country is particularly vulnerable to natural disasters. The country's economy further deeply suffered from both the disintegration of the Former Soviet Union in 1991 and the Civil War that began in 1992. Impoverished by sudden shortages of fuel, income, and food, the population reverted to subsistence practices, which put an extra burden on the natural resources and the environment of the country.

3. The environmental challenges in the country, according to the recent National Environmental Action Plan (NEAP) are (i) land degradation, including deforestation, degradation of pasturelands, arable and irrigated lands; (ii) lack of improved drinking water and water quality deterioration; (iii) waste pollution from agriculture and industry; (iv) deficiencies in sewerage system infrastructure and management; (v) uncollected and untreated solid waste; (vi) environmental hazards and natural disasters caused by floods and drought; (vii) energy supply; and (viii) lack of environmental education.

4. While acknowledging that the problems of unsustainable farming practices continue to persist, today's most important environmental challenges in Tajikistan consist of dealing with natural disasters like floods and draught and as well as reducing the incidence of waterborne diseases and illnesses caused by urban and indoor air pollution, and minimizing vulnerability of rural population to natural disasters. These categories of environmental damages have an economic cost of 4.8% of gross domestic product (GDP), and they primarily affect the poor. Future environmental challenges could result from climate change that exacerbates existing environmental problems. Soil degradation due to, irrational pastures management, and deforestation by indiscriminate felling of trees leading to the destruction of critical watersheds and wildlife habitats. Efforts to mitigate potential future environmental challenges would consequently need to control these potential detrimental activities and their cumulative impacts. In addition, efforts would be needed to prevent plundering and uncontrolled exploitation of Tajikistan's land and water resources, and to supporting reforms in key sectors like cotton, energy, and private sector development that may have impacts on environment and natural resources.

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[1] There has been an increasing inflow of remittances recently.

[2] Average GDP growth rate at constant prices over the period 2002-2006

5. Tajikistan has responded to its environmental challenges by developing and continuously strengthening the environmental management framework. Although the country suffered from civil war and political instability for about a decade since independence in 1992, policies and programs for environmental protection began to emerge as early as 1997. The government has since developed and implemented various programs for environmental protection. The analysis suggests that the key constraints in environmental management in the country are not from the absence of well defined environmental policies but rather from inadequate legislation and bylaws/guidelines to implement specific polices in particular, weaknesses in institutional design, lack of vertical and horizontal coordination, lack of capacity of institutions, and insufficient funding. A number of national and local/provincial level agencies and different ministries are involved in the environmental management. There exist opportunities for significant improvement in environmental management through better coordination among the different agencies. The analysis also suggests that policies currently followed do not provide economic incentives for pollution reduction and more efficient use of natural resources.

6. The CEA found that the government has set norms for air and water pollution, residual traces of chemicals and biologically harmful microbes in food, regulations regarding noise, vibration and magnetic fields, exceeding the threshold levels results in administrative actions and financial sanctions. However, their implementation remains unsatisfactory due mainly to weak institutions and lack of vertical and horizontal coordination. Although the government has enacted a number of laws and proposals to improve the state of the environment, there is very limited state capacity for policy development, regulation, and implementation.

CEA Objectives

7. The significance of natural resources in the development process continues to remain vastly underestimated in policy deliberations in Tajikistan. In part, this reflects the absence of credible quantitative evidence of the economic effects of environmental and resource degradation and understanding of the critical linkages between broader policy reforms and their implications for environment and resource base. The objectives of the Tajikistan Country Environmental Analysis (CEA) are: (a) to deepen the understanding of the economic costs of the country's major environmental challenges; (b) to assess institutional capacity within the country for sound environmental management; and (c) to help strengthen institutions and governance to enhance environmental outcomes.

Institutional Framework

8. Tajikistan faces a number of environmental challenges. The environmental degradation, including air and water pollution and their effects on environmental health, problems in waste management, soil erosion and degradation, degradation of rangelands, and orchards, deforestation and loss of biodiversity and natural disasters are highly visible in the country. There is a broad consensus at the national and sub-national levels that there is an urgent need to address the environmental problems in the country. In order to address these issues the country requires effective environmental policies, laws and strong institutions to implement them.

9. The constitution declares that the State must ensure a healthier environment and guarantee an efficient use of natural resources for the benefit of the people of Tajikistan. The environment protection law stipulates several types of controls and institutions to comply with at the state, ministerial, business and community levels. At the

national level there is an environmental block, the Department of Nature Use and Protection, chaired by a Deputy Minister under the Ministry of Agriculture and Nature Protection. The State Control Service of Natural Resources and Environmental Protection under the Department of Nature Use and Protection is the national level agency for environmental affairs in the country.

10. In addition to the SCSNREP, the Sanitary Inspection Service of the Ministry of Health and Inspection Service on Mining Safety, the Ministry of Mines are involved in environmental management. At the ministerial level, enforcement is done by different ministries and the state agencies; however with no effective coordination across the ministries. In addition to the state level and ministerial level controls there is a business level control that implies that every business has to observe the environmental law. Although the government has set norms for air and water pollution, residual traces of chemicals and biologically harmful microbes in food, regulations regarding noise, vibration and magnetic fields, exceeding the threshold levels results in administrative actions and financial sanctions: their implementation remains unsatisfactory mainly due to weak institutions to implement them and lack of vertical and horizontal coordination, across institutions.

11. The analysis found that the binding constraints for improved environmental performance in the country are: (i) weak institutional design (ii) lack of coordination among institutions; (iii) lack of economic incentives for pollution reduction and accountability; (iv) capacity limitations; (v) poor environmental governance and (v) insufficient funding for environmental management. The solutions to these problems will not arise from simply scaling up the institutions or increasing funding for environmental management, but to require careful planning and coordination at all levels backed by legal and regulatory mechanisms.

12. Both federal and provincial governments share legislative authority and responsibility for environmental management and efficient use of natural resources. In order to achieve better outcomes, institutions at all levels should have appropriate roles and responsibilities. At the national level the roles could include: (a) setting national environmental policy and defining specific goals for environmental quality; (b) providing resources, both technical and financial, and oversight for local/provincial environmental authorities; (c) reporting and publishing data on progress in meeting the national environmental objectives. The national environmental agency should have the mandate for enforcement of national laws and regulations and oversight on local/provincial environmental agencies.

13. While the national level agency sets the national policy, responsibilities of the provincial environmental authorities could include environmental clearance at the local level, implementation and compliance as well as monitoring of ambient environmental quality standards. There is also need for specific guidelines for national oversight of the provincial environmental authorities depending on the provincial laws and regulations for enforcement, adequacy of technical expertise, staff and resources.

14. Tajikistan has a set of economic incentives in the form of charges and payments for waste products generated and pollutant discharges in to air and water bodies. The analysis however showed that the fees for waste collection are not sufficient to stimulate reduction in wastes, development and adoption of environment friendly production technologies that reduce waste generation. In the case of air and water

pollution, current system of payments is not economically efficient as it does not provide enough economic incentives to reduce emissions. Automobile emissions constitute another main source of air pollution. The government charges an automobile tax that does not promote fuel efficiency and emission reductions.

15. In addition to prices and charges, the government has enforced quantity restrictions on the amount of wastes and pollutants that can be discharged into air and water. There are also quota restrictions on the quantity of water, mineral and other resources of that could be used by individual business entities. However, the enforcement of these restrictions is constrained by the available infrastructure for monitoring and enforcement.

16. One of the most serious weaknesses of Tajikistan's environmental management framework is the lack of capacity for environmental planning. A misalignment between environmental priorities, institutional efforts, and resource allocation is largely due to: (a) the absence of clearly identified priorities, based on the cost of environmental degradation; (b) the absence of an integrated system of reliable data to provide analytical support to the decision-making process; (c) the lack of representation of vulnerable groups; and (d) the absence of a formal mechanism for the allocation of financial and human resources, according to clearly defined environmental priories linked to poverty alleviation and social priorities.

17. Accountability and enforcement and monitoring capacity require urgent improvement. Accountability is diluted by: (a) the absence of clear responsibilities and capacities among agencies; and (b) the lack of an effective voice for the poor, stemming from the lack of awareness and absence of sound mechanisms for public participation. Monitoring capacity is constrained by a lack of reliable time series data on the state of the environment and natural resources, the nonexistence of a system of results-focused indicators of environmental quality, and insufficient resources to ensure an adequate institutional presence in the field. Finally, enforcement has been suboptimal mostly because enforcement power ultimately rests in the same ministries that are responsible for sector development, but also because quality standards still need to be defined in many areas.

18. Major reforms are needed to address Tajikistan's institutional weaknesses and respond to the country's most pressing environmental challenges. One of the first actions that the Government should consider developing is a robust mechanism for setting priorities, based on the following criteria: (a) the results of the analysis of the costs of environmental degradation; (b) the distributive impact of the costs of environmental degradation; (c) the population's perceptions, gauged through the conduct of surveys that primarily target vulnerable groups; and (d) analysis of the efficiency and effectiveness of environmental policies and of alternative interventions to reduce the cost of environmental degradation.

Revisiting Environmental Priorities

19. A study was conducted as part of the CEA to identify the environmental problems that are associated with the most significant economic costs. This analysis showed that the costs of environmental damages are significant in Tajikistan accounting for about 9.5% of its GDP in 2006. The highest damage is from land degradation, including soil erosion and salinity, the cost of which accounts for 3.7 % of the GDP, followed by natural disasters (1.6% of GDP) and then costs due to inadequate water

supply, sanitation and hygiene (1.5% of GDP). The cost of indoor air pollution and associated health risk is about 1% of the GDP; rangeland degradation (0.7 % of GDP) cost of urban outdoor air pollution (0.5 %), lead poisoning (0.2 %) and deforestation (0.2 %). The above estimates show the urgency in reversing the course of environmental damages in the country for sustainable economic growth and poverty reduction.

20. The analysis found that the land degradation is the principal environmental problem in the country, the main causes of which include irrigation-related land degradation, in particular secondary salinity, water-logging and irrigation-related soil erosion, soil erosion in rain-fed farmlands, degradation of summer and winter pastures in vast mountain areas, and other forms of land degradation caused by natural disasters and soil contamination. Although the principal cause of natural resource losses is degradation of agricultural lands, it is important to mention that all elements of natural resource degradation in Tajikistan are interrelated -- causality links often work both ways. Land degradation eventually causes more land slides and mudflows especially in the sensitive mountainous areas. Most affected by degradation are village-near pasture lands as well as bush and tree vegetation. Common causes include ineffective land management and the lack of energy resources. Land degradation not only affects agricultural productivity, biodiversity and wildlife, but also increases the likelihood of natural hazards, that in turn cause destruction to limited agricultural assets. The total annual loss, due to land degradation in Tajikistan, is about 270 million TJS.

21. The second major environmental damage is from fragile soil structure in the mountain area causing natural disasters by way of mudflows and boulders sliding down the hills. About 85% of Tajikistan's area is threatened with mudflows and 32% of the area is situated in the high mudflow risk zone. Anthropogenic activity, such as deforestation, irrigation and land use practices, as well as improper grazing systems adoption on the communnal property lands, increase frequency and magnitude of floods, landslides, avalanches, and storms, and intermitant droughts, the total costs of which is modestly estimated to account for about 115 million TJS.

22. In Tajikistan only 93% of urban population and 61% of rural population has access to improved source of drinking water. The costs associated with inadequately protected water supply, sanitation and hygiene include costs of mortality and morbidity from Diarrhea, Hepatitis A, Typhoid and Paratyphoid and averting expenditures associated with household boiling of drinking water. The cost of health impacts represents an estimated 95 % of total mean cost, and averting expenditures about 5 %. While rural areas account for 70 % of total cost, urban areas account for the rest 30 The estimated total cost associated with inadequate water supply, sanitation and hygiene is at about 110 Million TJS.

23. Indoor air pollution is mainly due to use of traditional fuels; acute respiratory illness in children represents 40% of cost; respiratory child mortality represents 34%; chronic obstructive pulmonary disease mortality in adult females and ARI morbidity in adult females represent 13% of cost each. Rural population bears 93% of the total cost of indoor air pollution, reflecting much higher load on poor households with above average number of children under 5. The estimated total annual cost of indoor air pollution is at 74 million TJS

24. Degradation of rangelands is due to desertification and denudation of vegetation from frequent drought and continuous overgrazing of lands around the

proximity of the villages. The communal nature soviet style farming system and the tragedy of the commons lead to improper grazing and degradation of grazing lands. Annual cost of rangeland degradation is estimated at 53 million TJS using two methods: market value and foregone livestock income from fodder losses.

25. The damages due to urban air pollution that constitute about 0.5% of the GDP are from deterioration in air quality as a result of particulate matter mainly related to air pollution from transportation. The mean estimated annual cost of urban air pollution due to PM is about 32 million TJS of which about 88% of the cost is due to mortality, and the remaining 12% is associated with morbidity. Measured in terms of DALYs, mortality represents 63% and morbidity 37%.

26. The estimate of costs associated with lead exposure is based on the loss of intelligence quotient and mid mental retardation. The estimated annual cost associated with lead exposure is at 15 Million TJS. As there is considerable uncertainty about the data on lead levels in blood in urban population and rural population in Tajikistan, the estimates presented here are only for the children under 5 in urban population of the cities with more than 100 thousand inhabitants.

27. The costs of deforestation include direct and indirect use values and non-use values. The direct use values include costs associated with loss of fruit trees and wood lots as fuel-wood production, non-timber products, and tourism and recreation uses. The nonuse values include option values and existence values. It may be noted that the forest cover is only about 3% of the total geographical area and hence the marginal costs of deforestation tends be higher in the country.

28. Among other environmental problems the Tajikistan Aluminum Plant (TaAZ) accounts for about 60-70% of all emissions from stationary sources (21,899 tons, or 68.75% of the total in 2001). A 2002 study found TaAZ responsible for notable fluoride water pollution in the region.

29. Management of industrial, mining and municipal wastes remains on the priority list of environmental problems in Tajikistan. Wastes are mainly generated from mining of mineral resources, chemical and cotton production, uranium tailings, building refuse and municipal wastes. Uncontrolled wastes disposal requires urgent development of modern methods to assess, document, and monitor solid waste disposals and processing and investing in wastes disposal.

30. The cost of environmental degradation in Tajikistan is comparable with other countries with similar income level. Studies of the cost of environmental degradation conducted in Pakistan, a low income country in Asia, and several other low and lower-middle countries in Asia, Africa and Latin America show that monetary value of increased morbidity, mortality and natural resources degradation typically lies from 4% to 10% of GDP, compared to 9.5% of GDP in Tajikistan.

31. Climate change costs were not quantified in the report due to the lack of consistent scenarios of negative impacts. On the qualitative level it is proved that increasing temperature and changing precipitation patterns are among the major reasons for recent extreme weather events in Tajikistan. Changing climate leads to glaciers retreat, water shortages, increased frequency and magnitude of natural disasters, as well as alters hydropower development and increases pressure on agriculture. Human health and ecosystems will be affected in the long run. Further analysis is needed to estimate annual losses due to climate change given current uncertainty of the climate models.

32. The burden of these costs falls most heavily on vulnerable groups. The poor are exposed to higher environmental risks than higher-income groups, and lack the resources to mitigate those risks. Environmental health impacts often have more severe repercussions on the poor than on the non-poor, because the latter tend to have more resources to cope with such events, better access to health services, and better health in general. Environmental impacts and natural disasters can also result in a loss of income or assets that is more detrimental for the livelihoods of the poor than for those of the non-poor.

Conclusions and recommendations

33. The analysis revealed that there are opportunities for improving environmental sector and its performance in the country. The cost of environmental degradation reveals the focus areas for such an improvement. For the nearest future, major focus should be on efficient land and water resource management, soil fertility and moisture conservation which are of critical importance for the productivity of agriculture, the prevention of human health risks, and energy security in Tajikistan. In longer term, the cost of environmental degradation will be exacerbated by climate change. Also, the priorities may be shifted overtime. Therefore, the improvement of monitoring, information systems, and forward looking risk analysis are essential. Due to multimedia and multidisciplinary character of the underlying problems, there is a need for robust interagency coordination. Along with strengthening of SCSNREP other agencies may also play an important role, for example: the State Committee for Emergency, the Water Management Authorities, and the Ministry of Energy At the same time, mitigation of environmental degradation costs should be closely linked with poverty alleviation strategy of Tajikistan (PRS).

34. Immediate measures should include improvement of land and cropping system management techniques with appropriate irrigation infrastructure rehabilitation, where it is viable. This is essential for sustaining and increasing the farm production and, furthermore, reducing microbiological and chemical contamination of surface and groundwater. Appropriate crop diversification and production practices instead of continued monocropping practices enhances employment opportunities and is an important factor of poverty alleviation in rural areas. Improved irrigation policy in combination with improved land management practice will reduce vulnerability to natural disasters. Taking into account specifics of Tajikistan, access to potable water and alternative energy sources like small hydropower will create highest value added with respect to mitigation of the current and future environmental degradation cost. Also, small hydro and improved stoves programs are important in reducing indoor air pollution related to solid fuels used for cooking. These and other recommendations related to general improvement of institutions and management are summarized in the table below.

Table 1: Recommended Actions

Objective	Recommended Short-term Actions
Institutional reform	• Develop a priority-setting mechanism based on: (a) the impacts of environmental degradation on the poor and other vulnerable groups, (b) the most urgent needs as perceived by the population, and (c) the major costs and risks that environmental degradation infringes on the overall society • Establish a planning process to align environmental expenditure with priorities • Establish Environmental Health Service within the SCSNREP to regulate environmental quality parameters that affect health including (i) emission of $PM_{2.5}$, lead, toxic pollutants; (ii) fuel quality to tackle air quality; and (iii) water quality parameters such as bacteriological quality, Persistent Organic Pollutants (POPs), Volatile Organic Compounds (VOCs) and heavy metals. It includes improvement of the infrastructure for monitoring emissions and fixing of liabilities on the polluters. • Ensure transparency in receipts and allocation of the environmental funds for improved planning and prospects for funding in the future • Develop a comprehensive database on available natural resources and resource use to facilitate a more transparent monitoring of actual natural resource depletion/use levels • SCSNREP to strengthen its capacity to coordinate and foster consensus-building among sectors.
Policy reform	• Establish effective legal systems and norms to monitor and enforce pollution regulations from manufacturing industries • Reforms in setting Maximum Permissible Discharge of hazardous pollutants (mostly into water bodies) based on environmental standards that are realistic, considering economical and technical efficiency issues • Reform of economic incentives for pollution reduction, misapplication of the irrigation waters. • Reform of economic incentives to prevent uncontrolled use of natural resources resulting in depletion and degradation
Reduce soil degradation	• Conduct/update new national inventories of (1) soil erosion and (2) soil salinity and fertility status, • Undertake soil and moisture conservation activities with special incentive to introduce biological methods of soil conservation techniques with vegetative barriers across the gradient, encourage rational use of water Rehabilitate irrigation and drainage infrastructure where it is feasible and cost effective. • Revise the Water Laws to authorize local communities to organize Water Users's Associations, to authorize them to collect rational , broad-based fees for O & M of water resources and its management services. • Improve land tenure registration system, encourage appropriate land management practice, provide information access to villagers on land use pattern with the use of zooming and mapping with modern geospatial tools • Introduce laws against irrational land unauthorized felling of trees, at the same time encourage with special incentives for tree planting programs
Reduce vulnerability to natural disasters	Adopt structural and nonstructural measures to reduce vulnerability to natural

	disasters, including the adoption of adequate construction technologies, practices, and standards in poor urban sectors and among the rural population
Reduce health risks associated with inadequate water supply, sanitation and hygiene	• Promote hand-washing programs that target children under the age of 5 • Promote safewater programs that include disinfection of drinking water at point-of-use • Rehabilitate aging water supply and sanitation infrastructure
Reduce cost of environmental degradation associated with indoor air pollution	• Promote small hydro and other cleaner fuels in areas that predominantly use solid fuel, and implement actions to improve availability and access to solid fuel users in a safe and cost-effective manner • Implement a program to promote improved stoves and biogas production from solid wastes
Reduce health risks associated with ambient air pollution	• Establish national ambient standards for PM2.5 and PM10 in priority urban areas and strengthen technology-specific emission standards for PM and its precursors (particularly sulfur and nitrogen oxides) • Implement an air quality monitoring program to monitor PM2.5, PM10, and ozone in priority urban areas • Implement air pollution control interventions aimed at reducing automobile emissions. The measures to reduce emissions include eliminating leaded gasoline, improving the quality include of the fuel, particularly the imported fuel, and improving the system of maintenance and inspections of the transportation fleet.
Reduce deforestation	• Improve land management practice through zooming and mapping with geospatial tools use, regular monitoring and updating of land use pattern of rangeland pastures, introduce practice of compartmental grazing and replanting of fruit and nut trees , balanced and regulated winter and summer pasture usage by the village management (Jamaot) committee instead of rain administration with appropriate fee for technically guided improvement of rangelands. • Development of legal system to protect biological and landscape diversity and development of better database on biodiversity in the country.
Reduce unauthorized disposal of industrial and municipal wastes	• Development of an effective system of waste management (collection, disposal and recycling) and effective environmental monitoring, particularly near waste management sites and landfills

35. In the longer term it is important to develop coordinated soil and moisture conservation systems in vast pasture lands of mountain areas and efficient water management systems in irrigated valley lands, and hydro power generation plans, enhancing cross country coordination and electricity trade, as well as to incorporate risk assessment policies across the various ministries and functional areas, from development planning to watershed management and hydro power projects. At the same time there is a need for follow-up work to do a more detailed analysis on which policies and investments would provide the largest benefits.

I Introduction

1.1 Economic performance and environmental challenges

Tajikistan is a small mountainous land locked Central Asian country with an economy that heavily depends on exports of cotton, aluminum and hydroelectricity—three rather environmentally sensitive sectors and remittances from migrants living abroad[3]. The macroeconomic performance has been impressive since the end of the recent civil war; the Gross Domestic Product (GDP) has been growing at an average rate of 8.7 %[4] in the last five years. The country has a population of about 7 million in 2007, of which about 75% live in rural areas and are dependent on agriculture. It has a per capita GDP of $390 which is lowest among the 15 former Soviet republics. The population has been growing at about 1.3% during 2002-2006 and the percapita income at 5.9 %. Table 1.1 below presents the summary of the development indicators in Central Asian countries.

Table 1.1: Summary of Development Indicators in Central Asia

	GDP/capita PPP USD, 2007	GDP growth, 2002-2006,%	Population, 2007, million	Pop growth 2002-2006,%	Life expectancy 2005	Adults literacy rate, 1995-2005,%	Under 5 mortality per 1000 live births, 2005	Undernourished population, 2002-2004,%	Population with improved water source, 2004,%	HDI 2007/2008
Tajikistan	1,600	8.8%	7.1	1	66.3	99.5	71	56%	56%	0.673
Turkmenistan	9,200	13% in 2007	5.1	1	62.6	98.8	104	7%	72%	0.713
Uzbekistan	2,200	7.6%	27.8	1	66.8	...	68	25%	82%	0.702
Kazakhstan	11,100	10%	15.3	0.5	65.9	99.5	73	4%	86%	0.794
Kyrgyz Republic	2,000	3.4%	5.3	1	65.6	98.7	67	6%	77%	0.696

Source: http://hdrstats.undp.org/countries/data_sheets/; http://ddp-ext.worldbank.org/ext/DDPQQ; https://www.cia.gov/library/publications/the-world-factbook

Social indicators are relatively strong in Tajikistan, even admitting existing data gaps and inconsistencies, although the recent civil conflict might have affected the pace of progress. In 2005, the life expectancy at birth was at an average of 66 years. Literacy rates in 2000 were as high as 100 % for males and 99 % for females. The net primary and secondary school enrollment ratios in 2005 were 97 and 80 % respectively. Both infant and child mortality rates declined over the period 1995 through 2005. The infant mortality rate and child mortality rate in 2005 were 59 per 1000 live births and 71 per 1000 respectively. In 2005, about 59 % of the population had access to improved potable water source, which shows a marginal decline from 61 % in 1995. Access to improved sanitation also fell marginally from 52 % in 1995 to 51 % in 2004. Although the prevalence of HIV is less than 0.1 %, recently there has been an increase in the incidence of tuberculosis in the country, increasing from 65 per 100,000 people in 1995 to 198 per 100,000 people in 2005.[5]

[3] There has been an increasing inflow of remittances recently.

[4] Average GDP growth rate at constant prices over the period 2002-2006

[5] World Development Indicators.

The country's program of structural and institutional reform centers on the following three pillars (a) reform of the public sector management, (b) development of private sector and attracting investments, and (c) development of human potential.

Environmental degradation and unsustainable use of natural resources including land and water are clearly constraints to sustainable economic growth and poverty reduction. With more than half of its territory situated above 3,000 meters, the country is particularly vulnerable to natural disasters. The country's economy deeply suffered from both the disintegration of the Former Soviet Union in 1991 with the break down of the centrally commanded intricate system of supply and services and the bitter Civil War that erupted in 1992. Impoverished by sudden shortages of fuel, income, and food, the population dependent on the soviet production system that abruptly came to a grinding halt lost their source of income, were forced to revert to subsistence practices, which put an extra burden on the natural resources and the environment of the country.

The environmental challenges in the country, according to the recent National Environmental Action Plan (NEAP) are (i) land degradation, including deforestation, degradation of vast area of winter and summer pasturelands and fruit and nuts tree plantations in mountain areas, arable and irrigated lands; (ii) lack of improved drinking water and water quality deterioration; (iii) waste pollution from agriculture and industry; (iv) deficiencies in sewerage system infrastructure and management; (v) uncollected and untreated solid waste; (vi) environmental hazards and natural disasters like droughts and floods; (vii) shortages in energy supply; and (viii) lack of environmental education.

The completion and approval of the NEAP in 2006 has brought much attention to the environmental challenges faced by the country and resulted in a public debate. The recent National Development Strategy 2015 and the Second Poverty Reduction Strategy Paper also recognize the importance of addressing environmental issues for growth and poverty reduction. The momentum thus created by these developments provides a window of opportunity to review and improve environmental management and policies based on an analysis of the performance of environmental institutions (since the creation of the Ministry) and the key environmental challenges that Tajikistan is facing. Such analysis will help the environmental authorities develop policies and interventions that take advantage of potential win-win opportunities, assess tradeoffs, and find the economic and social balance between protecting and restoring a deteriorating environment and avoiding unrealistic regulations that might hinder competitiveness and investment.

1.2. Rationale

The World Bank is supporting policy and institutional reforms in a number of areas through the Tajikistan Programmatic Development Policy Credit (PDPC) (Development Policy Lending) operation. These are aligned with the first two pillars of Tajikistan's PRSP: to improve the environment for private sector development, and to improve overall functioning of the public sector and the delivery of key public services. To promote private sector development, the PDPC program will support measures to reduce the cost of doing business, promote transparency of the privatization process, and assist with regulatory and institutional reforms in key strategic sectors (aviation, cotton, and energy). To improve the overall functioning of the public sector and improvements in the delivery of public services, the PDPC program will support public sector reforms aimed at

improving public sector management, and the efficiency and effectiveness of public spending. The program will also support reforms in education and health sector policies to improve access, quality, and equity of services.

Under the new Operations Policy (OP/BP 8.60) on Development Policy Lending (DPL) it is now required that the Bank determine whether specific country policies supported by the operation are likely to have significant effects on the country's environment and natural resources. For policies with likely significant effects, there should be an assessment of the relevant analytic knowledge of these effects and of the borrower's systems for reducing adverse effects and enhancing positive effects associated with the specific policies being supported. While Environmental Assessments (EAs) undertaken as a part of the Bank's safeguards process are very project specific, the environmental review of a DPL is expected to be much broader, and aimed at building country capacity to mitigate broader environmental effects resulting from policy reforms. There is much emphasis in the new policy on undertaking upstream analytic work, such as Country Environmental Analyses (CEAs) and Strategic Environmental Assessments (SEAs), especially in countries where Bank is a major driver of the development agenda through DPLs.

In the case of Tajikistan, the Bank is supporting reforms in key sectors like cotton, energy, and private sector development that may have impacts on environment and natural resources. The Bank is also supporting Tajikistan in implementing a community agriculture development program on watershed basis where Integrated models that enhance agricultural productivity and address land degradation adapted to conditions prevalent in high Mountain Regions of Tajikistan. The CPIA scores also indicate that the environmental institutions are weak in the country. The Country Environmental Analysis is designed to assess the environmental challenges in the country, economy environment interactions and status of environmental institutions and identify a phased approach to fill the gaps and build capacity of these institutions.

1.3. Objectives

The significance of natural resources in the development process continues to remain vastly underestimated in policy deliberations in Tajikistan. In part this reflects the absence of credible quantitative evidence on the economic effects of environmental and resource degradation and understanding of the critical linkages between broader policy reforms and their implications for environment and resource base. The objectives of the Tajikistan Country Environmental Analysis (CEA) are:

- To deepen the understanding of the economic costs of country's major environmental challenges;
- To assess institutional capacity within the country for sound environmental management; and
- To help strengthen institutions and governance to enhance environmental outcomes.

The CEA will improve the analytic basis of indicators with respect to environmental issues and thus enhance the short term and long term strategic goals of the PRSP. In addition to

the Government of Tajikistan, the findings of the analysis are also expected to guide support of the Bank and other development partners to strengthen capacity in Tajikistan for sound environmental management.

1.4. Key Issues

The CEA presents an in-depth analysis of critical environmental challenges and institutional and implementation issues and propose specific recommendations with a short- to medium-term focus. The focus of the environmental challenges is on the natural resources and factors of production that underpin economic growth and include: environmental health, the degradation of arable land, the rangelands, and natural disasters. More specifically, the key areas of focus are:

Human Capital Losses Associated with Environmental Degradation
Using existing data sources and conventional measurement techniques the CEA assesses the burden of disease due to environmental factors and computes the economic loss associated with environmentally related mortality and morbidity. The analysis includes (but not restricted to) losses resulting from: water-borne disease; poor sanitation; indoor air pollution; outdoor air pollution and lead poisoning.

Soil Degradation
Agriculture remains Tajikistan's principle occupation and accounts for approximately 24 % of GDP in 2006. Only 6% of the land area is arable; cotton is the most important crop. There is abundant evidence of stagnating yields and widespread degradation of the soils on which the agricultural sector depends, due to improper land use practices and adoption of monocropping, system. Salinity and water logging, both partly a consequence of profligate irrigation methods, and faulty drainage and heavy machnary usage, remain major threats to the agricultural sector's productive potential. The CEA quantifies the economic loss attributable to soil degradation (including salinity and water logging), as well as consequences of sedimentation leading to silting up of reservoirs reducing their capacities and silting up of canal and drainage systems and/or nutrient loss de to excewss water flow and leaching..

Rangeland Degradation
Natural pastures in Tajikistan occupy more than 3.5 million hectares. The rangelands are an important economic resource that can be efficiently harnessed for expanding and sustaining livestock population, large pastoral communities and the country's increasingly vulnerable biodiversity. Estimates suggest that much of the poor capcacity and quality rangeland is threatened by poor stocking and improper management and restoration of the natural vegetation. In Tajikistan, about 85% of the pastureland has been overgrazed around the immediate vicinity of the villages leaving farthest pastur lands unutilized/underutilized, so the potential profitability of livestock operations is declining, and desertification is increasing. The problem is particularly widespread in valleys and near villages of the Khatlon and in the Sughd regions. (NEAP 2006). The CEA quantifies the economic losses of unsustainable use of the rangelands.

Forest Resources

Wooded forests occupy a relatively small proportion of the land area in Tajikistan (some 3 %), but nevertheless play a vital role in the country's economy. Forests remain an important source of fuel wood, grazing land, livelihood and government revenue. Forests also provide multiple ecological-services such as water shed protection, soil protection, biodiversity habitat and play a vital role in assuring eco-system resilience (i.e. stability). The reduction of wooded forest area and low tree density exacerbated the soil erosion and mudflow causing natural disasters in 1992-1999. Since the 1970s, the area of Tajikistan's forestlands did not vary significantly, although the average wood stock has been reducing and now it is around 70% comparing to the former period. (Tajikistan 2002. State of the Environment Report). The CEA assesses the economic losses due to deforestation using the available data.

Natural Disasters

Poorer green cover and vegetation and fragile soil structure of the mountain area lead to incidence of dozens of landslides, hundreds of mudflows and avalanches in Tajikistan annually. The processes of deep soil erosion, gully formation, land slides, and deep depressions characterize many areas. About 80% of the reported natural disasters occur within the Gissar-Alai mountain system. Also, some 85% of Tajikistan's area is threatened with mudflows and rock boulders rolling down the fragile mountain area. About 32% of the valley area is situated in the high mudflow and boulder move risk zone.[6] The CEA focuses on 2-3 types of disasters directly related to anthropogenic activity (indiscriminate felling of forest trees and defective land use pattern of agricultural practices) causing the largest costs to society by way of flooding and land slides. There is therefore a very high potential for reductions in disaster impacts.

Climate Change[7]

Temperature rise leads to glaciers melting that is potentially disastrous to water supply in Central Asia. It alters development of major sectors of the Tajikistan economy including agriculture, water and electricity supply through deterioration in the river flows and consequent hydropower potential reducing the irrigation potential in the most affected river basins. Valuable tugai ecosystem could degrade because of shortage of water resources, reduction in vegetative cover leading to food shortages, increase in temperature, and enhaced fire risks. Land degradation could exacerbate due to longer dry periods and higher temperature in spring and summer. Adaptation policy suggests harmonized approach to soil and water conservation int eh uppercatchment, efficient and rational water use including potable water supply, effective irrigation and hydropower development.

1.5. Methodology and Approach

The analytical framework for the study uses both primary and secondary data sources, and is based on three types of analyses:

[6] Tajikistan 2002. State of the Environment Report.

[7] Climate change cost were not quantified in the report due to the data gaps and high uncertainty of climate change scenarios in he mountainous areas.

Cost of Environmental Degradation: A systematic exercise using state-of-the-art methodology is undertaken to assess the roots and economic costs of environmental degradation. This will help the government and other stakeholders to rank environmental concerns in Tajikistan, and identify the sectoral sources from which these concerns stem.

Policy, Legislative and Regulatory Analysis: The CEA provides an analysis of the laws, policies and regulations applicable to the environment and sustainable development. This includes stocktaking of existing laws, policies and regulations as well as an assessment of their effectiveness and relevance to Tajikistan's current challenges and environmental priorities. A gap analysis is undertaken to determine legal, policy and regulatory areas that need strengthening and provide suggestions as to the mechanisms for policy formulation, policy goal setting and trade-offs, and cost-effective measures for achieving desired outcomes.

Assessment of Institutional Capacity, Incentives and Constraints: Historically, the institutional framework for environmental management in Tajikistan has been inconsistent, the policy framework has lacked an integrated approach, and implementation is also weak. These problems have been compounded by an extended period of political instability, misplaced prioritization under the constrained budgets where environmental issues received minimal attention from the government. The result has been an often changing and highly centralized institutional and policy frameworks that suffer from institutional overlaps, lack of adequate resources and lack of sectoral coordination.

The CEA assesses the environmental management capacity of public agencies at national and sub-national levels. This is based on review of existing capacity in terms of plans, processes and personnel for environmental management in key institutions. The review specifically examines mechanisms and incentive structures for integrating environmental priorities in economic and sector-wide programs such as presence of well-resourced environmental units in key ministries, application of economic instruments, and capacity for environmental decision making and inclusively articulated participatory resource management in municipalities and district assemblies. The CEA identifies gaps in institutional capacity and recommends measures for restructuring and strengthening based on stakeholder discussions and available best practice. This will be the basis for the institutional reforms in the PDPC (DPL).

Environmental Licenses and Permits: More specifically, the CEA also examines the issue of environmental licenses and permits in the context of broader reforms in the area of licenses and permits supported under the PDPC. The aim of reducing the time to set up a business can place undue pressures for environmental clearances, which in some cases need time. The staffing in the environmental agencies is also assessed to meet with the demands for a more timely delivery of initial clearances and for the follow up monitoring.

Privatization: Privatization of certain environmentally sensitive industries (such as cement and aluminum) could have serious environmental implications if there is no adequate framework to deal with legacies of past pollution. This in many transition countries has in fact led to prolonged litigation with adverse impacts on the privatization process itself. The CEA examines the current framework to deal with legacies of past pollution or how to build this into the privatization efforts. Experiences from other countries are drawn up to recommend the legal framework so that mistakes of other countries are not repeated.

1.6. Structure of the Report

This report is arranged in seven sections. The first section develops the country context, the key environmental challenges, the rationale, objective and methodology followed. Section II provides the overall estimates of social and economic costs of environmental damage in Tajikistan. Section III presents annual costs associated health losses linked to environmental degradation, including inadequate water supply, sanitation and hygiene, indoor/outdoor air pollution and exposure to lead. Estimates of annual losses due to degradation of natural resources are presented in Section IV. They include land degradation due to irrigation, secondary salinity, water logging and irrigation-related soil erosion, soil erosion in rain fed farmlands, degradation of pasture lands, deforestation and related loss of biodiversity, and losses due to natural disasters in the country. Costs of climate change and hydropower development problems are reflected in the same section. An assessment of the existing institutions and the regulatory framework and the issues in enforcement of the policies and regulations is presented in Section V. The Section VI has an account of the organization structure and environmental governance in the country. The final section has the conclusions and policy recommendations.

II. Cost of Environmental Degradation

Environmental pollution, degradation of natural resources, natural disasters, and inadequate environmental services, such as improved water supply and sanitation, impose costs to society in the form of ill health, lost income, and increased poverty and vulnerability. This section provides overall estimates of social and economic costs of environmental damage in Tajikistan.

The estimated total cost of environmental damage in the country is about 690 Million TJS per year (Table 2.1 and Figure 2.1), accounting for about 9.5 % of the GDP in 2006. The costs were estimated for eight different damage categories. Among the eight categories of damages, costs of damages from land degradation, including soil erosion, loss of fertility and salinity was the highest, 39.3 % of the total cost of damages (3.7 % of the GDP); followed by cost of natural disasters (115 Million TJS) and then damages due to inadequate water supply, sanitation and hygiene (112 Million TJS). The cost of damages due to indoor air pollution was 74 Million TJS; rangeland degradation 53 Million TJS; cost of urban outdoor air pollution 33 Million TJS and lead poisoning 17 Million TJS. The smallest cost category is for deforestation at 15 Million TJS. This however does not account for loss of wild berries, fruits, and nuts having high food value, medicinal plants, in the mountainous forest area due to lack of official data.

The analysis shows that environmental degradation causes significant damages to the economy accounting for as high as 9.5 % of the GDP of which land degradation alone accounts for 3.8 % (Figure 2.2) followed by cost of natural disasters at 1.6 % of the GDP. The other cost categories are damages from inadequate water supply, sanitation and hygiene (1.5% of the GDP); indoor air pollution (1%); urban air pollution including outdoor air pollution cost from particulate matter and cost of lead poisoning (0.7%). Land degradation alone shares for 39 % of the total cost of environmental degradation in the country followed by natural disasters (Figure 2.2). Lack of adequate supply of improved water, sanitation and hygiene and indoor and urban air pollution together accounted about 35 % of the total damages.

