Meeting basic water needs in post-Soviet Naryn Kyrgyzstan: a case study of a Tien Shan Mountain community

Matthew J. Sanford
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MEETING BASIC WATER NEEDS IN
POST-SOViet NARYN, KYRGYZSTAN:
A CASE STUDY OF A TIEN SHAN MOUNTAIN COMMUNITY

by
Matthew J. Sanford
B.S. Morningside College, 1996
presented in partial fulfillment of the requirements
for the degree of
Master of Arts
The University of Montana
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Date
The dissolution of the Soviet Union brought independence to Kyrgyzstan in 1991. The Kyrgyz had become dependent upon the Soviets for employment, insurance, public services, and utility subsidies. Mountain communities such as Naryn, in the southeastern part of the country, have struggled since to meet basic water needs due to crumbling infrastructure, lack of revenue and planning, and water contamination. Employing a case-study approach in 2004, I synthesized data from interviews of residents and officials (public health, water, city), water sector documents, and field observations in order to identify key issues that the community faces.

Naryn utilizes four separate water systems, and problems of each are unique. Electric water pumps fail during regular power outages and entire regions go without water. Turbid water continues to be pumped to the city unfiltered and without sanitation. Residents on the city margins have limited access to potable water because city system development has halted while urban expansion continues. Furthermore, many go without water because the financially constrained water department has been unable to repair broken pipes and water hydrants. Residents from all regions of the city have had to resort to alternate, inferior drinking water sources, such as springs and the Naryn River. Drinking these untreated waters poses health risks to citizens. The beliefs about water-related illnesses were varied even within the health sector, and the prevalence of disease was difficult to quantify. Residents inhabiting city margins with alternate water sources nearby face the greatest public health risk because there is no treated drinking water.

Marginalized residents have become distrusting of water and government officials and do not want to pay for water because of poor water service and false promises by officials to resolve water issues. Without revenue, the water department cannot restore the water system and construct new facilities to meet the needs of residents. The findings of this research suggest that the situation has improved, in part, with international assistance from the City of Great Falls, Montana; the Urban Institute; and the World Bank. By making major improvements to the city water systems and receiving mentoring on water supply administration and management from Naryn’s international partners, the prospects of the Naryn water department regaining civic trust and becoming a self-sustaining utility are improved.
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<tr>
<td>ARIS</td>
<td>Community Development and Investment Agency</td>
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<tr>
<td>CIA</td>
<td>United States Central Intelligence Agency</td>
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<tr>
<td>DDT</td>
<td>Dichloro-Diphenyl-Trichloroethane. DDT is an insecticide banned in many countries because of its adversity to human health.</td>
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<tr>
<td>DSE</td>
<td>Department of Sanitation and Epidemiology</td>
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<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>ICMA</td>
<td>International City Management Association</td>
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<td>ICWC</td>
<td>Interstate Commission on Water Coordination</td>
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<tr>
<td>LSG</td>
<td>Local Self Government</td>
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<tr>
<td>MCL</td>
<td>Maximum Contaminant Level</td>
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<tr>
<td>NATO</td>
<td>North Atlantic Treaty Organization</td>
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<tr>
<td>NTU</td>
<td>Nephelometric Turbidity Units</td>
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<tr>
<td>OMC</td>
<td>Kyrgyz Government Medical Insurance</td>
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<tr>
<td>PTC</td>
<td>A region in east Naryn, pronounced Ertez</td>
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<tr>
<td>TDS</td>
<td>Town Development Strategy</td>
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<tr>
<td>TSS</td>
<td>Total Suspended Sediment</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>UNDP</td>
<td>United Nation Development Program</td>
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<td>USAID</td>
<td>United States Agency for International Development</td>
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<td>USD</td>
<td>United States Dollars</td>
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<tr>
<td>UV</td>
<td>Ultraviolet light</td>
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CHAPTER 1
INTRODUCTION

Do you have a house that you built yourself? Do you have a tree that you planted yourself? Nothing will stay except a house which we built and trees we planted for our children.

Kyrgyz Proverb

Since Kyrgyzstan’s independence from the Soviet Union in 1991, high inflation rates, surging levels of poverty, and declining economic performance have resulted from the loss of economic linkages between Kyrgyzstan and the surrounding states, Russia and the Central Asian republics, which were established during the Soviet period.1 Today, over forty percent of the 5.2 million Kyrgyz live in poverty, the unemployment rate is eighteen percent,
2 and the Kyrgyz economy lags, while those in adjacent Kazakhstan and Uzbekistan are bolstered by abundant oil and gas resources along with agriculture. Kyrgyzstan is a small, land-locked, mountainous country, and it lacks major fossil fuel energy resources. Gold and other minerals are important natural resources, but since Kyrgyzstan is the headwaters state of the Syr Darya, its substantial freshwater resources are of greater importance. Kyrgyzstan produces energy from hydroelectric dams and is in the process of capitalizing on the sale of water as a commodity to downstream countries for irrigation. Uzbekistan is opposed to buying water from Kyrgyzstan and contends that water be delivered promptly during the agricultural season. The issue of hydropolitics has instigated much contention between Kyrgyzstan and its downstream neighbor, Uzbekistan.

The political and economic histories of Kyrgyzstan are of importance in understanding issues related to potable water supply, wastewater treatment, and solid

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waste disposal. The collapse of the Soviet Union in 1991 brought a loss of central
governmental management of public services and a loss of revenue for public services.3
Without a stable economy and natural resources, communities face severe challenges.
Without reliable, clean drinking water in communities, economic development is limited
and public health issues abound.4

In developing countries, the availability of safe drinking water and water-related
illnesses are major public health and societal concerns.5 More than a billion people lack
access to clean drinking water.6 As a result of this urgent problem, the United Nations
General Assembly adopted the Millennium Development Goals in 2000. The United
Nations will work toward halving the number of people without sustainable access to safe
drinking water by 2015, but may fall short of this goal due to financial and political
constraints. Financial commitments from the Asian Development Bank, United Nations
Development Program, the Netherlands, Australia, and many others may not be adequate
to provide clean water to many people in developing countries.7

Hundreds of millions of people contract water-related illnesses each year.
Geographers Gilbert White, Sarah Halvorson, Daniel Buor, and others have made
significant contributions to the understanding of how communities and households deal
with water quality issues and water-related illnesses in Africa and South Asia. Risk
perception and choice of water sources, water supply infrastructure, and sanitation are
key factors that influence water-related illness infection rates.8 By developing

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community water supplies and improving water quality, infection rates decrease.\(^9\) To date, there have not been studies conducted in remote Tien Shan mountain communities that have specifically addressed the relationships among water supply, sanitation, and public health.

Research on water resources in Central Asia has almost exclusively focused on three interconnected issues solely in the Aral Sea Basin: regional hydropolitics and international water allocation; the ecological and social crises associated with the desiccation of the Aral Sea; and human/environmental impacts of large-scale irrigation in xeric regions.\(^10\) The Syr Darya and Amu Darya once sustained the Aral Sea, the fourth largest inland body of water in the world. However, since the 1960s, Russians, and later the Soviets, transformed traditional, sustainable agriculture in the Aral Basin to intensive grain and cotton production. This sharply increased the demand for water and decreased natural inputs into the sea.\(^11\) Uzbekistan has drawn the greatest percentage of water from the principle rivers of the Aral Basin, but all other Central Asian republics also continue to rely on these rivers for agriculture. Cotton agriculture requires enormous quantities of freshwater, and poor management and overuse of this resource have resulted in salinized and water-logged soils in irrigated regions.\(^12\) Poor agricultural practices have devastated

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arable land and aquatic and riparian habitat within the basin. This environmental disaster has lead to economic disaster for fishing communities and could impact other sectors.

Because I found no studies that investigated infrastructure problems, water quality, and public health in communities in the Tien Shan, I drew on literature with similar themes within the Aral Basin. In the context of the post-Soviet era, infrastructure and management are in decline. Sara O’Hara and Tim Hannan have described how irrigation infrastructure maintenance and water management in Central Asia have suffered as a result of the removal of the Soviet system. More importantly, Semenza et al. attribute crumbling water treatment facilities and distribution infrastructure in Nukus, Uzbekistan to high frequencies of diarrhea. The distribution network may transmit disease to the population of Nukus because wastewater from leaking pipes contaminates clean water in adjacent, broken water pipes. Other urban areas throughout the region are faced with poor water quality from obsolete and inadequately maintained water treatment plants. Water quality often does not meet national standards.

Naryn provided an ideal setting for a case study on urban water supply for two reasons. First, studies had not investigated water supply issues in urban areas of the high Tien Shan of Central Asia (Figure 1). Secondly, qualitative studies in remote, distant areas are normally limited due to a lack of resources and personal contacts. However, there were existing ties between Montana and Kyrgyzstan through the U.S. Department of Defense Partnership for Peace Program. Relationships from that program grew into ties between the cities of Great Falls, Montana and Naryn. City officials and water department administration collaborated from 1999-2004 on how to better manage water supply, wastewater, and solid waste disposal in Naryn. The goal of the Resource Cities Program was to address and overcome the challenges that Naryn was facing in providing basic municipal services to its residents. I was invited by the cities to become involved in the program. Further, I initiated this study to examine these water-related problems

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within the context of Naryn, Kyrgyzstan, and to formulate planning objectives that would aid in their rectification.

Figure 1.1. Map of Kyrgyzstan\(^\text{16}\) (inset map by Matthew Sanford).

This case study employed a qualitative approach consisting of two major components: (1) document and literature review and (2) fieldwork. The technical exchange program mentioned above provided a wealth of information. I collaborated with the City of Great Falls and received their records and reports generated throughout

---
the duration of the exchange program. The Water and Wastewater Master Plan included maps and a description of the water system. The fieldwork took place in Naryn in 2004 and included semi-structured interviews and field observation.

I interviewed officials and representatives working in the water and health sectors, as well as local residents. The resident perspective complemented the professional perspective and description of the system. The approach yielded a rich and in-depth view into the water supply problems of Naryn. The opinions of those impacted by the water supply and distribution systems contributed to a more complete understanding of Naryn’s water issues and provided a basis for sound management recommendations.

RESEARCH OBJECTIVES

The objectives of my research were the following: (1) to map and describe Naryn’s water system; (2) to identify factors that have impacted and continue to degrade water quality in Naryn; (3) to identify potential correlations between water quality and illness; (4) to spatially represent areas with little to no water service and source areas perceived to pose particular risk of water-related illnesses; and (5) to gain a deeper understanding of how Kyrgyz interact with water resources.

Presently, the water system does not provide reliable, clean water to Naryn’s 42,000 residents for a number of reasons. The city has lost government subsidies that were provided during the Soviet period for infrastructure maintenance and development. The distribution pipes are old and cracked, thereby resulting in the loss of water and potential microbial contamination.\textsuperscript{17} Infrastructure additions since the 1970s halted while city expansion continued, leaving residents without drinking water. These residents have to resort to the river and unimproved springs for drinking water. The community is unable to bear the financial burden of reconstructing and developing the system because of extreme poverty; therefore, the city has looked internationally for financial assistance.\textsuperscript{18} The City of Great Falls, the Urban Institute and the World Bank have assisted Naryn in developing urban water management strategies and have provided

\textsuperscript{17} David Brown, interview by author, 30 March 2004, Great Falls, Montana.

\textsuperscript{18} City of Great Falls, Water and Wastewater Master Plan (Great Falls, Montana: USAID, ICMA, Resource Cities Program, 2001); Jim Reardon, interview by author, 29 March 2004, Great Falls, Montana.
grants and loans for water supply system reconstruction. This is a remarkable story of how a severely impoverished city can rise out of apathy with the involvement of international partners. No longer is basic service delivery in Naryn restricted exclusively by the staggering economy.

ORGANIZATION OF THE THESIS

This thesis is divided into seven chapters including the introduction. In chapter two, I review the literature on water resource geography and trace its evolution to include urban water supply studies. I discuss former and current geographical studies on water in Central Asia and on water supply issues in mountain environments. Finally, I present an overview of several post-Soviet and Central Asian water supply studies and relate them to my research in Naryn.

In chapter three, I describe the research setting of Naryn, Kyrgyzstan. This chapter begins with a brief geography of the country and Naryn and then sets the post-Soviet context of political and economic instability and decentralization. After setting the context, I discuss examples of infrastructure and service failures. More specifically, in post-Soviet Kyrgyzstan there have been numerous problems with water supply infrastructure. Finally, I discuss the programs under which several international partners have provided Naryn with technical expertise and finances to begin resolving municipal drinking water issues.

In chapter four, I cover the methodology employed in this study. I discuss the qualitative methods used in the research, semi-structured interviews, water sector document review, and field observation. I conducted the research with the help of two Kyrgyz field assistants who primarily translated interviews into English. Overall, I encountered few obstacles while investigating water issues in Naryn. Both residents and officials were very open to participation in this research.

I present my data in chapters five and six. Chapter five describes the water systems and sources and challenges that the water department faces in providing the residents with clean, reliable water. Additionally, I discuss the concerns of residents and

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19 Jim Reardon.

20 Rector Almaz Akmataliev, interview by author, 8 March 2004, Missoula, Montana.
represent the problems spatially. Spatial analysis shows that residents living near the city margins face the greatest challenges in fetching clean water. I conclude the chapter with a description of the developments that Naryn’s international partners, The City of Great Falls, Montana, Urban Institute, and the World Bank, have made to repair the water supply and improve water service.

Chapter six details water quality and water-related public health issues that emerged in this research. The chapter begins with an overview of water quality data and stresses the importance of regular water quality testing. Interestingly, I found that the testing capacity of the Department of Sanitation and Epidemiology was limited for financial reasons. The next section provides quotes from health officials and residents on water-related illnesses and emphasizes the variability of beliefs about illnesses. Finally, I present resident perspectives on water-related illnesses and relate them to location. This approach was effective in bringing out issues such as varied beliefs about water-related illnesses and poor water quality of alternate sources.

The final chapter synthesizes the empirical data of chapters five and six and concludes with the major findings of this research. The loss of revenue as a result of the transition to a new democracy and economy beginning in 1991 has implications for all public sectors and residents of Naryn. Because drinking water quality is poor and public health is at risk, Naryn has had to look internationally to restore its ability to meet the basic water needs of residents.
CHAPTER 2
CONCEPTUAL FRAMEWORK AND RELATED RESEARCH

СУУ ЖАНА АБА АДАМДЫН ЖАШООСУ ДЕТ БИЛЕМ
Water and air are the life of people.
Kyrgyz Proverb

Geographers have a long-standing interest in the human role in modifying the physical environment. This study is situated in the environment and society tradition and intersects with the sub-fields of water resource and mountain geography. Geographers have established a tradition of studying water supply issues in large urban areas and rural settings. Mountain geographers have largely channeled their research efforts toward interpreting the processes that limit freshwater availability and quality on regional scales. In Central Asia, the primary water issues covered extensively in the literature have also been regional: crop irrigation, Aral Sea desiccation, and transboundary water conflicts. These issues have attracted global attention, research, and policy analysis. On the other hand, local water issues such as mountain water supply have been less emphasized. The purpose of this chapter is to review the literature on water resource research in Central Asia and water supply.

WATER RESOURCE GEOGRAPHY

Alarmingly, water use has outpaced the growth of the global population three-fold in the last 100 years. Water shortages and severely degraded water quality are emerging at an increasing rate.21 Because geographers have a long tradition of studying water resource issues in the United States and abroad, and because water-related problems have continued to surface, the body of literature has grown considerably. The geographical

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approach to describing and solving water problems plays a key role due to its interdisciplinary, spatial, and multi-scaled approach.

Geographical studies on water resource policy date back at least to George Perkins Marsh and John Wesley Powell in America. Later, extensive studies on water rights and allocations (water law) grew from these early traditions. For example, geographers have worked toward developing an understanding of the enormous contentions over water from the Colorado River Basin and Owens Valley of California. Efforts have aimed to conserve this precious and vital resource and resolve disputes by making policy recommendations and revising water management strategies.\(^{22}\)

As studies on regional river-basin planning expanded, two different approaches emerged by the 1960s:

1. **Physical geography**: geomorphology, hydrography, oceanography, meteorology and climatology
2. **Human geography**: human environment, geography of population and settlement (urban water supply), economic geography (hydropower, natural resources, agriculture, planning, irrigation, transportation).

Studies on urban water supply began to appear around this time under the category of geography of population and settlement, but in 1974 the American Geographical Society placed water supply in the economic geography category.\(^{23}\) Economic conditions play a key role in water supply issues. By the 1960s, American geographers were working abroad on urban, community, and household level water supply projects.\(^{24}\)

Studies on water supply continued to develop, and by the year 2000 they were placed in the water system approach amongst the six other primary approaches to water resource issues:

- water sectors (irrigation, urban water, flood hazards, etc.),
- water systems (water supply, demand, distribution, wastewater),
- hydrologic processes (watershed, riparian, groundwater),


\(^{23}\) Ibid.

\(^{24}\) White.
• major research trends (river basin surveys, behavioral approaches, institutional analysis),
• water problems (scarcity, pollution, hazards), and
• a combination of approaches.

James Wescoat has included water supply, demand, distribution, and wastewater in the water system approach, but I argue that it is important to also consider public health and water quality issues within it. Research on urban water issues in Central Asia has developed slowly. Below I will discuss the primary regional issues influencing the water sector that continue to attract global attention.

WATER RESOURCE RESEARCH IN CENTRAL ASIA

As mentioned above, extensive research on water issues in Central Asia has focused on three primary, regional topics: crop irrigation, desiccation of the Aral Sea, and hydropolitics and transboundary issues. Water supply and sanitation studies, however, have been infrequent. Because the goal of this section is to discuss water problems in Central Asia, I briefly discuss the regional issues in conjunction with a study on water supply in Nukus, Uzbekistan. It is not within the scope of this thesis, however, to review the incredible complexities and volume of literature on Central Asia’s regional water issues. A number of sources are listed in the bibliography if the reader hopes to investigate those issues further.

Cotton Irrigation: The Case of the Kara Kum Canal

Thousands of kilometers of irrigation canals have been constructed in Central Asia to meet the enormous freshwater demands for agricultural use. In the Aral Sea Basin prior to Russian occupation, the agriculturalists utilized a network of irrigation canals that drew water from the Syr Darya, the Amu Darya, and other rivers for vegetable and grain cultivation. It is argued that the pre-Russian traditions of Central Asia were sustainable and lasted for centuries. Since the 1960s, Russians and later the Soviets transformed traditional, sustainable agriculture in the Aral Basin to intensive grain and

25 J. L. Wescoat, "Water Resources."
cotton production which sharply increased the demand for water and decreased natural inputs into the sea.\textsuperscript{26} Russia had primarily imported cotton from the United States prior the American Civil War, but since cotton imports ceased during the war, Russia looked to Central Asia to satisfy the growing demands of the textile industry.\textsuperscript{27} The Russian empire made substantial investments in irrigation canal construction to bolster cotton production. For example, from 1885 to 1915, cotton production grew from fourteen percent to forty-four percent in the Fergana Valley with the development of a canal from the Syr Darya to Mirzachol Sahra (an area west of Tashkent) in 1898.\textsuperscript{28} By the 1930s the Soviets\textsuperscript{29} were bringing virgin xeric lands into production in order to further intensify irrigated agriculture.\textsuperscript{30} As cotton production grew, the continued demand for water led to the construction of the Kara Kum Canal in Turkmenistan. This canal is the largest irrigation structure in the world. It carries 12.9 km\textsuperscript{3} of water per year from the Amu Darya 1,370 km to 10,000 km\textsuperscript{2} of agricultural land. Water from the Kara Kum Canal irrigates more land than is protected within Yellowstone National Park.\textsuperscript{31}

Geographers from the Institute of Geography in Moscow described the Kara Kum Canal Project and investigated environmental impacts of the construction of the Kara Kum Canal. By 1975 there was concern about the mineralization of groundwater and groundwater level increases. Intensive and continued irrigation resulted in soil salinization and elevated water tables. In some cases, salt inflow rates tripled. Soil and

\begin{footnotesize}
\begin{enumerate}
\item \textsuperscript{26} Matley; O'Neill.
\item \textsuperscript{28} Matley.
\item \textsuperscript{29} The Russians were defeated by the Soviets in the war in 1917.
\item \textsuperscript{31} S. L. O'Hara and T. Hannan, "Irrigation and Water Management in Turkmenistan: Past Systems, Present Problems, and Future Scenarios."
\end{enumerate}
\end{footnotesize}
groundwater properties have been impacted and the productivity of agricultural and ecological systems has declined.\textsuperscript{32}