In addition to the mean estimates, "low" and "high" estimates of annual costs are presented in Table 2.1. The range for water supply, sanitation and hygiene is in large part associated with uncertainties regarding estimates of diarrheal child mortality and morbidity. In the case of urban air pollution and natural disasters two different valuation techniques for estimating the social cost of mortality have been applied which yielded the "low" and "high" estimates. The range for indoor air pollution is mainly from the uncertainty about the exposure level to indoor smoke from the use of fuel wood, and thus a range has been applied for the level of health risk. The range for agricultural soil degradation is associated with uncertainty of yield losses from salinity. The range for deforestation is associated with the uncertainty of the use and non-use benefits of forest and the range for lead exposure is mainly related to the uncertainty of loss of lifetime income due to the loss of cognitive ability.

Figure 2.1: Annual Cost of Environmental Damage (Million TJS per year)

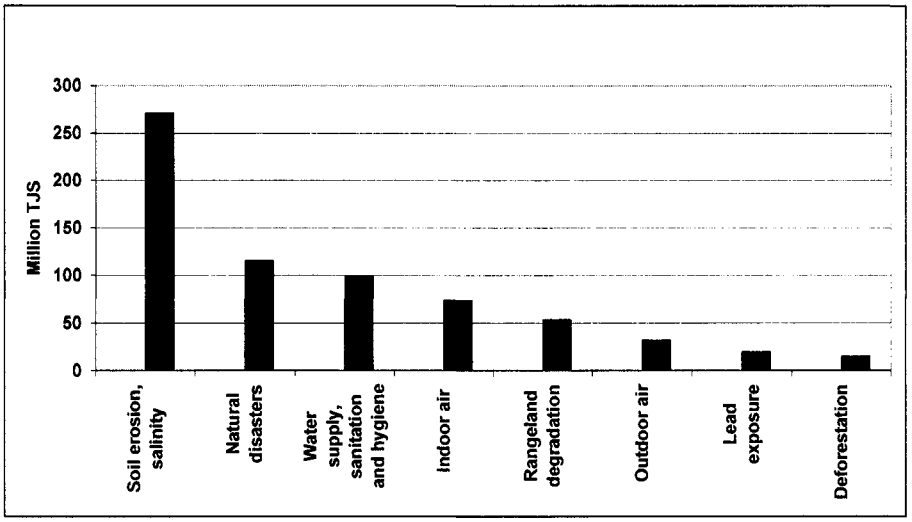


Figure 2.2: Annual Cost of Environmental Damage (% of GDP)

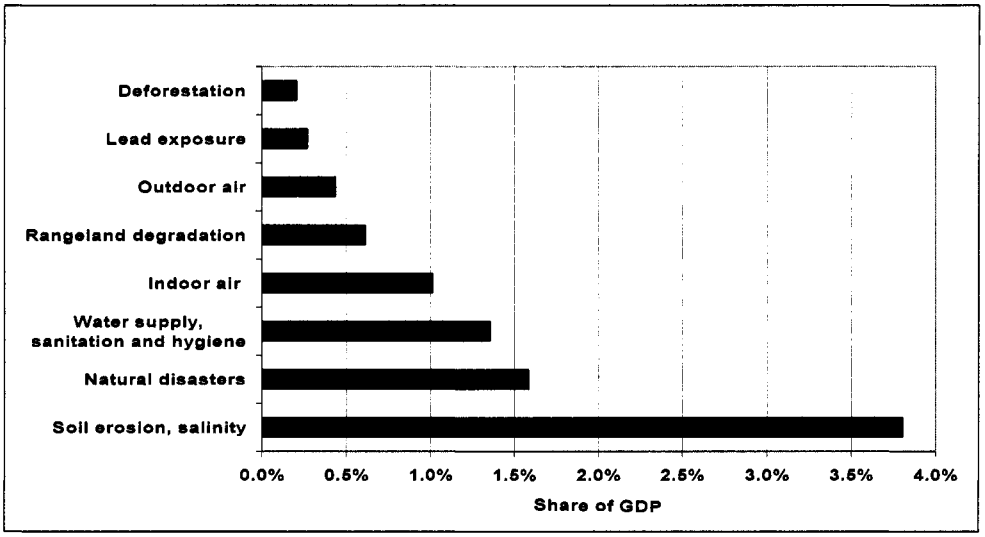
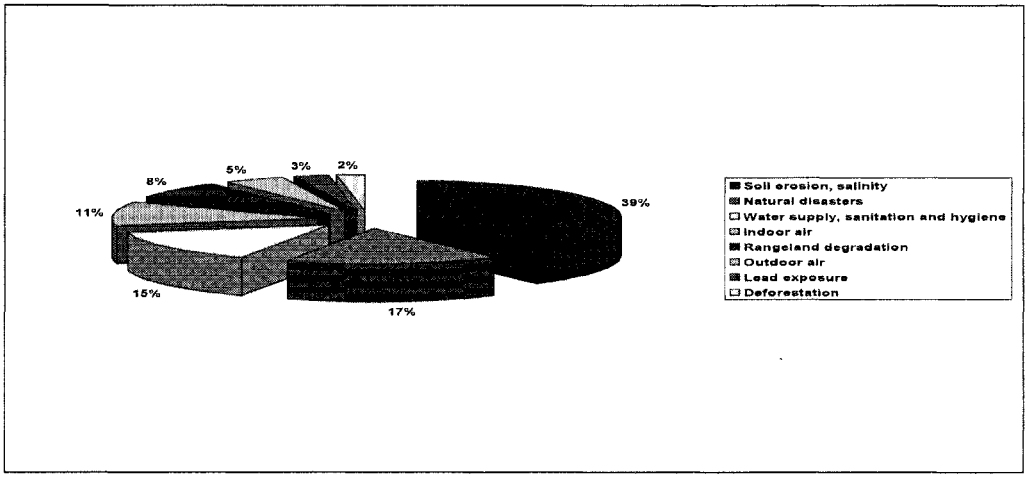


Figure 2.3: Relative share of Damage Cost by Environmental Category



A survey on the awareness of the public on environmental problems in Tajikistan showed that the general public considers land degradation, natural disasters and problems due to inadequate supply of improved, sanitation and hygiene as the major environmental problems in the country (Table 2.1), receiving highest rankings. These results are consistent with the study estimates of costs of environmental damages presented in Table 2.2.

Table 2.1: Prioritization of Environmental Problems by Population in Tajikistan

	Urgency coefficient*
Inadequate use and pollution of water	0.83
Desertification and soil degradation	0.77
Natural disasters	0.63
Biodiversity preservation	0.62
Mountain ecosystems degradation	0.62
Inadequate waste management	0.61
Inadequate ecotourism	0.56
Air pollution	0.53
Climate change	0.51

*For the most urgent the coefficient is equal to 1.
Source: Adapted from CARNet (2004)

The costs of damages associated with environmental health are distributed unevenly across the population. Figure 2.4 presents estimated costs per capita due to exposure of general population to environmental health risks. Losses due to outdoor air pollution and lead poisoning losses were estimated for the inhabitants of the cities with population over 100 thousand; costs of inadequate water supply, sanitation and hygiene costs were estimated for the whole population of Tajikistan; and indoor air pollution costs were estimated for the households that use solid fuel for cooking (about 40 % of households). Outdoor urban air pollution has the highest cost on a per person basis followed by damages due to indoor air pollution. Among the estimated cost items, inadequate water supply and sanitation has the lowest cost on a percapita basis. However, when comparing these estimates it should be noted that the entire population of Tajikistan is included in the estimation of damages

due to inadequate water supply, sanitation and hygiene. In the case of indoor air pollution the estimate is based on about 40 % of all Tajikistan (households are considered to bear indoor air pollution losses) but only 46 % of urban population was analyzed for the outdoor air pollution exposure.

The analysis shows that while almost all of the rural population is potentially experiencing losses from inadequate water supply, sanitation and hygiene, as well as from indoor air pollution, data on the proportion of urban population affected is less reliable. Similarly data on ambient air quality are available for only 46 % of the urban population and the analysis did not cover the remaining 54 % of the urban population although they suffer both from outdoor air pollution and inadequate water supply, sanitation and hygiene. The poorer sections of the population who live in big cities and use solid fuel for cooking, seem to be more affected by the environmental damages; those. A more detailed analysis would be needed to estimate the distributional impacts of such damages.

Figure 2.4: Estimated Cost of Environmental Health Effects per Person Exposed (TJS per Year)

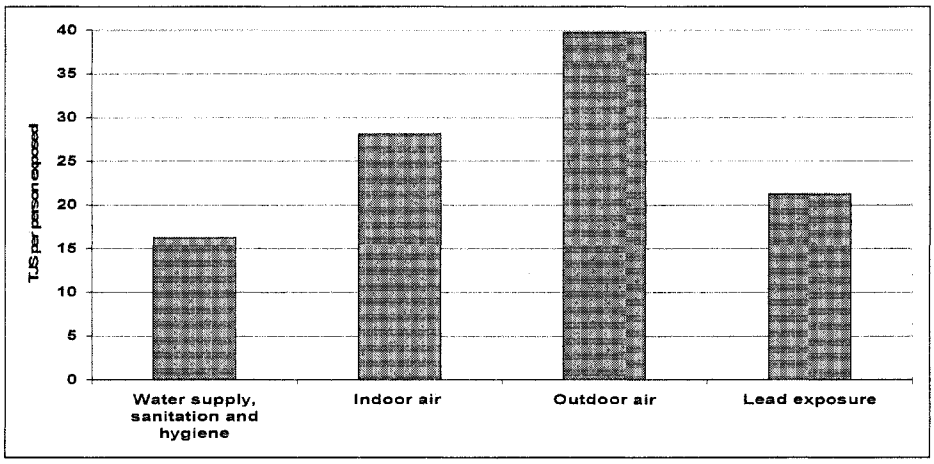


Figure 2.5 presents the burden of mortality related to environmental causes as %age of total mortality among adults and children under-5 years in Tajikistan. About 2 % of adult mortality is attributed to outdoor and indoor air pollution, and about 17 % of under-5 child mortality is attributed to inadequate water supply, sanitation and hygiene and indoor air pollution.

Figure 2.5: The Burden of Mortality Related To Environmental Causes

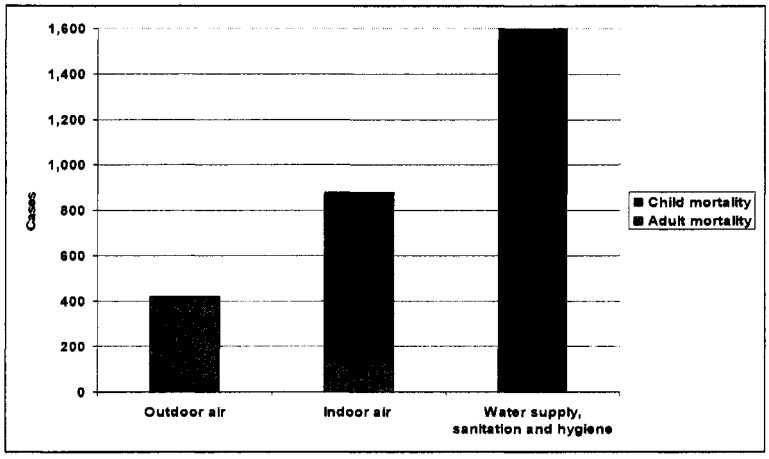


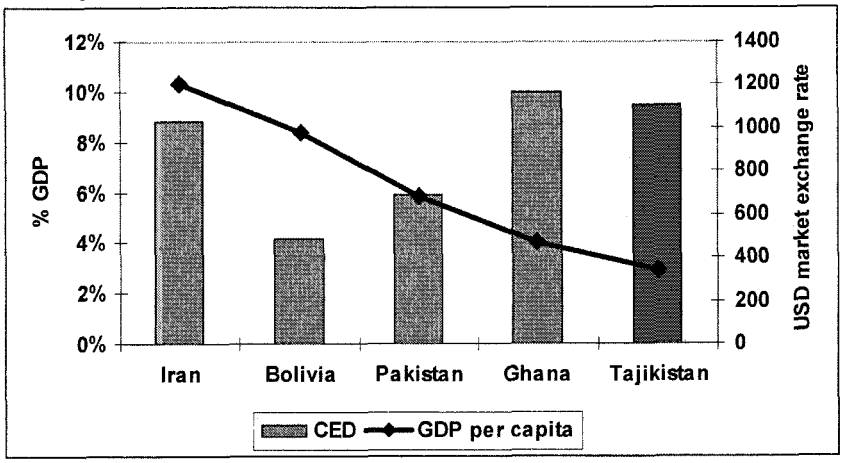
Table 2.2: Annual Cost of Environmental Damage – Low and High Estimates (Million TJS per year)

	"Low"	**Mean Estimate**	"High"
Environmental Categories			
Soil degradation*	202 (39.1)	270 (39.1)	340 (35.0)
Natural Disasters	33 (6.4)	115 (16.7)	200 (20.6)
Water supply, sanitation and hygiene	104 (201.1)	112 (16.2)	120 (12.4)
Indoor air pollution	66 (12.8)	74 (10.7)	82 (8.4)
Rangeland degradation	82 (15.9)	54 (7.8)	131 (13.5)
Outdoor air pollution	7 (1.4)	33 (4.8)	58 (6.0)
Lead exposure	14 (2.7)	17 (2.5)	20 (2.1)
Deforestation	9 (1.7)	15 (2.2)	20 (2.1)
Total annual cost	517 (100)	690 (100)	971 (100)

(Figures in parentheses are %ages of total) * Erosion and salinity of cultivated land and does not include loss of valuable orchards, fruits and nut trees like wild pistachio, almonds, hazelnuts, walnuts, etc, due to lack of published data.

The cost of environmental degradation in Tajikistan is comparable with other countries with similar income level. Studies of the cost of environmental degradation conducted in Pakistan, a low income country in Asia, and several low and lower-middle countries in Asia, Africa and Latin America show that monetary value of increased morbidity, mortality and natural resources degradation typically lies from 4 to 10 per cent of GDP, compared to 9.5 % of GDP in Tajikistan.

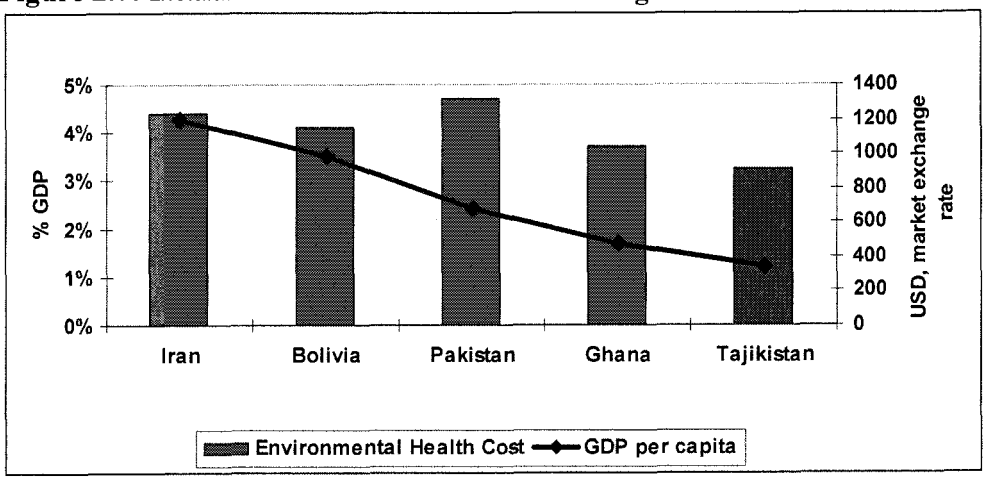
Figure 2.6: Cost of Environmental Degradation (Health and Natural Resources Damages)



Source: Bolivia: Environment and Poverty Policy Note, World Bank, 2006; Islamic Republic Of Iran: Cost Assessment Of Environmental Degradation, World Bank, 2005; Ghana Country Environmental Analysis, World Bank, 2006; Pakistan: Country Strategic Environmental Assessment, World Bank, Volume II, 2007.

The situation looks even more consistent across different countries if one compares health cost of environmental degradation. In all the selected countries they vary among 3-4 % of GDP. In Tajikistan health cost of environmental damage is at 3.25 % of GDP. It includes costs of inadequate water, sanitation and hygiene, cost of indoor and outdoor air pollution, and health cost of lead exposure.

Figure 2.7: Health Cost of Environmental Damage



Source:

Source: Bolivia: Environment and Poverty Policy Note, World Bank, 2006; Islamic Republic Of Iran: Cost Assessment Of Environmental Degradation, World Bank, 2005; Ghana Country Environmental Analysis, World Bank, 2006; Pakistan: Country Strategic Environmental Assessment, World Bank, Volume II, 2007.

III. Environmental Health Losses in Tajikistan

3.1. Urban Air Pollution

UNECE 2004 indicates that approximately 119,000 tons of harmful substances were emitted into the atmosphere in 2003. Industries and energy utilities together accounted for about 34,000 tons of emissions, of which Tajik aluminum plant alone accounted for about 22,000 tons. More recent estimates show that automobile emission is becoming a major source of air pollution in the cities. This is because of the growing number of registered vehicles, the poor quality of fuel and a large existing fleet of old motor vehicles (65% of the fleet is 8 to 30 years old) (UNECE, 2004)). In 2005, pollution from automobiles contributed as much as 83% of total atmospheric emissions or 170 thousand tons. This is more than twice of the emissions estimated in 2000. Other sources of outdoor air pollution are dust storms and burning of waste products.

There is substantial research evidence from around the world that outdoor urban air pollution has significant negative impacts on public health and results in premature deaths, chronic bronchitis, and respiratory disorders. A comprehensive review of such studies is provided in Ostro (2004) and Cohen (2004). The air pollutant that has shown the strongest association with these health endpoints is particulate matter (PM)[8], and especially particulates of less than 10 microns in diameter (PM 10) or smaller.

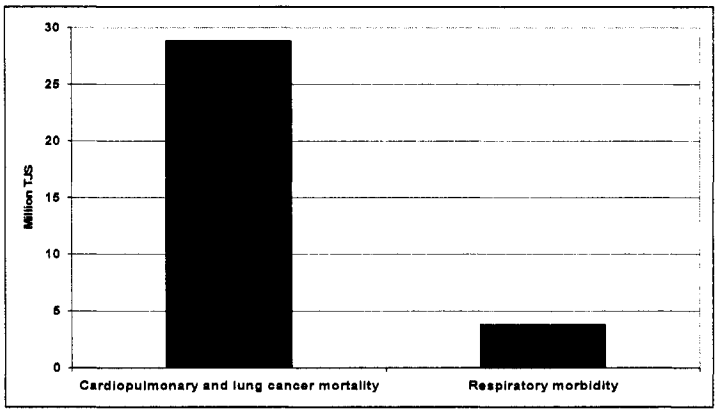
The estimated cost of health effects from urban air pollution in this analysis is based on Particulate Matter (PM) and lead exposure. This section first discusses cost of exposure to PM pollution. Lead exposure is discussed in the latter half of the section.

Particulate Matter

The mean estimated annual cost of urban air pollution due to PM is about 32 million TJS of which about 88 % of the cost is due to mortality, and the rest 12 % is associated with morbidity (Figure 3.1). Measured in terms of DALYs, mortality represents 63 % and morbidity 37 %.

[8] Also called as suspended particulates.

Figure 3.1.1: Annual Costs of Urban Air Pollution (Million TJS)



The focus of this study is on the health effects of fine particulates (PM10 and PM2.5). Three main steps were followed to quantify the health impacts from air pollution. First, the pollutants are identified and its ambient concentration measured. Second, the number of people exposed to the pollutant and its concentration is calculated. The third step then is to estimate the health impacts using data collected and based on epidemiological assessments. Once the health impacts are quantified, the value of this damage as a% of GDP can be estimated.

The present analysis covers only Dushanbe and Khujand, the two cities with population over 100 thousand. Although urban population in the other smaller cities are also exposed to ambient air pollution, due to the lack of monitoring data and estimated concentrations they were not included in the analysis. Total urban population exposed to air pollution is about 0.8 million or 46 % of total Tajikistan population in 2006.

Dushanbe is the capital of Tajikistan with a population of about 0.65 million. It is located in the central part of Tajikistan on the southern slope of Gissar mountain ridge in the valley at the height of about 800 meters above sea level.

State of the Environment in Dushanbe Report, 2001 (CEROI, 2001) reports that in the 1980s concentration of TSP in the atmosphere was about 1.5-3 times the Maximum Allowable Concentration (MAC), with emissions at about 0.15 mg/m3 per annum. The average observed TSP concentration in 2001 was 2.2 times the MAC or about 0.3 mg/m3, which indicates that the TSP concentration fell since the 1980s. (Also, it is estimated that on average TSP concentration has more than halved since then (CEROI, 2001)). Then applying default coefficient 0.5 for the PM10 fraction in TSP (Larson et al, 1999) annual average PM10 concentration is about 80 ug/m3. Using the econometric model developed by the World Bank for the world cities with population above 100 thousand, we have estimated the annual average PM10 concentration in Dushanbe at 59 ug/m3.[1] Similarly using the World Bank model the estimated annual PM10 annual average concentration in Khujand is 84 ug/m3.

Using the information from Annex 3 about applicable concentration-response coefficients that link annual average PM pollution with additional cardiopulmonary mortality and various morbidity end-points (see Annex 3), the annual health effects of ambient

particulate air pollution in Tajikistan are presented in Table 3.1.1. Urban air particulate pollution is estimated to cause around 420 premature deaths annually. Estimated new cases of chronic bronchitis are about 230 per year. Annual hospitalizations due to pollution are estimated at close to 630, and emergency room visits/outpatient hospitalizations at 12.5 thousand per year. Cases of less severe health impacts are also presented in Table 3.1.1 In terms of annual DALYs lost, mortality accounts for an estimated 63 %, chronic bronchitis around 10 % of the total, Restricted Activity Days (RADs) for 12 %, and respiratory symptoms for 9 %.

Table 3.1.1: Estimated Health Impact of Urban Air Pollution

Health end-points	Total Cases	Total DALYs
Premature mortality	420	3,153
Chronic bronchitis	233	512
Hospital admissions	632	10
Emergency room visits/Outpatient hospital visits	12,389	56
Restricted activity days	1,967,046	590
Lower respiratory illness in children	31,131	202
Respiratory symptoms	6,260,339	470
TOTAL		4,993

Estimated Cost of Health Impacts

The estimated annual cost of health damages due to urban air pollution is presented in Table 3.1.2. Cost of mortality is based on the Human Capital Approach (HCA) and the Value of Statistical Life (VSL), ranges from 3 to 55 million TJS. The methodology is discussed in annex 4.

The measure of the welfare cost of morbidity is often based on the willingness-to-pay (WTP) to avoid or reduce the risk of illness. It is often found to be several times higher than the cost of medical treatment and the value of time losses (Cropper and Oates 1992), and reflect the value that individuals place on avoiding pain and discomfort. There are however not a sufficient number of WTP studies from Central Asia. So the Cost-Of-Illness (COI) approach (mainly medical cost and value of time losses) has been applied to estimate morbidity (see Annex 3 for explanation).

Table 3.1.2: Estimated Annual Cost of Health Impacts (Million TJS)

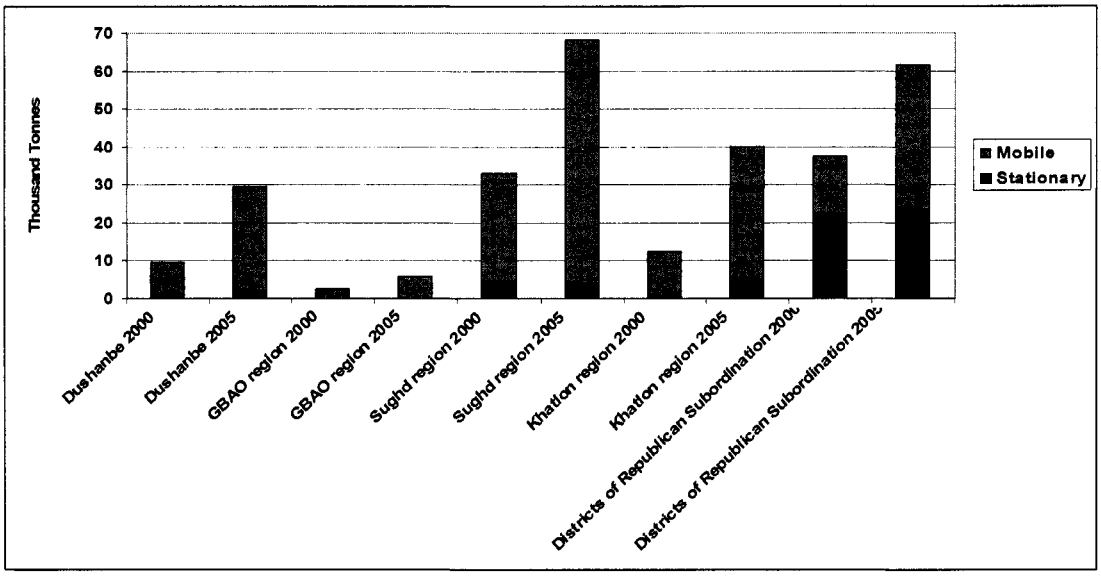
Health categories	Total Annual Cost*	% of Total Cost*
		(Mean)
Mortality	3-55	88%
Morbidity:		
Chronic bronchitis	0.3	1%
Hospital admissions	0.3	1%
Emergency room visits/Outpatient hospital visits	0.5	1%
Restricted activity days (adults)	2.1	7%
Lower respiratory illness in children	0.8	2%
Respiratory symptoms (adults)	0.0	0%
Total cost of Morbidity	4	100%
TOTAL COST (Mortality and Morbidity)	7-59	100%

3.2 Lead

The problem of lead pollution is quite serious in Tajikistan. The main reason is that transportation sector contributes about 70 % of air pollution (Dimitrov, 2004) and gasoline is still leaded. Another source of lead pollution is unregulated wastes incineration.

Emission from automobiles (transportation fleet) is the major contributor of air pollution in Tajikistan. There has been substantial decline in industrial production in the country since 1990s, which led to a change in the sources of air pollution in favor of the automobiles. Figure 3.2.1 presents composition of air pollution from stationary and mobile sources in 2000 and 2005. It may be noted that in 2005 emissions from stationary sources (industry, power plants, etc.) remain at the same lower level as in 2000, while emissions from the transportation sector grew significantly in 2000-2005 period.

Figure 3.2.1: Dynamics of Estimated Air Pollution from Stationary and Mobile Sources (2000-2005)



Source: Environmental Agency, Tajikistan 2007; UNECE, 2004

The Environmental Agency reported that annual increment of the automobile fleet in recent years has gone up at a rate of around 20 % annually. In particular, in 2005 the total number of vehicles was 164,000, which increased to 209,204 in 2006 and then to 234,189 in the beginning of 2007 (Environmental Agency, Tajikistan 2007). The average age of the automobile fleet is 10-15 years, most vehicles purchased in 1996-2000. The prevalence of low incomes leads to continuous ageing of the automobile fleet, and which in turn leads to increases in the volume of emissions. Most of automobile service stations do not have standard diagnostic equipments and trained staff to improve fuel efficiency and reduce emissions. Although there is a system of automobile inspections it is not efficient.

Use of leaded gasoline is still wide spread (Table 3.2.1).

Table 3.2.1: Gasoline specifications in Tajikistan and EU, maximum limits

Fuel grade	Parameter	Tajikistan	EU	
			until 1999	since 2000
76 leaded	Lead	0.17 g/l	banned	banned
93 leaded	Lead	0.37 g/l	banned	banned
Leaded	Lead		0.15 g/l	banned
All unleaded	Lead	0.013 g/l	0.013 g/l	0.013 g/l
All	Sulphur	0.1 wt%	0.05 wt%	0.015 wt%
All	Benzene	..	5 vol%	1 vol%
All	Aromatics	..	..	42 vol%

Source: State Committee for Environmental Protection and Forestry, 2003.
Note: wt% is weight per cent and vol% is volume per cent.

Estimated annual lead emission is 1 kg of lead per vehicle. A vehicle using 1000 liters of fuel on the average emits 200 kg of carbon monoxide, 1 kg of soot and solid pollutants and 200-400 grams of lead and the average consumption of fuel is 10-12 liter per 100km. Lead content in imported gasoline is not measured. Local experts hint that up to 60 % of gasoline is imported illegally and without certification.

The estimated annual cost associated with lead exposure ranges from 14 to20 Million TJS per year, with a mean of 15 Million TJS. This estimate is based on lead exposure from all sources (leaded gasoline, industry and possible other sources such as water, soil, paint and food) for the children under 5 living in cities with more than 100 thousand inhabitants, totaling nearly 0.8 million people or about 50 % of the urban population in Tajikistan.[9] Because of data limitations, only the most significant components of total loss, burden of IQ loss (89 %) and the cost of mild mental retardation (MMR) (11 %) could be estimated. There is no information available on the current Blood Lead Levels (BLL) for the urban population in Tajikistan. The estimated cost of lead exposure is therefore based on Blood Lead BLL measurements in children in Central Asian countries and in Russia with similar gasoline characteristics.

The methodology used to estimate environmental burden from lead exposure is described in (Fewtrell et al, 2003). Since there were several studies available (see Annex 3), a single weighted mean level of lead in blood (BLL) was generated at 6.6 ug/dl in children and 4.0 ug/dl in adults. These average levels are close to the lowest threshold (i.e., 5 ug/dl) for health effects reported in the Annex 3. Nevertheless, part of the population may have a BLL well above this threshold. This is reflected in the standard deviation reported by the studies.

The adjusted BLL and the range in standard deviation are applied in the model to estimate population BLL. The result suggests that an estimated 60-62 % of the children and 35-37 % of the adults have BLL > 5 ug/dl and an estimated 1 % of the children and no adults have BLL > 20 ug/dl.

[9] This corresponds to the population for which the cost of PM pollution was estimated.

Loss of intelligence (IQ loss) has been identified as the most important impact of BLL on health (See Annex 3 for literature on health impacts of BLL). Following the assumption of a normal distribution of IQ in the population, the number of children with MMR from lead exposure is estimated by multiplying the estimated number of children with elevated BLL by the children share with IQ of 70-73.5 points. The estimated annual loss of intelligence from lead exposure is presented in Table 3.2.2, totaling about 21 thousand IQ points and 120 cases of MMR.

Table 3.2.2: Estimated Annual IQ Losses and Cases of MMR from Lead Exposure

IQ Point Losses (thousands)	
IQ (1) - loss of 0.65 points per child	2.5
IQ (2) - loss of 1.95 points per child	5
IQ (3) - loss of 3.25 points per child	4.5
IQ (4) - loss of 3.50 points per child	9
Total Losses (thousands)	21
MMR	
Number of children with MMR	120

The estimated population at risk of MMR is summed for different IQ bands (Annex 3) and then multiplied by the regional MMR adjustment ratio, which is 1.53 for Euro B, the WHO sub-region where Tajikistan is part.

Other negative outcomes of lead exposure (increased blood pressure, gastrointestinal effects and anemia) were not quantified due to combination of two factors: significantly lower burden of these outcomes[10], and high uncertainty of lead blood data for Tajikistan[11]. If new data on lead level in blood becomes available, then missing characteristics could be estimated.

The estimated annual cost of lead exposure is presented in Table 3.2.3.

Table 3.2.3: Annual Cost of Health Impacts of Exposure to Lead Pollution

	Total cost(Million TJS)	Per cent of total cost
IQ loss children	15	89%
Mild mental retardation	2	11%
Total cost	17	

MMR is linked with the loss of 36.1 % (0.361 coefficient equal to disability weight for DALYs loss estimation) of DALYs and lifetime income. Although there is some indication that MMR is associated with lower life expectancy, additional evidence is needed to quantify this association (Pruss-Ustun et al., 2004). MMR-related lifetime income loss was estimated as 2 million TJS.

IQ losses were also linked to the loss of lifetime income. Cost of IQ losses are estimated based on expected lifetime income losses, assuming a 1.3-1.9 % decline in income for every one point loss in IQ based on studies in the United States (Schwartz 1994 and

[10] About 5 percent of total cost from lead exposure in Pakistan (Krupnick et al, 2006).
[11] No recent studies with the reported lead blood level in adults were identified for the countries of former Soviet Union.

Salkever 1995).[12] A mean estimate of corresponding income loss is 15 million TJS (Table 3.2.4).

Table 3.2.4: Estimated Loss of Life-Time Earnings Due To IQ Losses Associated With Lead Exposure (Million TJS)

	Low estimation	High estimation
IQ (1) - loss of 0.65 points	1.6	2.3
IQ (2) - loss of 1.95 points	3.1	4.5
IQ (3) - loss of 3.25 points	2.7	4.0
IQ (4) - loss of 3.5 points	5.1	7.6
Total cost	12.5	18.4

The DALYs lost due to MMR were estimated using DALYs tables of the WHO (www.who.int/evidence/nbd). Thus, the DALYs lost due to MMR is estimated at 1200.

We have presented above, a very conservative estimation of the cost of health impacts of exposure to lead pollution. It may be noted that this estimate does not include MMR health expenses (i.e. doctor visits, medication cost and time losses of care givers) and reduced life expectancy due to MMR. Further, it doesn't include cost of other health effects related to lead exposure such as elevated blood pressure, gastroenterological effects, and anemia. It should also be noted that the estimated costs are only for the children under 5 in the cities with urban population more than 100 thousand inhabitants, and that the estimates are based on BLL measurements from Uzbekistan, Kazakhstan and Russia. In the absence of data, there is a considerable uncertainty about BLL in the urban population as a whole and the rural population in Tajikistan. Hence it is necessary to undertake new studies of BLL in children and adults to provide a more accurate estimate of health effects and their costs.

Analysis of urban air pollution costs suggests that the focus should be on regulating PM, and particularly on PM2.5, which is most associated with health effects. Also, action should be taken to examine the outstanding sources of lead pollution, including lead in gasoline and lead in water and food to develop a plan for the phase out of all such emissions where justified. The government should devote enough resources to ensure that I&M program is effective. The record in the past has not been good and this is an area where cost effective reductions in emissions can be made. Other options to be considered is further introduction of abatement technologies at major polluting industries (Tajik Aluminum plant) and promoting establishment of warning systems and emergency plans for locations most vulnerable to catastrophic life-threatening pollution.

3.3. Water, Sanitation, and Hygiene

As UNECE, 2004 indicates, originally the quality of ground water, which is the major source of drinking water in Tajikistan, was very high. Over the years industrial pollution, municipal discharges and agricultural pollution related to heavy pesticides use and lack of drainage on irrigated lands resulted in the substantial loss of water quality. However,

[12] This reflects a lower and upper bounds of estimated income losses. An annual discount rate of 3 percent and a real increase in annual income of 2 percent is applied. A 0.5 percentage point income loss attributed to a reduced likelihood of labor force participation from a decline in IQ is not included because of inadequate comparable data on factors influencing labor force participation in Tajikistan vs the United States.

according to the to the latest Multiple Indicator Cluster Survey for Tajikistan, MICS 2005, only 93 % of urban population and 61 % of rural population has access to improved source of drinking water (piped water, public tap, borehole/ tubewell, protected well, protected spring or rainwater). In GBAO and Khatlon Oblast only 52-55 % of population has this access. As for sanitation, 97 % of urban population and 92 % of rural population have access to improved sanitation (connected to public service or has a septic tank).

Inadequate quantity and quality of potable water supply, sanitation facilities and practices, and hygiene conditions are associated with various illnesses both in adults and children. The major health effects of inadequate water quality and quantity, sanitation facilities and practices, and hygiene are diarrheal morbidity and mortality.[13] While diarrheal illness is generally not as serious as some other waterborne illnesses, it is more common and affects a larger number of people. WHO estimates that 90 % of diarrheal illness is attributable to these factors (WHO 2002).

Diarrheal mortality and morbidity

Basis for diarrheal mortality estimation is total child mortality. Tajikistan has in general relatively high child mortality, although the estimates are quite uncertain. According to the latest Multiple Indicator Cluster Survey for Tajikistan, MICS 2005, mortality among children under 5 is 79 per 1000 live births (http://www.who.int/whosis/en/index.html). Similar estimate of child mortality in 2000 was 126 deaths for 1000 live births (MICS, 2000). The main reason for uncertainty and year-to-year variation in the estimates is that only 88 % of births are registered (MICS, 2005).

Table 3.3.1 presents the estimated health effects from inadequate water, sanitation and hygiene. Details of the procedure are in the Annex 3. The estimates are based on the background health data, taking into account the WHO estimate that 90 % of diarrheal illness is attributable to water, sanitation and hygiene. % of diarrheal cases among children under 5 is estimated from MICS, 2000, and in the age group older than 5 is estimated from % of cases among children (MICS 2000) and the ratio of cases among children under-5 to the population above 5 years of age. The same method was applied to estimation of the treated cases when only % of treated cases among children under 5 was available from MICS 2000. The latter ratio is from the international sources discussed in the Baseline Health Data section.

Although the share of rural population in Tajikistan is about 74 %, estimated number of cases of diarrheal child mortality is about 10 % higher because the share of children in the population is substantially higher in rural areas. The larger share of children in the rural population, low public awareness of the health benefits of drinking boiled water and poor access to energy are also determinants of higher diarrheal illness in children in rural areas. The estimated number of cases of diarrheal illness in children under-5 is about 3.5 times higher in rural areas.

[13] Hygiene refers to personal hygiene (such as handwashing), domestic hygiene and food hygiene.

Table 3.3.1: Estimated Annual Health Effects from Water, Sanitation, Hygiene

	Cases	
	Urban	Rural
Children (under the age of 5 years) – increased mortality	280	1320
Children (under the age of 5 years) – increased morbidity	812,000	2,860,000
Population over 5 years of age – increased morbidity	1,230,000	3,990,000

DALYs lost from diarrheal illness (mortality and morbidity) is presented in Table 3.3.2 (see Annex 3 for the details of the analysis). About 85 % of the DALYs are from diarrheal child mortality.

Table 3.3.2: Estimated DALYs from Diarrheal Mortality and Morbidity

	Estimated Annual DALYs		
	Urban	Rural	% of total DALYs
Children (under the age of 5 years) – increased mortality	9,500	44,900	85%-89%
Children (under the age of 5 years) – increased morbidity	280	1000	2-3%
Population over 5 years of age – increased morbidity	1,400	4,600	9-12%
TOTAL	11,180	50,500	100%

Annual cost of diarrheal mortality and morbidity from inadequate water, sanitation and hygiene is estimated at 30 million TJS in urban areas and 72 million TJS in rural areas (Table 3.3.3). The cost of diarrheal child mortality is based on the human capital approach (HCA) discussed in the Annex 3. The cost of morbidity includes the cost of illness (medical treatment, medicines, and value of lost time). About 30-35 % of these costs are associated with the value of time lost to illness (including care giving), and 65-70 % are from cost of treatment and medicines.