In the more recent post-Soviet era, Hannan and O’Hara have investigated infrastructure condition and management of the Kara Kum Canal. They claim that irrigation is in decline due to the impact of the collapse of the Soviet system and the loss of revenue to maintain canal infrastructure. With a loss of water managers and revenue, the basic systems and infrastructure, such as the Kara Kum Canal, are crumbling. But water demand has continued to increase due to exponential increase in irrigated land from the 1980s into the post-Soviet period. Only fifty to ninety percent of diverted water reaches the crops because of poorly designed and maintained canal structures. Without reliable canals and keen water management, the agriculture sector will suffer. Overwatering, water-logging, and salinization of soils are leading to widespread land degradation and decreases in agricultural outputs. The vicious cycle of land degradation is difficult to control.\textsuperscript{33}

Funding and central planning for the Kara Kum Canal have been nearly lost; the annual budget has gone from 3.2 million to 2,000 USD. Canal and machine parts are no longer purchased; machines are no longer replaced; less than fifty percent of the original dredges needed to maintain the canals are operational. Water tariffs have been revised, but water usage has been difficult to monitor because of the lack of flow meters. Kazakhstan and Kyrgyzstan have made the greatest attempts to charge users, but the revenue generated do not cover operational and maintenance costs. Furthermore, the tariff billing and collection systems are ineffective in part because farmers believe it is their right to have free water. Additionally, water was free during the Soviet period and is social property according to Islamic law, which was predominant in the region prior to


Soviet occupation. When asked for remunerations, many farmers say they cannot pay. Finally, farms were state-owned in the Soviet period and continue to be so today in the countries of Turkmenistan and Uzbekistan. The burden of farm operations, machinery, maintenance, and infrastructure, therefore, is on the state.

Kyrgyzstan, however, has undergone land reform and divided the once huge state-farms into small, individual, private farms to decrease the economic burden on the state and raise the incentives to increase productivity. From 1990 to 1996, the number of farms in Kyrgyzstan increased from 450 to 40,000. Land privatization has adversely impacted irrigation and drainage structure maintenance because Kyrgyz farmers have not previously managed farms and lack the necessary skills to maintain them.

In summary, canal maintenance is severely impaired throughout the Aral Sea Basin and is leading to land degradation, environmental change, and further economic decline. Lack of revenue and management impacts many sectors including municipal water supply.

**Aral Sea Desiccation**

The Aral Sea has been shrinking for decades because enormous quantities of water are diverted for irrigation from the rivers that feed the sea. Environmental and economic disasters have resulted throughout the basin because the Soviets adopted economic development strategies that were short-term and devastating. Over 80,000 km² are irrigated with over ninety-seven km³ of water from diversions in the Aral Basin. The water of the Aral Basin is chiefly from the high Tien Shan. Excessive

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irrigation withdrawals from all Central Asian republics have severely diminished the recharge rate of the sea.\textsuperscript{39}

An article in \textit{Science} succinctly described the Aral Sea water crisis. The sea's area and volume have been measured since 1960. Scientists forecasted its size for 2000, just over a third of its original size of 1090 km\textsuperscript{3}. Micklin, an American geographer, has a strong background on water issues in the former Soviet Union and is an authority in the region. He saw the crisis explicitly as a water management problem and unable to be solved without diversion of water from Siberian rivers, hence the Siberian Diversion Plan. Due to the magnitude of such a project and lack of resources, the Siberian Diversion Plan will probably never be considered.\textsuperscript{40}

The environmental and human health implications of dewatering the rivers of Central Asia for irrigation are many. The Aral Sea is salinizing without historical inputs from surrounding rivers. Changing saline levels affects vegetation and fauna populations in and around the sea. Native species of fish can no longer survive in sea and populations have crashed.\textsuperscript{41} Salt deposits are left on the shores in the sand and when the wind blows, it creates a toxic dust that has affected the health of residents.\textsuperscript{42} The faulty irrigation structures and practices must be updated to curb further desiccation of the sea, environmental disaster in the region, and human health problems of residents.

\textit{Hydropolitics and Transboundary Water Disputes}

In addition to declines of infrastructure and maintenance and environmental disaster in post-Soviet Central Asia, political tension over water has grown. Agriculture is Uzbekistan's dominant economic activity.\textsuperscript{43} Uzbekistan depends on freshwater from mountainous Kyrgyzstan for crop irrigation, especially for cotton. Uzbekistan had

\textsuperscript{39} Glantz.


\textsuperscript{41} Raskin; Micklin, \textit{Managing Water in Central Asia}.

\textsuperscript{42} Tsukatani.

\textsuperscript{43} Micklin, \textit{Managing Water in Central Asia}. 

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42,000 km$^2$ of irrigated land in 1990, the most extensive in Central Asia. Kyrgyzstan generates eighty percent of the water of the Aral Sea Basin, but allocated the least by the Interstate Commission on Water Coordination (ICWC).\textsuperscript{44}

The ICWC, created in 1993 to ensure that the region’s water resources are jointly managed by the Central Asian republics, charges Kyrgyzstan to release additional water to Uzbekistan for irrigation in the summer. The water from the reservoir generates substantial electricity for Kyrgyzstan and is an important energy source, especially in the winter when demand peaks. Fossil fuel and alternative energy resources are limited in Kyrgyzstan. Hence, the Kyrgyz depend greatly on abundant freshwater from the Tien Shan Mountains with which to generate electricity. Resolutions such as Uzbekistan trading gas and oil for water were implemented during the Soviet period, but since 1991, political and economic tensions have weakened relationships between the countries and conflict has increased.\textsuperscript{45} For example, Kyrgyzstan has violated the ICWC by releasing water in winter. Unplanned, winter releases resulted in winter flooding and summer water shortages in Uzbekistan and Kazakhstan.\textsuperscript{46}

In an effort to capitalize on the most abundant natural resource in Kyrgyzstan, which is in great demand throughout the Aral Sea Basin, downstream users have been proposed to pay for the water it delivers. There is no alternate water source for Uzbekistan’s agriculture when Kyrgyzstan shuts off the water. The issue remains contentious and is very difficult to solve given the poor economies and political tension between the affected countries.

\textsuperscript{44} Ibid.


Urban Water Supply

Not only have there been large-scale, regional water problems in Central Asia linked to agriculture, but urban areas have been faced with declining water supply infrastructure and public health. I found only a single study in the literature that examined public health and water supply problems in Central Asia.\(^47\) In this section, I describe a study conducted by epidemiologists in Nukus, Uzbekistan on water quality and public health.

Nukus, population 200,000, is located on the Amu Darya south of the Aral Sea near the Turkmenistan border. There were risks associated with drinking water from a system with leaking distribution pipes. In Nukus, twenty percent of the residents do not have access to piped water. The epidemiologists quantified diarrhea cases of 1,583 participants (half of the households studied had access to municipal, piped water), determined the water sources associated with high frequencies of water-related illnesses, and assessed the efficacy of the chlorination equipment installed by the United States Agency for International Development (USAID) in 1996.

Regarding the various water sources of Nukus, people without taps in their garden or home took their water mostly from a well, a hydrant on the street, a hydrant of the neighbors, river, or a vendor. Those with piped water reported frequent pressure failures.

The researchers found that cross-contamination between leaky sewer and drinking water pipes was a primary cause of diarrhea. The control group chlorinated their drinking water at home, washed their produce with it, and received hygiene education. People had significantly greater rates of diarrhea when they used water from the system and did not chlorinate it at home (75/1000 per month). Interestingly, fecal coliform levels were not significantly different in the chlorinated water compared to the non-chlorinated water. With household intervention, the rates were greatly reduced (29/1000 per month). Those who used unpiped water without intervention experienced the greatest illness rates (179/1000 per month). The participants who drank water containing residual chlorine were much less likely to experience diarrhea. Boiling water as a sanitation measure was not assessed in the study. People who traveled over 200 meters for water were at great risk of infection. The group that received sanitation education experienced

\(^47\) Extensive literature review did not include sources in Russian.
the lowest levels of diarrhea. Public health education is an important measure that can reduce water-related illness levels in developing areas.\textsuperscript{48} It is clear from this study as well as three decades of research on waterborne disease that comprehensive water quality testing and analysis of water hygiene behavior are critical to understanding cause and effect relationships.

**MOUNTAIN GEOGRAPHY AND WATER SUPPLY ISSUES**

Mountains are huge catchment areas for up to eighty percent of the world’s freshwater.\textsuperscript{49} Much research has been conducted on factors that threaten freshwater quality and availability in high elevation regions. The breadth of mountain water research ranges from geomorphology, hydrology, spatial analysis, economics, social issues, agriculture, and irrigation. Interestingly, the literature has not merged mountain geography with community/urban water supply issues well. Changing economies and land use patterns and expanding human populations in mountain communities degrade water supply delivery capacity, water sources and quality, and public health.

Two ecologists from the University of Vienna used GIS to estimate vegetation change due to changing land use patterns and climate change in the water catchment area that supplies the city of Vienna. Dimbock and Grabherr warn of long-term, adverse impacts on Vienna’s drinking water supply due to drought and increased grazing in the watershed.\textsuperscript{50} This study emphasized the importance of maintaining highly functioning watersheds in order to supply urban areas with drinking water.

A study on water in the Middle Mountains of Nepal demonstrated that poor management of irrigation water for agriculture has threatened the integrity of water supplies, yet population growth has increased the demand for water. Community drinking water supplies are contaminated by feces, nitrates, and phosphates. People have

\textsuperscript{48} Semenza.