Table 3.3.3: Estimated Annual Cost of Diarrheal Illness (Million TJS)

	Estimated Annual Cost	
	Urban	**Rural**
Mortality		
Children under age 5	9	43
Morbidity		
Children under age 5, population over age 5	21	29
TOTAL ANNUAL COST	30	72

Hepatitis A, Typhoid and Paratyphoid

Number of recorded cases of hepatitis A and typhoid/paratyphoid in Tajikistan over the period 2000 to 2005 are presented in Table 3.3.4. There were about 3122 cases of typhoid and 7834 hepatitis cases per year during the above period. The total estimated annual cost associated with hepatitis and typhoid is 4.2 million TJS (Table 3.3.5).

Table 3.3.4: Annual Cases of Waterborne Infectious Diseases

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Typhoid/paratyphoid	4415	3388	3294	3148	2481	2010
Hepatitis A	9562	9201	7393	5414	10221	5215

Source: Ministry of Health

Cost of hospitalization and medication accounted for about 96 % of the total estimated cost.

Table 3.3.5: Estimated Annual Cost of Hepatitis A and Typhoid/Paratyphoid

	Estimated Total Annual Cost (Million TJS)
Cost of Hospitalization	2
Cost of Medication	2
Cost of time losses	0.2
Total Annual Cost	4.2

Averting Expenditures

In the presence of perceived health risks, people often take averting measures to avoid these risks. If people perceive there is a risk of illness from the municipal water supply, or from other sources of water supply they use, some of them are likely to purchase bottled water for drinking purposes, or boil their water. These averting expenditures associated with the purchase of bottled water and boiling the water account for the costs of health risks. However, MICS 2005 reports that only less than 1 % of population in Tajikistan use bottled water. Hence the averting expenditures associated with the purchase of bottled water have not been included in computation of costs of health risks. According to local surveys, nearly 30 % of households in Tajikistan boil their drinking water, either all the time or sometimes (Box 3.3.1). The estimated annual cost of boiling water for those households is 3-7 Million TJS per year.

Box 3.3.1: Boiling of Drinking Water in Tajikistan

Recent health survey of several districts of Dushanbe city done by one of the local primary health clinics has shown that up to 30 % of city inhabitants boil their drinking water. The above %age is expected to grow with increase in household income and level of education. Experts of sanitary-epidemiological units agree that this number is not more than 30% in other cities and towns of the country.

The share of population that boils drinking water in rural area is also around 30 %. The 2006 household survey in four jamoats of Kulob region (Ziraki, Zarbdor, Dagana and Kulob) show that only 25-30 % of rural population boil drinking water. It increases to about 40-50 % among the quintile of the population that is richest and the most educated. . Traditionally, local people often boil water for tea depending on the seasons; overall demand for hot drinks is lower in summer. However, very often people mix tea and raw water during the day and this could affect the results of the survey and lead to overestimation of the share of population that boils drinking water.

Source: Nodira Karimova per consultations with experts

Table 3.3.6 presents the data used to estimate the annual cost of boiling drinking water. It is assumed that the average daily consumption of drinking water per person is 0.5-1.0 liters among households that use boiled water. Residential cost of energy is estimated based on data from experts, using the average stove efficiency is for natural gas and wood fuel.

The total estimated averting expenditures ranges from 3 to 7 million TJS (Table 3.3.7) per year. This is about 5 % of the total estimated annual cost associated with inadequate water supply, sanitation and hygiene.

Table 3.3.6: Baseline data for estimation of costs due to waterborne diseases

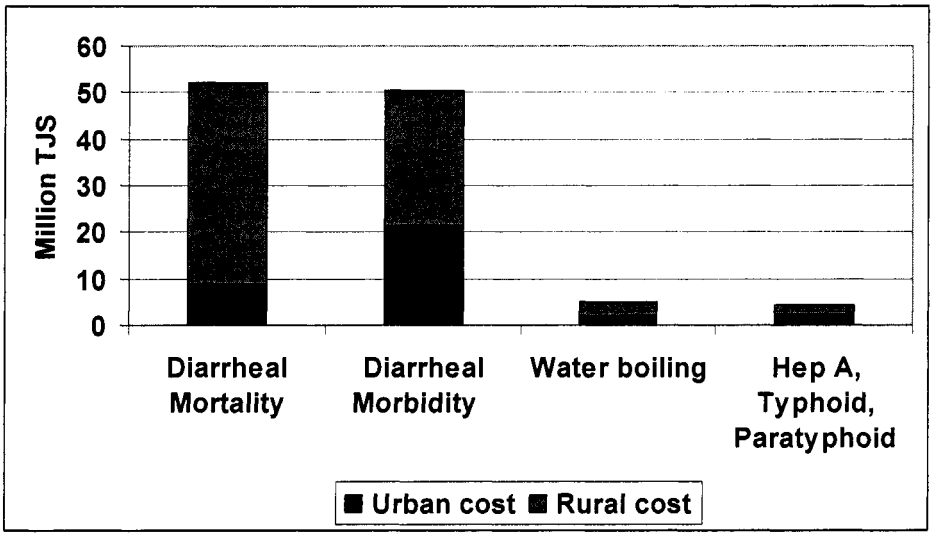
	Data:	
%age of households that boil their drinking water	30%	Local clinic and jamoats surveys
Average daily consumption of drinking water	0.5-1.0	Liters per person per day
% of households using electricity (urban-rural)	52-44%	MICS 2005
% of households using LPG (urban-rural)	11-2%	
% of households using fuel wood (urban-rural)	7-48%	
% of households using kerosene (urban-rural)	30-6%	
Energy requirement of heating of water (100% efficiency)	4200	Joules/ltr/1 degree C
Average Stove efficiency for heating of water	25-50%	Varies by type of stove
Average time of boiling water (after bringing water to boiling point)	10	Minutes

Table 3.3.7: Estimated Annual Household Averting Expenditures

	Total Annual Cost (Million TJS)	
	"Low"	"High"
Cost of bottled water consumption	0	0
Cost of household boiling drinking water	3	7
Total annual cost	**3**	**7**

The estimated total cost associated with inadequate water supply, sanitation and hygiene ranges from 104 to120 Million TJS per year, with a mean of about 110 Million TJS (Figure 3.3.1). The damages include health impacts, mortality and morbidity and averting expenditures which include mostly household boiling of drinking water. The cost of health impacts represents an estimated 95 % of total mean cost, and averting expenditures about 5 %. Cost of each of these categories is presented in Figure 3.3.1. While rural areas account for 70 % of total cost, urban areas account for the rest 30 %.

Figure 3.3.1: Annual Costs of Inadequate Water, Sanitation, and Hygiene (Million TJS)



Studies in different low income countries with similar water supply, sanitation and hygiene problems suggest that measures to reduce environmental damages are justified in a number

of areas on benefit cost grounds as well on grounds of benefiting the poor. For water supply and sanitation, improvements in facilities in rural areas yield benefits in excess of costs under most assumptions. In urban areas the focus should be on drinking water monitoring and rehabilitation of piped water supply and sewage systems. The programs are justified on the grounds that the benefits are concentrated primarily among the poor. Hygiene programs have estimated benefits far in excess of costs and should receive the highest priority. The same applies for programs to encourage disinfection of drinking water.

3.4. Indoor Air Pollution

WHO (2002b) estimates that 1.6 million people die each year globally due to indoor smoke from the household use of traditional fuels. The most common of such fuels are wood, agricultural residues, animal dung, charcoal, and in some countries coal. The strongest links between indoor smoke and health are for lower respiratory infections, Chronic Obstructive Pulmonary Disease (COPD), and for cancer of the respiratory system. Of all the respiratory diseases associated with indoor smoke, lower respiratory infections account for about 37.5 %, 22 % are COPD, and cancer of the respiratory system account for about 1.5 % globally (WHO 2002b).

Indoor air pollution is associated with use of traditional fuels (mainly cotton stalks in Tajikistan). About 50% of rural population and 7% of urban population use solid fuel for cooking in Tajikistan (MICS, 2005).

Desai et al (2004) provides a review of research studies from around the world that have assessed the magnitude of health effects from indoor air pollution from solid fuels. The odds ratios for acute respiratory illness (ARI) and chronic obstructive pulmonary disease (COPD) are presented in the Table 3.4.1. The ratios represent the risk of illness for those who are exposed to indoor air pollution compared to the risk for those who are not exposed. The range of "low" to "high" ratios reflects the review by Desai et al (2004), and have in this section been applied to young children under the age of five years (for ARI) and adult females (for ARI and COPD) to estimate the increase in mortality and morbidity associated with indoor air pollution.[14] It is these population groups who suffer the most from indoor air pollution because they spend much more of their time at home, and/or more time cooking than older children and adult males.

Table 3.4.1: Health Risks of Indoor Air Pollution

	Odds Ratios (OR)	
	"Low"	"High"
Acute Respiratory Illness (ARI)	1.9	2.7
Chronic obstructive pulmonary disease (COPD)	2.3	4.8

Source: Desai et al (2004).

[14] Desai et al (2004) present odd ratios for lung cancer, but this effect of pollution is not estimated in this Section. This is because the incidence of lung cancer among rural women is generally very low.

Table 3.4.1 presents the estimated health effects from indoor air pollution that include ARI mortality and morbidity among children under 5, COPD mortality and morbidity among women over 30, and ARI morbidity among women over 30. Details of the procedure are in the Annex 3. The estimates are based on the background health data on ARI and COPD prevalence available from MICS, 2005 and international sources (Annex 3), taking into account odds ratios presented in Table 3.4.1. % of ARI cases among children under 5 is estimated from MICS, 2005, and in the age group older than 5 is estimated from % of cases among children (MICS 2005) and the ratio of cases among children under-5 to the population above 5 years of age. The same method was applied to estimation of the treated cases when only % of treated cases among children under 5 was available from MICS 2005. The latter ratio is from the international sources discussed in the Baseline Health Data Table (Annex 3).

About 13 % of the cost of morbidity related to indoor air pollution is associated with COPD, and 87 % with ARI.[15] Mortality due to COPD and ARI accounts for about 47 % of the total cost, and morbidity about 53 %.

In order to estimate the cost of COPD mortality for adults, the Value of Statistical Life (VSL) is used as the upper bound and HCA as the lower bound (Annex 3). In the case of children, HCA is used to estimate the cost of mortality. The cost of morbidity includes the cost of illness (medical treatment and value of time lost due to illness). The estimated health impacts of indoor pollution in rural and urban areas are presented in Table 3.4.2.

Table 3.4.2: Estimated Annual Health Effects of Indoor Air Pollution

	Estimated Annual Cases	
Rural areas		
	"Low"	"High"
Acute Respiratory Illness (ARI):		
Children (under the age of 5 years) – increased mortality	585	87080
Children (under the age of 5 years) – increased morbidity	1,550,600	2,306,000
Females (30 years and older) – increased morbidity	388,000	577,000
Chronic obstructive pulmonary disease (COPD):		
Adult females – increased mortality	90	150
Adult females – increased morbidity	400	650
Total Disability Adjusted Life Years (DALYs)-mortality and morbidity	26,600	39,800
Urban areas		
	"Low"	"High"
Acute Respiratory Illness (ARI):		
Children (under the age of 5 years) – increased mortality	25	45
Children (under the age of 5 years) – increased morbidity	57,000	91,000
Females (30 years and older) – increased morbidity	16,000	29,000
Chronic obstructive pulmonary disease (COPD):		
Adult females – increased mortality	10	20
Adult females – increased morbidity	10	20
Total Disability Adjusted Life Years (DALYs)-mortality and morbidity	1,100	2,100

An estimated 34.8 thousand DALYs are lost each year due to indoor air pollution (mean estimate) of which about 75 % is due to mortality.

[15] Based on the mean estimated annual cost.

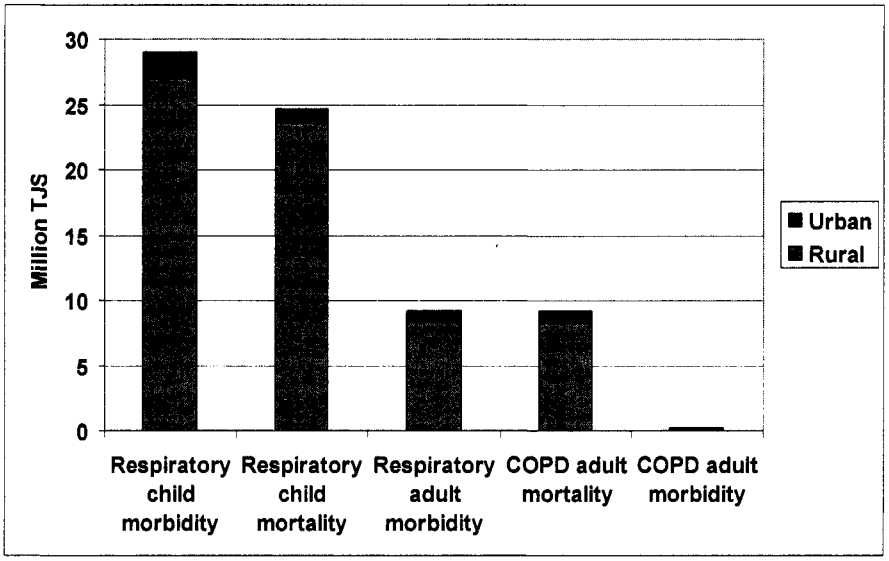
The estimated total annual cost of indoor air pollution ranges from 50 to 98 million TJS with a mean cost at 74 million TJS (Tables 3.4.3). The total costs accounted for about 1 % of GDP in 2006. As presented in Figure 3.4.1, acute respiratory illness (ARI) in children represents 40 % of cost; respiratory child mortality represents 34 %; chronic obstructive pulmonary disease (COPD) mortality in adult females and ARI morbidity in adult females represent 13 % of cost each. Rural population bears 93 % of the total cost of indoor air pollution.

So rural poor are predominantly affected with indoor air pollution and bear major costs.

Table 3.4.3: Estimated Annual Cost of Indoor Air Pollution in Tajikistan

	Estimated Annual Cost (Million TJS)	
	"Low"	"High"
Acute Respiratory Illness (ARI):		
Children (under the age of 5 years) – increased mortality	20	30
Children (under the age of 5 years) – increased morbidity	21	40
Adult females – increased morbidity	8	11
Chronic obstructive pulmonary disease (COPD):		
Adult females – increased mortality	1	17
Adult females – increased morbidity	0.2	0.3
TOTAL	50	98

Figure 3.4.1: Annual Costs of Indoor Air Pollution (Million TJS)



Deteriorating situation with domestic energy use requires urgent measures for negative health impact mitigation. The interventions could include promotion of cleaner fuels use in areas that predominantly use solid fuel for cooking, and implement actions to improve availability and access to solid fuel users in a safe and cost-effective manner. Development of small hydro power stations also could be mentioned as a solution for meeting population needs in the short term. Consistent use of improved stoves proved to be an effective approach given governmental support and promotion of the program.

3.5. Other Important Aspects Of Environmental Pollution In Tajikistan

3.5.1 Tajikistan Aluminum plant

The Tajik Aluminum plant (TaAZ) is the largest aluminum manufacturing plant in Central Asia. It is located in Tursunzade (Khatlonskaya Oblast), in the south-western part of Tajikistan. Its capacity is about half billion tones of aluminum per year and it consumes 40% of the country's electrical power[16]. As these sources report, in 2001, TaAZ was operating at 25% capacity (producing 113,000 tons), down from 86.5% capacity in 1990 (producing 450,000 tons, the closest it has come to full capacity utilization). The $210 million earned in export revenues constituted 53% of total export receipts for the year. In 2002, TaAZ's output increased to 307,000 tons, and plans are for it to reach 346,000 tons annual output by 2005. Almost all of its output is exported. The plant directly employs 12,000 to 14,000, and indirectly supports a community of 100,000. Thus TaAZ operation is linked to overstressed hydropower consumption in Tajikistan and adds to the already tensed relations with neighboring countries.

As UNECE, 2004 indicates the city of Tursunzade where aluminum plant is located, is particularly affected by air pollution from stationary sources, which account for 75.7% of total air pollution. The TaAZ accounts for about 60-70% of all emissions from stationary sources (21,899 tons, or 68.75% of the total in 2001 (UNECE, 2004, p.83). A 2002 study found it responsible for notable fluoride water pollution in the region. It also has been blamed repeatedly by the neighboring regions of Uzbekistan for their serious ecological problems. This plant creates a dangerous ecological situation in Tursunzade and nearby territories, especially with its discharge of fluoride compounds, but also other toxic pollutants (Table 3.5.1.1).

Table 3.5.1.1: Tajik Aluminum Plant: Estimated Emissions, 1999-2002

	1999	2000	2001	2002
Total	24,543.50	22,250.70	21,899.00	21,613.10
Dust	2,452.00	2,379.90	2,416.80	2,027.30
Total gaseous	22,091.50	19,870.80	19,482.20	19,585.90
Sulfur dioxide	700.2	700.5	700.8	692.6
Carbon monoxide	21,048.60	18,823.00	18,441.50	18,539.40
Nitrogen oxides	201.3	205.5	197	212.6
Hydrocarbons	21.2	22	22.3	22
Hydrogen fluoride	120.2	119.8	120.7	119.4

Source : State Committee for Environmental Protection and Forestry , 2004.

[16] http://src-h.slav.hokudai.ac.jp/sympo/97summer/islamov.html#46 ;
http://www.nationsencyclopedia.com/Asia-and-Oceania/Tajikistan-INDUSTRY.html

The box below presents results of one of the recent studies on hydrogen fluoride pollution in Tursunzade region.

Box 3.5.1.1. Fluoride pollution in Tursunzade Region

Studies of this region's water supplies discovered that the content of fluorides exceeds PDK in surface waters and underground waters (PDK = 1.5 milligram/liter). The content of fluoride in the surface waters of Jamoat Karatag and Telman State Farm made up is 1.72±0.3 milligrams per liter and 2.00±03 milligrams per liter, respectively. Analysis of samples of water from three different sources of water supplies situated in the territories of the Aluminum plant has shown the following concentrations of toxic substances:

- Fluoride: 3.6±0.8 and 7.1±1.4 and 11.0±1.8 mg/l,
- Sulfates: 72,8±6,7 and 57,8±5,1 and 88,1±4,6 mg/l,
- HCO: 103±14 and 240±20, 140±12 mg/l.

Inhabitants of southern regions consume between three and four liters of water daily during the summer months. If a teenager (13-17 years old) drinks 3 liters of water containing 3.5 mg of fluoride, then in twenty four hours he gets 1 mg of fluoride. An adult consuming four to five liters of water daily gets 1.4 -1.75 mg of fluoride. As was mentioned above, the population of Republic gets 1.5 mg of fluoride daily through foodstuffs, the biological effects of which equal 1.2 mg fluoride of drinking water. Consequently, the daily consumption of fluoride for teenagers makes up 2.2 mg, and for adults 2.6-3.0 mg, or 0.049 mg/kg of weight of body (accordingly). Although they intake a maximum quantity of content of fluoride in foodstuffs, nevertheless the daily intake of fluoride by each inhabitant of Jamoat Karatag in Tursunzade region makes up approximately 2.8 mg. Among schoolchildren of 6-10 years of the region is observed that 55 of 150 have dental caries (37%). Among schoolchildren of 15-17 years, 53 of 105 observed have dental caries (54%).

The content of ion fluoride in samples taken from plants in our zones of research made up 6.5 to 12 milligrams/kilogram in Jamoat Karatagand. At Telman State Farm , it was from 7.8 to 16.3 mg/kg. The content of fluoride in samples of soil also was more on the territory of Jamoat (region) Karatag and made up 13 mg/kg.

The local population is not aware about harmful effect of aluminum manufacturing on the environment and on fluoride toxicity. The aim of the project was to improve health in the unflavored area of Tursunzade region, where live 3,000 inhabitants (many of them are children less than 16 years old).

Source: Final Report - English language translation received by the Virtual Foundation (e-mail from ISAR-Central Asia office in Kazakhstan) January 17, 2002;
http://www.virtualfoundation.org/finreps/ebtwater01.html

NGOs and concerned population, but also Government of Uzbekistan attributes a lot of negative health outcomes to environmental pollution from TaAZ. Air pollution would be responsible for cardiopulmonary mortality and morbidity, as described in the urban air pollution section. To capture these effects monitoring stations should be in operation in Tursunzade and surrounding areas. Fluoride pollution of drinking water is also very stressful for human health. The long list of possible health outcomes would include lung and bladder cancer, bone deformity, hypothyroidism, fluorosis, tooth decay, osteosclerosis (hardening of the bones), sinus trouble, perforation of the nasal septum, chest pains, coughs, thyroid disorders, anemia, dizziness, weakness, nausea, diarrhea, respiratory disorders (sometimes termed "pot-line asthma'), hemorrhagic pulmonary edema (fluid accumulation and swelling in the lungs), hypocalcaemia (a low blood calcium level), hypomagnesaemia (deficiency of magnesium in the blood) , cardiac arrhythmias, renal failure, ventricular fibrillation, serious damage to vegetation, respiratory, eye, skin

problems in animals. In some studies it has been found that there is a possibility that fluoride can cross the placenta from the mother's blood to the developing fetus. Also, there is a possible increase in birth defects or lower IQ scores in children living in areas with very high levels of fluoride in the drinking water[17].

It is obvious that further research, including comprehensive epidemiologic studies are needed to estimate direct impact from TaAZ on public health and ecosystems. TaAZ has been proceeding with its equipment modernization to minimize negative impact, it has succeeded in modernizing abatement pollution equipment for two production lines and plans to modernize the remaining production lines. Future TaAZ development plans should incorporate environmental concerns and minimize adverse impact on public health and ecosystems.

3.5.2 Problems of Wastes Management

As Tajikistan 2002 State of the Environment Report estimates, over 22-25 million tonnes of solid waste, 20 million cub.m of liquid industrial waste and 200 million tonnes of mining waste are accumulated in the republic. Total area of lands under waste dumps and waste storage sites is 1,100 hectares, of which mining wastes occupy 800 hectares of lands and contribute 77% of the total waste accumulation. Management of industrial, mining and municipal wastes remains on the priority list of environmental problems in Tajikistan. Wastes are mainly generated from mining of mineral resources, chemical and cotton production, uranium tailings, building refuse and municipal wastes.

Industrial waste

The industrial wastes in Tajikistan are generated by the building sector and chemical, mining and metal and cotton industries. Major industrial waste generating industrial enterprises are presented in Table 3.5.2.1.

Table 3.5.2.1: Waste Generated In Main Industrial Installations, 1999

Location	Production type	Waste thousand tons	Major pollutants
Aininsk district Sogdsk Oblast	Anzob Integrated Mining and Concentrating Plant	11.7	Antimony , mercury
Adrasman Sogdsk Oblast	Integrated Mining and Concentrating Plant	217.0	Lead, zinc, gold
Pedjikent Sogdsk Oblast	"Zeravshan" Integrated Mining and Concentrating Plant	560.1	Cyanides
Chkalovsk Sogdsk Oblast	"Vostok-Red-Met"	147.0	Uranium, vanadium
Tursunzade Khatlonskaya Oblast	Tajik Aluminum Plant (TadAZ)	152.0	Fluoride, gas cleaning slime, flotation tailings

Source : UNDP. Regional Environmental Action Plan for Central Asia. September 21, 2001.

[17] http://www.alcant.co.za/health_hazards.html

There are about 400 sites that generate industrial wastes in the country. Of the total industrial wastes generated mining sites that process 40 different types of minerals generate about 77 % of all the industrial wastes. More than 200 million tons of mineral refuse is accumulated in around 70 mines, of which more than 23 million tons is hazardous. Annually, 50 enterprises generate 1,000 tons of galvanic toxic waste. The list of hazardous wastes generated in the country includes cobalt, arsenic, nickel, cadmium, mercury, aluminum, lead and antimony. The hazardous wastes are usually dumped with the rest of municipal refuse. These wastes are usually stored in the territories of enterprises and then dumped in landfills that occupy over 300 ha. There are neither centralized sanitary facilities for storage of hazardous wastes nor special facilities for treatment or secondary use of hazardous wastes.

During the Soviet times Tajikistan used to be the main producer of uranium. Official sources report about nine official sites for storage of radioactive wastes that occupy 300 ha with around 164 million tons of radioactive mining ores and 180 ha (65 million tons) of radioactive tailings, mainly located in Sughd region and Faizabad district. These storage facilities require urgent rehabilitation and impose substantial health risks to local populations that live as close as 6 km away from the sites.

Municipal waste management.

Annually up to 4-5 million cub. m of municipal wastes are generated nationwide, of which 1.2 million cub.m is from in Dushanbe city. Most of the waste is dumped at 70 legal landfills that cover approximately 300 ha. The rest is dumped at illegal landfills. Such illegal landfills carry about 120 cub. m of waste (no precise estimation is available). Half of municipal waste is formed by kitchen refuse; the rest contains other components like paper, plastics and resin, ceramics, glass, tree leaves and ash and about 7 % is medical waste. There is no waste sorting or treating facilities in the country. Existing communal waste sites (both small transit in-city and permanent out-of-city dumps) are poorly equipped resulting in toxic spills into water streams particularly after rain. There are no mechanisms to control smell from the landfills, especially during hot the weather.

Illegal burning of leaves and other wastes, mainly to reduce the volume of waste is another issue in the management of wastes. The smell of burning leaves and wastes can be felt daily in all parts of Dushanbe city. At least 60 large and numerous small waste burning cases are registered every year. Since tree leaves absorb harmful elements, such as lead and other heavy metals, including up to 40 toxic harmful substances, burning leaves along with plastic and other toxic elements pose a direct hazard to human health and further degrade urban outdoor and indoor air quality. Local population and often workers of municipal services are not aware of the health hazards of burning wastes and practice burning on a continuous basis.

The relationship between solid wastes and human health and ecosystems damages is difficult to quantify. The most straightforward way is to estimate the share of particulates and chemical pollution from waste burning. Also, health risk analysis methods could be useful to pinpoint the pressure from leaking of cadmium, cobalt, nickel, chromium, arsenic, and other elements from industrial wastes. However, modern monitoring procedures should be applied. At present Tajikistan does not nave a capacity to facilitate such an analysis.

Uncontrolled wastes disposal requires urgent development of modern methods to assess, document, and monitor solid waste disposals and processing and investing in infrastructure necessary to protect the environment and the public from the most dangerous areas of uncollected solid waste and from accumulation in the most dangerous un-managed or poorly-managed dumps.

Environmental health problems could be more effectively addressed by an independent entity with clearly defined responsibilities for environmental health management. A decentralized entity should be created within the Ministry of Health to regulate emission of PM2.5, lead, toxic pollutants, and fuel quality to tackle air quality, and enforcing bacteriological quality, persistent organic pollutants (POPs), volatile organic compounds (VOCs), and heavy metals, among others, to deal with water contaminants that affect human health.

IV. Natural Resources Damages in Tajikistan

As World Bank, 2007 indicates, "Difficult livelihood conditions and land management practices create high dependence and pressure on local natural resources, especially in the mountain areas eventually resulting in degradation of such lands". According to UNCCD, 2006 the, major categories of land degradation in Tajikistan are similar to those in other Central Asian countries. They include (1) soil erosion in rain fed farmlands, (2) pasture and range land degradation, (3) degradation of forests and bushes and related loss of biodiversity, (4) irrigation-related land degradation, in particular secondary salinity, water logging and irrigation-related soil erosion, and (5) other forms of land degradation as a result of natural disasters, soil contamination, etc. Land degradation eventually causes more land slides and mudflows especially in the sensitive mountainous areas. Most affected by degradation is village-near pasture land as well as bush and tree vegetation. Common causes are ineffective land management and lack of alternate energy resources. Land degradation not only affects agricultural productivity, biodiversity and wildlife, but also increases the likelihood for natural hazards(World Bank, 2007).

Although the principal cause of natural resource losses is degradation of agricultural lands, it is important to mention that all elements of natural resource degradation in Tajikistan are interrelated and causality links often work both directions. In other words, part of natural resources losses could be attributed to irrational felling of trees, irrational use of pasture and range lands leading to loss of green cover, deforestation and agricultural land degradation and vice versa. It is very difficult to quantify these relations due to the lack of data. However, the analysis allowed estimating direct losses of natural resources. Losses due to degradation are estimated for croplands, rangelands, forests and natural disasters. Losses to croplands include damages from soil salinity due to improper irrigation practices and human-induced soil erosion. In the absence of data on the annual increase in salinity and eroded croplands and rangelands, the annual loss of agricultural production (crop and rangeland fodder) is estimated based on accumulated degradation. This estimate may be more or less than the net present value (NPV) of annual production losses depending on the rate of annual increase in degradation. Annual deforestation data are highly uncertain and were estimated from secondary sources. Annual losses resulting from deforestation are estimated as the NPV of the value of forest area lost. Losses from natural disasters are estimated using 6-year average frequency of negative events and the available point estimation of damages in money terms.

4.1. Costs to Crop Production

4.1.1. Soil Salinity

Soil salinity reduces the productivity of agricultural lands and, if salinity levels exceed a certain level the land becomes unfit for cultivation. According to the conventional welfare economics, if agricultural markets are competitive, the economic costs of salinity are the losses in consumer surplus (consumer willingness to pay above market price) and producer surplus (profit) associated with the loss in productivity. The welfare losses include direct losses when degraded lands become unfit for cultivation and reduced yield as the land becomes saline or degraded. In addition to the above direct losses, there could also losses from crop substitution to more saline-tolerant but less profitable crops and other indirect

losses. Because of a lack of data, these losses are approximated by the value of "lost" output related to the salinity, with some simple adjustment for changes in cropping patterns.

Total irrigated land in Tajikistan is about 0.74 million hectares (Table 4.1.1.1). Nearly 16 % of the irrigated land suffers from various degree of salinity and related problems (water logging and soil erosion). Table 7.1.2 presents salinity levels of irrigated lands in Tajikistan. About 22 thousand hectares of lands with salinity more than 18 dS/m are cultivated. There is very little evidence on relationship between soil salinity and yield losses in Tajikistan. The single available literature is on the relationship between soil salinity and yield losses in cotton (Bucknall, et al. 2003). According to Bucknall, et al., if salinity is low then cotton yield loss is 20-30 %; moderate salinity results in 40-60 % cotton yield loss, and high salinity results in above 80 % loss. We have used these data to estimate cotton yield losses due to salinity. In addition to the above results, data on soil salinity thresholds and yield effects of salinity from the international empirical literature (Table 4.1.1.3) are used in this analysis.[18]

Table 4.1.1.1: Land use in Tajikistan (2002-2005)

	Million hectares
Total land area	14.3
Pastures	3.7
Irrigated Arable Land (potentially irrigated)	0.74
Perennial palntations	0.15

Source: UNCCD, 2006; Abdusaliamov E et al, 2000.

Table 4.1.1.2: Salinity Levels of Cltivated Irrigated Lands

Type of land	Salinity Level	Irrigated	
	dS/m	(000ha)	%
Very Low to low salinity lands,	0-4	619	84%
Slight saline lands,	4-9	21	3%
Moderately saline lands,	9-18	73.6	10%
High salinity lands ,	>18	21.5	3%
Total irrigated land		735.1	100%

Source: UNDP, 2004; Backnall J. et al, 2003.

Table 4.1.1.3: Crop Salinity Tolerance and Yield Effects

	Salinity Threshold (dS/m)	Yield decline per 1 dS/m over threshold
Pulses	1.5	15%
Maize	2	12%
Fodder	2	7%
Vegetables	2	10%
Rice	3	12%
Wheat	6	5%
Barley	8	5%
Cotton	8	5%

Source: Salinity threshold and yield declines are from FAO (1998).

[18] The dS/m values are rounded to nearest integer and percent, and relatively conservative values have been used.

Soil salinity results in changes in cropping pattern. There are no comprehensive data on changes in cropping patterns in relation to specific levels of soil salinity in Tajikistan. Hence to estimate the cost of salinity, it is assumed that more salt sensitive crops are cultivated on the lands with lower salinity. If salinity were the only soil characteristic affecting crop choices, optimal allocation would imply that the salt sensitive crops (from pulses to vegetables in Table 4.1.1.4) are cultivated on the land that has salinity lower than 4 dS/m (see Table 4.1.1.3) while crops on more saline land are mainly wheat and cotton.

We consider two scenarios of cropping patterns on saline lands (Table 4.1.1.4). The first scenario assumes that only cotton is cultivated on the saline lands. The second scenario assumes that cotton and wheat are cultivated on the saline lands, following the typical average cropping pattern in Tajikistan. These cropping patterns, though are unlikely in practice, represent an upper and lower bound of the cost of salinity because of the different market value and salinity tolerance of cotton and wheat.

Table 4.1.1.4: Assumed Cropping Patterns on Irrigated Lands

Salinity Level	dS/m	Scenario (1)	Scenario (2)
Minimal salinity	0-4	Pulses, maize, rice, vegetables, fodder, plus Wheat (204 th. ha), cotton (150 th. ha)	Pulses, vegetables, fodder, maize, rice; plus Wheat (152 th. ha) and cotton (196 th. ha)
Slight salinity	4-9	Cotton (21 th.ha)	Wheat (9 th.ha), cotton (12 th. ha)
Moderate salinity	9-18	Cotton (73.5 th.ha)	Wheat (33 th.ha), cotton (40 th.ha)
Severe salinity	>18	Cotton (21.5 th.ha)	Wheat (10 th.ha), cotton (12 th. ha)

The assumed cropping patterns on saline land correspond to a cropping intensity of 1 for wheat and cotton for agricultural lands. This cropping intensity is based on cropping intensity reported by the Ministry of Agriculture in Tajikistan.

To estimate crop losses from salinity it is necessary to estimate crop yields that would realize in the absence of salinity. The following equations are solved for cotton and wheat to estimate the crop yields if the soil is not saline:

$$aX_1+bX_2+cX_3=X \qquad (1)$$

$$X_1/(1-d_1)=X_2/(1-d_2)=X_3/(1-d_3) \qquad (2)$$

where X is observed average yield; X_i is yield on land with salinity level,i; a, b and c are share of land with salinity level"i"; and d_i is yield reduction on land with salinity level"i" which is estimated from the Table 4.1.1.3. Observed average yields, and estimated yields in the absence of salinity and on severely saline land are presented in Table 4.1.1.5.

Table 4.1.1.5: Observed and Estimated Yields

	Observed average yield on irrigated land (tons/ha)*	Estimated yield in absence of salinity (tons/ha)	Estimated yield on severely saline land (tons/ha)**
Seed Cotton	1.8	2.1-2.3	0.4
Wheat	2.0	2.2	0.5

*Source: FAO, 2005; Backnall J. et al (2003), ** Estimated at midpoint of 21 dS/m of salinity.

Table 4.1.1.6 presents the estimated annual cost to agriculture of soil salinity under scenario 1 and 2. In order to estimate the costs, the salinity threshold values and yield decline coefficients and the cropping patterns in Tables 4.1.1.3 and 4.1.1.4 were used. The total quantities of yield losses were then multiplied by local producer farm gate prices for cotton and wheat to get the total losses. Farm gate prices in 2006 for seed cotton and wheat were 1600 TJS and 700 TJS, respectively. The total annual cost of crop loss from salinity ranges from 105 to140 Million TJS with a mean cost of 124 Million TJS. The mean annual cost of salinity is about 1.8 % of GDP in 2006.

Table 4.1.1.6: Estimated Annual Cost of Crop Losses from Soil Salinity

	Salinity	Total Loss (million TJS)			% of GDP
	dS/m	Low	Mean	High	2006
Scenario 1					
Cotton	4-9	0	4	8	0.05%
Cotton	9-18	27	88	150	1.24%
Cotton	>18	44	50	56	0.70%
Total loss from salinity		71	142	214	1.99%
(Scenario 2)					
Wheat	4-9	0	1	2	0.02%
Wheat	9-18	8	19	31	0.27%
Wheat	>18	9	12	15	0.17%
Cotton	4-9	0	2	4	0.03%
Cotton	9-18	13	43	73	0.61%
Cotton	>18	21	30	39	0.42%
Total Loss from Salinity		51	107	164	1.52%

4.1.2. Agricultural Soil Erosion

In addition to soil salinity land degradation caused by wind and water erosion is substantial in Tajikistan (Table 4.1.2.1).

Table 4.1.2.1: Eroded Lands in Tajikistan (in %)

		Degree of soil wash off					
Types of soil	**Unwashed soils**	**Weak**	**Medium**	**Strong**	**Subject to water erosion**	**Subject to wind erosion**	**Total eroded**
Grey-brown	-	-	-	-	-	100	100
Grey earths light	15.6	11.8	6.0	4.7	22.5	62.0	84.5
Grey earths typical	20.6	18.8	14.9	13.6	47.3	32.1	79.4
Grey earths dark	28.0	20.5	18.9	16.1	55.5	16.5	72.0

Grey earths meadow	81.0	-	-	-	-	19.0	19.0
Total	**21.4**	**16.2**	**13.1**	**11.4**	**49.7**	**37.9**	**78.6**
Mountain brown carbonate	15.7	16.7	33.2	34.4	84.3	-	84.3
Mountain light brown carbonate	15.4	12.5	23.2	32.3	57.9	16.7	84.6
Mountain light brown	7.2	3.7	21.2	67.9	92.8	-	92.8
Mountain light brown lixiviated	5.7	7.4	21.4	34.3	63.1	51.6	94.7
Mountain brown typical	17.4	13.1	25.2	44.3	82.6	-	82.0
Mountain soils of juniper forests	0.6	13.7	58.4	27.3	99.4	-	99.4
Total	**14.2**	**13.3**	**27.7**	**36.7**	**77.7**	**8.1**	**85.8**
Alpine meadow steppe	5.5	13.4	23.4	57.7	94.5	-	94.5
Alpine steppe	0.5	4.2	21.6	44.2	70.0	29.5	99.5
Total	3.7	9.8	22.6	52.6	85.0	11.3	96.3
Grand total	**17.7**	**14.8**	**20.1**	**23.9**	**58.8**	**23.5**	**82.3**

Source: State Land Management Committee

Soil salinity is interrelated with water logging, soil erosion and nutrient losses. Lack of drainage on irrigated lands increases soil salinity and elevates water table. This reduces yields, places a greater load on plowing and traction machinery and compacts the subsoil. As a result of such practices about 5 thousand hectares of irrigated lands are not used every year (Abdusaliamov. et al., 2000). If this land could be used for wheat or cotton production, it could generate 8-16 million TJS annually, with mean of 12 million TJS or 0.17 % of GDP in 2006.

Soil erosion also contributes to sedimentation of dams in Tajikistan.

Box 4.1.2.1 Dams in Tajikistan

As FAO AQUASTAT country profile reports in 1994, there were 19 dams in Tajikistan: 5 in the Syr Darya River basin and 14 in the Amu Darya River basin (7 on the Vakhsh River, 4 on the Pyandzh River and 3 on the Kafirnigan River). Their total reservoir capacity is about 29 km^3 and the reservoir area is 934 km^2. There are nine large reservoirs (capacity more than 500 million m^3 each) with a total capacity of 25.34 km^3 and an area of 690 km^2. The largest reservoirs are: the Nurek on the Vakhsh River (10.5 km^3), the Kayrakkum on the Syr Darya River (4.16 km^3), and the Lower Kafirnigan on the Kafirnigan River (0.9 km^3).

Source: http://www.fao.org/nr/water/aquastat/countries/tajikistan/index.stm

This in turn reduces the capacity of dams and thus reduction in irrigation capacity. We do not have reliable data on sedimentation of dams and reduction in capacity of dams in Tajikistan. Hence estimates of losses in crop reduction as a result of sedimentation could not be made. Abdusaliamov et al., 2000 report that sedimentation in Tajikistan results in reduction in dam capacity that could additionally irrigate about 37 thousand hectares of land. The estimated loss of revenue from wheat production on this land, which could otherwise be irrigated in the absence of sedimentation, is about 42 million TJS or 0.6 % of GDP in 2006.

Another problem associated with soil erosion is the loss of soil nutrients. Abdusaliamov et al., 2000 report that annually about 1 million tonnes of major nutrients is leached out from the lands in Tajikistan, about 10 % of which is leached out from the rain fed croplands

alone. Table 4.1.2.2 presents an estimate of the amount of fertilizers required to substitute annual humus loss of nutrients through leaching.

Table 4.1.2.2: Fertilizers for Nutrient Loss Substitution

	Required to replace the leached out major nutrients, in, 000 tonnes	Price in 2006, TJS/t
Ammonia sulfate	50	700
Phosphorus	10	500
Potassium	100	500

Source: Abdusaliamov E. et al., 2000; Consultations with local experts.

The estimated cost of soil nutrients (in terms of N P K) substitution is about 90 million TJS or 1.3 % of GDP in 2006. Thus, the total annual loss due to land degradation in Tajikistan is about 270 million TJS or 3.8 % of GDP in 2006 (Table 4.1.2.3).

Table 4.1.2.3: Estimated Annual Cost of Crop Losses Due to Land Degradation

	Total Loss (million TJS)			% of GDP
	Low	Mean	High	2006
Salinity losses	61	124	189	1.76%
Unused land losses	8	13	18	0.19%
Irrigated as rain fed use losses	43	43	43	0.60%
Nutrients losses	90	90	90	1.26%
Total Crop Losses	202	270	340	3.81%

4.2. Cost of Rangeland Degradation

The main causes of rangeland degradation in Tajikistan are irrational land use management practices leading to denudation of vegetation from rangelands and, exacerbated by intermittent draughts has resulted in many pockets to desertification.. According to the National Program for Combating Desertification (Abdusaliamov et al., 2000) degraded rangelands constitute 96-100 % of total rangelands in the country. Table 4.2.1 presents data on the extent of rangeland degradation in Tajikistan.

Table 4.2.1: Area, yield and degree of desertification of rangelands in Tajikistan

Types of pastures	Area, thousand ha	Initial yield	Yield of dry mass, centners /ha (edible in total)	Degree of land erosion,% from total area
Autumn-winter-spring pastures				
Low grassy semi-savannah	450	7.8	2.5-5.0 / 2.0-3.5	98.0
Large cereal semi-savannah	260	21.6	10.0-18.0 / 8.0-12.0	96.0
Semi-deserted, wormwood-salty foothills & low mountains	300		5.0-7.5 / 1.5-2.5	100
Ephemeroid-wormwood & eurotia of Pamirs Alpine	170		0.5-0.7 / 0.2-0.5	100

Passing (xerophylle Sparse growth of trees)	600		5.0-7.0/ 3.0-4.5	98
Summer pastures				
Large grassy semi-savannah	500		16.6-10.0/ 2.5-8.0	97
Steppe & prickly grass	760		5.0-9.0/ 2.5-5.0	97
Meadow (high grassy & low grassy)	170	20	6.0-12.0/ 3.5-7.0	96
Ephemeroid-wormwood, Ayania of Pamir Alpine	360		0.5-0.9/ 0.3-0.5	100
T O T A L	3570			

Source: Abdusaliamov E. et al., 2000

Two methods are used to estimate the cost of rangeland degradation. The first method estimates the reduction in fodder production and is then valued at the price of fodder. The foregone livestock income due to the loss of fodder as a result of rangeland degradation based on livestock feed requirement is then used as an estimate of the cost of rangeland degradation in the second method.

Very limited data are available on rangeland fodder yields. Based on interviews with rangeland experts in Tajikistan and data in Table 8.1 the current average yield is estimated at 0.5-0.7 tons of DM per hectare on degraded rangelands. This implies that the yield decline from cumulative degradation is at least 0.6-0.7 tons per hectare. Given the rangeland area of 3.6 million hectares, the estimated total average loss due to cumulative degradation is 1-1.4 million tons of DM per year. At a fodder price of 30-70 TJS per ton of DM (per consultations with experts in Tajikistan), the loss as a result of the reduced fodder production in 60-80 million TJS per year average for a sustainable rangeland fodder utilization rate of 40 or 60 %.

The second method uses the reduction in livestock income as a result of rangeland degradation. Relaible data needed to estimate foregone livestock income are presented in Table 4.2.2. Total feed requirement in DM for the animal stock in Tajikistan is estimated at 5.3 million tons per year. The analysis showed that in the absence of the rangeland yield decline of 1 million tons of DM per year, of which 40-60 % could be sustainably utilized, the rangelands could have supported an additional 20-30 % of current animal stock. Given that the total household net income from livestock is around 0.34 billion TJS per year (Höllinger, 2006), the loss in livestock income from rangeland degradation is about 22-51 million TJS.

Table 4.2.2: Total livestock numbers and estimated annual feed requirement

	Weight, kg	Feed requirement, TDM t/year	Total animal, mill 2006	Total TDM, mill t
Horse	460	4.2	0.08	0.31
Cattle	350	3.2	1.38	4.40
Sheep	20	0.2	1.89	0.35
Goat	20	0.2	1.16	0.21
Total			4.51	5.27
Annual average per animal		1.2		

The estimated annual cost of rangeland degradation for the two methods is summarized in Table 4.2.3. The two methods provide quite similar estimate of annual cost, with a mean of 53 million TJS at 0.62 % of GDP in 2006.

Table 4.2.3: Annual Cost of Rangelands Degradation in Tajikistan

	Million TJS	% of GDP
Market value of fodder losses	60-80	0.6-0.9%
Foregone livestock income from fodder losses	22-51	0.3-0.7%
Mean cost	53	0.62%

The recommendations below have a common origin, namely, deterioration of soils in Tajikistan due to irrational irrigation infrastructure management, lack of drainage, improper grazing practices, felling of trees and cutting down the natral bushes/vegetations causing deforestation on the mountain slopes and growing improper harnessing and use of water causing scarcity starting from civil conflicts period in the early 90ies. Given the shortage of Tajikistan's arable land area, it has come at a price: high levels of denuded and eroded lands and increasing salinity and water logging problems in irrigated valley areas are increasingly common in Tajikistan. At the same time rigorous analysis would benefit from improvement of data. It is vital to conduct new national inventories of land use pattern, degree of soil erosion and high water table and salinity inflicted areas using the supported by modern geospatial tools. Better data would allow better identification of problem areas and focus limited resources correspondingly. Although action has been taken recently under CAWMP[19] to strengthen the Capacity of Tajik Land Specailists in the use of Geospacial tools. The study results[20] of the four watersheds under CAWMP however provides the typical situation of the vegetation cover and degradation risk classes with a population of abot 550,000 people with a agricultural area of about 400,000 ha only with an overall land area of 36,000 km^2 area presenting the magnitude of the problem in Tajikistan. Further sections address necessary institutional and policy changes in the area of natural resources management in Tajikistan. It is important to ensure harmonized natural resources management: land management should be coordinated with irrigation rehabilitation and supported by comprehensive feasibility analysis of soil conservation in the vast area of pasture and range lands, in mountain areas and improvement of irrigated agricultural lands with investments in canal conveyance and drainage systems rehabilitation.

4.3. Deforestation

The cost of deforestation and degradation of forests is the aggregate social loss associated with degraded or deforested lands. These costs include, in theory, a wide range of local,

[19] The CAWMP project engaged the The Centre for Development and Environment (CDE) of the Institute of Geography, University of Bern (Switzerland) financing from the CTF, to work on the Capacity Building in Use of Geospatial Tools for Natural Resource Management (TA-P105244-TAS).

[20] The Land Degradation Risk data on vegetation cover and Degradation risk classes on the maps for the four watersheds based on SRTM -3 topographic information , using Landsat ETM+ images (Vanjob, Surkhob, Tohirs and Zarafshon watersheds of Mountain areas of Tajikistan under of CAWMP project, lead by Ms. Jessica Mott Ref: http://www.cde.unibe.ch/transfer/CTF_Database/geo_database.zip).

regional, national, and even global costs. Examples include direct losses like loss of timber, fuel wood and non-timber products, recreation and tourism losses and indirect use losses (such as those associated with damages to ecosystem services, water supply and carbon sequestration), and non-use value loss associated with loss of forests. This section examines each of these categories of losses with the available data. The losses associated with carbon sequestration have not been considered, except as noted in Box 4.3.2.

Tajikistan's forest resources cover only about 3 % of total land area. The total forest are in the country in 2004 is only about 401,000 hectares (UNECE, 2004). Although the Tajik Forestry Research Institute facilitated the FAO effort on the Global Forest Resource Assessment for Tajikistan in 2005, the report has not provided any data on change in forest cover after 1990 (FRA 2005). This is because forests in Tajikistan is protected by law and only secondary cutting is allowed, only about 6.5 cubic meters is officially allowed to cut for wood fuel (UNECE, 2004). However, about 500-600 violations are reported annually and it is estimated that allowed cut is exceeded about 25 %.[21]

Although the official documents do not provide evidence of change in forest area due to deforestation in recent years, other documents suggest a more significant clearing of forests. According to the First National Report on Biodiversity Conservation (2003), nearly 6000 ha of forested area with a total volume of 10,000-15,000m3 are affected by illegal logging each year. Given the paucity of reliable official statistics, the study used the above estimates to arrive at a lower bound on the losses due to deforestation and degradation of forests. In addition to the above, SAVCOR's 2005 report to the World Bank estimates about 90,000 cubic meters of illegal logging annually (equivalent of 7000 hectares using about 13 cubic meters country average timber volume per hectare). This estimate is applied as an upper bound to estimate the losses due to annual deforestation.

The UNECE, 2004 reports the following reasons for extensive illegal logging in Tajikistan:

- Shortage of fuel, especially during winter time;
- Scarcity of wood for construction;
- High cost of imported wood;
- Ignorance of local communities of legislative-statutory acts and general preservation benefits.

In the absence of official data on deforestation or forest degradation, the loss of forest value estimate is highly uncertain. However, there are some attempts to estimate the value of forest ecosystems for local population to support the establishment of new conservation zones. For example, the GEF project for Dashtijum Biodiversity Conservation Project (DBCP) documented existence of forests cover in almost all of project area for the project (Box 4.3.1).

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[21] http://www.unece.org/trade/timber/docs/sem/2004-1/tajikistan.pdf.

Box 4.3.1: Dashtijum Biodiversity Conservation Project (DBCP)

Project preparation activity included a survey of about 1280 households in the project area. These households confirmed the significant dependence on nature resources: over the half of the households collect wild fruits (58%) and herbs (52%); close to half of the households collect wild nuts, mainly walnuts and pistachio (46%); and one of every 12 households collects mushrooms (8%). Around 17% of the households have reported an average income of US$33 for 2002 and US$50 for 2003 from such economic activities. Only a small %age of households (1.5%) reported nature products gathering as their main source of income. Average annual income per household was $233-$333. Agriculture is the main economic activity of the population and almost all households own land. Almost two third (65%) have reported that agriculture activities are the main income source for their households. Due to climatic and geographical characteristics of the region, the agricultural occupations are limited to livestock breeding, wheat production on small slope land plots, and fruit gardening. Agriculture production is at the level of subsistence. The population is experiencing serious problems with fuel supply and energy sources because of the lack of infrastructure and organized trading system. About 86% of households use collected wood for heating, averaging 5-7 cubic meters per family, which covers less than 1/3 of the household needs (Source: MSP Project Brief: Tajikistan Dashtijum Biodiversity Conservation Project 23).

There are about 1280 households in the project area and they annually collect about 7.5 thousand cubic meters of wood. Taking into account that project area is about 80,000 hectares and average wood density in Tajikistan is 13 cubic meters per hectare, they denude around 600 hectares annually, about 0.7 % of its area. Note that this estimate is lower than the one based on the first National Report on Biodiversity Conservation (2003), which suggests about 1.5 % of annual deforestation rate.

The major threats to forests in this area were identified as: uncontrolled hunting and gathering of rare plants, logging and intensive cattle grazing.

Deforestation has a number of effects, both direct and indirect, and hence the cost of deforestation is very difficult to estimate. In addition to direct costs, deforestation may contribute to increased frequency and severity of flooding and landslides, and is likely contributing to agricultural land erosion problems. It is also associated with impacts on quality of water resources. However, it is practically very difficult to identify and estimate these costs of deforestation at the national level particularly in a country like Tajikistan where there is very limited data and past literature on forestry and biodiversity effects. Since data and background information are not available for Tajikistan we have used estimates of values for the forests in other countries, applying a range of values to reflect the uncertainties of using these values in Tajikistan.

According to Fisher (2003) based on his study in Republic of Kyrgyzstan (another Central Asia country) some of the reasons why it is difficult to obtain reliable data on the contribution of forest products to household income are:

- There is likely to be systematic under-reporting of income by the tenants themselves;
- Much of household income is in the forms of subsistence goods and most of the goods are bartered. Even nuts, which is an important part of cash income, is sometimes bartered;
- Other benefits from forest plots (firewood, mushrooms and sale of various fruits) are either non-cash benefits or are not recorded systematically;
- The value of access to arable fields and pastures access cannot easily be converted to cash equivalent;

- Nut harvests (and, to a lesser extent, fruit harvests) are extremely variable from season to season. As households do not usually record income, the data reported are from memory and hence not reliable;
- Market process vary considerably even within a particular season and between seasons and hence valuation is very difficult.

The estimates in this analysis are based on the background studies by Pearce et al (2001) and Lampietti and Dixon (1994). Because of the high degree of uncertainty and data problems, we present here average as well as high and low estimates. The high-end estimates are based on the assumption that it is possible to internalize all forest benefits based on a forest "inventory" by the local community in the short term, which obviously is an overestimation. The low-end estimates, on the other hand, are based on the possibility that almost no forest benefits can be internalized because of the absence of market infrastructure, roads, favorable public policy and high discount rates.

Important social forest values should be considered from a long-term perspective. The present analysis considers only flows out of sustainable wood fuel supply and non-timber products collection. The financial flows from concessions and profit of predatory logging are not estimated. Although it is generally accepted that in the short-term profits from predatory logging are higher than from sustainable forest management, in the long term with a real discount rate less than 20 %, sustainable management theoretically has a higher net present value (Pearce et al, 1999). Pearce et al (1999) study debunks common perceptions about higher profitability of predatory logging. In Tajikistan, all forests were classified as category one which means that timber production is not allowed anywhere. Only secondary cuts for wood fuel are allowed in very limited amounts. So for the study purposes, three components of direct use forest value were estimated: non-timber products, sustainable fuel wood production and ecotourism.

Sustainable fuel wood production is estimated by the governmental agency in Tajikistan (UNECE, 2004). It is estimated that about 6.5 thousand cubic meters of fuel woods is produced annually over the total forest area in the country. Then for the deforested area annual sustainable fuel wood losses would be 3-4 thousand TJS. Lampietti and Dixon's estimates of non-timber values in Central and South America ranges from US $9 to $10 per hectare. Using a value of 9 TJS per hectare of deforested land in Tajikistan the total non-timber lost annually is then 167-195 thousand TJS.

Another direct use value is ecotourism. Pearce et al (1999) estimates these values in the range of US $5-10 per hectare of forest depending on the location specific character of the forests. Since tourism industry is very underdeveloped in Tajikistan, we use 0-10 TJS per hectare as a range, and the corresponding upper limit on the annual loss of tourism value of recreational forest is 217 thousand TJS.

The indirect use values of forest include watershed protection, nutritional and erosion/flood prevention, and water/nutrient recycling. Although there is no definite agreement in the literature about the magnitude of the indirect forest value, Pearce et al (1999) presents a higher end estimate of TJS 30 per hectare of forest based on a review of literature on values associated with forests. Applying this value to the annual forest losses in Tajikistan gives an annual cost of 558-651 thousand TJS. In addition to the above

indirect benefits, Pierce et al also gives an option value for forest associated with bioprospecting (prospects of new drugs to be developed in the future using rich forest biodiversity). The option value associated with bioprospecting is in the range of TJS 0.01-21 per hectare. Using the upper bound the option value associated with bioprospecting lost due to deforestation is 456 thousand TJS per year. We assign zero as the low-end estimate. Pearce et al (1999) based on an extensive literature of review has also estimated the existence value of forest associated with forest preservation at about TJS 13-27 per hectare. This implies an annual loss of existence values as a result of deforestation cost at around 242-586 thousand TJS.

As mentioned before, this analysis does not include the lost carbon storage values of forest as the carbon market price is uncertain at this point in time. Carbon markets are only gradually emerging in the region and currently deforestation reduction is not eligible for any compensation. However, the situation could change in the near future. Then forest values should be updated using carbon market prices and the eligible share of the forest that can be counted for carbon sequestration could be included in the computation of losses due to deforestation (Box 4.3.2).

The estimated costs of deforestation from different cost categories in Tajikistan are summarized in Table 4.3.1. NPV is the present value of the stream of costs from one year of deforestation. The direct use values, reflecting local private forest losses, include the losses from non-timber products, fuel wood, tourism and recreation. Indirect use values include watershed protection services values. Non-use values lost include bioprospecting and existence values.

Taking into account only the direct and indirect use values of forest, the mean cost (NPV) of annual deforestation of 6-7 thousand hectares in Tajikistan is estimated at about 15 million TJS (0.2 % of GDP in 2006), with a range from 9-20 million TJS. It may be noted that values associated with ecotourism, indirect use and non-use values approximated from the literature account for about 88 % of the total annual cost of deforestation. Since the indirect use and non-use values are highly uncertain the estimate of the total cost should also be used with caution.

Table 4.3.1: Costs of Annual Deforestation (Thousand TJS)

Forest service	Annual Cost			NPV*
	Low estimate	Mean	High estimate	(mean)
Direct use values	167	290	412	2,747
Fuel wood production	3	4	4	38
Non timber products	167	181	195	1,719
Tourism and recreation	0	109	217	1,028
Indirect use values	558	605	651	5,730
Non-use values	242	642	1042	6,083
Option value (bioprospecting)	0	228	456	2,160
Existence value	242	414	586	3,923
Direct Plus Indirect	725	894	1063	8,478
Total value	967	1536	2105	14,560

Source: Estimated using FRA, 2005; UNECE, 2004; Pearce D. et al, 1999; Lampietti and Dixon, 1994.; An annual discount rate of 10 % is used to calculate NPV.

Box 4.3.2. Carbon storage value

Carbon storage value of the forest is an indirect use value and it is quite an essential asset from a global climate perspective. An average biomass from 1 hectare of forest in Tajikistan is 14.5 tons[22], or 7.2 tons of carbon per hectare[23], as in (FRA, 2005). A carbon price at US $30 per ton CO2, as at the European spot carbon market, implies a carbon value of about US $780 per hectare. The carbon benefit of forest is however not internalized at the current stage of the Kyoto Protocol negotiations. If the international community would acknowledge an important role of forests in carbon storage in a post-Kyoto regime, then some mechanism could be initiated to provide compensation for reductions in deforestation (Strukova, 2004). This mechanism is under intensive discussion at the Conferences of the Parties to the Climate Change Convention.

Given 100 % protective status of forests in Tajikistan, environmental regulation should concentrate on improved mapping, zoning and forest inventories to ensure better control of illegal logging. At the same time, it is important to promote cleaner energy sources for domestic use to reduce demand for fuel wood and establish clear land use regulation prohibiting improper use of hillside lands for agricultural purposes. International cooperation should be the base for technical support for tree plantations, reforestation and agroforestry.

4.4. Natural Disasters

Tajikistan is annually afflicted by natural disasters such as droughts, floods, landslides, avalanches and storms. Severe earthquakes occur periodically. The total mean annual cost of natural disasters is estimated at 115 million TJS, or 1.6 % of GDP in 2006.

Box 4.4.1 presents the documented anthropogenic reasons of natural disasters in Tajikistan (Tajikistan State of the Environment Report, 2002).

Box 4.4.1. Documented Anthropogenic Reasons of Natural Disasters in Tajikistan

The overpopulation of mountain areas and the improper selection of sites for economic activity, as well as use of technologies, cause the formation of man-made landslides, rock falls, and deep depressions, such as Shurab coal mines and other sites. The improper construction and exploitation of irrigation systems resulted in Zakhmatabad, Kamcha, and Sharora landslides, which caused the huge damage and death of many people. Building settlements in potentially dangerous landslide areas caused the destruction of the villages by huge landslides. Large reservoirs, like Nurek Reservoir, contribute to the local seismic activity, reinforcing the tectonic movements.

Source: http://enrin.grida.no/htmls/tadjik/soe2001/eng/htmls/disas/press.htm

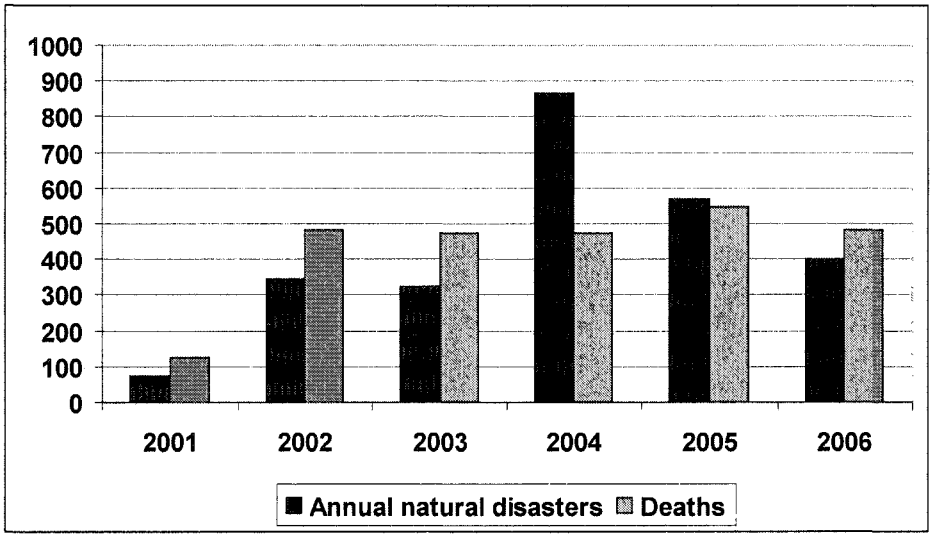
State Statistical Agency of Tajikistan maintains a large database on disasters. The database contains information on fatalities, the number of injured persons, houses affected, hectares of arable land affected, and roads, railroads, bridges, as well as public buildings, churches, educational institutions, and water supply systems and other forms of infrastructure affected/destroyed by disasters. The number of natural disasters and fatalities are presented in Figure 4.4.1 for the period 2001-2006. Figure 4.4.2 presents the number of injured people and houses affected during the same period. The figures include disasters

[22] Including above (10 t) and below ground (4 t) biomass, and dead wood biomass (0.5 t) also.

[23] Applying 0.5 coefficient of carbon content of biomass (FRA,2005).

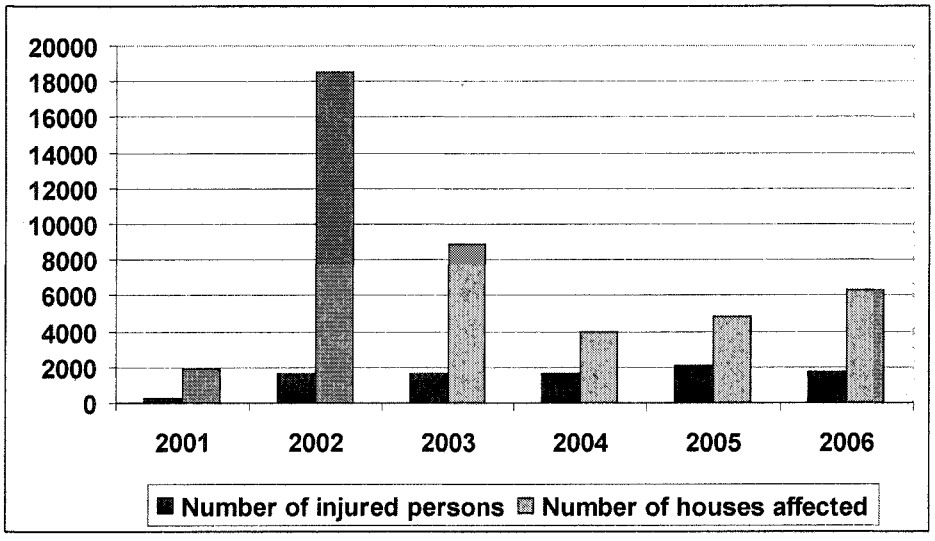
that occur more or less annually. Table 4.4.1 presents more details of the impacts of the disasters.

Figure 4.4.1: Number of Natural Disasters and Fatalities in Tajikistan (2001-2006)



Source: State Statistical Agency of Tajikistan.

Figure 4.4.2: Impacts of Natural Disasters in Tajikistan (2001-2006)



Source: State Statistical Agency of Tajikistan.

Table 4.4.1: Natural Disasters and Impacts in Tajikistan, 2001-2006

Description	2001	2002	2003	2004	2005	2006	Total
Number of deaths	124	483	475	475	547	482	**2586**
Number of injured people	247	1643	1620	1601	2036	1737	**8884**
Residential houses affected	1889	18,542	8896	3961	4789	6296	**44,373**
Schools and kindergartens affected	66	505	288	169	175	136	**1339**
Health centers affected	6	154	44	63	43	47	**357**
Community centers and other state buildings affected	34	162	37	92	64	121	**510**
Damaged roads, km	224	1588	658	1247	6358	681	**10,756**
Bridges affected	39	152	92	81	115	15	**494**
Damaged irrigation canals, km	169	877	550	419	254	57	**2326**
Hydro-stations and facilities affected	21	72	65	47	69	9	**283**
Water supply and sewage systems affected, km	19	50	48	30	24	11	**182**
Total natural disasters	**2037**	**2170**	**2165**	**2438**	**2289**	**2207**	**13,306**

Source: State Statistical Agency of Tajikistan

The State Statistical Agency of Tajikistan is responsible for maintaining and reporting data on natural disasters in the country. The data on number and cost of damages from natural disasters reported by the Statistical Agency are adopted in this report to provide an order of magnitude of the annual cost of natural disasters. The cost of annually occurring disasters is based on annual averages for the 6-year period 2001-2006, for which data are available.

The total estimated annual cost of natural disasters is 115 Million TJS (Table 4.4.2). The largest cost is associated with damages to housing followed by deaths, and then damages to roads.

Table 4.4.2: Estimated Annual Cost of Natural Disasters (Million TJS)

	Million TJS
Number of deaths	35*
Number of injured people	4
Residential houses affected	41
Schools and kindergartens affected	5
Health centers affected	2
Community centers and other state buildings affected	1
Damaged roads, km	15
Bridges affected	6
Damaged irrigation canals, km	5

Hydro-stations and facilities affected	2
Water supply and sewage systems affected, km	0
Total	115

* Valuation of mortality is discussed in Annex 3. An average of HCA and VSL is used here.

Unit costs of disaster impacts used to estimate the total annual costs are presented in Table 4.4.3. These estimates are derived from the cost estimates of the State Statistical Agency of Tajikistan as discussed above.

Table 4.4.3: Unit Costs Applied to Frequently Occurring Disasters

	Low (TJS)	High (TJS)
Per house	1,100	10,000
Per school	2,000	41,000
Per health center	5,000	61,000
Per state building	3,000	15,000
Per road km	2,000	15,000
Per bridge	10,000	130,000
Per irrigation canal, km	5,000	20,000
Per hydro station facilities	15,000	68,000
Per WSS affected km	6000	17000
Per human life*	32,000	130,000
Per injured person**	1600	3,200

Source: Estimated from State Statistical Agency of Tajikistan; *Risk to human life is estimated as in Annex 3;**Risk of injury is estimated as in Larson, 2004.

To address natural disaster problem, it is necessary to develop an integrated response that emphasizes prevention, vulnerability analysis, and risk assessment. A crucial element of the strategy would be the creation of a fund to provide incentives for local governments to advance in the preparation and implementation of prevention plans. Additional nonstructural and structural measures that the Government should consider include establishing as a national priority the reduction of disaster risk and vulnerability, adoption of disaster prevention and risk assessment tools at all levels of government, managing risks in land use and urban planning, and diffusion of appropriate and safe construction technologies. Mitigation of natural disasters' impact should be an integral part of adaptation to climate change strategy.

V. Climate Change and Hydro Power Potential

Climate change triggered by the rise in average temperature has became a global environmental problem. In Tajikistan, the consequences of global warming are mainly observed in retreat of mountain glaciers, increase in runoff and increase in the occurrence of natural disasters. Due to the peculiar geographic location, the glaciers of Tajikistan occupy up to 6% of the country's territory and are regarded as the main glacial knot of Central Asia that regulate the climate of the region and its river flow. Rivers of Tajikistan are considered as main sources of local power generation, irrigation and replenishing of the Aral Sea.

During the period of 1961-1990, the mean temperature in the valleys increased by 0.7-1.2 C^{o} and in the mountains by 0.1-0.7 C^{o} (First National Communication, 2002). The increase in temperature in large cities was twice as high as 1.2 to1.9 C^{o} due mainly to rapid urbanization, infrastructure development and production growth. Models of future climate project that annual mean near surface temperature in Tajikistan will increase within the interval of 1.8-2.9°C by the year 2050. The projected rate of warming is much greater then the observed changes during the 20th century. Due to complexity of mountain landscape, there is medium and low confidence in precipitation scenarios, where projection varies from medium increase to some decrease. Major problem associated with temperature change in Tajikistan is glaciers retreat.

Box 5.1. Shrinking of Glaciers in Tajikistan

Pamir glaciers are shrinking because of global warming, which jeopardizes the nation's water supply and increases the number of natural disasters. Based on recent space photographs of the Russian Academy of Sciences there are 5729 glaciers with the total area of 7493.4 square meters and capacity of 660 Cub. Km. in Pamir mountains. In Hissor-Alay mountains there are 3890 glaciers with the total area of 2327.8 square meters and capacity of 135 Cub. Km. Experts argue that between 1957 and 1980 Hissor-Alay mountain range lost 341.6 Sq. Km of ice or 15.6% of its total ice capacity and Pamir Mountains lost 773.3 Sq. Km or 10.5% of their total ice capacity. Thus the Pamir-Alay range together lost 1114.9 Sq. Km or 11.7% of its ice volume. Smaller glaciers that comprise 80% of all glaciers melt more intensively than the larger ones. Since 1933, Fedchenko, the largest Pamir glacier shrank by at least 1 Km and continues to lose 16 m a year, Skogatch glacier lost 98.8 mil. cub. m. Although several experts argue that these numbers are overestimated, these are the most precise estimations available as glaciers were not closely monitored in recent years. On average, glaciers that are located on the eastern side melt faster than those that are located on the northern side of the mountains.

Since climate experts cannot give a precise scenario of melting of glaciers several alternative projections should be considered. In the worst case scenario, if the average temperature will go up by another 1.5 C^{o} between now and 2050 one third of the total ice capacity can be lost and many small glaciers will disappear. Zeravshan river affluent will change from ice-snow to snow-ice. Kofarnihon river will lose all glaciers. Vaksh river will be affected to a smaller degree. The glaciation area of the right bank of Surhob river will shrink by up to 20 % and the ice area by 25-30 %. Kizilsu-Alai affluent will be less affected due to its exposition to the northern site of mountains and onflow from Zaalai mountain (this slows down the melting process). Muksu river basin glaciers will shrink by 10-20%. Obihingou river basin can lose up to third of its volume. Glaciers of Western Pamir will lose up to 25% of their volume. Eastern Pamir glaciers will be less affected as they are located higher than any other glaciers.

Source: First National Communication of the Republic of Tajikistan, 2002

The First National Communication states that glaciers melting negatively affects different local biodiversity on the mountain slopes. First National Communication, 2002 especially is citing potential damage to tugai ecosystem (flood plain) will degrade because of shortage of water resources, increase of temperature, and fire risk. Land degradation could exacerbate due to longer dry periods and higher temperature in spring and summer. Glaciers melting also alters development of major sectors of the economy including agriculture, water and electricity supply through deterioration of the irrigation potential, reduction of river flows and hydropower potential, especially concentrated in the most affected river basins.

The expected temperature change evaporation will increase and irrigation systems would need more water delivered through irrigation. It is estimated that water needs for irrigation of basic agricultural crops will rise by 20-30% compared to present climate conditions. 20 % reduction of irrigation water in the vegetation period will cause the 15 % reduction of cotton yield, while a 50 % of water supply deficit will result in 35 % cotton yield drop. At the same time process of dams sedimentation will accelerate. Since efficiency of irrigation systems in Tajikistan is only 0.65, the impact could be a dramatic increase of water demand for irrigation (First National Communication, 2002).

Irrigation potential is has the same source as hydropower in Tajikistan. About 90 % of power generating capacity in Tajikistan is hydroelectric (Library of Congress. Country Profile: Tajikistan, 2007, http://lcweb2.loc.gov/frd/cs/profiles/Tajikistan.pdf). About 70 % of the hydropower potential is concentrated along rivers Panj and Vakhsh (Table 5.1) that could be potentially affected by climate change.

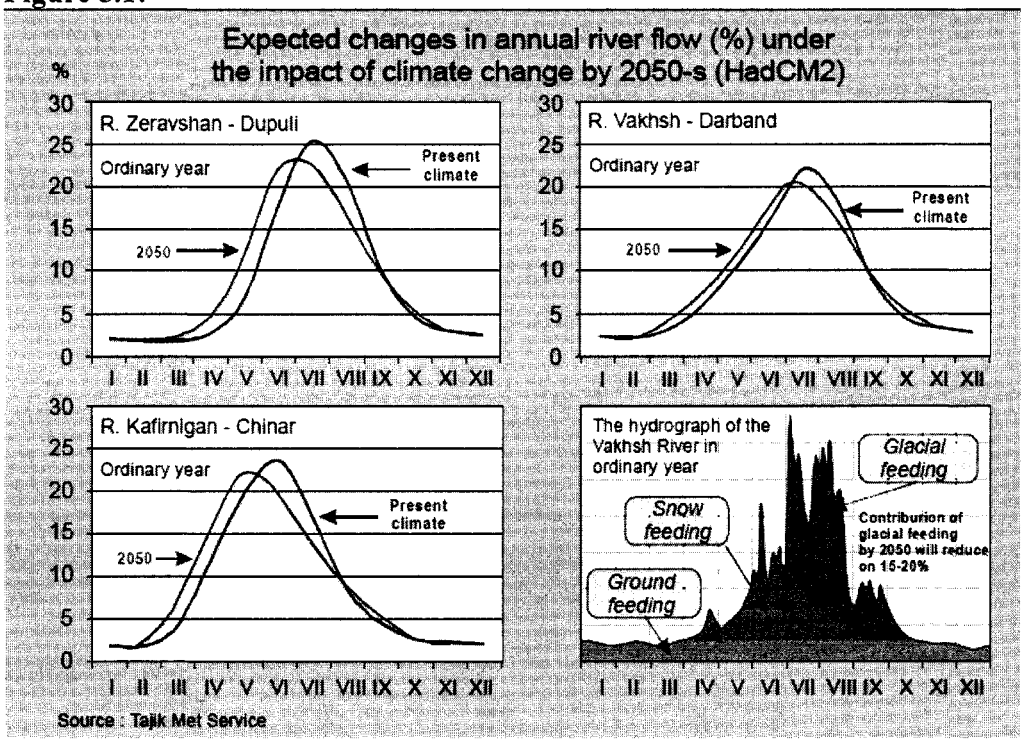
Table 5.1: Potential Hydropower Resources in Tajikistan

Бассейны рек Pools of rivers	Среднегодовая мощность,мВт. Fair annual power,mWt	Средне годовая энергия, ТВт.ч. Fair annual energy, TWt.h	Доля в общем объеме, % Share In general volume,%
Пяндж Panj	14030	122,90	23,2
Гунт Gunt	2260	19,80	3,73
Бартанг Bartang	2969	26,01	4,93
Ванч Vanj	1191	10,34	1,96
Язгулем Yzgulem	845	7,40	1,39
Кызыл-Су Kyzyl-Su	1087	9,52	1,78
Вахш Vakhsh	28670	251,15	48,00
Кафирниган Kaphirnigan	4249	37,22	7,00
Оз. Кара-Куль Lakes Kara-kul	103	0,90	0,17
Сурхан-Дарья Surkhan-Daray	628	5,50	1.03
Зеравшан Zeravshan	3875	33,94	6,38
Сыр-Дарья Syr-Daray	260	2,28	0,43
Итого Total	60167	527,06	100,00

Source: http://www.untj.org/principals/minutes/Future_prospect_of_hydro-power_engineering_in_Tajikistan.pdf

Although currently only 5 % of hydropower is used, still most hydropower facilities are located there (Nurek Power Station) and some new hydropower facilities have been designed for construction on that river too (Rogun and Sangtuda Power Stations). Figure 5.1 below presents expected changes in annual river flow associated with climate change. According to some projections, a constant increase of temperature by 3-4°C in comparison with today's climate will dramatically shift the area and the volume of glaciers thereby causing catastrophic decline of water resources by 30% and more (First National Communication, 2002).