\textsuperscript{50} T. Dimbock and G. Grabherr, "GIS Assessment of Vegetation and Hydrological Change in a High Mountain Catchment of the Northern Limestone Alps," *Mountain Research and Development* 20, no. 2 (2000).
looked toward more developed rural water supply infrastructure, but they have not wanted to bear the cost because of the widely held belief that “water is free.” It will be particularly challenging for mountain communities to bear the cost burden of water infrastructure improvements when they have traditionally used low cost springs, rivers, and gravity-fed systems. Often people take water from shallow wells that are easily contaminated by agricultural pollution and pathogens. Therefore, boiling water is a necessary method of sanitation. But people do not always boil their water in part due to the arduous task of collecting wood and/or the high cost of kerosene. From a management perspective, the catchment areas must be protected and surface water not mixed with spring water. More importantly, the residents must be involved in the process of educating each other and developing strategies to overcome water quality and public health issues in the face of increased resource use.\textsuperscript{51}

Sarah Halvorson has conducted research in the Karakoram of Northern Pakistan on how risk perception of water-related illnesses affects public health. The foci of her research have been child health, gender, and diarrhea. Child mortality may be as high as fifty percent in Northern Pakistan due to waterborne illnesses. Interestingly, over half of the respondents in her study believed their drinking water could cause diarrhea, but they did not always boil it due to a range of socio-economic constraints. Although, nearly ninety percent of her respondents believed water could transmit diarrhea, people continued to be at risk of illness due to poor water handling practices.\textsuperscript{52}

Halvorson has also described how women are the principal managers of water in mountainous regions in developing countries because they are the ones who choose and prepare water for household members. They manage water at the household level. Unfortunately, women have been excluded from the process of managing community and local water supplies because of gender ideologies. Since women have important knowledge of drinking water issues based on direct experience at the household level,

\textsuperscript{51} Merz.

their voices and concerns must be implemented into community drinking water projects and potable water policies.\textsuperscript{53}

Few geographers have examined drinking water issues in mountain communities in developing countries. Their studies have shown changing land use patterns, demographic change, economic and social change, gender, and water supply management to be key factors that affect public health, water projects, planning pressures, and water quality.

**URBAN WATER SUPPLY RESEARCH**

Geographical research on urban water issues has been less emphasized in the literature than studies on the geography of floods, wetlands and groundwater depletion, and policy issues at regional and watershed scales.\textsuperscript{54} Gilbert and Anne White and David Bradley pioneered ethnographic research on community water supplies in the 1960s. Their work at both the community and household levels assessed water-related illnesses and related findings to water supply improvement projects. They conducted a case study in three East African countries (Kenya, Tanzania, and Uganda) and addressed questions such as: What are the effects of water on work productivity and community well being? How do people respond to water-source improvements and developments? What are the social costs of water used in households? What is the relationship between water quality, water-related illness infection rates and range of choice of water sources?\textsuperscript{55} Other important studies emerged from this tradition. In 2001, a follow-up study on *Drawers of Water* was published by Thompson et al.\textsuperscript{56}

Ridgley worked on water supply and sanitation issues in Cali, Colombia, in the wake of urbanization pressures. Urbanization necessitates planning, and without it water


\textsuperscript{54} J. L. Wescoat, "Water Resources."

\textsuperscript{55} White.

supply and sanitation problems often result. He evaluated alternative technologies that could provide these basic services on an urban scale and examined cost and other challenges in order to formulate urban planning and policy making.\textsuperscript{57} Urban planning and water demand management have been studied extensively by Baumann et al.\textsuperscript{58} Developing planning and water management strategies has been essential in resolving complex municipal water issues.

Swyngedouw’s work added a strong component of political ecology to urban water issues and development. He looked at how the political climate historically has impacted the urbanization of Guayaquil, Ecuador, and how that related to the development of the water supply system. The political and historical contexts helped explain why thirty-six percent of the two million residents have had no water and how this has translated into an ongoing social struggle for potable water. Hundreds of thousands of residents in Guayaquil relied on private vendors for water and the prices were up to 400 times greater than from the city system.\textsuperscript{59} He employed a similar theoretical framework in his research on water supply in Spain.\textsuperscript{60}

Also on the theme of water distribution inequity, Reweta and Sampath detailed how residents in subpopulations in Dar Es Salaam, Tanzania, were not given access to clean, safe water. They forecasted this trend to worsen.\textsuperscript{61} Other work by Reweta and Sampath focused on development issues. They argued for the importance of maintaining an urban water supply for residents in order to minimize time spent fetching and boiling water. If development is to occur and economies are to strengthen, people must be available to engage in development activities and spend time engaged in generating


Very recently, Daniel Buor addressed health issues and drinking water needs in Kumasi, Ghana, a city with more than 2.5 million residents. The metropolitan areas are sourced by piped water from reservoirs. It is treated for chemical, physical, and microbial contamination. The municipality is nearly thirty percent short of meeting water demands because it relies on outdated, inefficient pumps. Water is also piped from streams and hand-dug wells in and around the city, and it is completely unfit for human consumption. On the city periphery are wells and boreholes used by residents that are left untreated.

Because people's choices were limited, they took water from inferior sources. Buor found that during periods of water scarcity, women’s health was influenced by income, water quality, and hours spent fetching water. Interestingly, people from both the core and periphery areas were at greater health risk at times of scarcity. If the treated water was not available in the city core, people had to resort to alternatives. They had to spend more time fetching water and therefore suffered from greater health risks. Spatially, water quality and health risks were illustrated.\footnote{Buor.}

The context of water supply issues in the former Soviet Union, however, is unique due to abrupt political and economic collapse. There were substantive concerns about infrastructure, service delivery, and public health issues in a post-Soviet context found in the literature. In the remainder of this chapter, I review findings of two papers that are empirically and theoretically relevant to the study presented here. They include water shortages in Bulgaria and problems with the distribution system in Moscow.

Water consumption was excessive during the Soviet period and water was nearly free. High maintenance of water infrastructure and issuing expensive water tariffs are tactics that increase water conservation. People paid nominal water tariffs and cities maintained water supply infrastructure in the Soviet era. Prior to the Soviet collapse, residents of Bulgaria had access to an adequate supply of high quality potable water. But
after the 1989 collapse, Bulgarian cities have faced water shortages and had to ration water because of recent periods of drought, leaky infrastructure, and ineffective water meters. Poor water planning may also play a role in water shortages. Continued drought may cause severe shortages in cities such as Sophia and water conservation strategies must be established.64

A paper on Moscow’s water system distribution network was published in the *Journal of Water Supply* in 2005. People of Moscow are suffering from the Soviet legacy of poor construction and maintenance and now suffer from a decline in water quality, reduced supply efficiency, poor infrastructure, and increased maintenance costs. Most of the system was constructed with uncoated, corrosive, steel pipes that last just over thirty years. This was the case in most former Soviet republics. The former republics currently experience the highest pipe failure rates in the world. Moscow has the largest distribution network in Europe and 150,000 kilometers of water and sewage pipe are in need of replacement. Each year there are 10,000 breaks in the system. Municipalities in the former Soviet republics including Moscow no longer have the revenue for water system maintenance and repair. Without the resources to construct new systems, Stanislav, Khramenkov and Oleg stressed the importance of maintaining and repairing operational, existing structures to improve quality and meet the demand.65 This research conducted in former Soviet States expands our understanding of urban water issues in a variety of contexts.

**SUMMARY**

The purpose of this chapter was to review the literature on water resource geography and meld this study within the conceptual framework of water supply problems. Economies of communities in mountainous regions are transitioning. Factors such as growing human populations and changing land use patterns are contributing to water supply problems. These factors also threaten watersheds, water quality, potable water delivery, and public health.

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The loss of government subsidies and centralized management has been catastrophic for many sectors of countries of the former Soviet Union. Much work has been done on how the collapse of the former Soviet Union in the 1990s has adversely impacted the economy and irrigation networks. However, few studies have addressed urban water issues in Central Asia and mountain environments.

Urban water supply studies are deeply rooted in geography and recent research has emphasized marginalization, price inequity, water quality, illness perception, and public health. Factors such as water handling practices, time spent fetching water, distance to drinking water sources, condition of water supply infrastructure, poor water quality, and illness perception affect disease infection rates. Without centralized, treated water, residents' range of choice is limited. Inferior, contaminated water sources are used when municipalities cannot meet the demand for clean water.

The United Nations, non-governmental organizations (NGOs), and communities are addressing these problems because they inhibit development and cause high mortality rates. To resolve water supply issues and create durable management strategies, water managers and policy makers must incorporate the concerns of those who make household water decisions into projects and policy.
CHAPTER 3
THE RESEARCH SETTING: NARYN, KYRGYZSTAN

СУУ БАШЫ МӨЛТҮР БҮЛАК
The water’s beginning is a beautiful spring.
Kyrgyz Proverb

This study was conducted in Naryn, Kyrgyzstan. Naryn is located in the southeast of the country and approximately 200 kilometers southeast of Bishkek. The population of Naryn is about 42,000. Naryn is isolated in the Tien Shan and tribal, semi-nomadic cultures persist in the region. But interestingly, the city is relatively modern with basic infrastructure such as paved streets, a centralized water supply, telecommunications, electricity, and multi-level homes, businesses, and government offices. The infrastructure in Naryn, however, is crumbling and revenue for maintenance is in short supply.

Independence for Kyrgyzstan meant the country and local governments had to assume control of and finance important sectors such as water supply and public health, but without proper management training and experience and government subsidies, infrastructure has deteriorated. Other factors such as tribalism and corruption have also contributed to the erosion of basic systems and even democratic institutions, but their analysis is not within the scope of this research.

To rise from a collapsed government and economy, Kyrgyzstan has been open to foreign influence. At the local level, the City of Great Falls, Montana mentored the City of Naryn as part of a technical exchange program to develop city planning strategies in order to repair the water supply system. Furthermore, the World Bank began collaborating with the City of Naryn in 2004 and has agreed to assist Naryn make major, costly improvements to the water supply and other city infrastructure.

GEOGRAPHY OF KYRGYZSTAN AND NARYN

Kyrgyzstan is one of the five Central Asian Republics along with Turkmenistan, Tajikistan, Uzbekistan, and Kazakhstan located between the Caspian Sea and China. Four countries border Kyrgyzstan: China to the east, Kazakhstan to the north, Uzbekistan to the west, and Tajikistan to the south. Slightly smaller than the state of South Dakota, Kyrgyzstan occupies only 199,000 km² of land area.

The Tien Shan Mountains dominate Kyrgyzstan’s landscape. More than ninety-four percent of its land mass is above 1,000 meters and forty percent of its elevation is over 2,000 meters. Many peaks in mountain ranges such as the At-Bashi Range in southern Kyrgyzstan are over 5,000 meters. Peak Pobeda, Kyrgyzstan’s highest peak at 7,439 meters, is situated on the far eastern border with China.