Figure 5.1:



Source: First National Communication, 2002

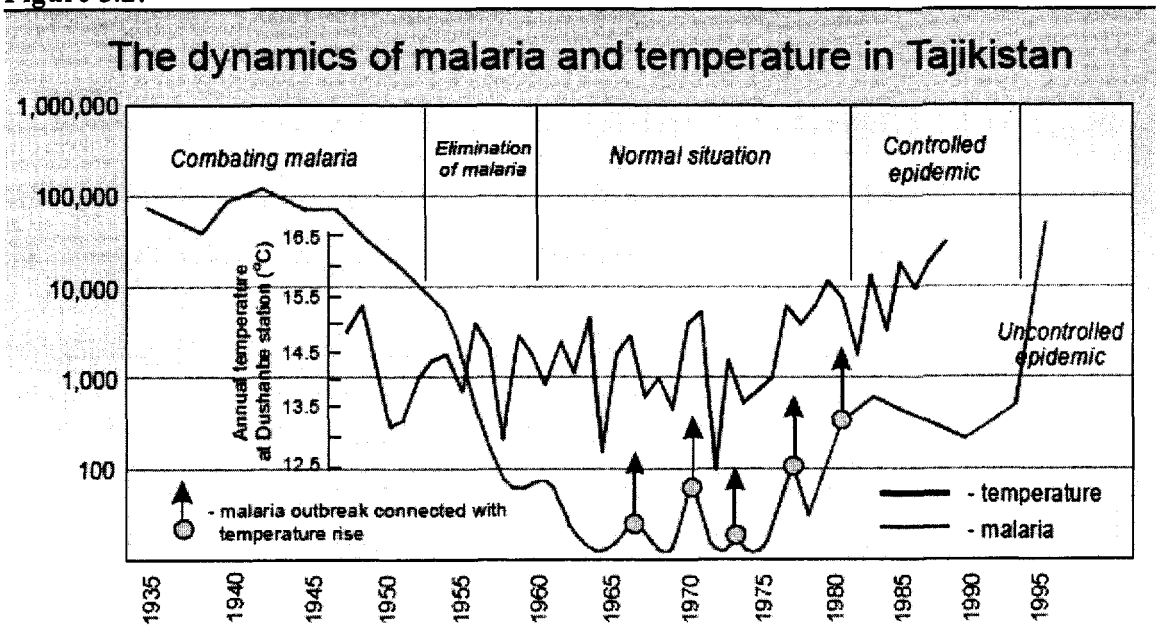
Climate change also could affect hydropower engineering through increased frequency of increased risk of landslides and floods. Mountains occupy about 93 % of the territory in Tajkistan. High air temperatures lead to rapid snow melting and ice thawing thereby creating conditions for formation of glacial-born mudflows. Sometimes mudflows happen as a result of a glacial lake outburst formed by surging glaciers. There will be a necessity in reconstruction, alteration of the operation mode of hydropower facilities, adapting in agricultural policy to mitigate risk of catastrophic events. First National Communication, 2002 reports that in 1991-2000, annual loses of agricultural gross product from extreme weather events totaled to 1/3 of overall agricultural loss. Losses could be even higher in the longer term with further temperature increase.

Deficient energy supply and extreme weather events could aggravate difficult living conditions and lead to excess winter and natural disaster related deaths, as it happened in 2008. Industries will be affected too. As mentioned in section 3.5.1 Tajik Aluminum Plant consumes about 40 % of power generated in Tajikistan. Any interruptions of energy supply

alter aluminum production with significant adverse effects on fiscal revenues and balance of payments of Tajikistan.

Climatic change would likely lead to further reduction of available water resources for population in Tajikistan. Already limited access to clean water (See section 3.3) could be reduced further without adequate adaptation policy. Then in the longer term already elevated diarrheal mortality and morbidity among children under five and older population could rise further. Among other adverse effects of temperature increase WHO reports (Campbell-Lendrum, D. and Woodruff R., 2007) additional cardiovascular diseases in urban ares and increased area and numbers of infectious and vector-born diseases. There were studies in Tajikistan that link malaria and temperature increase.

Figure 5.2:



Source: First National Communication, 2002

It is important that poor are the most vulnerable to adverse effects of climate change because they do not have resources for coping and adequate adaptation.

There has been a positive movement in the recognition of the importance of climate change adaptation strategy. Phase 2 of the First National Communication of the Republic of Tajikistan, 2003 studies the potential for mitigation and adaptation in Tajikistan. Adaptation section especially concentrates on the water resources problems and hydropower engineering strategy with regard to changing climatic conditions. This document determines priorities and scope of measures that could be taken by the Republic of Tajikistan to adapt to climate change and reduce greenhouse gas emissions.

This is clear from the incorporation of these concepts in major documents on socio-economic development could reduce vulnerability to existing negative weather events and to the future climate impact. Yet, as a matter of practice, the focus is still on emergency events and dealing with their immediate impacts, without a sufficiently integrated response that emphasizes prevention, vulnerability analysis and risk assessment. Suggested

recommendations include highlighting disaster prevention and the reduction of climate change risk and vulnerability as a national priority. Such a move would also help promoting a consistent unification of climate change adaptation into socio-economic development programs, designing coordinated water management – irrigation and power generation plans, enhancing cross country coordination and electricity trade, as well as incorporating risk assessment policies across the various ministries and functional areas, from development planning to watershed management and hydro power projects. It is important to strengthen technical and organizational capacities, especially at the regional and local levels, to manage risk reduction and organize the adequate response.

VI. Policies and Institutions for Environmental Management

Tajikistan faces a number of environmental challenges and environmental degradation is highly visible in the country -air and water pollution and their effects on environmental health, problems in waste management, soil degradation, degradation of rangelands, deforestation and loss of biodiversity and natural disasters. There is a broad consensus at the national and sub-national levels that there is an urgent need to address the environmental problems in the country. In order to address these issues the country requires effective environmental policies, laws and strong institutions to implement them. This section presents an assessment of the existing institutions and the regulatory framework and the issues identified in enforcement of the policies and regulations.

Harmonized land use pattern, soil and moisture conservation measures in mountain area, with rational water management in the irrigated agricultural valley lands are core issues of environmental damage cost reduction. Inefficient irrigation practices with inadequate drainage as well as poor land use cropping pattern approach results in low farm production income level. Limited access to drinking water and deteriorating water supply and sanitation infrastructure are major reasons of increasing children mortality and morbidity. Harmonized water management should also account for declining hydropower potential and ensure resilience` of development projects to climate change and adaptation needs. Lack of energy resources puts additional pressure on the poor in Tajikistan. Although analysis of water management problems in Tajikistan is constrained due to data gaps, cost of environmental degradation structure identifies clear priorities and areas for future policy interventions.

The analysis suggests that the key constraints in environmental management in the country are not from the absence of well defined environmental policies but rather inadequate legislation and bylaws/guidelines to implement specific polices in particular, weaknesses in institutional design, lack of vertical and horizontal coordination, lack of capacity of institutions and insufficient funding. A number of national and local/provincial level agencies and different ministries are involved in the area of environmental management. There exist opportunities for significant improvement in environmental management through better coordination among the different agencies. The analysis also suggests that policies currently followed do not provide economic incentives for pollution reduction and more efficient use of natural resources.

6.1. Assessment/review of the policies and programs for environmental protection and natural resource use

Although the country suffered from civil war and political instability for about a decade since independence in 1992, policies and programs for environmental protection began to emerge as early as 1997. The government has since developed and implemented various programs for environmental protection. The different government programs and action plans formulated for protection of the environment and their progress are reviewed below:

a. State Environment Program for 1998-2008

Adopted by the government in 1997, this is the first key policy document in the environmental sector, and sets the basis for the broader set of environmental policies. It recognizes the importance of a healthy and clean environment for sustainable economic development and human survival. The program envisages participation of government, business, nongovernmental organizations and the general public in protecting and improving the environment and to teach everyone about the importance of sustainable use of natural resources. The state of the environment in each oblast is described in detail and sets out the activities needed to restore or maintain an ecological balance or rectify a particular environmental problem. It also lists immediate practical measures for preventing land erosion, allocating land for highly productive crops, reforestation and protection of sensitive areas, restoration of air and water quality and encouraging local industries to use environment friendly raw materials and production techniques.

In addition to the list of actions, the document identifies the nature of each action, how it should be implemented, the governmental bodies responsible for the activity and the time-frames within which each activity should be completed. Each year since 1998, the environmental agency (the former Ministry of nature protection and then the State Committee for Environmental Protection and Forestry, and now Ministry of Agriculture and Nature Protection) prepares annual progress reports. While there has been progress in implementation of some of the actions envisaged, some others are often delayed by a year or two, primarily because of lack of funds.

There has been some progress in implementation of activities like expansion of specially protected territories- such areas now cover one fifth of the country. Also, reforestation efforts are showing encouraging results in the densely populated areas in the Hissor Valley, in Dushanbe and its surroundings, and in Sughd oblast. However, there has been little progress in provision of improved water management and sewage treatment. For example, the construction of a biogas plant at the sewage collection facility in Khujand is less than 10% complete and was suspended midway, despite its obvious importance for the Sughd oblast and downstream territories, mainly because of lack of funding from the Sughd oblast environmental protection committee.

b. State program on environmental education

The state program on environmental education adopted by the government in 1996 envisages conservation in use of natural resources, the importance of recycling and gradual transition to a closed-cycle production at all enterprises. The program calls for a system of continuous and universal environmental education giving emphasis on education for managers of enterprises that may have adverse impacts on the environment or who work in the area of nature protection. However, the analysis undertaken for this study suggests that the implementation of this program has been very weak from the Government side and has not received adequate donor attention.

c. National action program to combat desertification

In 2001, the Government appointed the chair of the State Committee for Land Administration to coordinate the development of a national action program to combat

desertification. The program analyzed the extent of desertification and soil degradation in the country, their causes and consequences- environmental, economic and social -and developed a strategy to combat desertification. The strategies include, inter alia, monitoring the desertification process and creating an information system on desertification problems, classifying the territories according to the degree of soil degradation, measures to combat erosion and soil degradation, drafting new legislations and modifying existing legislation on the use of natural resources, increasing the participation of the local population and non-governmental organizations and developing social and economic instruments for action against desertification.

d. National strategy and action plan on conservation and sustainable use of biodiversity

In September 2003, the Government adopted the National Strategy and Action Plan on the Conservation and Sustainable Use of Biodiversity and established the National Biodiversity and Biosafety Center to oversee its implementation. The Strategy and Action Plan are intended to provide the basis for sustainable development of all biodiversity, from genotypes of plants and animals, communities and ecosystems, wild and cultivated plants and domestic animals.

e. National action plan for mitigation of climate change

The Government adopted the National Action Plan for the Mitigation of Climate Change in June 2003. The plan sets priorities and measures to address the problem of climate change, to develop capacity for further research and analysis of the climate system, and to strengthen international cooperation in this area. The measures are meant to serve as a basis for planning and decision-making at the state and sectoral levels.

f. National action plan in environment and health

The national action plan on environment and health has a mandate to provide information on air and water pollution and to develop measures to reduce air and water pollution to meet the WHO quality standards.

g. Center for Environmental Policy and Information

The Center for Environmental Policy and Information was established in 2005 with technical assistance from Asian Development Bank in order to develop capacity in strategic planning and coordination of environmental policy. The center's objectives are to facilitate better integration of environmental issues in strategic development plans of Tajikistan and creation of a database to improve coordination within and across departments and among the donors on environmental issues. The CEA study team found that this center has not been able to meet any of its objectives so far.

h. National Environment Action Plan (NEAP)

The NEAP aspires to establish an effective system to monitor meteorological and environmental data, improve the quality of meteorological services, implement international obligations related to the environment, inclding the national implementation

plan (NIP) in the Stockholm Convention on Persistent Organic Pollutants (PoPs) and other chemical pollutants like **D**ichloro**D**iphenyl**T**richloroethane (DDT), to phase them out and stopping their use, under pesticide usage. The Governement has resolved to develop a forecasting system for natural disastersand and to assess climate pattern and climate change. Following the NEAP, the National Development Strategy (NDS) and Poverty Reduction Strategy (PRSP-2), laid out the following priorities for the environment sector:

- improvement of institutional potential to address environmental issues with the object of achieving environmental sustainability;
- development of institutional capacity to forecast natural disasters and effective management of natural disasters should they occur;
- enhancement of natural resource management, preservation of biodiversity and protection of ecosystems.

In the light of the above NDS/PRSP-2 priorities and the problems in the sector, the NAEP has identified the following two priorities for the strengthening environmental protection:

a. Implementation of institutional reforms and improvement of legislative base and promotion of existing and new investment projects. This includes measures to optimize and strengthen the functions of potential agencies responsible for the development and implementation of policies and to reinforce the legislative for environmental activities.
b. Promotion of existing and new investment projects in the area of environmental protection. The specific measures include investments to promote environmental sustainability and at preventing the release into the environment of hazardous substances that have a negative impact on public health and the natural environment with emphasis on key sectors like energy, industry, agriculture, eco-tourism, etc.

It should however be noted that although the environmental policies, plans, and strategies in Tajikistan are rather well developed and documented, majority of laws lack implementation mechanisms due to the limited interdepartmental coordination including poor coordination across various line ministries and state agencies.

6.2 Constitutional provisions and laws regarding environment

Adopted in 1994 and amended in 1999 and then in 2003, the Constitution declares that the State undertakes to ensure a healthier environment and guarantees the efficient use of natural resources for the benefit of the people of Tajikistan. Under the Constitution, land and mineral resources, water, air, animals and plants, as well as other natural resources, belong exclusively to the State. Although the Constitution declares that the State acknowledge, respect and protect individual rights and freedoms and that the State bodies and officials should grant access to information related to individual rights and interests, it does not guarantee environmental safety or right for individuals to use natural resources, including such essential ones as air, water and land. In order to enforce the constitutional provisions the government has enacted a number of legislations regarding environment and use of natural resources, which are reviewed below.

a. Law on nature protection

The Law on nature protection was adopted in 1993 and later amended in 1996 to delineate the environment-related powers of various governmental bodies – the Government, the then Ministry of Nature Protection and the local Khukumats (councils/municipalities). It was again amended in 2002 to preserve the uniqueness of protected territories and to define more precisely the guarantee of a healthy and favorable environment to the general public. The law stipulates protection of the environment, sustainable use of natural resources and minimization of the impacts of economic activities on the environment and natural resources. In order to implement the environmental policies, the law identifies the applicable legal principles, the protected objects, the competencies and roles of the Government, the State Committee for Environmental Protection and Forestry, local authorities, public organizations and individuals. It mandates a detailed ecological and environmental impact assessment on any activity that could have a negative impact on the environment. Furthermore, it requires and outlines the procedure for developing environmental quality standards.

In its efforts to deal with environmental emergencies and natural disasters the law defines environmental emergencies and disasters and prescribes the order of actions in such situations, defines the obligations of officials and enterprises to prevent and eliminate the consequences, as well as the liabilities of the persons or organizations that caused damage to the environment or otherwise violated the Law. The Law also laid provisions for environmental education so as to create awareness among the public on environmental issues and sustainable use of natural resources.

b. Law on Specially Protected Territories

The 2002 law on specially protected territories is designed to conserve the protected areas like nature reserves and natural parks from overexploitation. The law requires all such territories to be regarded as one system owned by the State and should be recorded in the Cadastre of Specially Protected Territories. Each type of specially protected territory is subject to a different protection and use regime, for instance all activities are strictly prohibited in nature reserves, while certain areas of natural parks can be used for tourism and other limited economic activities. The use of protected territories is subject to strict environmental screening so as to ensure that such uses do not cause any ecological harm.

c. Law on Radiation Safety

The 2003 law on radiation safety vested the Agency for Nuclear and Radiological Safety with all aspects of radiological control. According to the above law, all activities related nuclear and radiological applications, nuclear waste disposal and waste sites has to be licensed by the above agency. The country has also ratified a number of international conventions in this area, which were included into the system of national legislation.

6.3 Environmental Policy Instruments

The 2002 amendment to the Law on Nature Protection sets out a number of instruments for environmental protection. They include the Environmental Impact Assessment (EIA), market based economic incentives, quota on pollution and use of natural resources,

environmental education and environmental information system.

6.3.1 Environmental Impact Assessment

In Tajikistan, Environmental Impact Assessment is a component of State Ecological Expertise (SEE), as set out in the 2002 amendments to the Law on Nature Protection and in the Law on Ecological Expertise. The amendment requires that all new facilities and activities that may have an impact on the environment be subject to EIA. Once environmental impact assessment is undertaken, it is subject to mandatory review by the State Ecological Expertise. The laws also require the Government to approve a list of activities and objects for which EIA is mandatory. The procedures for environmental impact assessment were approved by the GoTR (as per Decree on 3.10.2006, №464). It authorizes the State Ecological Expertise currently under the system of State Control in the Ministry of Agriculture to be responsible to conduct such assessments.

The Environment Protection law envisages two types of environmental impact assessments – State Ecological Expertise (SEE) and Public Ecological Expertise (PEE). The PEE allows public with expertise and businesses to participate in the general process of the ecological assessment of a project. While the SEE is the pre-condition to begin any type of activity, PEE is binding only after its results are approved by the SEE, the official organ. According to the 2003 law, the objective of Ecological Expertise is not only to prevent negative environmental impact as a result of the proposed activity but also to periodically monitor environmental and anthropogenic impacts.

Both private individuals and public associations, who are permitted by their charters, can initiate PEE. Such PEE may be initiated only after a formal application with the local authority (Khukumat) and its approval. The State Environment and Nature Use Control Service do the SEE. The SEE may attract leading scholars and qualified third-party specialists to draft the SEE and review it.

According to the Sughd Oblast Department of State Environment Control all the SEE drafters must submit their requests to do an SEE at least before beginning of new construction for no land can be allotted for without positive response from Khukumat. The final SEE draft need to be submitted before the business is allowed to actually run. An SEE is mandatory for reconstruction of business although the number of SEE requests for reconstruction of businesses is less, as reconstruction is usually less visible.

6.3.3 Economic incentives and quantity restrictions

The economic instruments for pollution reduction include charges for waste disposal, emission charges for pollutants discharged into water bodies, emission charges for air pollutants and charges for use of natural resources. In addition to the prices and charges, the government has also imposed quantity restrictions on pollution discharges and use of natural resources.

One of the major environmental problems in the country is the management of wastes. The wastes from industries, both toxic and non-toxic, and solid domestic wastes are collected and disposed by waste management services for which they receive a payment. There is a charge per unit of waste disposed and the total payments are based on the

quantity of waste collected.

In the case of atmospheric emissions there are quotas and charges per unit of emissions for the different pollutants identified, the chargeable air pollutants cover 123 components. In the case of automobiles, the government charges an annual tax on vehicles, which is a source of revenue for oblasts, cities and rayons. The State Inspectorate for Water Resources and local (oblast, city and rayon) services dealing with water resources enforces charges on pollution discharges into water bodies. There are also quotas and charges for use of water resources. Although the system of charges exists for a long time, their low level would not provide sufficient incentives for pollution reduction. The major benefit of this system is creation of institutional background for environmental protection.

VII. Environmental Governance

7.1. Institutional design: vertical and horizontal coordination

The previous section reviewed the government programs, action plans and the institutions set up for protection of the environment. This section takes a closer look as to whether these programs and institutions are capable of or have succeeded in addressing the key environmental risks and concerns. The CEA found that the government has set norms for air and water pollution, residual traces of chemicals and biologically harmful microbes in food, regulations regarding noise, vibration and magnetic fields, exceeding the threshold levels results in administrative actions and financial sanctions. However, their implementation remains unsatisfactory due mainly to weak institutions to implement them and lack of coordination, vertical and horizontal, across institutions. Although the government has enacted a number of laws and proposals to improve the state of the environment there is very limited state capacity for policy development, regulation, and implementation.

The measures to improve coordination in implementation of environmental policies are further outlined in the Priority 1 and Priority 2 of the recent NDS. Priority 1 of the NDS identifies implementation of institutional reform and improvement of legal basis, among others to bring environmental policy in compliance with the existing social and economic realities. It further recommends optimization of functions and capacity building of the organizations responsible for environmental policy implementation and guidelines to ensure that funds allocated to environmental protection are not actually spent for other purposes. The Priority 2 of the NDS has proposals for new investment projects in environmental protection to reduce emissions from agriculture, industry and energy sectors. It also plans to develop ecological tourism in the country.

The environment protection law stipulates several types of institutions to implement the environmental regulation at the state, ministerial, business and community levels. The state level control is exercised by the State Control Service on Nature use and Protection in the Ministry of Agriculture and Environment Protection and by the Sanitary Inspection Service of the Ministry of Health and Inspection on Mining Safety. At the ministerial level enforcement is done by different ministries and the state agencies under them with no effective coordination across the ministries. Organizational structure of environmental management in Tajikistan is described in Annex 4.

7.2 Environmental Governance

The government has enacted a number of legislations that set forth responsibility for violation of specific environmental laws. In particular, the Administrative Code of 1998 establishes an administrative liability for businesses, their staff members and individuals for violations related to negligence in land use for agriculture, water use or state ecological expertise. The administration and enforcement of the provisions of the law are vested with different agencies and/or administrative units so that administrative sanctions can be applied by such agencies like administrative commissions of hukumats, courts, inspectors

of the State Service, veterinary inspectors, and State Committee on Land Use. The authorities of these agencies are well explained in the Code.

There are also controls at the business level. The business-level control implies that every business has to observe the environmental laws. Both individuals and employees are subject to administrative enforcement (fines). The most common administrative enforcement (fine) ranges from salaries for 10 months for individuals and up to salaries for 15 months in the case of employees.

However, in practice, both the ministerial and business-level types of controls are less than effective because of the strong economic interest in promotion of businesses which in some cases overrides environmental concerns. Should a violation occur, neither a ministry, nor business would suspend their activity in that area, nor would they report to the State Service or related state agencies. The state agencies, however, lack enough resources and technical capacity to perform periodic monitoring of the sites. There are also instances of corruption due to low salaries and morale of the staff.

The inspectors who are in charge of enforcing the regulation often lack enough resources to perform inspections on a systematic basis. Usually, it takes the inspector over a year to revisit a business with inspection to see if the remedial measures suggested based on previous year's inspection are implemented or not. It is only during this second visit that an inspector could impose a fine for noncompliance if any.

An environment protection agency can suspend operation of an enterprise if it is found in violation of the codes. For instance, in 2003, in Sughd oblast local environment protection committee suspended over 70 such enterprises. Prosecutors investigate ecological violations/citations and thus play an important role in environmental law enforcement. Functions of environment protection inspectorate do not duplicate functions attached to the prosecutors rather they cooperate with each other. The citations are forwarded to local police departments and prosecutors' offices for investigation, and then such case may turn into a criminal violation.

The Criminal Code adopted in 1998 includes punishments for violations of laws regarding environmental safety, poaching, land degradation and pollution, protection of subsoil resources. The minimal fine for such violations is up to 2000 minimal monthly salaries or up to 8 years of imprisonment as maximum punishment. However, only 2 criminal cases were initiated since 1998. Since both were related to military activity they were not taken up in courts.

In addition to state agencies, public organizations or trade unions can exercise control of a state organ, a business or individual by reporting violations to law enforcement organizations or local environmental committees.

The analysis conducted for this study found that although environmental laws and regulations exist, they are complex and are outdated, most of which could be traced back to Soviet period. Such complex regulations and weak regulatory systems result in poor environmental governance. There has been much discussion on the use of economic instruments to stimulate environment friendly production systems in agriculture, industry and other sectors, but there has not been much progress in actual implementation of such

policies. It may be noted that pollution reduction if any achieved may not be due to the success in environmental governance and use of economic incentives, but rather due to closure of enterprises and or cut-back in production.

The country has received both technical and financial support from international organization for environmental protection. Tajikistan is a signatory to the UN conventions and regional agreements regarding environment. The government has since then ratified domestic environmental laws and regulations so as to conform to the frameworks of these international conventions and agreements.

The analysis shows that restructuring of the Sate Committee for environmental protection and its merger with the Ministry of Agriculture has not improved its performance and delivery of environmental outcomes. The current SCSNREP is working with outdated norms and standards, inadequate legislative base for implementation and constitutional base that bring chaos and misunderstanding at all levels. Further, it may be noted that the Ministry of Agriculture and Nature Protection has traditionally been attaching low priority to environmental protection.

The SCNREP under such a Ministry may not be able to effectively deliver better outcomes. The agency does not have enough capacity, in terms of number of inspectors, to conduct regular inspections and enforce citations. Hence, with limited number of inspectors, they concentrate on larger (more visible) businesses, or respond to specific claims submitted by public (for instance reports on unauthorized garbage dumping, trees felling, etc.). The scarcity of inspectors and their work overload results in low number of reported violations (fines). Inspectors would not normally be able to impose fine or draw up a report unless the violator is revisited and proved that the violation was not repaired.

Local inspectors are well integrated into the departments of state environment control. The decisions on how to distribute responsibilities between officers on sites is done at the local level. This often results in inspectors running unauthorized inspections with a main objective of rent seeking. In some cases, the Service and the Departments run joint inspections, normally, as requested by the latter.

7.3 Licensing and Permitting

According to the 2002 amendment to the Law on Environment Protection all new businesses that are expected to have an environmental impact need the State Ecological expertise (SEE). An Environment impact assessment (EIA) is a component of the SEE and the EIA has to be accepted by the environmental protection authorities. The government has initiated compilation of a list of economic activities and facilities subject to these guidelines. As regards the EIA procedure, guidelines on the limits of inspections, consultations, access to information, decision making process, cooperation with NGOs and other structures as they may comply with the Arhaus Convention and role of courts have not been finalized. The laws require public hearings on the list of activities and the EIA procedure itself that has not yet been done. The analysis found that licensing procedure is not clearly defined in the environmental law.

The license holders are granted permits to use a certain quantity of a particular resource at a specified territory over a specified period of time. Permits can be issued both to

individuals (for types of animals or plants) and entities (to use ground waters). There are also permits for discharge of wastes to industrial or agricultural entities. Such permits are issued by relevant State Inspection agency (for instance water or air), or by local departments. Permits allow discharge of certain amount of pollutant and are usually issued for one year.

Individual and legal entities are eligible to become ecological experts who can conduct the impact assessments. However, such entities need to be licensed as per the licensing procedure adopted by the Tajik government in June 2003 by submitting their application to obtain license from the State Environment Control Service. License is granted for a successful bidder in 15 days and is valid for 2 years with the option for extension. The licensee may be subjected to inspection and review by State environment control authorities to comply with the license requirements. License is necessary to participate in the EE procedure, hazardous wastes handling, industrial safety, ionized radiation, production of pesticides and other agrichemicals and their handling. As a rule, license is granted by a higher regulatory authority in the Ministry (Ministerial Committee) or other authorized structure.

7.4 Compliance and enforcement mechanisms

There are established standards for water and air quality, noise and vibration, magnetic fields, and other physical pollutants. As regards food, the government has established food quality standards with threshold limits on chemicals or biologically hazardous bacteria in food. Violation of the threshold limits results in administrative procedures and penalties including financial sanctions.

Individual ministries establish environmental quality standards within its authority. For instance, the Ministry of Health has the authority to regulate levels of noise, magnetic fields and other physical factors. The former Ministry of Environment had the authority to regulate emission of pollutants into air and water and treatment and management of wastes. The 1998 Administrative Code sets liabilities for violation of environmental laws the enforcement of which is entrusted to the respective ministries/state agency. The above code sets liabilities on business entities, their staff and individuals for violations including violation of SEE expertise. Administrative sanctions for violations can be enforced by administrative commissions of Khukumats, courts, inspectors of state service, vet inspectors of the Ministry of Agriculture, Agency for Land Use, Geodesy and Cartography.

The most frequently practiced punishment is a monetary fine – up to 10 monthly salaries for individuals and up to 15 monthly salaries for employees. The fees and charges collected for violations are deposited in an ecological fund. However, the number and amount of such fines and charges collected are very low because of poor infrastructure to enforce the laws. According to the Sughd department only about 10 % of the violators paid the fine in 2001, which increased to about 50 % recently in 2006. Such increase in compliance is because inspectors are reporting to the cases to departmental lawyers who in turn take the cases to court. The courts in turn dispose the cases in 2-8 weeks. The Ecological Service may also suspend business activity of the violator. In 2003, the local environment protection committee in Sughd oblast suspended operation of 70 business entities.

The 1998 Criminal Code describes crimes against ecological safety and environment; industrial safety rules, poaching, land contamination, misuse of subsoil resources. The maximum fine can reach up to 2000 MMS and term of imprisonment up to 8 years. In practice, only 2 such cases were considered for over the past 2 years. Lack of vertical coordination between Ecological Service and environmental agencies result in problems when performing joint inspections. Another problem is weak staffing policy and financial support in every inspectorate. Although the government has made a number of bold steps in the form of legislations, the institutional capacity currently in place is insufficient to implement the proposed initiatives.

The wastes from industries, both toxic and non-toxic, and solid domestic wastes are collected and disposed by waste management services for which they receive a payment. The payments are based on the quantity of waste collected. Local (oblast, city and rayon) committees for environment protection prescribe limits for disposal of wastes for enterprises, review and approve the settlement of payments (to be prepared by enterprises and submitted to committees) and collect payments. The State Inspectorate for Land and Wastes Disposal and local committees supervise (separately or jointly) the compliance of enterprises with ecological legislation and settlement of all ecological payments. The inspectors have the power to impose penalties for violation of the legislation on wastes disposal (including the cases of unauthorized scrap-heaping and disposal of wastes).

Charges for disposal of utility wastes are equivalent to their retail price. Such charges are enforced to stimulate enterprises to seek markets for waste products or encourage processing of wastes by the enterprises themselves. The country has a very low capacity to process wastes from industries. This is the main reason for the absence of a system for collection and trading of wastes with the exception of waste paper, which is processed at small-scale factories. The charges for the disposal waste paper ranges from 0.024 to 0.24 somoni per ton or cubic meters while the charges for disposal of waste products like ash, rubber wastes, metallurgical sludge, non-toxic industrial wastes and solid domestic wastes are about 0.12 somoni per cubic meters.

The revenue from payments received for collection of wastes is the main source of funding for the ecological funds in the country, in spite of the low charges for waste disposal (on the average about $0.04 per cubic meter for non-toxic industrial wastes). For example, the Sughd oblast annually collects 223,000 somoni (of which 66% are payments for disposal of wastes within allowable limits and 34% for exceeding the limits). In aggregate they make two-thirds of total payments received by the ecological fund.

Cities establish their own charges for collection and disposal of wastes. In large cities where such services are offered there is at least one municipal agency responsible for collection of wastes. A typical example of a large city is Khujand, the second biggest city after Dushanbe. Collection, transportation and disposal of wastes in Khujand are the responsibility of the City of Khujand Garbage Truck Depot under the Housing-and-Communal Services Agency. The former fixes charges for collection based on its costs, subject to approval by the City Housing-and-Communal Services Agency, Khukumat and the City Anti-Monopoly Committee. Enterprises based within the city shall sign an agreement for collection and disposal of wastes with the City of Khujand Garbage Truck Depot. The payments are based on de facto quantities of wastes collected. The City of Khujand Garbage Truck Depot has concluded an agreement of collection of street garbage

and earth closet sewage also with the Khukumat. The cost of this service is borne by the municipality. The revenue from collection charges is the major source of revenue (about 80%) for the Truck Depot. Charges for disposal of domestic garbage for the year 2004 was 3 somoni (less than US$1) per capita. However, only about 25 % of households made their payments promptly. The projected revenue for the year 2004 from collection charges was 1.05 million somoni, which would be sufficient to cover all costs incurred by the agency, including costs for purchase of updated machinery or starting a new landfill

The analysis however showed that the charges for waste collection and the other economic incentives are not sufficient to stimulate reduction in wastes and development and adoption of environment friendly production technologies.

The State Inspectorate for Air Pollution Control and local (oblast, city and rayon) environmental committees regulate atmospheric emissions in the country. The functions of the State Inspectorate are to fix the emission quotas for the different entities and the emission charges for the set quotas and to collect the payments. The inspectors may impose penalties for violations, if any, including the cases of unauthorized discharges and air outbursts due to industrial accidents or machinery breakage.

Though chargeable air pollutants cover 123 components, only a few of them are tested and included in payments. The local environmental coefficients are considered in estimating the emission charges. For example, local coefficients for the City of Dushanbe are estimated at 2, for Kurgan-Tube (an administrative centre of Khatlon oblast) it is 1.7; the coefficients for Khujand (an administrative centre of Sughd oblast) and Tursunzade (the site of the Tajik Aluminum Plant) are 1.4 and 1.6 respectively.

The enforcement of the emission charges however has a lot of problems and limitations. The air pollution charges, in principle, is based on annual actual quantities discharged. However, since no enterprise (except for the Tajik Aluminum Plant) is equipped with monitoring facilities such estimations cannot be made. Instead, the estimators take into account the type and number of operating machineries, the term of their service and availability of gas-cleaning facilities. Then in order to fix the limits it is assumed that an enterprise shall be operating at full capacity. Since most of the enterprises use only part of their capacity, it is natural that they should claim preferential tariffs. As a rule, such claims are met.

The analysis found that the current system of payments for air pollution is not economically efficient, as it does not provide enough economic incentives to reduce emissions. For example, in the entire Sughd oblast the local ecological fund in 2003 amounted to 8,775 somoni ($2,925). The Tajik Aluminum Plant whose share in Tajikistan industrial production volume constitutes 40% annually pays only 12,500 somoni (about $ 4,000) in air pollution penalties while its exports revenues for the first half of 2003 amounted to $ 200,000,000.

The state owned enterprises, particularly the electric utilities and heating companies, are excluded from payment of emission charges because of their poor economic standing. The inspectors in association with officers of local ecological agencies may also agree on preferential payment rates for these entities

Another major source of air pollution in the country is the emission from automobiles and the transportation sector. The government charges an annual tax on vehicles, which is a source of revenue for oblasts, cities and rayons. Neither the annual tax on vehicles nor the transportation tariffs promote fuel efficiency and emission reductions from the automobiles and in the transportation sector.

The water resources in the country are managed jointly by the State Inspectorate for Water Resources and local (oblast, city and rayon) services. The local offices (oblast, city and rayon) fix quotas for intake of water and for discharge of pollutants into water bodies and collect the respective charges. The state inspectors verify the statements on the quantities of water intake, pollutions discharges and impose penalties for breach of any agreements including cases of unauthorized water intakes, discharge of pollutants including discharge of pollutants as a result of industrial accidents or problems with machinery.

In cities the charges for water use supply and sewage charges are fixed and collected by rayon water supply agency, which is an integral part of housing-and-communal services agencies. The tariffs are to be approved by the municipal housing-and-communal services agency, the Khukumat and the local anti-monopoly committee. While household consumers pay for water supply service, the Constitution does not allow for charges when water is used as a resource. So till recently water used for irrigation purposes, which accounted for 85% of all water use, was not charged. However, now all farms, agricultural and industrial entities are subject to payments for water supplied through the irrigation systems.

In principle the households are supposed to pay for the volume of water consumed. But since the water supply agencies do not have meters to measure the amount of water consumed it is estimated based on the number of people living in each dwelling unit and the average per capita consumption. Currently water tariff rates in the country are so low that it may not even cover the costs of water meters. Further the low-income groups are either exempted from payment of water tariffs or are given preferential rates depending on their annual household income.

The current tariff structure for water and sewage is so low that the revenues do not cover the operating, let alone the maintenance costs. For instance the Dushanbe Water Supply Agency (Dushanbe "Vodokanal") reports that the water consumption charges collected from all types of consumers constitute 63% of its revenues and that it is significantly less than the operating and maintenance costs of the water supply and sewage infrastructure. The current tariff structures do not adequately reflect the value of water and do not promote efficient use of water resources for household consumption, irrigation and industrial uses.

The system of charges for discharge of pollutants into water and their reporting are similar to those applied for air pollution. The chargeable pollutants cover 197 chemical compounds including 101 different kinds of pesticides. An entity has to report to the State Committee for Statistics and Agency for Water Disposal and Sewage Discharge the quantity of pollutants discharged into water bodies and into sewage. However, such data on discharges and the charges collected are not available. The current system of charges for pollutant discharges does not promote economically efficient outcomes for pollution reduction.

Poaching has been prohibited in the country and there are penalties for violation. Penalties, especially for poaching species under extinction, are the highest of all ecological penalties. In order to determine the penalties, coefficients are established for each species. The total penalty is calculated as the coefficient multiplied by the minimum monthly remuneration (7 somoni per month). For example, the coefficient for a Pamir wild ram and Bukhara mountain wild ram is estimated at 4,000 somoni, and the total penalty charged per each ram is equal to 28,000 somoni (or $9,300). Similarly, the coefficient for a snow leopard, red wolf and Bukhara reindeer is equal to 2,000 somoni and for a brown bear the coefficient is 1,000 somoni. The jaegers (huntsmen) are held responsible for preservation of species under threat of extinction and imposing and collecting poaching penalties. The collected penalties, by rule, are to be transferred to the local ecological Fund. However, the accounts of such transfers of penalties collected, to the ecological fund are not available.

Mining and use of mineral resources require formal licenses. The Government issues licenses for mineral resources such as oil, natural gas, metallic ores and precious stones; the licenses for mining less valuable mineral resources (sand, clay and gravel) being the responsibility of Khukumats (local authorities). The license fees are estimated as a % of the value of the mined mineral. The fees vary from 1 to 5 % for ferrous metals and 2 to 4 % for building materials (gravel, sand and clay) to 4 to 8 % for non-ferrous metals and precious stones. All fees collected are divided equally between state (government) and local budgets.

Thus the main problems in enforcement are the problems with the institutional setup in the country and lack of economic incentives to reduce pollutions. Although the government has proposed a few economic incentives, lack of institutions and laws and legislations to implement them have prevented the implementation of the proposals. The main constraints of the environmental agencies are:

- lack of enough resources to run inspections and guarantee compliance, quality staff and independence;
- lack of clear and concise rules and procedures for inspections, including demarcation of responsibilities at the central and local levels;
- poor coordination at all levels and lack of exchange of information among staff;
- lack of uniform qualifications, national standards, licensing structure and incentives for improving technical skills for inspectors.

7.5 Economic incentives for pollution reduction

It has been observed that some of the initiatives for economic incentives are not supported with laws and mechanisms to implement them. One example is the case of the Environmental Insurance Fund. Although the law provides for such a fund, it was never created. The law sets forth tax credits for the entities willing to use low-waste and no-waste technologies regardless of their form of ownership and for entities involved in the recycling or similar environment-friendly business. However, the Tax Code is not reformed to incorporate such provisions. Similarly although it has been proposed to encourage commercial banks to advance low-rate loans to environment–conscious businesses, such provisions have not been made in the lending laws.

The local authorities have not been successful in using additional economic stimuli to encourage environment friendly business/production practices. Some documents mention the need to use economic instruments for environment protection and expenses. The National Strategy and Action Plan of Nature Conservation and Rational Use of Biodiversity approved by the Government in September 2003 is another initiative to promote economic instruments for sustainable use of natural resources, in particular, biodiversity protection including potential sources of preferential financing for such activities. The measures proposed under this initiative are tax incentives for activities that promote biodiversity protection-including those investments in roads and power transmission lines, mechanism of mandatory insurance of technologies impacting environment, better financing opportunities for investments that promote biodiversity protection, and fees for traversing and visiting of protected areas. The government, in 2001, developed a draft concept on Rational Use and Protection of Water, but has not made significant progress with this initiative.

7.6 Funding for environmental protection

There has been a proposal to increase the allocations to the environmental sector to at least 5 % of the total government expenditures by the year 2010. Another recommendation is to allocate a portion of funds earmarked for privatization to environmental protection. However, the share of environmental expenditures in the total government expenditures continues to be trivial and is about 0.31 %.

Tajikistan receives environment related funding from both domestic and international sources. The domestic sources include budget and extra-budget allocations from government and local budgets, and investments by state and private entities. In addition to the above, the government invests in environment related projects jointly with international organizations. For instance in 2004 the Tajik government's share in the World Bank Project to secure the Sarez Lake and to rehabilitate the water supply system in Dushanbe city was 130,000 somoni. In addition to the direct funding for the environment, the state budget also allocates funds to ecological agencies and other ministries, government structures and local governments for ecological purposes. There is practically no information in respect of ecological expenditures. Although the total ecological funding, including funding of local departments, has been growing its share in the total budget still remains at a low level, around 0.31 %.

The Ministry of Finance manages the accounts of the Ecological Fund.[24] The ecological agencies make proposals for investment and other activities with projected expenditures. The Ministry of Finance approves the proposals and expenditures prior to allocating the funds. Beginning November 1998 all transfers to Ecological Funds are deposited on accounts of local government and ecological agencies. Local governments have their own budgets for ecological funds (the expected revenues and their expenditure per each item) to be approved by Khukumats (local authorities).

[24] Until November 1998 the Ministry for Nature Protection was authorized to directly manage and allocate funds. The Government has changed the system with a view to intensifying the supervision of reporting on financial operations and disposal of funds for ecological purposes.

All revenues for ecological funds are raised in rayons and oblast cities. The revenues raised are allocated on the following principle: 60% of funds remain at rayon or city for disposal; 30% are transferred to the oblast fund and the remaining 10% to the government ecological fund. Of all funds transferred to ecological funds which have been raised in rayons and cities and in Dushanbe 60% remain at the disposal of a rayon or a city and 40% are transferred to the state ecological fund (of which 30% is reserved for ecological activity in the region which transferred such funds). All transfers are taxable at 10 %, the tax revenues being transferred to the State Budget.

There is no data on spending from the ecological funds at the national level. A review of the available accounts showed that the expenditures of ecological funds are not itemized. However, there is some limited data on individual regional funds. According to Dushanbe and Sughd oblast departments 60 % of the funds are allocated to fund specific ecological projects and the remaining 40 % are used to meet administrative and other needs of local committees. However, the current regulation does not specify the proportion of expenditures that should be allocated to ecological activities and for administrative purposes.

In the year 2003, the city of Dushanbe Ecological Fund received 151,000 somoni which was spent to purchase refuse containers for two districts in the city, finance programs of ecological training (sponsorship of TV programs, publishing of ecological newspaper), plant young trees, purchase of monitoring facilities and special shoes for inspectors, to celebrate Environment Day (including ecological awards; purchase of a vehicle for inspectors; purchase of office stationery). The Fund's monetary facilities were also used to remunerate officers of ecological traffic inspectorate who supervise and control exhaust systems of vehicles and disclose facts of illegal logging of trees. In addition to the above expenditures, 29 employees of the Dushanbe department are remunerated out of the committee's budget (including eight employees of four district committees).

7.7 Privatization and environmental governance

Although privatization in Tajikistan can be traced back to 1991, it gained momentum only in 1997 after the adoption of Law on Privatization of State Property. The above law specified the general principles and terms and conditions for privatization of state property in the country. It also provided guidelines on responsibilities of different government authorities to facilitate privatization and assignment of revenues gained in consequence of privatization and provision of information to mass media. In order to further speed up privatization the government adopted by-laws like the 1997 Regulation on Auctioning and Tendering Objects of Privatization, the 1998 Regulation on Privatizing Entities and the 1997 Decree on Objects not Subject to Privatization and Objects Subject to Privatization upon the Government Decision (amendments).

In 2003, the Strategic Scheme of privatizing medium and large-scale entities and restructuring natural monopolies (large-scale entities in particular) was approved by the Government which replaced all previous legislations for privatization. The Strategic Scheme that is currently in effect, provided conditions for further promotion of market reforms and development of the private sector, inflow of domestic and foreign investments and increasing job opportunities with little pressure on the State Budget.

There were some public entities that are not subject to Strategic Scheme for privatization. In the case of such entities, the government has constituted a Task Force consisting officers of appropriate ministries and government agencies, whose purpose is to analyze business performance of an entity and its competitiveness and to seek potential buyers thereof and arrange auctions (tenders). The task force is entrusted with the responsibility for analysis of an entity's liabilities in respect of environmental protection and collection of relevant information and documents like certificates, licenses, permits, materials of legal cases (proceedings) pertaining to entities using natural resources; disposal of sewage; air, water and soil pollution.

It may, however, be noted that the legislation did not adequately address the environmental impacts of privatization. Information as to how entities comply with environmental regulation and the previous environmental liabilities if any are not given due consideration in privatization legislations. For instance, any outstanding liabilities to the Ecological Fund are not considered in the valuation of the entity when it is being appraised.

The State Committee for Management of State Property set up in 1997 is responsible for privatization of state-owned entities. Besides supervising the process of privatization, it has been authorized to coordinate the activity of ministries, state committees and local governments in matters of privatization of both national and municipal property. It was also authorized to take part in establishing exchanges and other structures dealing with privatization and to promote the government policy in respect of arranging investments. The local (oblast, city and rayon) committees on management of state-owned property are responsible for privatization of small- and medium-size entities within their jurisdiction.

Although the Law on Privatization of State-Owned Property guarantees transparency and access to up-to-date information on privatization, it is neither easily accessible nor available in practice. The web site of the State Committee on Management of State-Owned Property has information only until the first quarter of 1999. So far privatization has not brought expected results with many of privatized entities.

There is no information on the effects of privatization on environment in the country; in particular on investments made by privatized entities in improved production technologies, rehabilitation of gas-cleaning facilities or investment in modern equipment. According to some of ecological agencies in Sughd Oblast the newly privatized companies observe the ecological legislation better than the state-owned entities including the payment of ecological charges, ecological expertise charges and fulfillment of inspectors' instructions pertaining to improvement of the ecological situation. Local ecological agencies are not involved in the process of privatization though they are authorized to inspect entities prior to and after privatization.

The environmental/ecological agencies are not obliged to disclose to new owners any information in respect of the entities' outstanding ecological debts not covered in the appraisal or the absence, if any, of permits or certificates of ecological expertise though they can provide such information if requested. As a result new owners of entities often have to meet ecological claims the existence of which has not been disclosed to them. Pursuant to the Strategic Scheme for privatization there are privatized large entities and natural monopolies whose products though economically essential are hazardous to the environment. However, the legislation and existing practices do not guarantee that

privatization of those large entities and natural monopolies shall not cause harmful environmental impacts.

Currently privatization in Tajikistan is coming to its final stage and the largest entities and natural monopolies are scheduled for privatization and restructuring in four years. The analysis undertaken for the study found that the state environmental agencies are not involved in the process of privatization of small, medium or large-scale entities. As a result there is no system under which all ecological charges and liabilities of an entity being privatized as well as liabilities of a new owner thereof in respect of improving the ecological situation would be contractually specified.

7.8 Opportunities for improvement in environmental governance

Environmental governance suffers mainly due to lack of efficient institutions, poor coordination among them and inadequate economic incentives for improved environmental performance. There are opportunities for improving environmental performance in the country, some of which are outlined below:

1. Transparency in receipts and allocation of funds- the accounts of the funds do not provide details of the receipts from the different entities, NGOs and public at large. The accounts do not provide details spending for different activities as well. Better transparency in receipts and expenditures are needed for improved planning and prospects for funding in the future;
2. Need for economic incentives for more efficient use of resources: the current system of tariffs does not promote economic efficiency in their use. An example is the tariff structure for water. Although the law on nature protection proposes different tax incentives for environment friendly economic activities, their implementation is constrained by lack of appropriate by-laws. For example, the Tax Code does not provide for reduced tax rates for companies which invest in ecologically acceptable technologies although the law on nature protection proposes such incentives;
3. The current system of pollution charges does not provide enough incentives for pollution reduction. Under the current system of pollution charges it is cheaper to pay charges and penalties than investing in pollution reduction; important components of air pollution (PM10, PM2.5) are not regulated.
4. There is a need to improve the infrastructure for monitoring and emissions and fix liabilities on the polluters. The facilities currently available are not sufficient to enforce the pollution charges;
5. Provision of adequate and timely information on environmental performance, with effective legal mechanisms and management tools concentrating more on pollution prevention rather than clean-up;
6. Effective legal systems and norms to monitor and enforce laws and regulations regarding pollution from manufacturing industries;
7. Measures to prevent uncontrolled use of natural resources resulting in depletion and degradation. For instance, the existing land use practices do not consider the actual resource capacities, productivity and spatial diversity which in turn results in degradation;

8. Development of an effective system of waste management (collection, disposal and recycling) system and improving effective environmental monitoring, particularly near waste management sites and landfills;
9. Development of legal system to protect biological and landscape diversity and development of better database on biodiversity in the country;
10. Reforms in setting Maximum Permissible Discharge of hazardous wastes for each pollutant (mostly into water bodies) or source based on environmental standards that are realistic from economical and technical perspective;
11. There are opportunities for better coordination of different stakeholders to achieve improved environmental performance. Preconditions for better involvement of private sector and the civil society in sustainable development and protection of the environment should be created .

VIII. Conclusions and Recommendations

This section first presents a summary of the estimated costs of environmental damages in the country. It then presents a case for strengthening institutions and to promote economic incentives for pollution reduction and efficient use of resources.

Costs of Environmental Damage

The analysis showed that costs of environmental damages are significant in Tajikistan accounting for about 9.5 % of its GDP in 2006. The highest damage is from land degradation, including soil erosion and salinity, the cost of which accounts for 3.7 % of the GDP, followed by natural disasters (1.6 % of GDP) and then costs due to inadequate water supply, sanitation and hygiene (1.5 % of GDP). The cost of indoor air pollution and associated health risk is about 1 % of the GDP; rangeland degradation (0.7 % of GDP) cost of urban outdoor air pollution (0.5 %), lead poisoning (0.2 %) and deforestation (0.2 %). The above estimates show the urgency in reversing the course of environmental damages in the country for sustainable economic growth and poverty reduction.

The analysis found that land degradation is the principal environmental problem in the country the main causes of which are irrigation-related land degradation, in particular secondary salinity, water-logging and irrigation-related soil erosion, soil erosion in rain-fed farmlands, degradation of pastures and forests and related loss of biodiversity and other forms of land degradation as a result of natural disasters and soil contamination.

The second major environmental damage is from periodical natural disasters such as floods, landslides, avalanches, and storms, and severe earthquakes the total costs of which accounts for about 1.6 % of the GDP. The costs associated with inadequate water supply, sanitation and hygiene include costs of mortality and morbidity from Diarrhea, Hepatitis A, Typhoid and Paratyphoid and averting expenditures associated with household boiling of drinking water. Indoor air pollution is mainly due to use of traditional fuels (mainly cotton stalks); acute respiratory illness in children represents 40 % of cost; respiratory child mortality represents 34 %; chronic obstructive pulmonary disease mortality in adult females and ARI morbidity in adult females represent 13 % of cost each. Rural population bears 93 % of the total cost of indoor air pollution.

Degradation of rangelands is due to improper land use practices, denudation of vegetation becasue of indiscriminate grazing practices exacerbated by intermittent draughts leading to desertification. The communal nature of farming and the tragedy of the commons lead to overgrazing and degradation of grazing lands. The damages due to urban air pollution that constitute about 0.5 % of the GDP are from deterioration in air quality as a result of particulate matter.

Estimate of costs associated with lead exposure is based on the loss of intelligence quotient and mid mental retardation. As there is considerable uncertainty about the data on lead levels in blood in urban population as a whole (and the rural population) in Tajikistan, the estimates presented here are only for the children under 5 in urban population of the cities with more than 100 thousand inhabitants. It does not include MMR health expenses (doctor visits, medication cost and time losses of care givers), reduced life expectancy due to MMR and health effects related to lead exposure such as elevated blood pressure,

gastroenterological effects, and anemia. The costs of deforestation include direct and indirect use values and non-use values. The direct use values include costs associated with fuel-wood production, non-timber products and tourism and recreation uses. The nonuse values include option values and existence values. It may be noted that forest cover only about 3 % of the total geographical area and hence the marginal costs of deforestation tends be higher in the country.

Climate change costs were not quantified in the report due to the lack of consistent scenarios of negative impacts. On the qualitative level it is proved that increasing temperature and changing precipitation patterns are major reasons for recent extreme weather events in Tajikistan. Changing climate leads to glaciers retreat, water shortages, increase frequency and magnitude of natural disasters, alters hydropower development and increases pressure on agriculture. Human health and ecosystems will be affected in the long run. Further analysis is needed to estimate annual losses due to climate change given current uncertainty of the climate models.

Institutions and Environmental Governance

The constitution declares that the State undertakes to ensure a healthier environment and guarantee the efficient use of natural resources for the benefit of the people of Tajikistan. The environment protection law stipulates several types of controls and institutions to comply with at the state, ministerial, business and community levels. At the national level there is an environmental block, the Department of Nature Use and Protection, chaired by a Deputy Minister under the Ministry of Agriculture and Nature Protection. The State Control Service of Natural Resources and Environmental Protection under the Department of Nature Use and Protection is the national level agency for environmental affairs in the country.[25]

In addition to the SCSNREP, the Sanitary Inspection Service of the Ministry of Health and Inspection Service on Mining Safety by the Ministry of Mines are involved in environmental management. At the ministerial level enforcement is done by different line ministries and the state agencies under them with no effective coordination across the line ministries. In addition to the state level and ministerial level controls there is a business level control that implies that every business has to observe the environmental law. Although the government has set norms for air and water pollution, residual traces of chemicals and biologically harmful microbes in food, regulations regarding noise, vibration and magnetic fields- exceeding the threshold levels results in administrative actions and financial sanctions-their implementation remains unsatisfactory due mainly to weak institutions to implement them and lack of coordination, vertical and horizontal, across institutions.

Strengthening institutions and defining specific roles

The preceding analysis found that the binding constraints for improved environmental performance in the country are: (i) weak institutional design (ii) lack of coordination

[25] The other agencies under the Department of Nature Use and Protection are Agency on Hydrometeorology and Anti-hail service, Agency on Forestry and Hunting, Tajik Scientific Research Institute of Nature Use and Forestry, Scientific-Research Center on Water Resources Protection, Scientific-Research Laboratory on Nature Protection, State Department on specially protected areas "Tajik National Park", Scientific-Production Center "Tabiat" and the State Enterprise, "Saidu Sayokhat".

among institutions; (iii) lack of economic incentives for pollution reduction and accountability; (iv) capacity limitations; (v) poor environmental governance and (v) insufficient funding for environmental management. The solutions to these problems will not arise from simply scaling up the institutions and or funding for environmental management, but require careful planning and coordination at all levels backed by legal and regulatory mechanisms.

Both federal and provincial governments share concurrent legislative authority and responsibility for environmental management and efficient use of natural resources. In order to achieve better outcomes, institutions at all levels should have appropriate roles and responsibilities. At the national level the roles could include: (a) Setting national environmental policy and defining specific goals for environmental quality; (b) providing resources, both technical and financial, and oversight for local/provincial environmental authorities; (c) reporting and publishing data on progress in meeting the national environmental objectives. The national environmental agency should have the mandate for enforcement of national laws and regulations and oversight on local/provincial environmental agencies.

While the national level agency sets the national policy, responsibilities of the provincial environmental authorities could include environmental clearance at the local level, implementation and compliance as well as monitoring of ambient environmental quality standards. There is also need for specific guidelines for federal oversight of the provincial environmental authorities depending on the provincial laws and regulations for enforcement, adequacy of technical expertise, staff and resources.

Institutional coordination for better environmental outcomes
The SCSNREP is responsible for the coordination of environmental management at all levels and across ministries. However, the preceding analysis shows poor coordination, both along vertical and horizontal levels. The poor coordination results in problems with inspections and enforcement of set standards and charges. Although the government enacted a number of laws and proposals to improve the state of the environment there is very limited state capacity for policy development and implementation.

Economic incentives
Tajikistan has a set of economic incentives in the form of charges and payments for waste products generated and pollutant discharges in to air and water bodies. The analysis however showed that the charges for waste collection are not sufficient to stimulate reduction in wastes and development and adoption of environment friendly production technologies that reduce waste generation. In the case of air and water pollution, current system of payments is not economically efficient as it does not provide enough economic incentives to reduce emissions. Automobile emissions constitute another main source of air pollution. The government charges an automobile tax that does not promote fuel efficiency and emission reductions.
Quantity restrictions

In addition to prices and charges, the government has enforced quantity restrictions on the amount of wastes and pollutants that can be discharged into air and water. There are also quota restrictions on the quantity of water, mineral and other resources of that could be

used by individual business entities. However, the enforcement of these restrictions is constrained by the available infrastructure for monitoring and enforcement.

Recommendations

The analysis revealed that there are opportunities for improving environmental sector and its performance in the country. The cost of environmental degradation reveals the focus areas for such an improvement. For the nearest future, major focus should be on water resources management, which has critical importance for the productivity of agriculture, the prevention of human health risks, and energy security in Tajikistan. In longer term, the cost of environmental degradation will be exacerbated by climate change. Also, the priorities may be shifted overtime. Therefore, the improvement of monitoring, information systems, and forward looking risk analysis are essential. Due to multimedia and multidisciplinary character of the underlying problems, there is a need for robust interagency coordination. Along with strengthening of SCSNREP other agencies may also play an important role, for example: the State Committee for Emergency, the Water Management Authorities, and the Ministry of Energy At the same time, mitigation of environmental degradation costs should be closely linked with poverty alleviation strategy of Tajikistan (PRS).

Immediate measures should include improvement of appropriate soil and water conservation coupled with efficient irrigation water manangement practices through improvement of the canal and drainage infrastructure where it is viable. This is essential for sustaining and increasing the farm production both in mountain areas and valley lands Furthermore, reducing chemical contamination of surface and groundwater also is an equally important aspect. Rangeland and pasture land improvement is important to enhance the income levels of the farming communities in the mountain area. Improved irrigation water use policy in combination with improved land management practice of the rainfed lands will reduce vulnerability to natural disasters. Taking into account specifics of Tajikistan, access to potable water and alternative energy sources like small hydropower will create highest value added with respect to mitigation of the current and future environmental degradation cost. Also, small hydro and improved stoves programs are important in reducing indoor air pollution related to solid fuels used for cooking. These and other recommendations related to general improvement of institutions and management are summarized in the table below.

Table 7.1: Recommended Actions

Objective	Recommended Short-term Actions
Institutional reform	• Develop a priority-setting mechanism based on: (a) the impacts of environmental degradation on the poor and other vulnerable groups, (b) the most urgent needs as perceived by the population, and (c) the major costs and risks that environmental degradation infringes on the overall society • Establish a planning process to align environmental expenditure with priorities • Establish Environmental Health Service within the SCSNREP to regulate environmental quality parameters that affect health including (i) emission of $PM_{2.5}$, lead, toxic pollutants; (ii) fuel quality to tackle air quality; and (iii) water quality parameters such as bacteriological quality, Persistent Organic Pollutants (POPs), Volatile Organic Compounds (VOCs) and heavy metals. It includes improvement of the infrastructure for monitoring emissions and fixing of liabilities on the polluters. • Ensure transparency in receipts and allocation of the environmental funds for improved planning and prospects for funding in the future • Develop a comprehensive database on available natural resources and resource use to facilitate a more transparent monitoring of actual natural resource depletion/use levels • SCSNREP to strengthen its capacity to coordinate and foster consensus-building among sectors.
Policy reform	• Establish effective legal systems and norms to monitor and enforce pollution regulations from manufacturing industries • Reforms in setting Maximum Permissible Discharge of hazardous pollutants (mostly into water bodies) based on environmental standards that are realistic, considering economical and technical efficiency issues • Reform of economic incentives for pollution reduction • Reform of economic incentives to prevent uncontrolled use of natural resources resulting in depletion and degradation
Reduce soil degradation	• Conduct/update new national inventories of (1) soil erosion and (2) soil salinity • Rehabilitate irrigation infrastructure where it is viable • Revise the Water Laws to authorize higher, broad-based fees for water use. • Improve land management practice through zooming and mapping with geospatial tools use
Reduce vulnerability to natural disasters	Adopt structural and nonstructural measures to reduce vulnerability to natural disasters, including the adoption of adequate construction technologies, practices, and standards in poor urban sectors and among the rural population

Reduce health risks associated with inadequate water supply, sanitation and hygiene	• Promote handwashing programs that target children under the age of 5 • Promote safewater programs that includes disinfection of drinking water at point-of-use.
Reduce cost of environmental degradation associated with indoor air pollution	• Promote small hydro and other cleaner fuels in areas that predominantly use solid fuel, and implement actions to improve availability and access to solid ful users in a safe and cost-effective manner • Implement a program to promote improved stoves
Reduce health risks associated with ambient air pollution	• Establish national ambient standards for $PM_{2.5}$ and PM_{10} in priority urban areas and strengthen technology-specific emission standards for PM and its precursors (particularly sulfur and nitrogen oxides) • Implement an air quality monitoring program to monitor $PM_{2.5}$, PM_{10}, and ozone in priority urban areas Implement air pollution control interventions aimed at reducing automobile emissions. The measures to reduce emissions include eliminating leaded gasoline, improving the quality include of the fuel, particularly the imported fuel, and improving the system of maintenance and inspections of the transportation fleet.
Reduce deforestation	• Improve land management practice through zooming and mapping with geospatial tools use • Development of legal system to protect biological and landscape diversity and development of better database on biodiversity in the country.
Reduce unauthorized disposal of industrial and municipal wastes	• Development of an effective system of waste management (collection, disposal and recycling) and effective environmental monitoring, particularly near waste management sites and landfills;

In the longer term it is important to develop coordinated water management – irrigation and power generation plans, enhancing cross country coordination and electricity trade, as well as incorporating risk assessment policies across the various ministries and functional areas, from development planning to watershed management and hydro power projects. At the same time there is a need for follow-up work to do a more detailed analysis on which policies and investments would provide the largest benefits.

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Annex 1. Law on Nature Protection

The Tajikistan Law on Nature Protection warrants the polluter to pay for the damages based on the national principle "he who pollutes shall pay". The polluters shall be charged for industrial waste and disposal thereof within and beyond the allowable pollution limits. In the case of natural resources the guiding principle is "he who uses shall pay" whereby the users of natural resources shall pay for the right to utilize resources within the established limits and beyond the limits. The Law specifies the following economic instruments for environmental protection and natural resource management:

- Payments for use of natural resources;
- Payments for disposal of pollutants;
- Payments for elimination of waste and other kinds of pollutants;
- Preferential of tax and interest rates for entities using pure technologies;
- Penalties for damage inflicted on the environment and human health and compensation to those affected;
- Additional taxation of entities whose activity is hazardous to the environment.

The Law also allows local governments to use any other economic incentives for environmental protection.

The Law provides for three sources of funding activities aimed at environmental protection: government and local budgets; government and local funds of nature protection; voluntary contributions of physical and legal persons. The nature protection funds have been established for the purpose of funding environmental protection and to provide compensation for damages inflicted to nature. In addition to the government funds and voluntary contributions the charges for use of natural resources; disposal and elimination of waste and pollutants; penalties for violation of the ecological legislation; voluntary contributions also contribute to the environmental fund.

The Government determines the amounts of payments, methods of their estimation and collection, penalties and charges for the use of natural resources and environmental pollution; besides it prescribes the procedure of establishing ecological funds and of the disposal of their funds. In Tajikistan all kinds of charges including those payable for environmental pollution beyond the established limits are called payments; the term "penalty" is used exclusively for an individual liability in accordance with OSCE terminology nomenclature and includes all kinds of payments chargeable to companies and individuals for pollutions beyond the established limits. The term "pollution charges" means payments for environmental pollution (including waste disposal) within the established limits; "payment for services" means payments for services rendered such as water supply; "charges" are payments for licenses and permits. All payments, charges and penalties shall be indexed in accordance with inflation rates.

In order to implement the Law on Nature Protection the government has passed a a few decrees and regulations, which together developed the following framework:

- The procedure of charging payments for environmental pollution, pollution disposal and their margins as approved by the Council of Ministers in 1993 and subsequent instructions prescribe a practical guide on use of economic instruments;
- The guiding document on nature protection "Methodological Instructions on Collection of Charges for Environmental Pollution" (РД-01-93) specifies a procedure and methods of calculating various payments and charges for environmental pollution. The 2001 additions and amendments thereto prescribe new tariffs payments for waste disposal and elimination thereof and details other payments, collections and compensation for environmental damage with due regard for inflation rates as provided for in Law on Environmental Protection. The documents aforementioned were issued by the then Ministry of Nature Protection and approved by the Ministry of Economics and Commerce and the Ministry of Finance.
- The 1998 Regulation on Government and Local Funds for Nature Protection specifies the sources of funding, allocates the payments received to local and government Funds and outlines the purposes of their disposal.

The Law on Nature Protection determines economical instruments for air pollution control including the sources of funding thereof as well as charges for air pollution (within and beyond established limits). The Law on Management of Production Waste specifies that the waste management payments depend on the volume of wastes and their toxicity category. Both Laws are complemented with Guiding Document RD-01-03 (see above), which regulates the payment procedure.

The Law on Natural Resources contains provisions pertaining to payments for geological prospecting and mining of mineral resources. The precise procedure of collecting payments is provided in regulations on the amount, manner and terms of collecting payments for disposal of natural resources and in Regulations on licensing the right to use such resources.

The Water Code contains provisions of charges for disposal of pollutants in water bodies and compensation for damage to water resources. The water users who are engaged in socially beneficial activity aimed at rational disposal and protection of water resources are remunerated according to the procedure of awarding premiums. Such activities includethe development and implementation of technologies for economical disposal of wastes into water resources, advanced technologies f sewage purification, construction of water purification facilities, closed water supply systems and implementation of processes preventing the accumulation of sewage. There are no special national or local funds for payment of premiums for such activity although the additional investments may be needed to initiate such environment friendly activities. The money therefore is supposed to be provided by entities which is possible only in the event that the activity aforesaid has allowed them to make sufficient savings.

Annex 2. List Of Environment Related Legislations and Authorities In-charge of Issuing Permits, Approvals, Inspection and Law Enforcement

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
	Wastes	There is not uniform wastes management strategy or policy. ►**State environmental program 1998 – 2008** adopted in 1997 contain no wastes management sections of chapters but highlights some of the problems. In includes: • Rational use of natural resources; • Development of low wastes technologies; • R&D works to produce environmentally acceptable methods of mining, including industrial wastes recycling; • Introduction of clean production mechanisms in processing and mining industry and • Reduce wastes discharge and disposal. Yet, there is no monitoring information on the implementation which makes it difficult to assess real situation. No actions are taken. ►**Law on industrial wastes and consumption - 2002.** Introduces terminology and types of wastes and technological processes of their disposal and discharge. It prescribes rather strict rules on the state control over all the norms and wastes management standards including industrial, hazardous and municipal wastes; requirements to open wastes disposal sites specifically those located in the risk zones; expects design of state classification system of industrial and municipal wastes; issuance of "wastes management passports with the data on wastes and their quality parameters, including toxicity class and licensing of hazardous wastes management activity. The would stimulate minimizing wastes volumes, their recycling and separation of valuable components. ►**The Ministry Soviet in 1993** adopted its Decree setting **fees and norms for wastes**. ►**The law on Environment** is the legal basis to introduce economical instruments. It envisages economic mechanisms to environment protection to stimulate state organs and public to implement measures for rational use of natural resources. The law introduces principles "the polluter pays" when the polluter pays for the right to use natural resources under the established limits. The polluters pay for discharges and wastes, pollutants, wastes disposal and other types of wastes. The law enumerates economical instruments for environment protection including payments for wastes removal and disposal. ► **«Payment fees for environment pollution, wastes management»** as approved by the Ministry Soviet in 1993 and Instructions for practical guidance to apply economical instruments». ►**The Law on Industrial Wastes and Consumption** informs on that the wastes management methods depend on their volume and toxicity class. The	►The government defines the norms, calculation methods and application of fees, charges and fines for use of natural resources and environment pollution. ►the Environment protection committee (EPC) and other related organs are entitled to observe implementation of the Law on wastes and consumption. The first stage must be instructions drafting and adoption. Iaw Government decree in June 2003 there were promulgated by-laws on licensing of hazardous wastes handling. ►Functions of radiation control, licensing in nuclear industry and nuclear wastes inventory was vested in the Agency of nuclear and radiation safety. ►local (oblast, city and rayon) environment protection committees set forth the limits for wastes removal, approve and revise charges (fees) (prepared by enterprises and submitted to the committees) and collect charges. ►The state inspection on land and wastes and local committees separately inspect (rarely together) compliance of the environmental law by businesses, including payment of all ecological charges. Inspectors may levy fines for violations of the wastes management law (including wastes removal without permits and unauthorized wastes dump). Charges for secondary raw material removal are the same as their wholesale prices. In theory, this must stimulate businesses to look for secondary raw materials market, or recycle it. Lack of processing capacities for the majority of secondary materials indicates almost zero system of recycled raw material market. The only exception is waste paper. (there are small paper recycling businesses). ►Oblast/city EPCs establish own charges for wastes collection and disposal. In big cities there is normally one such municipal waste

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
		calculation fees for this Law are described in the «**Methodological instructions to levy charges for environment pollution**» **(РД-01-93)** issued by the former Ministry of Environment Protection and approved by the Ministry of Economy and Trade and Ministry of Finance.	management business.
	Discharges	**The Law on Environment protection** of 1993 lists economic instruments for environment protection including charges and fees regulation for wastes management; The law also allows for local authorities apply other types of economic instruments for environment protection. In addition to the Law on Environment Protection and a number of other legal instruments, such as: • Regulating document for environment protection Руководящий документ по охране природы «**Methodological instructions to levy charges for environment pollution**» **(РД-01-93)** describes procedures and methodologies for fees and charges calculation and in the amendments of 2001 expects new tariffs for wastes disposal and damage to environment including inflation rates. They are issued by the Ministry of Economy and trade and Ministry of Finance.	The major economic instrument on of air quality management are the fees for pollutants discharge by stationary and mobile sources. Distribution of responsibilities between the State inspection on air and local (oblast, city and rayon) EPCs is similar to the State inspection on Land and wastes and local committees. Insignificant difference is that a number of large enterprises (e.g. Tajik aluminum plant and Khudzhand furniture plant) are under direct control of the state inspection and are not subject to inspection by local EPCs. ►Inspections set up their quotes for air pollution, revise and approve of calculation of charges for air pollution and collect charges. Inspectors may impose fine for air law violations (including air pollution without permits and pollution outbreaks because of the equipment failure or malfunction). Permits for pollutants discharge are issued by relevant inspection (e.g. State water inspection or State air inspection) of local EPCs to industries or farming businesses who discharge their by products. The permits allow pollution in the established quantities (gases, liquids, hard wastes). The permits are normally issued for one year where maximum permissible concentrations are indicated. Inspectors in coordination with local inspectors have the right to completely relieve environmental charges or reduce air pollution fees for state enterprises taking into account general economic conditions. ►The guiding document РД-01-93 defines enterprises producing heat and electricity for households authorized to ask for reduced or canceled air pollution fees. ►Another air quality management tool is quality management and transportation in the form of annual

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
			transport tax. Its purpose is to accumulate budget revenues (in oblast, city or rayon). Tariffs remain very low and do not reflect transport impact on environment.
	Pollution of water, soil and ground water	►Sustainable use and protection of water is the political priority in Tajikistan. According to the Constitution water is the state property and it is designed to ensure rational water use and protection. ► **The Water Code** was enforced in 2000 and is implemented by a number of instructions. The Water Code improves economic mechanisms of water use and defines organizational system of water use and protection. It also set forth the legislative basis for the Associations of Water Users (AWU) and their relations with the state rogans involved in water issues. However, a serious problem is that AWUs may not be proprietors of water supply systems ; they can only assists in water use issues. However, such legislative frames are not strong enough as prescribed by the Concept of rational water use and water resources protection which calls for drafting new instructions to revise water use tariffs, drinking water supply, water monitoring and water protection. Other laws regulating permits for water intake and water inspections are not established yet. There is still no law regulating water intake practice and use of ground waters. The Water Code does not reflect modern principles for it support the centralized system of management and does not include complex management of hydrographic basins, does not coordinate policies and practices of the authorities in charge and does not mention monitoring and actions as the fundamental management tool. ►**Law on Nature Protection of 1993** includes several articles on agriculture. For example, they regulate use of fertilizers and pesticides, use of biological and chemical substances and protection of food from such pollution, soil pollution and rational land use, protection from cattle farming pollution practices. ►According to the Constitution all the land is the state property and is not subject of sale. ►**The Land Code** is the main law that regulates land use including its management and taxation. A land user may rent land or acquire it for use for lifetime (for individuals) with the right to inherit this land. Every household has its right to enjoy a 0,15-0,40 ha land plot. The land Code contains mechanisms for revocation of land use rights including situations when such land use leads to its degradation. Such decision is made by local authorities. The "due land use" means harvest cultivation and cropping. A farmer who has no funds to procure seeds and other materials during one year is exposed to the risk of losing his right to land tenure. In practice, the land can be taken back to the state if it is not used for 2 years in a row, and such practice is often	Water management issues are distributed between ministries and authorities as defined by the government decree of 2002 regulating powers of water use and protection among the authorized state organs. In particular, 5 organs are involved: ►water units and their ecosystems protection are in the jurisdiction of EPC under the Tajik government; it is also responsible for hydrometeorology and forestry. The powers include general water management issues and water distribution in particular among the economy sectors, while practical water distribution issues are vested in the relevant ministries and organs. ►Ministry of melioration and water resources (MMWR) is in charge of practical water distribution issues and agricultural sector supply, water supply infrastructure servicing of rural population. It collects water use charges, negotiates water distribution with the neighboring countries and oversees the national water use quota. ►**Ta**jikgeologija monitors auriferous layers and ground water quality, drills new water holes. ►Sate committee for control over industrial safety and in mining industry is managing thermal and mineral waters and ensures safe operation of industrial mines, and monitors water discharged from mines. ►Ministry of Energy and Industry is managing water supply for electric power generation. All these state organs have their regional departments and offices. ►Ministry of health is in charge of drinking water quality, monitors water infections, in charge of 73-stations network of epidemiological stations. ►The Tajik vodokanal outlets (in oblasts and rayons) and

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
		exercised to the state-owned farmers. For less serious violation land user is subjected to fines. ► **Law on Land management** of **2001** obligates the state authorities to practice land mapping and monitoring of land quality including land pollution, soil erosion and water logging. The Ministry of Agriculture is preparing a new draft law on soil fertility. ►**Law on Dehkhan (Farmer) Household of 2002** defines the process of privatization in agriculture. It also introduces 3 forms of private farms: managed by individual farmers, family farms and cooperatives, of "partnership" farms. The shareholders of the former state farms decide on their meetings on new form of farm ownership. Such decision must be approved by the local authorities. The privatizations decisions are not fully transparent and fall under the "cotton interests" of the state and other stakeholders. A larger farmer units are easily managed in cotton growing other than large number of small farms. Another reason to keeping big farms together are big irrigation systems covering big land areas, require technical maintenance as one system. Limitations are administrative failures for private farmers to obtain land certificate, their cost varies from $20 to $400 USD. Further every land user must pay land tax and depending on the land quality and category 85% of this tax must be used for land improvement. However, this tax is also used for another purposes. Being dependent on irrigation the Land Code of 2000 is important for agricultural land management. ►**Law on Ecological Expertise of 2003 and Decree to establish Commission on Chemical Safety of 2003** set forth rudimentary regulatory frames for pesticides and other chemicals registration and use. The Chemical Safety Commission regulates the system of chemicals registration, testing and control. It is headed by the Vice-prime minister and includes representatives of the State committee on environment protection and forestry, Ministry of health. The commission meetings approves the list of pesticides as may be requested by distributors or manufacturers. Now the new list of chemicals is being prepared.	Tajikkomuniservice managing water supply infrastructure of water supply and waste water treatment at the national level. Such fragmented water management needs better coordination with the other line state organs and ministries being integral parts of this system. **Monitoring** Six different organs monitor water quality: • State organ on hydrometeorology, Committee on environment protection managing the hydrometeorological network and monitor water quality and quantity (physical and chemical parameters). There are 97 water monitoring stations, of them 81 operational. The frequency of measurements, types of measurements and the number of monitored parameters has significantly decreased since 1991 due to the lack of budget financing. • MM&WR monitors water quantity discharged from its infrastructure to agriculture, power generation facilities, industry and households. • Tajikgeologija is in charge of the quality and ground water levels at the depth exceeding 15 meters. Observations performed twice a year, yet the need is to do it every month. It also keeps the ground water cadastre. • The vodokanals in rural areas and in cities monitor water quality supplied to public. They suffer from lack of labs due to the budget deficit after the civil war. • 73 sanitary epidemiological stations and laboratories monitor drinking water quality, in particular bacteriological quality and may apply measures where the need may be. • The oblast level inspection of the Committee are responsible for pollution sources monitoring and apply measures if concentrations exceed permissible levels. The Committee includes 4 laboratories with new equipment supplied in 2003. if necessary, they can conclude contracts with the State Organ on Hydrometeorology

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
			or other laboratories to perform chemical analysis. In general, all the monitoring organizations suffer from the lack of financing and monitoring activities supply few valuable data. Any obtained data are used to employ fines and charges policy but not to employ protection or remediation measures. There are several economic instruments of water resources management. They include charges for water pollution, water supply, treatment and water law violations. The renewed economic instruments integrated in the Water Code, such as fees for water supply and rights and obligations of water users. Allocation of responsibilities between the State Water Inspection and local (oblast, state and rayon) EPCs is similar to the same for the other inspections and EPCs. Local committees set up limits for enterprises for water pollution volumes, water intake, review and approve of the fees/charges calculation methodologies and collect payments. Inspectors may levy charges for the water law violations (including water pollution without permits or due to the equipment malfunction). Fees for water supply and sewage water servicing in cities introduced and managed by local vodokanals (municipal enterprises which are a part of communal services). The tariffs must be approved by municipal communal department, hukumat and local anti monopoly committee. Since the suppliers according to the Constitution must pay for water supply there is no such category of payment for water as resource. Until recently there were no payment for a service for water supply for irrigation which makes up to 85% of total used water. The MM&WR now levy charges from farmers, agricultural and industrial enterprises if water supplied through its water supply system. The Table 3.6 shows data on the current payments for services in water supply sector. If the tariffs for households are