The climate in Kyrgyzstan is generally continental and sunny, some areas average eight hours of sun per day. In the lowlands, the average January temperature is -5°C, but in mountain valleys such as Naryn, it averages a bitter -30°C or even lower. Naryn is known as the coldest town in Kyrgyzstan. In July and August, the average temperature ranges from 26 – 30°C for elevations between 800 – 1,700 meters. Rainfall normally comes in April, May, and June, and runoff from snowmelt also peaks in this period. The mountains harbor numerous glaciers and receive large quantities of snow. Annual precipitation in the mountains east of Osh, in southeast Kyrgyzstan, averages 1,000 millimeters. The lowlands receive very little precipitation, yet the rivers which drain the Tien Shan deliver abundant water for various uses. The Naryn River primarily feeds the Syr Darya, a crucial source of irrigation water for agricultural areas in the Fergana Valley, Uzbekistan, and Kazakhstan. Some regions receive less than 100 mm of precipitation per year. Naryn receives approximately 300 mm of annual precipitation.

Kyrgyzstan’s population consists mostly of Kyrgyz, Russians, and Uzbeks. Prior to Russian occupation, which began in the 1860s, the people of this region were primarily

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67 UNDP, Human Development in Mountain Regions of Kyrgyzstan, United Nations Development Program in Kyrgyzstan, National Center for Mountain Regions Development in the Kyrgyz Republic (United Nations Development Program, 2002).

68 R. Stewart and S. Weldon, Kyrgyzstan, First ed. (Hong Kong: Airphoto Ltd., 2002).
Kyrgyz. The mountain landscapes are largely utilized by ethnic Kyrgyz and are dotted with yurts, goats, cattle, sheep, and yaks. Camels are seldom seen in the country.

Most Uzbeks in Kyrgyzstan live near the border of Uzbekistan along the margins of the Fergana Valley and in several Uzbek enclaves in Batken Oblast in southwest Kyrgyzstan. Russians, on the other hand, live mostly in urban areas. Naryn is considered a town or small city in Kyrgyzstan and its ethnic makeup is Kyrgyz.

Numerous languages are spoken in Kyrgyzstan, but the primary languages are Russian and Kyrgyz. Kyrgyz is a Turkic language and tends to be spoken more in rural areas. Russian is the dominant language in urban centers such as Bishkek and is strongly affiliated with business and professional work. In Naryn, interestingly, the Russian population is very low, yet both languages are spoken and often hybridized. All Kyrgyz in Naryn speak their native tongue, but in Bishkek they may only speak Russian. Kyrgyz formerly used the Arabic script, but the Soviets adopted and changed the script of both languages to Cyrillic. Just across the border in Xinjiang, China, the Uighur people continue to use Arabic.\(^{69}\)

A very strong, traditional mountain culture persists in Kyrgyzstan. The Kyrgyz have a strong connection to the land and mountains. Each summer many families move from the villages to high, verdant mountain pastures with their livestock. In these remote areas, there are no faucets or hydrants; people take water from mountain streams and springs as they have for centuries. These semi-nomadic Kyrgyz live in yurts and spend long days on horseback. The horse is an integral part of these mountain societies. The significance of the horse is exhibited in this Kyrgyz proverb, "If you have one day to live, spend half of it in the saddle."

Remote mountain areas where yurts are the primary mode of housing are referred to as the jailo. The jailo is an important vacation destination for city-dwelling Kyrgyz and an avenue through which they can maintain their culture. Kyrgyz culture continues to thrive in the jailo. Both vacationers and mountain residents engage in traditional Kyrgyz culture: horseback riding, drinking kimiz (mare’s milk fermented in a smoked goat skin), creating beautiful felt rugs, constructing yurts, playing traditional musical

\(^{69}\) Ibid.
instruments, and singing traditional mountain songs with contagious vigor. The City of Naryn is surrounded by the jailo and these semi-nomadic communities.

The City of Naryn is remotely located in southeast Kyrgyzstan and situated in the Naryn River Valley (Figure 3.1). It sprawls for sixteen kilometers along the Naryn River. The Terskey Range lies to the north and the Naryn Mountains rise abruptly to the south to over 3,600 meters. The elevation of Naryn is 2,060 meters.

The City of Naryn began as a military fort in 1868 as Russians infiltrated the Tien Shan. The area was remote and the fort maintained postal communications and conducted military operations. Access to the fort was by a road utilized by horse-drawn carts.\textsuperscript{70} Naryn continued to be an important strategic location for the Soviet military because of its location relative to China, Pakistan, and Afghanistan. The city expanded throughout the Soviet period and became the administrative center for the oblast. There is very little industry in Naryn and the economy relies heavily on agriculture and the military base. The economic crisis in Naryn is directly related to its isolation and the fact that it has always been a military town with few other developments.

**POST-SOVIET CONTEXT**

Much like other cities in the country, Naryn is facing significant economic and social challenges that are rooted in Kyrgyzstan's political history. Kyrgyzstan was formerly part of Turkistan and did not become a nation-state until 1922.\textsuperscript{71} Because of the extreme terrain of the Tien Shan, tribes developed over centuries in major valleys isolated by mountain ranges. The concept of a nation-state was foreign and political and social

\begin{footnotesize}
\footnotetext{70} Lev Feofilovich Kostenko (1841-1891), *The Turkistan Region Being a Military Statistical Review of the Turkistan Military District of Russia, or, Russian-Turkistan Gazetteer* (Simla: Government Central Branch Press, 1882-1884).

\end{footnotesize}
Figure 3.1. City of Naryn, Kyrgyzstan
relations did not extend beyond the family, clan, and tribe.\textsuperscript{72} Political agendas were clan-based.\textsuperscript{73} Land tenure, water rights, and leadership varied with the strength of the tribes.\textsuperscript{74} Huskey asserts that the Naryn Valley was the most isolated and therefore the Kyrgyz of that region adhere to the most traditional, tribal principles.\textsuperscript{75} After centuries of nomadic, tribal culture, life changed for the Kyrgyz when the Russians established a permanent garrison on the shore of Lake Issyk-Kul in 1864 and tribes pledged allegiance to the czar.\textsuperscript{76}

The Russians conquered Central Asia to capitalize on abundant resources with which to supply the growing empire. Before the American Civil War, Russia imported cotton from the United States. Cotton imports were halted during the war and Russia conquered Central Asia largely to meet its increasing demand for cotton.\textsuperscript{77} Other agricultural products such as grain and livestock were also important resources for the empire. The empire, however, lost power in 1917.

In 1917, the Soviets defeated the Russian Empire and divided Central Asia into nation-states. Kyrgyzstan was an autonomous republic in 1922, but in 1936 it became a Soviet-ruled republic. For decades the communist central government in Moscow dictated social organization and government policy to isolated villages such as Naryn until Soviet collapse in 1991. This rigid and top-down ruling regime has left a legacy of apathy and inadequate leadership, management, and planning skills in the new government.

The new government which began in 1991 under the leadership of Askar Akaev embarked on a process of democratization and capitalist economic reform. Kyrgyzstan's

\begin{itemize}
\item \textsuperscript{73} Kuchukeeva.
\item \textsuperscript{74} R. A. Pierce, \textit{Russian Central Asia 1867-1917: A Study in Colonial Rule} (Berkeley: University of California Press, 1960).
\item \textsuperscript{75} Huskey.
\item \textsuperscript{76} Matley.
\item \textsuperscript{77} Ibid.
\end{itemize}
democratic leadership and economic policies have made the country accessible and appealing to foreign investors and international development institutions. Strong international partnerships have been formed with Kyrgyzstan in an effort to build political and socio-economic stability.\footnote{K. Watters, “Environmental NGOs and the Development of Civil Society in Central Asia,” in \textit{Civil Society in Central Asia}, ed. M. H. Ruffin and D. C. Waugh (Seattle: University of Washington Press, 1999).}

In order to build the economy and generate revenue, Kyrgyzstan has embarked on the path of globalization. Multinational corporations have invested in the economy, especially in the capital. Bishkek is emerging as a global city and is becoming attractive for tourism. For example, the demand for Coca-Cola®, franchises, global products, foreign institutes of education, shopping malls, internet cafés and foreign music is growing. Due to the growth in Bishkek, people from rural areas migrate to the capital for greater job opportunities.

Other foreign influence and assistance have permeated Kyrgyzstan through programs with the United States, NATO (North Atlantic Treaty Organization), and international NGOs. The United States Army Corps of Engineers constructed Manas Air Force Base near Bishkek. The United States Department of Defense conducts military operations from Manas Air Force Base to aid with security in the region. Following, USAID has funded and continues to fund dozens of projects with a broad range of objectives.\footnote{Ibid.} Kyrgyzstan became a member of NATO and its Partnership for Peace program. Together they have worked toward increasing stability and strengthening security. International NGOs that have assisted Kyrgyzstan include the Asian Development Bank, the World Bank, the United Nations Development Program, and the Department for International Development.

In the mid-1990s, Kyrgyzstan adopted the Law on Local Self Government and Local State Administration to initiate the process of delegating authority to local-self governments (LSGs). Although Kyrgyzstan has received numerous forms of assistance from organizations and multinationals to aid its transition to democracy and capitalism,
political instability, corruption, and the challenges of decentralization have been limiting.\textsuperscript{80}

**DECLINING INFRASTRUCTURE AND SERVICES**

Kyrgyz towns were endowed with infrastructure and utilities by the state during the Soviet period. Residents paid nominal fees or received non-wage benefits for those services.\textsuperscript{81} After the dissolution of the Soviet Union in 1991, Soviet subsidies were lost, the industrial sector collapsed, and municipal infrastructure services plummeted.\textsuperscript{82}

This collapse is reflected in the economic indicators for the country. In 2003 the gross domestic product (GDP) per capita was less than $400, making it one of the lowest in Central Asia. Poverty is rampant in Kyrgyzstan. In 2003 forty-one percent of the population lived below the poverty line.\textsuperscript{83} Furthermore, poverty is the most extreme in Naryn Oblast. From 1997 to 2000, over eighty percent of the population of Naryn Oblast lived below the poverty line.\textsuperscript{84} The collapsing economy has brought in its wake a loss of qualified water managers and basic urban infrastructure maintenance.\textsuperscript{85}

A lack of municipal revenue and poor leadership has taken a toll on water supplies. LSGs have been unable to follow the decentralization legislation because Kyrgyz administrators have had no previous experience devising and executing democratic policy. The Kyrgyz had never governed as a democratic nation because rule was tribal prior to Russian occupation and they lived under Soviet control thereafter until independence.\textsuperscript{86} While under state control, management and maintenance issues were

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\textsuperscript{80} In 2005 Askar Akaev, the first president of Kyrgyzstan, 1991-2005, was ousted.

\textsuperscript{81} A retired man in Naryn with an indoor faucet paid less than 0.40 USD per year for water service during the Soviet period.

\textsuperscript{82} World Bank, *Small Towns Infrastructure and Capacity Building Project* (World Bank, 2004).

\textsuperscript{83} Ibid.


\textsuperscript{85} O'Hara, "Lessons from the Past: Water Management in Central Asia."

\textsuperscript{86} World Bank.
resolved by the central government. Kyrgyz officials were unprepared to assume management and maintenance responsibility for the water systems. More importantly, since 1991 a lack of government funds crippled maintenance programs and rapid system deteriorations resulted.

Years of neglect and poor construction have led to severely deteriorated systems which are overdue for replacement. Service delivery is unacceptable and is the primary concern of residents. Because of decades of piped drinking water provided by the Soviets, Kyrgyz have come to expect such modern services. The following testimony from an elderly Kyrgyz man illustrates this point:

"Water pipes were constructed seventeen years ago [during the Soviet period] and water used to flow through them. But having lasted for eleven years the system broke, the pipe cracked, and there has been no more water for six years."

These problems are evident throughout Kyrgyzstan. For example, the water distribution system in Bishkek is crumbling. There are 1,100 kilometers of water pipes in the city network, 200 kilometers of which are in need of replacement, but only 4 kilometers are replaced each year. At that rate, Bishkek's pipes would be in use for 275 years. Modern cities aim for less than 100 years for pipe replacement. The breakdown of water supply infrastructure and shortage of clean water is an economic, social, cultural, and political problem. Many argue that measures must be taken to halt further degradation of basic infrastructure.

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87 UNDP, Human Development in Mountain Regions of Kyrgyzstan.

88 O'Hara, "Lessons from the Past: Water Management in Central Asia."

89 Ibid.


91 UNDP, Human Development in Mountain Regions of Kyrgyzstan.


Rural mountain areas face additional concerns. Seventy-seven percent of the families surveyed in mountain villages in Naryn Oblast used water from springs, rivers, or irrigation ditches as their primary sources; ninety-four percent in Osh Oblast.\(^{94}\) Figure 3.2 compares water-source types to elevation zones (high, 2000-3500 meters; mid, 900-2200 meters; low, 500-1200 meters). This graph illustrates that hydrants are the chief water access point for people. Fewest people rely on wells and springs for drinking water. Centralized water systems are most likely to be developed in lower elevation areas, but Naryn (elevation 2,060 meters) has one. Only for high, mountain areas were rivers and irrigation ditches more common than centralized water systems. Wells are also utilized but are reliant on electric pumps. Electricity is unreliable due to outdated structures and a disintegrating centralized system.\(^{95}\) Further compounding the issue of unreliable electricity, people remove copper from electric structures and sell it as salvage to China.\(^{96}\) Poverty in Kyrgyzstan has broad and harsh implications and provision of potable water cannot be taken for granted. Health problems have emerged as a result of an inadequate potable water supply.\(^{97}\)

TECHNICAL EXCHANGE PROGRAM: NARYN AND GREAT FALLS, MONTANA

As a potential result of foreign influence and globalization in Kyrgyzstan, local governments in places such as Naryn, have recently been establishing planning strategies and seeking revenue to support municipal programs and services. The City of Naryn has been assisted by the City of Great Falls, Montana, International City Managers Association (ICMA), the Urban Institute, and the World Bank.

\(^{94}\) UNDP, *Human Development in Mountain Regions of Kyrgyzstan.*

\(^{95}\) Ibid.


\(^{97}\) World Bank, *Small Towns Infrastructure and Capacity Building Project.*
Initial contact between Montana and Kyrgyzstan occurred when the Montana Army National Guard instigated a natural hazard training program in Kyrgyzstan in the 1990s. An ICMA administered, technical exchange program between the cities of Naryn and Great Falls grew out of this. The USAID funded partnership continued from 1999 through 2004. The objectives of the exchange were to improve water supply, wastewater treatment, sanitation, public education processes, and local self-government efficacy. In order to improve the above listed municipal services, delegations were sent to Naryn and Great Falls to exchange information, collect and share data, and devise planning strategies. The delegations toured city facilities, held meetings, devised planning objectives, wrote reports, and developed the Water and Wastewater Master Plan for the City of Naryn. The planning objectives and trainings were essential in applying for grant applications for infrastructure improvements. This program has attracted the attention of other donors, namely the World Bank, and initiated other water supply interventions.

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98 UNDP, *Human Development in Mountain Regions of Kyrgyzstan*. 

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The World Bank involvement is monumental for Naryn because of the extreme condition of the water system that will cost millions of dollars to repair. The poverty of Naryn residents limits the amount of revenue that could be generated through water tariffs. Naryn needs a substantial capital investment to begin to make significant improvements to the system and become self-sufficient in providing clean, reliable drinking water to the residents. Chapter five deals with the water system and the Urban Institute and World Bank interventions more directly.

SUMMARY

The collapse of the Soviet Union has impaired the ability of municipalities to provide quality water supply to people. Many communities continue to rely on springs and irrigation canals for drinking water. As Kyrgyzstan enters the global arena, development and land use will increase, with implications for watershed integrity, water quality, and so forth. Historically, Kyrgyz took clean, running water for granted, but without political and economic stability and foreign investment in a modernizing Kyrgyzstan, water supplies are expected to continue to decline.

Foreign influence in Kyrgyzstan has grown since 1991. International organizations have been aiding the country transition to a democracy. Furthermore, development agencies have provided funding to cities and rural communities for projects. For example, the City of Great Falls, Montana, USAID, the Urban Institute, and the World Bank have assisted the City of Naryn in achieving city planning goals and better meeting the basic water needs of the residents.

In this study, I investigate the complex changes people face in Naryn as they relate to the topics of infrastructure condition, water quality, and public health. I employ a case-study approach to identify issues from residential, official, and expert perspectives.
CHAPTER 4
METHODS AND DATA SOURCES

ТАЗА БОЛОН СУУ БОЛ БААРЫН КЕТИРГЕН, ООР БОЛСОН ЖЕРДЕ БОЛ БААРЫН ЧЫДАП КӨТӨРГӨН.
If you think you are clean, be like the water which can wash everything. If you think you
are heavy, be like the earth which holds everything.

Kyrgyz Proverb

In this case study, I investigated issues related to drinking water at municipal and
household levels in Naryn, Kyrgyzstan. I utilized multiple qualitative research
techniques and drew upon numerous data sources in this research.99 This research began
in February 2004 by interviewing city and water officials from Great Falls about Naryn’s
water supply and challenges Naryn faces in meeting the basic needs of residents. The
field research was conducted in Naryn from June to August 2004. The intent of this
research was to supplement water planning efforts in Naryn. These findings can be
integrated for improving water service for residents who do not have access to reliable,
clean water.

Geographers have applied qualitative techniques to studies on local water and
public health issues to capture people’s experiences and perceptions of problems for
decades. In remote regions of developing countries, data can be limited on water quality,
water supply condition, public health, and management strategies. In the case of Naryn,
data were very limited. However, the experiences of the officials of Great Falls through
the city exchange program with Naryn were crucial in gaining a general, preliminary
understanding of infrastructure problems in Naryn.

Not only are there limited data in remote regions, but language barriers can inhibit research. People in Naryn speak Kyrgyz and some Russian. To overcome language

barriers, I employed two Kyrgyz field assistants to translate the interviews into English. Both studied English at Naryn State University. Mirlan translated the interviews with officials and Chyngyz independently conducted the interviews with residents.

This chapter is organized into the following sections: entrance into the research setting, methods and data sources, data quality, and ethical issues. The data presented in this study were obtained through semi-structured interviews with officials, experts, and residents of Naryn, water sector and public health documents and field observation. I utilized a variety of methods to capture a comprehensive view of issues related to the water system.

ENTRANCE INTO THE RESEARCH SETTING

There were minimal issues I had to confront prior to entering the research settings in Great Falls and Naryn. I initially called the Director of Public Works in Great Falls and introduced myself and my study and asked if he was willing to assist. Immediately and openly, I was invited to visit his department, attend meetings with a Kyrgyz delegation, and meet other city administrators involved in the Kyrgyz Water Project. The Americans as well as the Kyrgyz received me very well. Naryn’s water department presented me with copies of data and reports upon request. During my second visit to Great Falls I met with all involved personnel and was offered access to all files, maps, and pictures from the project. The Great Falls and Naryn counterparts welcomed my collaboration and provided me critical feedback on the study design.

Prior to my arrival in Naryn, I had been introduced to the water department accountant, Vice-Mayor of Naryn, Chairman of Condominia\(^\text{100}\), and Rector of Naryn State University. They took an interest in the study and offered to assist when I arrived in Naryn. Almaz Akmataliev, Rector of Naryn State University and former mayor of Naryn and Vice-Governor of Naryn Oblast assisted in many ways. Naryn State University and The University of Montana are institutional partners. In the 2003-2004 school year, Almaz was a Fulbright scholar at The University of Montana. He and his wife Jurgal

\(^{100}\) The Chairman of Condominia was involved in implementing water metering systems and a water education program in Naryn.
hosted me while in Naryn. Almaz also helped to arrange interviews with city officials in Naryn.

Naryn State University was an invaluable resource in this research. Almaz provided me with an office in International Programs. Also conveniently based in International Programs were several Peace Corps volunteers who assisted with translation. Further contributing to my smooth transition to life and research in Naryn were numerous enthusiastic students of the English program. They were very eager to practice their language skills and assist me in my research. My two field assistants were the most competent English students at the university. We never encountered difficulty in communicating on a multitude of topics.