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
			calculated per cubic meter, the actual payments are based on the actual number of residents for there are no water meters (their installation cost economically is not feasible). The vodokanals review tariffs based on the per capita water consumption norms. This fee is not adequate for due technical maintenance of water supply infrastructure, including due waste water treatment befoe its discharge. Even at the 100% of collected fees the current tariffs are not enough to cover maintenance costs and water supply infrastructure improvement. The inspectors rather focus on the regulatory and punitive measures regarding water use and waste water discharge. E.g., they impose fines for water law violations (including undue or unapproved water use) and for ignoring earlier prescriptions of technical improvement, overdue payments for water pollutants dumping and complete or partial enterprise suspension if the enterprise do not comply the limits for water pollutants discharge. The of payments for discharge and reporting are similar to the same for air pollution. Payments for water pollution are established for 197 compositions, including 101 of pesticides. An enterprise must report to the State statistics committee and EPC for the use of water and sewage water discharge (including pollutants content in the dumped water). Yet, there is no data on the collected amounts by pollutants within the established limits. The modern structure of payments for water supply services does not serve as financial stimulus for water protection and rational water use and do not cover current maintenance costs in the water sector. Payments and fines for water discharge are unable to reduce or prevent water pollution and ensure incomes into ecological funds. Instruments for natural resources management include payments for survey and extraction of minerals,

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
			fines for pouching. Fines for pouching for the endangered species are the highest of all the ecological penalties. Forest rangers are responsible for protection of endangered species, fines imposing and collection. The collected amounts must be kept at the local ecological funds yet there is no data on actual amounts collected. It is expected that payments for exploration and extraction of minerals must support budget. The license fee is calculated as a per cent fee of the extracted material. The range is 1-5% for black metals and 2-4% for construction materials (gravel, sand, clay) up to 4-8% for precious metals and stones. License is issued by the government for oil, gas, ores and precious stones, and by hukumats for the so-called mined materials (sand, clay, gravel). All the collected fees will go to local budgets (oblasts, city, rayon). Fees for licensing and other minerals are divided between the state and local budgets (50/50). These revenues are not marked as for special purposes. This instrument ' are not related to environment protection. Ministry of agriculture is first hand responsible for agricultural policy but due to the ongoing privatization it is loosing its role. Over the past years the number of employees reduced from 1200 до 180. Department of water and land use of 3 staff is responsible for rational use of farmlands. Role of the EPC in the issues of land management and agriculture is very limited. The state land and wastes inspection is responsible for land use control and in charge of the work of ecological inspectors in oblasts and rayons. Control is primarily relates land contamination, drainage, use of humic horizon, weed grass invasion and crop rotation. The inspection's resources are very limited. Committee of land management, cartography and geodetic surveys

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
			with its oblast, city and rayon offices[26] is responsible for land policy, land reform and land use control. It is the main organ responsible for implementation of the Land Code. Its main department of state land control over land resources also controls land use in cooperation with State inspection on land and wastes. Chairman of of the Committee for land management, cartography and geodetic survey is responsible for works related to the UN Convention on Desertification. Two institutes of the Committee are in charge of the major portion of practical work related to land reform including land cadastre and mapping. MM&WR is responsible for water management and water infrastructure. Commission on chemical safety is responsible for registration and use of pesticides and fertilizers. Cooperation and coordination between state organs is not always smooth. In this context cooperation between the ministry of agriculture, committee on land management and EPC ,ay be improved. Now, for instance, the information flow between the organs is reduced. The two mentioned WB projects on privatization and water infrastructure rehabilitation for irrigation include skills upgrading component; such center was established. It offers training courses for farmers, local administrators and experts. In 2004 it is panned to hold training for 7 000 people. Ecological aspects are discussed at 1-2 weeks long courses. Licensing are legislative instruments to regulate potentially dangerous activity where minimum qualification is required and strict observance of the rules to guarantee effective and safe operation, and that it will not lead to potentially irreparable harm to environment and health. Licensing is necessary

[26] В сельской администрации (ямоат) Государственный комитет по землеустройству также имеет местного сотрудника, земельного смотрителя

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
			to participate in ecological expertise; operations with dangerous wastes, industrial safety, sources of ionized radiation, production of pesticides and other agricultural chemicals and their handling. As a rule licenses are issued by the higher controlling organizations of the sector (ministry or committee) or authorized structure. For example, licenses for tourism companies serving foreign tourists are issued by the ministry of economy and trade. The license fee is established by the government or higher regulating body for relevant economy sector. Licensing is also used to ensure more effective and sustainable use of natural resources. Licensing is required to perform exploration works, mining or underground structures which are not regarded as mine works. Law of ecological expertise and Regulation on Commission on ecological expertise and Commission on chemical safety provide the system of registration of chemical and biological chemicals and other substances and compounds which are offered for initial use or import to Tajikistan. These substances or compounds must be subjected to the state testing in the laboratories and field testing to assess their biological, toxicological and ecological parameters. Should the results turn up positive the substances must be registered by the commission and included in the list of chemical substances allowed for use. Permits are designed to ensure sustainable nature use. There 2 types of permits: for the use of natural resources and for discharges and dumps. *Permit for pollutants discharge* Is issued by the relevant inspection (state water or air inspection) of local EPCs and municipal structures who discharge by-products. The permits allow for discharges of certain quantity of pollutant (gas, liquid, hard waste). They are issued as a rule for 1 year where the permissible allowable

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
			concentration is indicated, the permissible volume of pollutant and allowed pollutants. Ecological norms and standards for pollution are established for air pollution, noise, vibration, magnetic fields and other physical factors and traces of biologically dangerous chemicals or microbes in food products. Excess of the set limits leads to administrative sanctions. Several ministries define ecological quality standards each for own competence. Allowable levels of noise, for example, vibration and magnetic fields are established by the ministry of health.
	Use of natural resources	►**Priorities** defined in the **National development strategy and Poverty reduction** is the main task for the government. .However, taking into account the size of agricultural sector, its environmental impact and natural resources, close relations to the life conditions and poverty some urgent measures in this sector are advised. ►**National Report on Sustainable Development RIO +10** The Report was prepared to the Global summit on sustainable development in Johannesburg in 2002 calling for a number of political actions which correspond with actions as defined in the poverty reduction strategy. In particular, it voices to protect SMEs and private business as employment alternatives in agriculture, calls for further reforming of agricultural sector, in particular, privatization and farms development. ►In March 2004 the government adopted **Program for economic development until 2015.** The program expects poverty reduction as the prerequisite for sustainable economic development. It underlines the importance to creating employment opportunities, raising pensions and salaries for state employees, professional education, system of social support, increasing of minimal salaries, social work, state regulation of labциальной работы, обеспечения правительственного регулирования внешних трудовых миграций, борьбы с коррупцией иг migration flows, regulation of shadow economy. The program calls for reforms in agriculture. ►In **2002 the Government adopted State Employment Program and Pogram to Support Employment for 2003-2005.** Implementation of the two programs includes development and improvement of the system to advertise vacancies and support the system of microfinancing. ►**State Ecological Program for 1998 – 2008** underlines importance of land recultivation, anti-erosion activities and improved melioration. The land use is one of the priorities for the State committee on Environment Protection and Forestry. ► **The UN Convention on Desertification: in 2001**	There developed a system to assist low-income families to make monthly payments for gas and electricity (decree on the terms of subsidies to low income families and individuals entitled for subsidies iaw Constitution and raise of tariffs for gas and electricity as adopted by the Government in March 2003). The system of social support was improved through the program of cash subsidies for children from low income families, increased pensions and budget salaries. The government established the mechanisms of financial support to families residing in mountain areas and migrants from the territories suffering from natural disasters. Yet these migration schemes encounter problems due to inadequate financing and land plots allocation, infrastructure and water supply. Amendments introduced in 2002 into the Law on migration are aimed at labor migration regulation to guarantee the rights of migrants by introducing licensing of the agencies and organizations recruiting Tajik labor force to work abroad. Ministry of agriculture is primarily responsible for agricultural policy, but due to the continued privatization its role is decreasing. Different R&D institutes of the NAS and Academy of Agricultural sciences retain significant potential for scientific works. Same as in the former Soviet republics due to the

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
		there was adopted the National Program against desertification. ►**Law on Environment Protection of 1993** contains several articles on agriculture. They regulate use of pesticides and herbicides, use of biological and chemical substances, soil pollution and contamination of food stuffs, rational land use and protection from contamination from cattle farms. ►According to the **Constitution** all the land is the state property and is not subject for sale. The Land Code is the main law regulating land use including its management and taxation. ►**3Land Code of 2000** includes mechanisms which make it possible to select permits for farmers for land use including in the situations when the land use leads to land degradation. ►**Law on land Management of 2001** obligates authorities to map and monitor land quality including land contamination, erosion and water logging. ►**Law of 2002 on Dehkhan (farm) households** defines the privatization process in agriculture. It also set forth 3 forms of private farms: individual, family and cooperative or partnership farms. The shareholders of the former state farms decide on their meetings which of the best forms of ownership to choose. This decisions must be approved by the local authority. ►**Water Code** set forth the basis to establish water users associations (WUAs). ►**Law on Ecological expertise of 2003 and Decree to establish Commission on Chemical Safety of 2003** set forth rudimentary legal frames to register and use pesticides and other chemicals.	lack of financing the system of scientific research works is underfinanced. The soil research institute and institute of hydrotechnics and melioration are the leading research institutions on such important issues as soil and irrigation. The skills upgrading center (training center) of the World Bank offers trainings for farmers, local administrators and specialists. In 1997 was established national farmers network. The association includes almost 30 000 members who are using more than a half of total farmland. Its main idea is to support right of the newly formed farms. Farmers do not pay much attention to ecological aspects despite erosion is the direct threat to farm production. Because of the day-to-day difficulties farmers may not always apply their knowledge. In the absence of alternative sources of energy most likely that even anti-erosion forests will be destroyed. In addition to that lack of qualified staff and information seriously impedes safe agricultural practice development. Few farmers are duly educated or have access to consultation services despite the efforts by the government and donors. The FAO projects and other bilateral donor projects also focus on better information and services for farmers.
	Natural resources protection	The frames of the environmental law in Tajikistan primarily consist of the sub-laws issued by various ministries and committees (Committee on Environment Protection at large). Besides, during the recent past Tajikistan has ratified several international conventions and they were included in its national legislation. ► Law on environment protection of 1993 is the frame ecological law. It was amended in 1996 to specify jurisdiction various state structures in environment protection – the government, the by-then Ministry of Environment and local majilis. Amendments of 2002 are mainly about ecological expertise in the protected areas and more precise definition of environmental rights for general public. The law expects that ecological policy of Tajikistan must provide ecological priorities based on scientific principles of cohesion economic and other activity	A number of legislative acts establish responsibility for violation of environmental law which is observed by several state organs. In particular the Administrative Code of 1998 expects administrative responsibility for organizations, their staff and individuals for violations of the negligent land use and violations of rules of water use or water protection or violation of state ecological expertise. There are many organs authorized to observe administrative compliance for violations of certain types of ecological rules. So, administrative sanctions for ecological violations

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
		which impacts environment and sustainable development. Also individual rights for healthy environment must be observed. The law is designed to manage interrelations between nature and society in such a way to ensure interests of the both. The law defines due legal principles, protected units, limits of jurisdiction and the role of the government, Environmental Committee, local authorities, public organizations and general public. More importantly, the Law provides measures to ensure rights of society and individual to safe environment. The law requires to adopting joint system of ecological expertise and EIA during decision-making. Moreover, it also set forth the frames for ecological standards. The law also defines emergencies and natural disasters and prescribes the order of actions to be taken, describes responsibilities of authorities to mitigate the impact, and responsibility of individuals and organizations found guilty in damaging environment or otherwise violated the law. The law set forth several types of control to comply with environmental law: state control, ministerial control, control at the level of enterprise, and public control. . ▶**Law of 2002 on Protected Territories** provides priorities for protected areas over industrial and social-economic interests. But it also positively allows to use protected areas provided scholars concluded that certain type of activity satisfies economic interests with no harm to environment. The other environmental laws are: ▶**Quality of air** • Law on atmospheric air protection • Law on hydrometeorology ▶**Mineral resources** • Law on mineral resources ▶**Water** • Water Code ▶**Land management** • Land code • Law on land management • Law on land value assessment ▶**Forests** • Forest code ▶**Flora and fauna** • Law on flora and fauna use and protection • Law on flora protection • Law on plants quarantine ▶**Health and safety** • Law on sanitary and epidemiological safety • Law on vet medicine • La won iodinized salt • Law on quality and safe food products • Law on industrial safety of hazardous industries and sites • Law on radiological safety ▶**Wastes management and chemicals**	may be imposed on by administrative commissions of hukumats, courts, Committee inspectors, vet inspectors of the Ministry of agriculture, committee on land use, geodetics and mapping. Their jurisdiction to investigate certain types of violations and enforcement is explained in the Code. The most frequent administrative punishment is the fine of up 10 minimal monthly salaries for individuals or up to 15 minimal salaries for employees of organizations. Problems of ecological law arise due to that environment protection organs are limited in their resources to perform systematic inspections. As a rule, it takes 1 year until inspectors will again come visiting to check if the last year prescription was repaired only during the second inspection the inspector may actually impose fine if the former prescription was ignored. A bit more time is needed to obtain permit form industrial court against a business to levy the charge. Even despite quite fast work the court hearing may begin within several months. The Committee does not pay the obligatory state duty for court process. A committee may suspend a business operation which violates environmental law. Prokuratura and police may investigate ecological crimes and may play significant role by applying environmental law. Authorities of the Committee in the sphere of administrative violations investigation and imposing fines is not related to the authorities of prokuratura or militia. In fact, they cooperate to some extent because local EPCs forward such cases to militia and prokuratura. If the inspectors are successful to prove the fact which can be classified as a crime. The Criminal Code of 1998 covers crimes against nature and environment and ecological safety such as safety at work, pouching, land pollution, misuse of subsoil resources and their protection. The maximal fine is up to 2000 minimal

№№	Key environmental sectors	Key legislative/political instruments	Authorities in charge of issuing permits, approvals, inspection and law enforcement
		• Law on production wastes and consumption • Law on production and safe pesticides and agrochemicals management ►**Sate ecological program until 1998 – 2008 was adopted by the government in 1997** with the purpose to define country development vector during transition period. The program underlines importance of continued healthy environment for successful economic development and dependence of human survival on the biosphere sustainability. The program calls for balance between economic interests and ecosystem's bearing capacity. Main objectives are to employ all parts of society (government, business circles, NGOs, general public) to protect and improve environment and to educate people of the importance of rational use of resources and best ways to doing it. The program provides a detailed description of the environment and its ecological problems, set forth a number of types of activities necessary to recover and sustain ecological balance or remediation of certain ecological problem. It also contains urgent practical measures, such as: • Land erosion prevention; • Land allocation for high production crops; • Re-forestation, expansion of protected areas; • Restoration of high air quality, water and other resources; • Encouragement of local industry to use local raw materials • Creduction of energy consumption and introduction of energy-saving technologies.	monthly salaries, and maximal imprisonment is up to 8 years.

Annex 3. Methodology for Health Cost Estimation

1. Particulate Matter Pollution

Research in the United States in the 1990s and most recently by Pope et al (2002) provides strong evidence that it is even smaller particulates (PM 2.5) that have the largest health effects. The gaseous pollutants (SO_2, NOx, CO, and ozone) are generally not thought to be as damaging as fine particulates. However, SO_2 and NOx may have important health consequences because they can react with other substances in the atmosphere to form particulates.

Dose Response Coefficients

In order to estimate the health impacts, we have used recent work by Ostro (1994), Abbey *et al* (1995) and Pope *et al* (2002). Ostro (1994) and Abbey et al (1995) have used dose response coefficients to analyze the morbidity effects and provides estimates of dose response of PM (PM10) to chronic bronchitis. A survey of the current status of worldwide research shows that the risk ratios or dose response coefficients from Pope et al (2002) are likely to be the best available evidence of the mortality effects of ambient particulate pollution (PM 2.5). These coefficients were applied by the WHO in the World Health Report 2002, which provided a global estimate of the health effects of environmental risk factors. The mortality and morbidity coefficients from the above studies are presented in Table A.3.1.

Table A.3.1: Urban Air Pollution Dose-Response Coefficients

Annual Health Effect	Dose-response Coefficient	Per 1 ug/m^3 annual average ambient concentration of:
Mortality (% change in cardiopulmonary and lung cancer mortality)	0.8%	PM 2.5
Chronic bronchitis (% change in annual incidence)	0.7%	PM 10
Respiratory hospital admissions (per 100,000 population)	1.2	PM 10
Emergency room visits (per 100,000 population)	24	PM 10
Restricted activity days (per 100,000 adults)	5,750	PM 10
Lower respiratory illness in children (per 100,000 children)	169	PM 10
Respiratory symptoms (per 100,000 adults)	18,300	PM 10

Source: Pope et al (2002) for the mortality coefficient. Ostro (1994) and Abbey et al (1995) for the morbidity coefficients.

Pope et al (2002) provide the most comprehensive and detailed research study to date on the relationship between air pollution and mortality. The study confirms and strengthens the evidence of the long-term mortality effects of particulate pollution found by Pope et al (1995) and Dockery et al (1993). Pope et al (2002) utilized ambient air quality data from metropolitan areas across the United States for the two periods 1979-83 and 1999-2000, and information on certified causes of mortality of adults from the American Cancer Society (ACS) database over a period of 16 years. The ACS database has individual specific information for more than 1 million adults that were obtained through questionnaires. The study could therefore control for a large set of factors that may also affect variations in mortality rates across metropolitan areas,

such as age, smoking behavior, education, marital status, body weight, occupational risk factors, and dietary indices.

The study found a statistically significant relationship between levels of PM 2.5 and mortality rates, controlling for all the factors discussed above. All-cause mortality was found to increase by 4-6 % for every 10 ug/m^3 increase in PM 2.5. The increase in cardiopulmonary mortality was 6-9 %, and 8-14 % for lung cancer. No statistically significant relationship was found between levels of PM 2.5 and all other causes of mortality (Table A.3.2).

The share of cardiopulmonary and lung cancer deaths in total mortality varies sometimes substantially across countries. It may therefore reasonably be expected that the risk ratios for cardiopulmonary and lung cancer mortality provide more reliable estimates of mortality from PM 2.5 than the risk ratio for all-cause mortality when the risk ratios are applied to countries other than the United States. The former two risk ratios are therefore used in this report. The mortality coefficient in Table A.3.1 is a combination of the cardiopulmonary and lung cancer mortality risk ratios in Table A.3.2.

Table A.3.2: Mortality Risk Associated With a 10 ug/m^3 Change in PM 2.5

	Adjusted Relative Risk Ratios (RR)		
Cause of Mortality	**1979-1983**	**1999-2000**	**Average**
All-cause	1.04	1.06	1.06
Cardiopulmonary	1.06	1.08	1.09
Lung cancer	1.08	1.13	1.14
All other cause	1.01	1.01	1.01

Reproduced from Pope et al (2002).

In order to use the mortality coefficients in Table 3.1.2 to estimate mortality from urban air pollution in the Tajik cities, baseline data on total annual cardiopulmonary and lung cancer deaths are required. For Dushanbe and Khujand, data on estimates of total urban death were obtained from the UN statistical data (5.6 per 1000)[27]. In addition to the above data, estimates of mortality due to cardiopulmonary and lung cancer from the Ministry of Health combined with WHO data by the cause of deaths were also used. Data from the above two sources showed an average rate of 56 % of total deaths due to cardiopulmonary and lung cancer. In order to estimate the mortality effects, a threshold level of 7.5 ug/m^3 of PM 2.5 has been applied, below which it is assumed there are no mortality effects. The World Health Report 2002 (WHO) also used this procedure. No threshold level has been applied for morbidity.

An estimate of annual incidence of Chronic Bronchitis (CB) is required in order to apply the CB coefficient in Table A.3.1. In the absence of data on CB incidence for Tajikistan, we have used the rate from WHO (2001) and Shibuya et al (2001) for the Euro B region of WHO of which Tajikistan is part of. It has therefore not been possible to use city specific CB incidence rates.

Other morbidity health endpoints considered are hospital admissions of patients with respiratory problems, emergency room visits (or hospital out-patient visits), restricted activity days, lower respiratory infections in children, and respiratory symptoms. The coefficients are expressed as

[27] Deaths and crude death rates, by urban/rural residence: 1999 – 2003 (UN Statistical Division, 2007)

cases per 100,000 in the absence of incidence data for Tajikistan, though it would be preferable to have incidence data and use coefficients that reflect %age change in incidence. Increases in asthma attacks among asthmatics have also been related to air pollution in many studies. But such data are on the %age of the population that is asthmatic and frequencies of asthma attacks are not readily available for Tajikistan.

The health effects of air pollution are converted to disability adjusted life years (DALYs) to facilitate a comparison to health effects from other environmental risk factors. DALYs per 10 thousand cases of various health end-points are presented in Table A.3.3.

Table A3.3: DALYs for Health Effects

Health Effect	**DALYs lost per 10,000 cases**
Mortality	75,000
Chronic Bronchitis (adults)	22,000
Respiratory hospital admissions	160
Emergency Room visits	45
Restricted activity days (adults)	3
Lower respiratory illness in children	65
Respiratory symptoms (adults)	0.75

Note: DALYs are calculated using a discount rate of 3% and full age weighting based on WHO tables. Estimates of DALYs for the morbidity end-points are from Larsen (2004a,b).

Table A.3.4 presents the disability weights and average duration of illness used in this report to calculate the DALYs as presented in Table A.3.5. The weights for Lower Respiratory Illness (LRI) and Chronic Bronchitis (CB) are average disability weights.[28] Disability weights for the other morbidity end-points are not readily available, and are estimates by Larsen (2004a) based on weights for other comparable illnesses.[29] Average duration of CB is estimated based on age distribution in Tajikistan and age-specific CB incidence in Shibuya et al (2001). Years lost to premature mortality from air pollution is estimated from age-specific mortality data for cardiopulmonary and lung cancer deaths, and have been discounted at 3 % per year. Average duration of illness for the other health end-points is from Larsen (2004a).

Table A.3.4: Calculation of DALYs Per Case of Health Effects

	Disability Weight	Average Duration of Illness
Mortality	1.0	(7.5 years lost)
Lower respiratory Illness – Children	0.28	10 days
Respiratory Symptoms – Adults	0.05	0.5 days
Restricted Activity Days – Adults	0.1	1 day
Emergency Room Visits	0.30	5 days
Hospital Admissions	0.40	14 days*
Chronic Bronchitis	0.2	20 years

* Includes days of hospitalization and recovery period after hospitalization.

Estimated Health Impacts

[28] See: http://www.dcp2.org/pubs/GBD

[29] The disability weight for mortality is 1.0.

The total annual costs were computed from the total cost per case (Table A.3.5) and the number of estimated cases. For morbidity the cost of illness alone has been estimated. In the case of respiratory symptoms, the estimated cost per occurrence is zero and hence the total annual estimated cost due to respiratory symptoms in Table A.3.5 is zero.

The baseline data that were used to estimate the cost per case of illness is presented in Table A.3.6. The opportunity cost of time lost because of illness for adults is estimated based on urban wages. The average urban wage in Tajikistan is about 120 TJS per month. In the case of both income earning and non-income earning individuals, 75 % of the average urban wage rate has been imputed as the opportunity cost of time lost due to illness. In the case of non-income earning individuals, the above rate is justified as most of them provide a household function that has a value and they could as well choose to join the paid labor force.

Table A.3.5: Estimated Unit Cost by Health End-Point

Health categories	Cost-of-Illness Per Case (TJS)
Chronic bronchitis	800
Hospital admissions	345
Emergency room visits/Outpatient hospital visits	40
Restricted activity days (adults)	1
Lower respiratory illness in children	25
Respiratory symptoms (adults)	0

There is very little information about the frequency of doctor visits, emergency visits and hospitalization for CB patients in developing countries. However, Schulman et al (2001) and Niederman et al (1999) provide some information on frequency of doctor visits, emergency visits and hospitalization for CB patients in United States and Europe.[30] In the absence of specific data on Tajikistan, results from the above studies have been applied to Tajikistan. Estimated lost workdays per year are based on frequency of estimated medical treatment plus an additional 7 days for each hospitalization and one extra day for each doctor and emergency visits. These days are added together to reflect the total time needed for recovery from illness.

To estimate the cost of a new case of CB, the medical cost and value of time losses have been discounted over 20 year duration of illness. An annual real increase of 2 % in medical cost and value of time lost has been applied to reflect an average expected increase in annual labor productivity and real wages. The costs are discounted at 3 % per year, a rate commonly applied by WHO for health effects.

Table A.3.6: Baseline data for estimation of cost of health impact due to air pollution

	Baseline	**Source:**
Cost Data for All Health End-Points:		
Cost of hospitalization (TJS per hospitalization)	50	Per consultations with medical service providers, and health authorities
Cost of emergency visit (TJS) – urban	30	
Cost of doctor visit (TJS) (mainly private doctors) – urban	20	
Value of time lost to illness (TJS per day)	4	75% of urban wages in Tajikistan
Chronic Bronchitis (CB):		
Average duration of Illness (years)	20	Based on Shibuya et al (2001)
% of CB patients being hospitalized per year	1.5%	From Schulman et al (2001) and

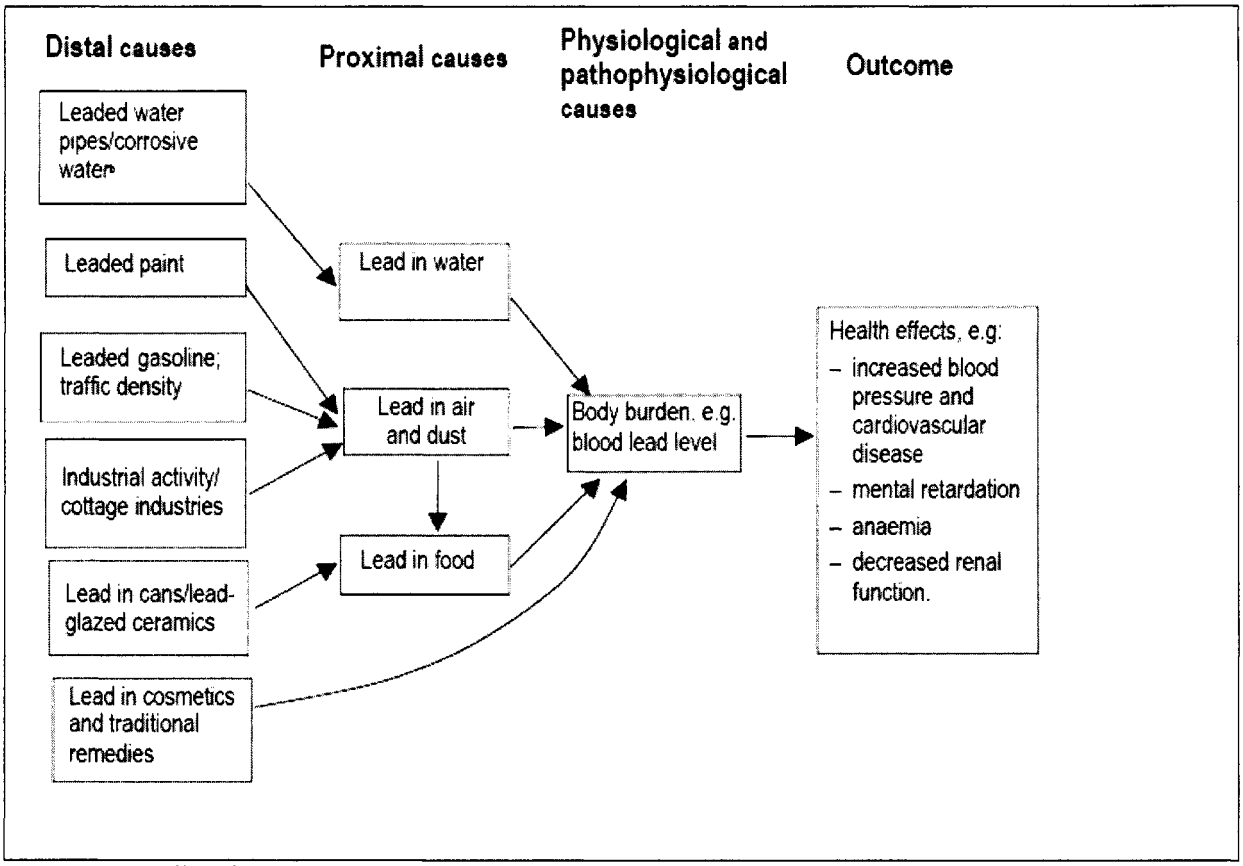
[30] CB is a major component of COPD which is the focus of the referenced studies.

Average length of hospitalization (days)	10	Niederman et al (1999)
Average number of doctor visits per CB patient per year	1	
% of CB patients with an emergency doctor/hospital outpatient visit per year	15%	
Estimated lost work days (including household work days) per year per CB patient	2.6	Estimated based on frequency of doctor visits, emergency visits, and hospitalization
Annual real increases in economic cost of health services and value of time (real wages)	2%	Estimate
Annual discount rate	3%	Applied by WHO for health effects
Hospital Admissions:		
Average length of hospitalization (days)	6	Estimates
Average number of days lost to illness (after hospitalization)	4	
Emergency Room Visits:		
Average number of days lost to illness	2	
Restricted Activity Days:		
Average number of days of illness (per 10 cases)	2.5	
Lower Respiratory Illness in Children:		
Number of doctor visits	1	
Total time of care giving by adult (days)	1	Estimated at 1-2 hours per day

2. Lead Exposure

We do not have data on the concentration of lead in the atmosphere. However, according to experts there the lead concentration exceeds safe limits and results in substantial health impacts. There are also significant accumulations of lead in soil and water already that could have impacts on health. The figure A.3.1 presents the major sources for lead exposure. The main indicator of lead exposure effect is the level of lead in the blood. WHO (Fewtrell et al, 2003) recommends that lead concentration in blood (BLL) is the best indicator to analyze the health impacts of exposure to lead pollution as lead from different exposure pathways accumulates in blood. Table A.3.7 presents a summary of health effects of lead.

Figure A.3.1: Lead Exposure Pathways



Source. Fewtrell et al, 2003

Table A.3.7: Health Effects of Lead

Outcome	Blood lead threshold[a] (µg/dl)		Relationship
	Children	Adults	
IQ reduction[b]	5	ND	Linear relationship between 5–20 µg/dl BPb[c] (loss of 1.3 IQ points per 5 µg/dl BPb); loss of 3.5 IQ points above 20 µg/dl.
Increased systolic blood Pressure[d]	ND	5	Linear relationship assumed between 5–20 µg/dl (increase of 1.25 mmHg per increase of 5 µg/dl BPb for males, and 0.8 mmHg for females); above 20 µg/dl, an increase of 3.75 mmHg for males, and 2.4 mmHg for females.
Gastrointestinal effects	60	ND	20% of children are affected above these rates[e].
Anaemia	70	80	20% of people are affected above these rates[e].

[a] Thresholds for gastrointestinal effects and anaemia are levels "at risk", as defined by ATSDR (1999).
[b] The disease burden is always estimated for one particular year and the effects of previous exposures are not accounted for in the year of assessment As a result, only children aged 0–1 year old were considered in the calculations, since the effects of lead on previous cohorts were considered in previous years.
[c] BPb: blood lead level (in µg/dl).
[d] Adults aged 20–79 years only.
[e] Based on Schwartz et al. (1990); see section 4.1.
ND No documented effects or insufficient evidence.

Source: Fewtrell et al, 2003

We do not have data on lead levels in blood in Tajikistan. So data from countries in NIS with same specifications for lead in gasoline are used. They are Uzbekistan (Semenov& Mutalova, 2004); and Kazakhstan (Kaul, 2000)), in Central Asia and Russia (Rubin et al, 2002). The above studies showed that these countries with identical specifications of gasoline have elevated levels of lead in blood among children (see studies mentioned above). The study in Russia further identified leaded gasoline as the main source of lead exposure, if stationary industrial sources are not located in the city. The table below presents major results of the studies:

Table A.3.8: Blood Levels Of Children In Former Soviet Union Countries

Blood lead, mean (ug/dl)	Year of study	Sample size	Study
<10	2002	355	Semenov& Mutalova, 2004
10-20	2002	23	Semenov& Mutalova, 2004
4-7	1999	475	Kaul et al, 2000
5.9-6.9	1997	601	Rubin et al, 2002
6.1-7.5	1997	281	Rubin et al, 2002

The above studies showed that in Russia when 23 % of children had elevated lead blood levels, whereas only 6 % of children in Uzbekistan had this condition. In order to estimate the cost of health effects due to lead pollution, the effects on children in major cities with population above 100,000 inhabitants alone are considered. In the absence of data on lead blood level among adults no analysis could be conducted for lead exposure in this population group. There are about 0.8 million people in these cities and about 100 thousand children under 5 years old. In the case of younger children lead can cause significant neurological deficit, characterized by reduction in IQ, as it is indicated in table A.3.7.

Since there were several studies available (Table A.3.8), a single weighted mean level of lead in blood (BLL) was generated by multiplying the sample sizes by the natural logarithm of the mean BLL for different samples.

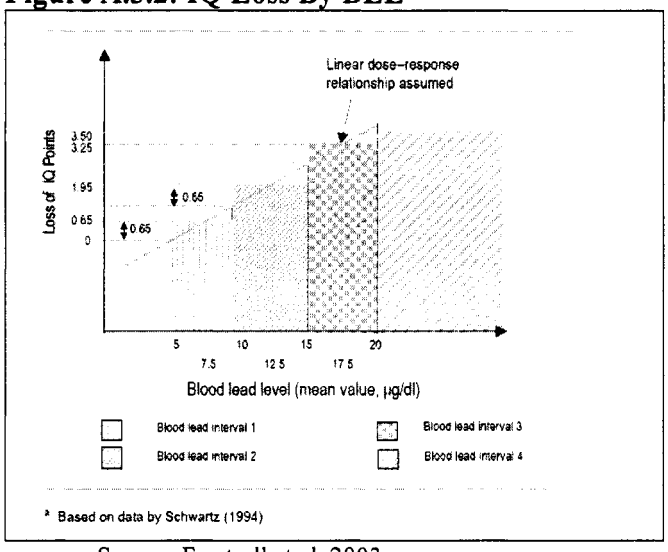
In order to quantify the damages from lead exposure, the log-normal distribution of BLL in the population was obtained using the function LOGNORMDIST in the Excel spreadsheet provided by WHO and the results are presented in Table 3.2.4. 1- LOGNORMDIST gives the proportion of the population above a given interval of BLL. This step was repeated for each BLL interval above a given value (5 ug/dL, 10 ug/dL, 15 ug/dL, 20 ug/dL, >20 ug/dL, ≥60 ug/dL, ≥70 ug/dL, ≥80 ug/dL). As in Fewtrell et al, 2003 it is assumed that IQ losses take place during the first 5 years of a child's life.

Table A.3.9: Population At Risk With Different BLL

	Total population	Age groups
		0 to 4
Population (1000s)	820.00	98.40
% in this age group	100%	12%
BPb urbans		6.6
Total population share with BLL 5-10ug/dl		0.28
Total population share with BLL 10-20ug/dl		0.21
Total population share with BLL 10-15ug/dl		0.14
Total population share with BLL 15-20ug/dl		0.07
Total population share with BLL >20ug/dl		0.13

As presented in Fewtrell et al., 2003 the loss of IQ points is quantified by assuming a linear dose-response relationship and a loss of 1.3 IQ points per 5ug/dL (Figure A.3.2).

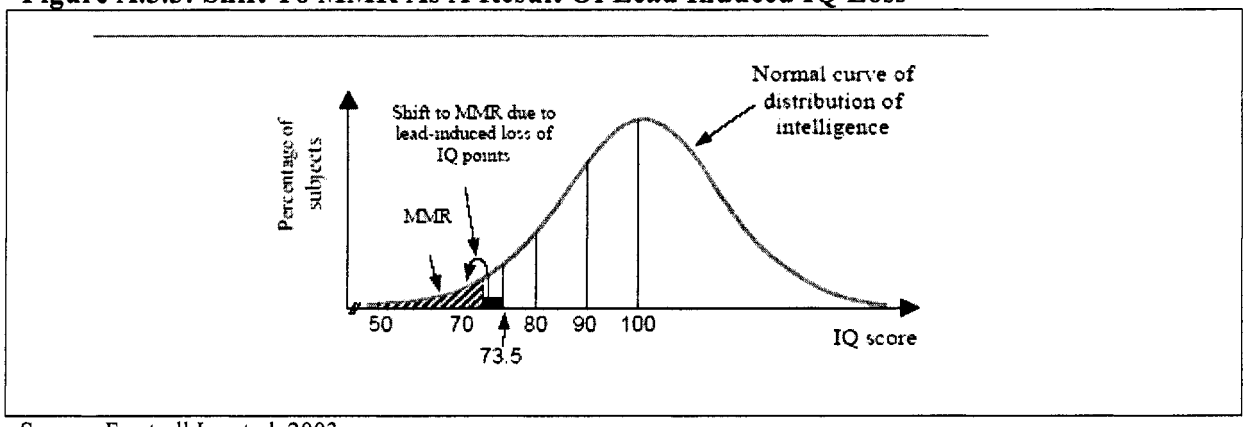
Figure A.3.2: IQ Loss By BLL



Source: Fewtrell et al, 2003

The next step is to convert IQ loss into mild mental retardation (MMR). We estimate incidence of MMR per 1000 children in the age range 0-4 years old. For this the number of children with IG loss in each BLL interval estimated above is multiplied by the %age of the population in the IQ interval. MMR occurs when the IQ is below 70 points but above 50 points (Fewtrell L. et al, 2003). Following the assumption of normal distribution of IQ across the population, it is possible to estimate the population in IQ intervals that would be at risk of MMR, as presented at the Figure A.3.3 below:

Figure A.3.3: Shift To MMR As A Result Of Lead Induced IQ Loss



Source: Fewtrell L., et al, 2003

The normal population is distributed within the specified IQ intervals as indicated in Table A.3.10. As we mentioned before, the population with IQ level of 70 pts is in the risk of having MMR from lead exposure:

Table A.3.10: Distribution Of A Normal Population Within IQ Increments That Are At Risk Of MMR

IQ band	IQ interval	Population in IQ interval (%)
IQ (1)	70-70.65	0.24
IQ (2)	70-71.95	0.8
IQ (3)	70-73.25	1.45
IQ (4)	70-73.50	1.59

Source: Fewtrell L., et al, 2003

The estimated population at risk of MMR is summed for different IQ bands (table A.3.10) and then multiplied by the regional MMR adjustment ratio, which is 1.53 for Euro B, the WHO subregion which includes Tajikistan. Estimated incidence of MMR due to lead exposure in the age group 0-4 years old is at 119 annual cases.