Entering the research setting and conducting qualitative research in Naryn was very efficient. I was received very well by both residents and officials and formed friendships immediately. All interviewees, male and female, with the exception of the pharmacists seemed interested in being interviewed initially and agreed to interview right away. Kyrgyz were very accessible and willing to participate in this research. Many people were excited to hear I was from Montana because they were aware that the City of Great Falls was the sister city of Naryn. People of Naryn believed and/or hoped the outcomes of my project would bring good things to their city. The accessibility of participants may have been due to several additional factors: the importance of drinking water to people; the apolitical nature of the topic; the efforts to be frank with participants; and a cultural practice of assisting each other when needed. However, people’s enthusiasm was less during follow-up interviews.

METHODS AND DATA SOURCES

The field research conducted in the summer of 2004 consisted of three components: interviews with officials and experts, resident interviews, and field observations. By gathering information from a range of stakeholders, I was able to compare perspectives and formulate a comprehensive list of issues. Data from interviews with officials were instrumental in describing the water system and its management,

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101 Some transportation and all meals and lodging were provided while in Naryn from June to August 2004.
water quality testing, and public health concerns. Resident interviews contributed to an understanding of how people in Naryn relate to water and issues associated with the different water sources and systems and respond to the problems.

The data sources of this study include: water sector documents, field observations, interviews with officials from the water sector, interviews with health and scientific officials and experts (medical doctor, pharmacists, chemists, and microbiologist), residents, and spatial analysis.

**Water Sector & Health Documents**

I searched multiple resources for reports and documentation. I received invaluable water sector data from Great Falls. The Public Works department of Great Falls compiled a report, *Water and Wastewater Master Plan*, on the technical exchange program from 1999 to 2004 between city and water officials of Great Falls and Naryn. The “Master Plan” described the water systems in Naryn from a management perspective. The “Master Plan” also included maps of the water mains and chemical analyses of the city spring and well water sources. Additionally, other reports, pictures, and maps were provided by Great Falls. These materials provided a rich background on the topic and the baseline data for the research. Furthermore, the Naryn Water Department also provided important documents, budget reports, tariff schedules, and accounts payable, for use in this research.

I also attempted to acquire water quality data from the Department of Sanitation and Epidemiology (DSE) in Naryn and public health records from several hospitals in Naryn and the Ministry of Health in Bishkek. I attained data from DSE and infectious disease hospital, but unfortunately, they were not adequate for an extensive, quantitative assessment of water quality, waterborne disease, and public health issues of Naryn. I received only data from the last sampling period in March 2004 from DSE. The hospital had infectious disease records from 2002 and 2003; however, medical personnel suggested there was a high degree of inaccuracy in those records. This inaccuracy stems from the fact that people do not come to the hospital with water-related illnesses unless the illnesses and symptoms are severe and even then they might not seek treatment from a hospital. The Ministry of Health did not have health records for Naryn. In future
studies, I would suggest developing closer relationships with those holding potential records and build a foundation of trust before inquiring about water quality and disease statistics. It is crucial to be sensitive to trust and data mishandling issues.

**Interviews with Officials and Experts**

The goal of these interviews was to get a professional perspective on water issues in Naryn ranging from water system analysis, water quality, and public health, to water supply management. Interviews of “officials and experts” included all primary persons involved in the Naryn Water Project and persons with significant experience and professional knowledge of Naryn’s water systems and issues and water-related public health issues (total = 18). Interviewees sometimes directed me to other more qualified persons. Documentation on water issues and Naryn’s water systems was limited, and therefore, the interviews with officials were the backbone of my project. Interviews were conducted with the following Great Falls officials: City Manager, Director of Public Works and Water Chemist. While in Naryn I conducted interviews with the following individuals: representatives of local NGOs and the Ministry of Health (Bishkek); Chief Engineer, Director, and Head Accountant of the water department; Mayor of Naryn; pharmacists; and public health and water quality experts. It was crucial to compare these interviews to those of residents in order to corroborate data. Interviews lasted from 30-60 minutes and were tape-recorded. Attachment 1 includes the interview questions.

People in Kyrgyzstan often go to pharmacies (*apteka*) for medications and advice when they are stricken with illness rather than consult medical doctors. This may be due to two primary reasons: doctor prescriptions are not needed for many medications and the cost of medical consultation is prohibitive for many impoverished Kyrgyz. An investigation of water-related illnesses through extensive pharmacist interviews was attempted. However, this investigation was largely unsuccessful, in part, because only three pharmacists participated in an interview. My Kyrgyz assistant who conducted the interviews stated that most pharmacists asked for an interview were scared about being involved in this research and did not want to risk their jobs or upset the business owners.
Resident Interviews

The goal of the resident interviews was to learn about water system issues from a resident perspective and to gain rich insight into water handling behavior and perceived risk of water-related illnesses. I analyzed the qualitative data spatially with the aim of identifying contaminated water sources and regions with marginal water service.

My field assistant and I interviewed thirty-eight residents from all areas of Naryn, thirty-one women and eight men. Since Kyrgyzstan is a Muslim country, there was concern about the gender of the researcher/investigator (both male), but we found women and men alike to be interested in participating in the research.102

Women were more often at home than men during the daytime interviews, which was reflected by the greater percentage of female participants in the study. Women normally fetch water and are the primary handlers of water in the home, and therefore experience water quality and perceive water-related health risks differently than men. Women usually boil water for tea and prepare beverages to be served with meals, but Kyrgyz men rarely engage in such activities.

The ages of the residents interviewed ranged from early twenties to seventy. Most were between the ages of thirty and sixty. Their occupations varied and included doctors, nurses, pharmacists, teachers, and librarians. However, many were unemployed and tended to daily household activities. All residents interviewed had a high school education; those employed in a professional capacity had advanced degrees.

The thirty-eight resident locations were selected through stratified random sampling of households in Naryn, see Figure 4. Participants were interviewed at or near their homes. Naryn, a city sixteen kilometers in length, lies in a long mountain valley along the Naryn River; it is oriented form east to west. Within this river basin, locations of the residents varied greatly. Some lived near the river, near the mountains, near the city perimeter, near springs, near city water sources, and far from city water sources. Because of Naryn's diverse geography and complex water problems, a spread of sample locations was crucial. These tape-recorded interviews lasted from 20-45 minutes.

I began each interview by giving an introduction to the study and asking people for their voluntary participation. To capture the regular experiences people had with water, I began with, “Tell me about the water in Naryn.” I wanted the participants to tell me about the issue(s) most on their mind. After they had a chance to discuss any primary issues or thoughts about water in Naryn, I asked about several specifics ranging from boiling water, water-related illnesses, and water and health education. My goal was to investigate where people lived, the water sources they used, and particular issues associated with those locations (see Attachment 2).

The second half of each interview included questions about rights to clean water, agencies responsible for water provision, changes since the Soviet period, and recommendations for improvement. With these data I was able to obtain a deeper understanding of how residents confronted the water issues discussed in the first half of the interviews. This approach was grounded in the belief that local people have important knowledge and ideas to share and that these insights can be applied to city water management.

Thirty-eight residents of Naryn do not represent the entire population of 42,000. Ideally, sampling would be representative, but time and budget constraints did not allow for more extensive investigation. The objective of this method, however, was to interview people who used various water sources throughout Naryn to attain a
comprehensive perspective of water problems and a general understanding of water handling behavior and perceived risk of water-related illnesses.

Field Observations

While living and working in Naryn for two months during the summer of 2004, I gathered data through field observations. Field observations were an important data source because I was able to record information on infrastructure condition and water handling behavior not achieved through the other research methods. I observed water handling behavior in three settings: while residing with a Kyrgyz family in a home with running water, during resident interviews when I was invited into people’s homes, and near community hydrants when walking through residential areas of Naryn. The majority of residents rely on outdoor community hydrants. Also while in people’s homes, I observed the type of household water connection. Most homes did not have faucets, one had a garden spigot, and those near the city center were more likely to have indoor faucets than homes distant from the city center. Additionally, when using water in homes of friends and colleagues I observed particulates in water from faucets. These residents who were not interviewed provided additional perspectives about water quality.

By participating in cultural events and festivals and attending social gatherings in Naryn, I formed relationships with many local Kyrgyz and American Peace Corps volunteers and discussed issues residents of Naryn face in an informal setting. These conversations and interactions provided important information about socio-economic and political challenges residents are confronted with in Naryn. The people whom I formed relationships with guided me around Naryn, introduced me to others, and helped guide me while making field assessments of water system infrastructure.

I conducted a survey of water hydrants in all regions of Naryn to document their physical condition. My assistant and I rode bicycles on all streets of Naryn to locate hydrants and also asked local residents where we could find the nearest hydrant. I recorded the location of the hydrants with a GPS and the corresponding condition in a field notebook. The GPS data were brought into a GIS. We located all springs through the same method. All hydrants and springs were photographed. In addition to recording
hydrant locations while touring Naryn, I observed water fetching behavior of people at hydrants.

I also toured the main city water source areas with the senior water department engineer and my interpreter. I explored the water catchment area of Ak-Bechel and photographed the head works facilities. I also toured and photographed the well facilities. It was important to be able to ask the water department engineer questions while observing facilities. Field observation was an integral component in the development of a complete understanding of water systems, life, culture, and economy in Naryn.

Spatial Analysis

I used ArcGIS® 9.1 to organize spatial data and generate the maps in this thesis. Great Falls Public Works Department gave me an AutoCAD® map of Naryn and the water mains. I used that as a base map and I layered data collected with a Garmin® 12 GPS. Data were catalogued with Waypoint+® 1.8.03 software and later transferred into ArcGIS® with a Garmin GPS extension made by the Minnesota Department of Natural Resources. All maps are unprojected and in geographical coordinates.

Qualitative data were brought into the GIS via the attribute tables of resident and hydrant locations. Fields were inserted and coded responses from interviews and field observations were recorded. Modifying the attribute table of the GPS layers proved to be a very successful and convenient means of mapping qualitative interview data.