Studies have found an average loss of 1.3 IQ points per 5 ug/dl BLL in children. Fewtrell et al (2003) apply a lower threshold of 5 ug/dl BLL below which no IQ loss occurs, and an upper threshold of 20 ug/dl BLL above which no further IQ losses are expected (i.e., a loss of about 3.5 IQ points for BLL > 20 ug/dl). For some children an IQ loss will cause Mild Mental Retardation (MMR), occurring at an IQ of 50-70 points. Thus children with an IQ of 70.5-73.5 points are at risk of MMR from lead exposure. It is assumed that IQ losses takes place during the first 5 years of a child's life.

3. Inadequate Water Supply, Sanitation And Hygiene

Esrey et al (1991) provides a comprehensive review of studies documenting this relationship for diseases such as schistosomiasis (bilharzia), intestinal worms, diarrhea, etc. Fewtrell and Colford (2004) provide a meta-analysis of studies of water supply, sanitation and hygiene that updates the findings on diarrheal illness by Esrey et al (1991). Water, sanitation and hygiene factors also influence child mortality. Esrey et al (1991) find in their review of studies that the median reduction in child mortality from improved water and sanitation is 55 %. Shi (1999) provides econometric estimates of the impact of potable water and sewerage connection on child mortality using a data set for about 90 cities around the world. Literacy and education level are also found to be important determinants of parental protection of child health against environmental risk factors. Esrey and Habicht (1988) reports from a study in Malaysia that maternal literacy reduces child mortality by about 50 % in the absence of adequate sanitation, but only by 5 % in the presence of good sanitation facilities. Literacy is also found to reduce child mortality by 40 % if piped water is present, suggesting that literate mothers take better advantage of water availability for hygiene purposes to protect child health. Findings from the Demographic and Health Surveys from around further confirm the role of literacy in child mortality reduction. Rutstein (2000) provides a multivariate regression analysis of infant and child mortality in developing countries using Demographic and Health Survey data from 56 countries from 1986-98. The study finds a significant relationship between infant and child mortality rates and piped water supply, flush toilet, maternal education, access to electricity, medical services, Oral Rehydration Therapy (ORT), vaccination, dirt floor in household dwelling, fertility rates, and malnutrition. Similarly, Larsen (2003) provides a regression analysis of child mortality using national data for the year 2000 from 84 developing countries representing 95 % of the total population in the developing world. A statistically significant relationship between child mortality and access to improved water supply, safe sanitation, and female literacy is confirmed.

Baseline health data for estimating the health impacts of inadequate water supply, sanitation and hygiene are presented in Table A.3.11. Data from Medical Statistics Centre of the Health Ministry indicates that 12-14 % of child mortality was due to intestinal diseases in 2004. This is used as a range for diarrheal mortality estimation.

In the case of diarrheal morbidity, it is very difficult or practically impossible to identify all cases of diarrhea as a substantial share of cases is not treated or does not require treatment at health facilities, and therefore are never recorded. Further, those cases that are treated by private doctors or clinics are often not reported to public health authorities. Household surveys therefore provide the most reliable indicator of total cases of diarrheal illness. Most household surveys, however, contain only information on diarrheal illness in children. Moreover, the surveys only reflect diarrheal prevalence at the time of the survey. As there is often high variation in diarrheal prevalence across seasons of the year, extrapolation to an annual average will result in either an over- or underestimate of total annual cases and correcting this bias is often difficult without knowledge of seasonal variations.

MICS 2005 also provides data on diarrheal prevalence in children under the age of five years. It reports a diarrheal prevalence (preceding two weeks) rate of 18.6 % in urban areas and 21.5 % in

rural areas. This rate is used to estimate the number of annual cases per child under-5, and then the total annual cases in all children under-5. The procedure applied is to multiply the two-week prevalence rate by 52/2.5 to arrive at an approximation of the number of annual cases of per child. The prevalence rate is not multiplied by 26 two-week periods (i.e. 52/2), but multiplied by 52/2.5 for the following reason: The average duration of diarrheal illness is assumed to be 3-4 days. This implies that the two-week prevalence captures a quarter of the diarrheal prevalence in the week prior to and a quarter in the week after the two-week prevalence period.

Since MICS does not (nor does any other household survey in Tajikistan) provide information on diarrheal illness in the population above 5 years of age, estimations from other countries were used. The study therefore used data on cases of diarrheal illness for several years based on reported information from health care facilities (Larsen, 2004a,b). This database provides an indication of the annual incidence of diarrhea per child relative to annual incidence for the rest of the population. An analysis of the database suggests that diarrheal incidence in the population above 5 years of age is $1/5^{th}$ of incidence in children under 5 years. It should be noted however that the database contains information on cases of diarrhea treated at health facilities. In general, the %age of cases of diarrhea that are treated at health facilities is higher among young children than older children and adults.

Sometimes diarrheal illness requires hospitalization. However, there are no available centralized records in Tajikistan that provide data on the annual number of diarrheal hospitalizations. So the number of hospital admissions due to diarrhea was estimated using information on hospitalization rates provided in Baschieri and Falkingham (2007). Hospitalization rate of 0.2 per cent was applied to all cases of diarrhea estimated from the MICS 2000 to equal the figure on total number of hospitalizations due to intestinal diseases.

Table A.3.11 also has DALYs per cases of diarrheal illness, which are used to estimate the number of DALYs lost because of inadequate water supply, sanitation and hygiene. The disability weight for diarrheal morbidity is 0.119 for children under-5 and 0.086 for the rest of the population, and the duration of illness is assumed to be the same (i.e., 3-4 days). However, the DALYs per 100 thousand cases of diarrheal illness are much higher for the population over 5 years of age. This is because DALY calculations involve age weighting that attaches a low weight to young children and a higher weight to adults that corresponds to physical and mental development stages.[31] For diarrheal child mortality the number of DALYs lost is 34. This reflects an annual discount rate of 3 % of life years lost.

Table A.3.11: Baseline Data on Health

	Urban	Rural	Source:
Under-5 child mortality rate in 2004 (per 1000 live births)	70	83	MICS 2005
Diarrheal 2-week Prevalence in Children under 5 years	18.6%	21.5%	MICS 2000
Estimated annual diarrheal cases per child under- 5 years	3.9	4.5	Estimated from MICS 2000
Estimated annual diarrheal cases	0.8	0.9	Estimated from a combination of

[31] It should be noted that some researchers elect not to use age weighting, or reports DALYs with and without age weighting.

per person (> 5 years)			MICS 2000 and international experience
% of diarrheal cases attributable to inadequate water supply, sanitation and hygiene	90%	90%	WHO (2002b)
DALYs per 100 thousand cases of diarrhea in children under- 5	40	40	Estimated from WHO tables using age weighting and an average duration of illness of 4 days, and age weighting and 3 % discount rate for mortality
DALYs per 100 thousand cases of diarrhea in persons > 5 years	130	130	
DALYs per case of diarrheal mortality in children under- 5	34	34	

Baseline data used for the estimation of the cost of morbidity are presented in Table A.3.12. % of diarrheal cases in the age group older than 5 years treated at medical facilities is estimated from % of treated cases among children (MICS 2000) and international experience (Larsen 2004a,b). Cost of medical services reflects the cost of estimated private health care (WHO-CHOICE). This is a better indication of the economic cost of health services than public services that are subsidized in Tajikistan.

The value of time lost for adults is imputed based on urban and rural wages. The analysis used 75 % of the urban and rural wages in Tajikistan as the imputed value for both income earning and non-income earning adults. It may be noted here that the non-income earning adults are engaged in a household function that has value and they also have an opportunity to join the paid labor force.[32]

Table A.3.12: Baseline data for estimating health effects due to lack of improved water sanitation and hygiene

	Urban	Rural	Source:
% of diarrheal cases treated at medical facilities (children < 5 years)	21%	10%	Ministry of Health, reported cases
% of diarrheal cases treated with ORS (children < 5 years)	35%	35%	MICS 2000
% of diarrheal cases (children < 5 years) treated with use of pharmacy	21%	10%	Ministry of Health
% of diarrheal cases treated at medical facilities (population > 5 years) and with medicines	14%	4%	Estimated from MICS 2000 and international experience
Average Cost of health services (TJS per visit)	20	10	Per consultations with pharmacies, medical service providers, and health authorities
Average Cost of medicines for treatment of diarrhea (TJS)	20	20	
Average cost of ORS per diarrheal case in children (TJS)	5	5	
Average duration of diarrheal illness in days (children and adults)	4	4	Assumption
Hours per day of care giving per case of diarrhea in children	2	2	Assumption
Hours per day lost to illness per case of diarrhea in adults	2	2	Assumption
Value of time for adults (care giving and ill adults) TJS/hour	0.6	0.2	75% of urban and rural wages in Tajikistan

[32] Some may argue that the value of time based on wage rates should be adjusted by the unemployment rate to reflect the probability of obtaining paid work.

% of diarrheal cases attributable to Inadequate water, sanitation and hygiene	90%	90%	(WHO 2002b)

4. Indoor Air Pollution

There are two main steps in quantifying the health effects of indoor air pollution. The first step is to estimate the number of people or households exposed to pollution from solid fuels, and measure the extent of pollution, or concentration. The second step is to quantify the health impacts from the exposure based on epidemiological assessments. Once the health impacts are quantified, the value of this damage can be estimated.

We have used the MICS 2005 data on household use of fuels for cooking. The data indicate that around 8 % of urban and 49 % of rural households used fuel wood for cooking in 2005.

Desai et al (2004) provides a review of research studies around the world that have assessed the magnitude of health effects of indoor air pollution from solid fuels. The odds ratios for ARI and COPD are presented in Table 5.1. The odds ratios represent the risk of illness for those who are exposed to indoor air pollution compared to the risk for those who are not exposed. The exact odds ratio depends on several factors such as concentration level of pollution in the indoor environment and the amount of time individuals are exposed to the pollution. A range of "low" to "high" ratios is therefore presented in Table 5.1 that reflects the review by Desai et al (2004).

Studies around the world have also found linkages between indoor air pollution from traditional fuels and increased prevalence of tuberculosis and asthma. It is also likely that indoor air pollution from such fuels can cause an increase in ischemic heart disease and other cardiopulmonary disorders. As discussed in the section on urban air pollution, Pope et al (2002) and others have found that the largest effect of urban fine particulate pollution on mortality is for the cardiopulmonary disease group. As indoor smoke from traditional fuels is high in fine particulates, the effect on these diseases might be substantial. More research is however required in order to draw a definite conclusion about the linkage and magnitude of effect.

The odds ratios in Table A.3.13 have in this report been applied to young children under the age of five years (for ARI) and adult females (for ARI and COPD) to estimate the increase in mortality and morbidity associated with indoor air pollution.[33] It is these population groups who suffer the most from indoor air pollution. This is because they spend much more of their time at home, and/or more time cooking than older children and adult males.

Table A.3.13: Health Risks of Indoor Air Pollution

	Odds Ratios (OR)	
	"Low"	"High"
Acute Respiratory Illness (ARI)	1.9	2.7
Chronic obstructive pulmonary disease (COPD)	2.3	4.8

Source: Desai et al (2004).

To estimate the health effects of indoor air pollution from the odds ratios in Table A.3.13, baseline data for ARI and COPD need to be established. These data are presented in Table

[33] Although Desai et al (2004) present odd ratios for lung cancer, this effect of pollution is not estimated in this report. This is because the incidence of lung cancer among rural women is generally very low. The number of cases in rural Tajikistan associated with indoor air pollution is therefore likely to be minimal.

A.3.14, along with unit figures for disability adjusted life years (DALYs) lost to illness and mortality. Data on COPD mortality and especially incidence of morbidity, according to international disease classifications, are not readily available for Tajikistan. Regional estimates from WHO (2001) and Shibuya et al (2001) for the Euro B region are therefore used.[34]

The national average of two-week prevalence rate of ARI in children under 5 years from the MICS 2005 was used to estimate total annual cases of ARI in children under-5. The procedure applied is to multiply the two-week prevalence rate by 52/3 to arrive at an approximation of the annual cases of ARI per child[35].

The MICS does not (nor does any other household survey in Tajikistan) provide information on ARI in adults. So international evidence on annual incidence of ARI per child relative to annual incidence per adult (Larson, 2004a,b) was used. An analysis of the database suggests that ARI incidence in population over 5 years is about 1/5th of the incidence in children less than 5 years of age. ARI mortality in children under 5 years is 17-20 % of total estimated child mortality (Health Ministry, UNICEF). Table 5.2 also presents DALY per cases of ARI and COPD, which are used to estimate the number of DALYs lost because of indoor air pollution. The disability weight for ARI morbidity is the same for children and adults (0.28), and the duration of illness is also assumed to be the same (7 days). The DALYs per 100 thousand cases of ARI is however much higher for adults. This is because DALY calculations involve age weighting that attaches a low weight to young children, and a higher weight to adults, that corresponds to physical and mental development stages.[36] For ARI child mortality the number of DALYs lost is 34. This reflects an annual discount rate of 3 % of life years lost.

Table A.3.14: Baseline Data for Estimating Health Impacts of indoor air pollution

	Baseline		Source:
	Urban	Rural	
Female COPD mortality rate (% of total female deaths)	2.3%	2.3%	WHO (2002) and Shibuya et al (2001)
Female COPD incidence rate (per 100 thousand)	55	55	
ARI 2-week Prevalence in Children under 5 years	22%	46%	MICS 2005
Estimated annual cases of ARI per child under 5 years	3.8	8	Estimated from MICS 2005
Estimated annual cases of ARI per adult female (> 30 years)	0.8	1.6	Estimated from a combination of international data and MICS 2005
ARI mortality in children under 5 years (% of child mortality)	17-20%	17-20%	Ministry of Health, UNICEF
DALYs per 100 thousand cases of ARI in children under 5	165	165	Estimated from WHO tables
DALYs per 100 thousand cases of ARI in female adults (>30)	700	700	

[34] Tajikistan belongs to the Euro B region of WHO, which is one of three WHO regions in Europe.
[35] A factor of 52/3 is applied for the following reason: The average duration of ARI is assumed to be about 7 days. This implies that the two-week prevalence captures half of the ARI prevalence in the week prior to and the week after the two-week prevalence period.
[36] It should be noted that some researchers elect not to use age weighting, or reports DALYs with and without age weighting.

DALYs per case of ARI mortality in children under 5	34	34	
DALYs per case of COPD morbidity in adult females	2.25	2.25	
DALYs per case of COPD mortality in adult females	6.8	6.8	

DALYs lost per case of COPD morbidity and mortality is based on life-tables and age-specific incidence of onset of COPD reported by Shibuya et al (2001) for the Euro B region. A disability weight of 0.2 has been applied to COPD morbidity.[37] A discount rate of 3 % is applied to both COPD morbidity and mortality.

Estimated Health Impacts

Annual new cases of ARI and COPD morbidity and mortality (D_i) from fuel wood smoke were estimated from the following equation:

$$D_i = PAR * D_i^B \quad ; \qquad (1)$$

where D_i^B is baseline cases of illness or mortality, i (estimated from the baseline data in Table 5.3), and PAR is given by:

$$PAR = PP*(OR-1)/(PP*(OR-1)+1) \qquad (2)$$

where PP is the %age of population exposed to fuel wood smoke (8 % of urban and 49 % of rural households according to MICS 2006), and OR is the odds ratios (or relative risk ratios) presented in Table 5.1.

Treatment costs are estimated based on costs of health care services offered by the private sector as these are likely to better reflect the true economic costs. % of ARI cases in the age group older than 5 years treated at medical facilities is estimated from % of treated cases among children (MICS 2005) and the ratio of treated cases among children under-5 to treated cases among the population above 5 years of age. The latter ratio is from the international estimations discussed in the Baseline Health Data section.

The time lost in the case of adults is valued at 75 % of average hourly wages. There is very little information about the frequency of doctor visits, emergency visits and hospitalization for COPD patients in the developing countries. Since such data are not available for Tajikistan, data derived from Schulman et al (2001) and Niederman et al (1999) on United States and Europe are used in this study. Estimated lost workdays per year is based on frequency of estimated medical treatment, an additional 7 days for each hospitalization and one extra day for each doctor and emergency visit. These days are added to reflect time needed for recovery from illness.

To estimate the cost of a new case of COPD, the medical cost and value of time losses are discounted over 20 year duration of illness. An annual real increase of 2 % in medical cost and

[37] See: http://www.dcp2.org/pubs/GBD

value of time has been applied to reflect an average expected increase in annual labor productivity and real wages. The costs are then discounted at 3 % per year, a rate commonly used by WHO for health effects.

Baseline data used to estimate the cost of morbidity are presented in Table A.3.15. The treatment costs are based on costs of private sector health care services, as these are likely to better reflect economic cost. Cost of mortality is discussed bellow. In order to estimate the % of ARI cases in the age group older than 5 years, treated at medical facilities, the % of treated cases among children obtained from MICS, 2005 are combined with international experience. The time lost due to illness in the case of adults is valued at 75 % of average of hourly wage for urban and rural workers. The rationale for such valuation of time is discussed in the previous sections.

Table A.3.15: Baseline data for estimation costs of health impacts from indoor air pollution

	Rural	Urban	Source
% of ARI cases treated at medical facilities (children < 5 years)	33.7%	55.1%	MICS 2005
%age of cases with use of pharmacy (children <5 years)	34%	55%	MICS 2005
Cost of medicines for treatment of acute respiratory illness (population < 5 years) (TJS)	25	25	Per consultations with pharmacies
% of ARI cases treated at medical facilities (females > 30 years)	30%	49%	Estimated from a combination of the MICS 2005 and international experience
% of COPD patients being hospitalized per year	1.5	1.5	Assumption based on Schulman et al (2001) and Niederman et al (1999)
% of COPD patients with an emergency doctor/hospital outpatient visits per year	15	15	
Average number of doctor visits per COPD patient per year	1	1	
Estimated lost workdays (including household work days) per year per COPD patient	2.6	2.6	Estimated based on frequency of doctor visits, emergency visits, and hospitalization
Cost of doctor visit (TJS per visit)	10	20	Per consultations with pharmacies, medical service providers, and health authorities
Cost of hospitalization (TJS per day)	50	50	
Cost of emergency visit (TJS per visit)	30	30[38]	
Average duration of ARI in days (children and adults)	7	7	Assumption
Hours per day of care giving per case of ARI in children	2	2	Assumption
Hours per day lost to illness per case of ARI in adults	3	3	Assumption
Value of time for adults (care giving and ill adults) – TJS/hour	0.2	0.6	75% of wages in Tajikistan
Average length of hospitalization for COPD (days)	10	10	Larsen (2004b)

[38] These costs include charges for a bed and costs of medicines including the what the government incurs for these services

6. Valuation of Mortality

Two distinct methods of valuation of mortality are commonly used to estimate the social cost of premature death: the Human Capital Approach (HCA) and the Value of Statistical Life (VSL). Although both the approaches are being used, the VSL approach is more common in the last couple of decades. In this report, the HCA has been applied as a lower bound and VSL approach as the higher bound in estimating the cost of adult mortality. However in the case of child mortality, the HCA has been used.

Human Capital Approach

The HCA is based on the economic contribution of an individual to society over the lifetime of the individual and death results in an economic loss that is approximated by the loss of all future income of the individual. Future income is discounted to reflect its value at the time of death. The discount rate commonly applied is the rate of time preference. Thus the social cost of mortality, according to the HCA, is the discounted future income of an individual at the time of death. If the risk of death, or mortality risk, is evenly distributed across income groups, average expected future income is applied to calculate the social cost of death. Mathematically, the present value of future income is expressed as follows:

$$PV_0(I) = \sum_{i=k}^{i=n} I_0(1+g)^i/(1+r)^i \qquad (1)$$

where PV_0 (I) is present value of future income (I) in year 0 (year of death), g is annual growth in real income, and r is the discount rate (rate of time preference). As can be seen from (1), the equation allows for income to start from year k, and ending in year n. In the case of children, we may have $i \in \{20, 65\}$, assuming the lifetime income on average starts at age 20 and ends at retirement at age 65. An annual growth of real income and the discount rate used in this study are 2 % and 3 % respectively.

Several important issues are often raised regarding the HCA. The first issue is regarding the application of this valuation approach to individuals who do not participate in the economic activities, i.e., to individuals, such as the elderly, family members taking care of the home, and children who do not earn an income. One may think of an extension of the HCA that recognizes the value of non-paid household work at the same rate as the average income earner, or at a rate equal to the cost of hiring a household helper. In this case, the HCA can be applied to the death of non-income earners and children (whether or not children will become income earners or take care of the home during their adult life). In the case of the elderly, the HCA would not assign an economic value to old individuals that have either retired from the workforce or do not make significant contributions to household work. This obviously is a serious shortcoming of the HCA approach.

The second issue regarding the HCA is that the social cost of mortality is limited to the economic contribution of an individual or value of household work if the individual takes care of the home. Alternative approaches to the valuation of mortality, or social cost of mortality, have therefore been developed and increasingly been applied in the past couple of decades. These approaches

employ a concept or measure called VSL, which nowadays is much more widely used in public policy than the HCA approach.

The estimated cost of mortality in Tajikistan based on HCA, using Eq. 1 is presented in Table A.3.16. Average annual income is approximated by GDP per capita, at about 1050 TJS per year.

Table A.3.16: Cost of Mortality (per Death) using HCA

	Average Number of Years Lost	Thousand TJS
Adults:		
Mortality from Urban Air Pollution	7	7.4
Mortality from Indoor Air Pollution	6.8	7
Children:		
Mortality from Indoor Air Pollution	65	32.5
Mortality from Diarrheal Illness	65	32.5

Value of Statistical Life

While the HCA involves valuation of the death of an individual, VSL is based on valuation of mortality risk. Everyone in society is constantly facing a certain risk of dying. Examples of such risks are occupational fatality risk, risk of traffic accident fatality, and environmental mortality risks. It has been observed that individuals adjust their behavior and decisions in relation to such risks. For instance, individuals demand a higher wage (a wage premium) for a job that involves a higher than average occupational risk of fatal accident, individuals may purchase safety equipment to reduce the risk of death, and/or individuals and families may be willing to pay a premium or higher rent for properties (land and buildings) in a cleaner and less polluted neighborhood or city.

Hence by observing individuals' choices and willingness to pay for reducing mortality risk (or minimum amounts that individuals require to accept a higher mortality risk), it is possible to measure or estimate the value to society of reducing mortality risk, or, equivalently, measure the social cost of a particular mortality risk. For instance, it may be observed that a certain health hazard has a mortality risk of 1/10,000. This means that one individual dies every year (on average) for every 10,000 individuals because of that particular health hazard. If each individual on average is willing to pay 10 TJS per year for eliminating this mortality risk, then every 10,000 individuals are collectively willing to pay 100 thousand TJS per year for eliminating the mortality risk. This is the VSL for eliminating the mortality risk. Mathematically it can be expressed as:

$$VSL = WTP_{Ave} * 1/R \qquad (2)$$

where WTP_{Ave} is the average willingness-to-pay (TJS per year) per individual for reducing the mortality risk of magnitude R. In the illustration above, R=1/10.000 (or R=0.0001) and WTP_{Ave}= 10 TJS. Thus, if 10 individuals die each year from the health risk illustrated above, the cost to society is 10* VSL = 10*100 thousand TJS = 1 million TJS.

Estimating VSL

The main two approaches to estimate the VSL are revealed preference and stated preference analyzes. Most of the studies that use revealed preferences are hedonic wage studies, which estimate labor market wage differentials associated with differences in occupational mortality risk. The stated preference studies use Contingent Valuation Methods (CVM), which estimates Willingness-To-Pay (WTP) of individuals for mortality risk reduction.

Mrozek and Taylor (2002) provide a meta-analysis of VSL estimates from labor market studies from around the world. They identify a "best-practice" sample and control for industry characteristics other than occupational mortality risk that also affects inter-industry wage differentials. The study concludes that a lower estimate for VSL of USD 2 million can be reasonably inferred from labor market studies when "best-practice" assumptions are used. It should however be noted that the VSL range inferred by Mrozek and Taylor (2002) is substantially lower than average VSL estimated in some other meta-analyses where the mean VSL is as high as US $6 million. As a higher bound for VSL a mean estimate of VSL meta analysis from of USD 5.4 million was applied. The latest meta analysis of VSL estimates is by Kochi et al (2006) utilizing the empirical Bayes pooling method to combine and compare estimates of the VSL data from 40 selected studies published between 1974 and 2002, containing 197 VSL estimates.

Benefit Transfer

There are no studies on VSL in Tajikistan. The overwhelming majority of VSL studies have been conducted in countries with substantially higher income level than in Tajikistan. Hence VSL estimates from these countries have to be adjusted to suit the conditions in Tajikistan. One commonly used approach in benefit transfer is to use income elasticities. [39] Viscusi and Aldi (2002) estimate an income elasticity of VSL in the range of 0.5-0.6 from a large sample of VSL studies. The range in income elasticity is however influenced by three unusually high estimates of VSL from labor market data from one state in India. Leaving out these three studies provides an income elasticity of about 0.80.

However, the most appropriate income elasticity to use for low-income countries, such as Tajikistan, remains uncertain as the income level in Tajikistan falls far outside the range of income in the sample of countries from which the income elasticities of VSL is estimated in the empirical literature. A prudent approach might be to apply an elasticity of 1.0 in order to reduce the risk of overstating the cost of mortality in Tajikistan.

Table A.3.17 presents the VSL for Tajikistan from benefit transfer based on the range of VSL reported by Mrozek and Taylor (2002) as the lower bound, and Kochi et al (2006) as the upper bound, and an income elasticity of 1.0. These figures are substantially higher than the ones from the HCA, especially for adult mortality due to urban air pollution and indoor air pollution. A comparison is presented in Table A.3.18.

Table A.3.17: Estimated Value of Statistical Life in Tajikistan

[39] The income elasticity is the percentage change in VSL per percentage change in income.

	"High"	**"Low"**	**Source:**
Average VSL in high-income countries (million US $)	5.4	2	Kochi et al (2006), Mrozek and Taylor (2002),
Average GDP/capita in high-income countries (US $)	30 000	30 000	World Bank*
GDP per capita in Tajikistan (US $ in 2004)	340	340	WDI 2006
Income elasticity	1.0	1.0	
Estimated VSL in Tajikistan (thousand TJS)	189	70	Benefit transfer

* Weighted average GDP per capita, based on the sample in Mrozek and Taylor (2002).

Table A.3.18: A Comparison of HCA and VSL estimates applied to Tajikistan

	Ratio of VSL/HCA
Adults mortality	18
Children mortality	4

Annex 4. Institutional design of environmental management system in Tajikistan

The environment protection law stipulates several types of controls and institutions to implement the environmental provisions at the state, ministerial, business and community levels. The state level control is exercised by the State Control Service on Nature use and Protection in the Ministry of Agriculture and Environment Protection and by the Sanitary Inspection Service of the Ministry of Health and Inspection on Mining Safety. At the ministerial level enforcement is done by different line ministries and the state agencies under them with no effective coordination across the line ministries. In addition to the state level and ministerial level controls there is a business level control, which implies that every business has to observe the environmental law.

Pursuant to Article 12 of the Tajik Constitution "On the Government of Republic of Tajikistan" and Decree of the President dated November 30, 2006 the then agency responsible for environmental affairs, State Committee on Environment Protection and Forestry (SCEPF) was dismissed and its functions were assigned to the Ministry of Agriculture and Nature Protection. The government through its decree on December 28, 2006 created the State Control Service of Natural Resources and Environmental Protection (SCSNREP) under the Ministry of Agriculture and Nature Protection (MANP)[40]. The newly reconstituted MANP has the Department of Nature Use and Protection, chaired by a Deputy Minister. The different agencies under the DNUP are SCSNREP, Agency on Hydrometeorology and Anti-hail service, Agency on Forestry and Hunting, Tajik Scientific Research Institute of Nature Use and Forestry, Scientific-Research Center on Water Resources Protection, Scientific-Research Laboratory on Nature Protection, State Department on specially protected areas "Tajik National Park", Scientific-Production Center "Tabiat" and the State Enterprise, "Saidu Sayokhat". The organizational setup of the environment block in the MANP is presented in Chart 1. The organizational chart of the SCSNREP is presented in Chart 2

The role of the national government is to approve regulations of the ministries and state committees, define their structures and to be responsible for their coordination and international cooperation for enforcement of environmental laws. In order to achieve these, the government is expected to undertake the following specific functions: (1) formulate unified state policy on the use of natural resources, environment protection and environmental safety, (2) adopt measures to provide rights to residents for a healthy environment and environmental safety, (3) coordinate activities of the state environmental protection agencies, state and intergovernmental environmental programs aimed at prevention of natural and manmade disasters and their mitigation, and (4) implement control over nature protection and use of natural resources.

[40] Earlier Ministry of Agriculture was limited in its functions in environment protection. The most important functions were import and export control, control of agriproducts production, processing and stocking, of wastes and equipment to manage final products and environmental safety in general. The Ministry was also responsible for quarantine of plants and animals, coordination of studies in land use, application of chemical fertilizers. The Ministry had no right to enforce administrative sanctions for violations of environment protection law as they were applied by the specialized inspectorate and the Ministry could only refer to that inspectorate.. As regards quarantine,the Ministry had had its own State Inspection service to enforce quarantine of plants and State Veterinary Inspection the veterinary quarantine requirements

The mission of the State Control Service of Natural Resources and Environment Protection (SCSNREP) Agency is environmental protection and sustainable use of natural resources and to ensure effective interdepartmental coordination. The SCSNREP is entrusted with the following functions:

- define national policies for environmental protection, research on sustainable use of natural resources, mitigation of effects of global climate change;
- prepare and publish information bulletins and bi-annual reports on environment;
- draft environmental laws and standards and develop a framework for sustainable use of natural resources;
- issue individual permits for the use of specific types of resources and overseeing their compliance and revocation in case of violations;
- develop a system of economic instruments to stimulate sustainable use of natural resources;
- establish limits on the use of certain types of strategic natural resources;
- manage the special (off-the-budget) ecological fund.

The Service is entitled to: (1) obtain required environmental information from other governmental services; (2) request reports related to the environment from other governmental agencies and issue mandatory decrees; (3) suspend or limit economic activities which violates environmental law; (4) prohibit import or transit of hazardous cargo in case of violations of environmental law; (5) prohibit projects whose implementation violates environmental requirements.

The SCSNREP has its own laboratory and expertise needed to conduct the following four specialized inspections:

- State Water Inspection in regard to the water resources in the country;
- State Inspection of Animals and Plants to ensure safe use and protection of plants and animals;
- State Inspection of Land and Wastes so as to facilitate sustainable use of lands and optimal waste management practices;).
- State Air Inspection for the implementation of ambient air quality standards;

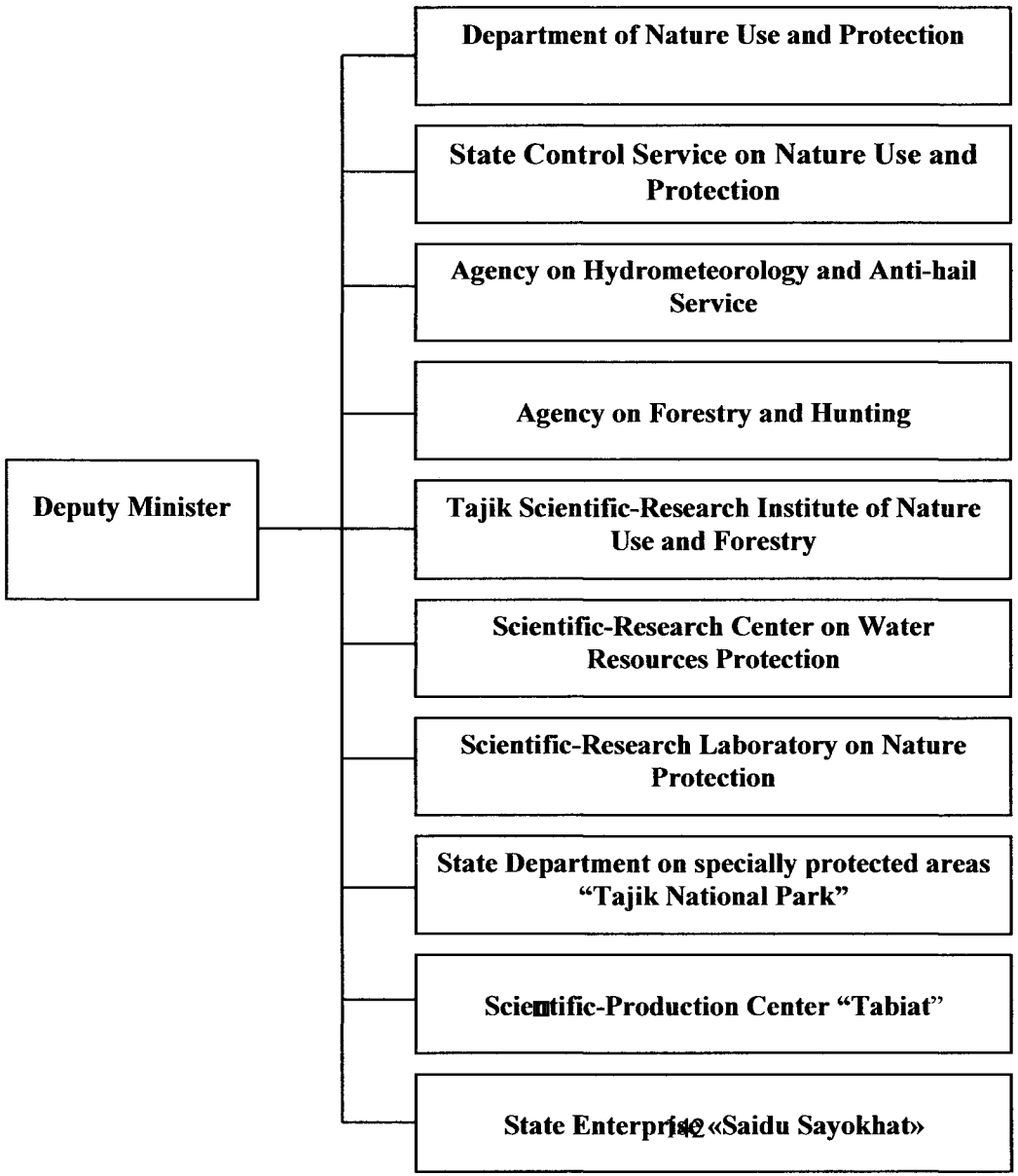
The Inspection officers of the SCSNREP have right to:

- access any business or other facility with the purpose of inspection of relevant documents, performance of water treatment facility and controlling devices;
- issue mandatory instructions to mitigate ecological consequences;
- enforce administrative sanctions and request environment authorities to initiate criminal cases against violators, and sue them in civil courts for damage done;
- suspend or terminate business operations hazardous to environment or public health.

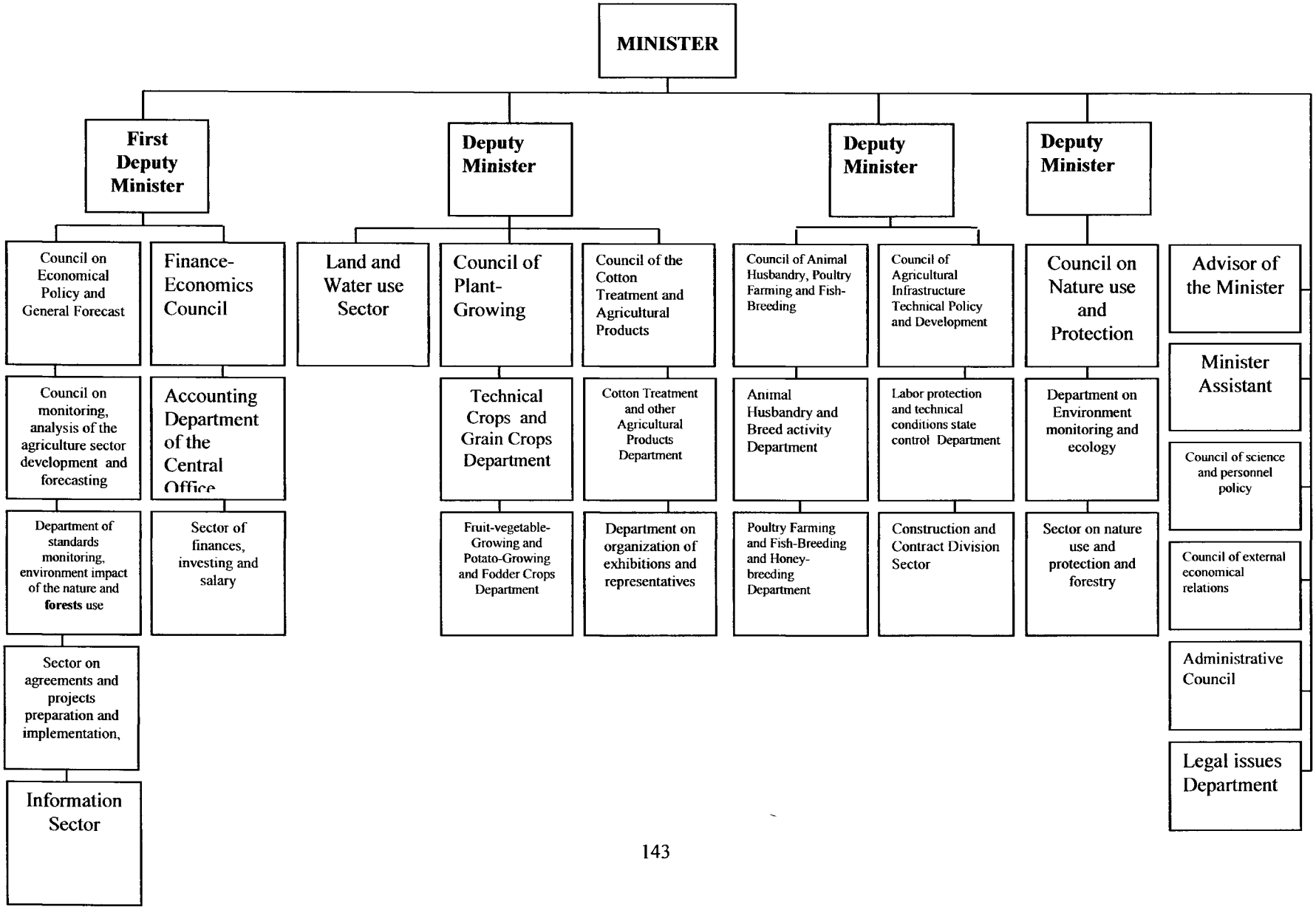
The inspection officers can operate independently but are limited by their powers as defined by law (Administrative Code, Environment protection law).

Khukumats (the local authorities with executive power) are responsible for enforcement of environmental laws in oblasts, rayons and cities. Their chairmen are appointed by the President and approved by Majlisi Oli.

Environmental Block in the Ministry of Agriculture and Nature Protection



Central Apparatus of the Ministry of Agriculture and Nature Protection



Organizational Chart of the State Control Service on Nature Use and Protection – July, 2007