DATA QUALITY

Prior to the inception of the fieldwork, I tested the interview schedule with two male university students and a middle-aged woman who had a career as a librarian. The initial interview demonstrated the need for interview question revision. Mostly, the questions had to be more general and applicable to all residents. Initially, I devised the questions to acquire detailed information about microbes, chlorine, and arsenic in water. The average resident in any location would not have the information with which to answer those questions. After I made the changes, I tested the interview on two more

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103 GPS data were collected with a minimum of four satellites.
residents, an unemployed truck driver and a retired surgeon, and found that the questions were more easily translated and pertinent to issues people faced in Naryn. The interview schedule for officials was also revised to make questions more clear and concise.

It was imperative that competent translators verified the translations in order to maintain data quality. As mentioned earlier, I required Kyrgyz field assistants to translate interviews and documents because of language barriers in Naryn. Mirlan translated the interviews with officials from Kyrgyz and Russian to English. He assisted me in all interviews with officials and experts. We both took notes and after each interview, we reviewed them and discussed the interview content a second time. The review usually lasted for thirty to forty-five minutes. This review process was very helpful in creating complete, legible notes that were ready for transcription. All interviews were transcribed into Microsoft Word® each evening. Field notes were also transcribed from the notebook to Microsoft Word® documents when time permitted.

My other field assistant, Chyngyz, conducted most of the resident interviews. Initially, we interviewed several residents together. His primary role was translator. After he became comfortable with the format and the content of the interviews, he conducted them independently. All resident interviews were tape-recorded. He translated the interviews as I transcribed them into the computer at the end of each day. This worked very well because we discussed each interview in detail as I transcribed. Therefore, the translation and transcription processes were efficient. When the grammar of the translations became challenging, I probed and discussed the material with Chyngyz. In all cases we reached a mutual understanding of the data before I transcribed them. Furthermore, I believe it was more effective to have a local Kyrgyz perform the interviews rather than take time to develop trusting relationships with the residents in order to be accepted in the research setting.¹⁰⁴

I used QSR’s NVivo® 2.0 to code and analyze my data. I coded interviews, field notes, and documents and later analyzed them for themes and key water issues. I found the software to be an excellent means of organizing the data. For example, it allowed me

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Triangulation of methods and data sources is an important, widely used technique by qualitative researchers to enhance the reliability of research data. I triangulated the professional documents, interview responses, and field observations of this study.

Regarding the spatial analysis and cartographic data, using the AutoCAD® data presented a mapping accuracy issue. ArcGIS® can convert CAD data into shapefiles. Because the CAD data were missing spatial reference data, I assigned them the same reference system as the GPS shapefiles. This presented a problem because I did not have a GIS world file to use in this process and had to resort to an inferior method, matching two points on each map. This method did not account for the projection that was digitized into the CAD data. The centers of the CAD and GPS maps did not match perfectly. Because the analysis objective was to represent general patterns and depict water sources of each resident, this slight error was acceptable. Moreover, the resident interview locations were slightly offset which obscured their exact location. The maps cannot be used to locate the interviewed residents.

ETHICAL ISSUES

The primary ethical issue I faced was protecting the anonymity of interviewees. I eliminated any names from interviews and prepared the maps so they could not be used to detect interview locations. In each informed consent we told participants about the research goals and that participation in the study was strictly voluntary and that they could discontinue the interview at anytime. Because of the reliance on people as information sources, we took extra time to explain the purpose of the study and thanked people for their participation.

The research budget did not provide recompense for participation in the study. Several people joked about "receiving money for information," but I did not want to


encourage this philosophy nor enter the dynamics of choosing or negotiating the amount or type of reward. All but three residents we invited for an interview consented immediately, one suggested coming back at a later time and two chose not to participate. All officials agreed to be interviewed. Not paying interviewees for participating in the research did not seem to be a limitation.

SUMMARY

Other geographers such as Gilbert White, Sarah Halvorson, and Daniel Buor have also employed qualitative methodologies in their research on drinking water problems, water supply, and water-related illnesses. The methodological approach of this study has proved to be an effective means of investigating water at both the urban and household scales in order to gain rich insights into Naryn’s water issues. Not only did the methodology provide a means of describing the issues, but it also provided a view into how residents of Naryn relate to water and confront the challenges of marginal water service.
CHAPTER 5
NARYN’S WATER SYSTEMS, SOURCES, AND ISSUES

Kyrgyz Proverb

The City of Naryn has confronted major financial and administrative challenges in maintaining water supply since the collapse of the Soviet Union. In this chapter I describe Naryn’s water systems, alternate water sources, and issues specific to each. With a comprehensive system analysis, the magnitude of the problems the city faces in repairing the system and the issues residents have vocalized are apparent.

Ak-Bechel is the main city water source, and I give a full description of the system from the source waters, catchment area, filter, and chlorination system to the distribution system. The other city systems are well-sourced, and the well pumps require electricity. All of Naryn’s water systems are unreliable and do not meet the regular needs of residents. Sparse and broken hydrants and unreliable sources cause people to travel long distances to fetch water. I connect system unreliability to the use of alternate water sources, springs, and the Naryn River. Residents prefer city water, but often have no choice but to use these undeveloped water sources.

This mass of water problems has created a “longing” for the former Soviet times when resident water needs were met. Because water and government officials have not resolved the water problems, but have promised marginalized residents that they will solve them, residents have begun to strongly distrust officials and are often unwilling to pay their water tariffs. Without water tariffs and government subsidies, the water department cannot perform its function of system maintenance and repair. International assistance has brought great hope to the City of Naryn. The City of Great Falls, Montana; the Urban Institute; and the World Bank have helped Naryn better administer
water supply issues and have contributed financially to make major repairs to improve water service.

WATER SYSTEMS

Approximately 30,000 of Naryn’s 42,000 residents use city, centralized water. These 30,000 residents obtain water from either an outdoor communal hydrant or an indoor faucet. All condominia have indoor faucets and 2,555 homes are directly connected to the water system, together 12,000 residents have indoor faucets. The remaining 18,000 people who use centralized water, but who do not have indoor faucets, rely on seventy-two community water hydrants or kolonkas (Russian) dispersed across Naryn. Hydrant water is from wells, runoff, and springs; all are supplied by Naryn’s four water systems. The water department estimated that 12,000 people did not have water service.

There are four separate, piped water systems in Naryn (Figure 5.1). Construction of the main system began in the 1930s and further construction and system additions took place from the late 1950s to the 1970s. Ak-Bechel is Naryn’s largest water source, and it supplies the main system in Naryn. Water from mountain springs and runoff are collected and piped down to the city. Zapadni well serves most of the people living in west Naryn. East well serves those in PTC, the eastern residential section of Naryn. And yet a smaller well on the north side of the Naryn River, Kizpiz Zabod, serves only two community hydrants. The 12,000 residents, twenty-eight percent of the community, without water service rely on alternate sources, primarily springs and the Naryn River. Those who use undeveloped sources reside near the city periphery, but several live relatively near the city center.

Ak-Bechel

Mountain spring and runoff water are collected above the City of Naryn and piped to town. This gravity-fed system supplies 1.6 million gallons of water per day to fifty-seven hydrants, numerous condominia, and some homes with outdoor spigots and/or indoor faucets independent of electricity.
Figure 5.1. Naryn's Water Systems: Hydrants, Springs and Wells
Catchment Area

The catchment area entails a seven hectare, fenced area where water is collected. It is located two miles south of the city, just off of the road to At-Bashi. Its elevation is about 250 meters higher than the valley bottom. The spring water flows all year and does not freeze in the winter. This creates a reliable source for the city. The spring water appears very clean and only runs over the surface for a short distance before entering channels that divert it underground to the filter. The largest spring produces about 4.5 million gallons/day. The runoff water does carry noticeable sediment which increases during high runoff periods.

The fenced area around the catchment is patrolled by a guardsman who lives on site. Beyond the fenced area there are livestock and wildlife that frequent the watershed. The protected catchment area does not include the entire watershed. Even the fencing is not maintained due to budget constraints and the zoning for limited access above the fencing is not enforced. There is no control of access into the upper watershed area about four kilometers above the Ak-Bechel collection system. During the fieldwork season in
the summer of 2004, the patrolled area had no disturbance by animals. Animals in the upper watershed, however, could have contaminated the water. The spring water also flows over the surface for about 100 meters before being piped underground and is prone to contamination.

Headwall

The headwall is a small dam that diverts the source water from the stream and springs underground to the filter. It prevents flooding of the filter below by diverting water around the area through a canal and past the filter. The gate shown in the picture is where the city water is collected and piped to the filter. The system was designed to handle spring peak flows based on a 100-year storm event and the total watershed area.

![Figure 5.3. New Headwall at Ak-Bechel](image)

Filter

In the up-flow filter, water enters from below and flows up through the filter. The filter material consists of large filter particles (gravel) at the bottom and small filter particles (sandy soil) at the top (Figure 5.4). This filter design was intended to filter large particulates out before fine sediments to reduce clogging. The sandy layer is supposed to remove fine sediments, but even Temerbek, head Vodokanal engineer, said it was not designed to filter this kind of spring/runoff water because the suspended sediment
particles in the water are too small for the filter. It does not work well or even at all. The influent and effluent were both turbid. The filters are cleaned and changed every six months.

![Diagram of Ak-Bechel Filter](image)

Figure 5.4. Cross-section of Ak-Bechel Filter, 2-Chambered, Up-Flow, Open-Air system (diagram drawn by author).

The surface water trickles into the gutters at the top and flows underground again to the chlorination facility. The filter is not contained and has had a history of contamination due to flooding. Insects, dirt, and organic matter were visible floating on the effluent water. Also, there was fungal and algal growth on the structure (Figure 5.5). Responses by residents who were connected to the main system were concerned that the water was dirty and unfiltered.

Twenty-two respondents were served by the main system. Thirty-two percent of residents (n=7) served by the main system referred to this seasonal flooding/dirty water issue. For example, a resident from Aral said, “It comes from the water system and I am not sure if they filter it or... Sometimes when it rains, the water is dirty in the kolonkas.” One woman mentioned that, “The water can get really dirty, black.” Residents observe evidence of dirt from the water in teapots, as one woman stated, “If you will see the teapot, you will notice there is a big bunch of dirt in it after using it. It is like a filter. I clean it every time. I think the water is not clean.” Others have found grass and insects in the water from their faucets especially in the spring.

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108 Dirty water complaints were only regarding the main system.
Chlorination

Calcium hypochlorite was added to the water up to about 1997 for sanitation purposes. It was mixed in an old bathtub and then dripped or drained into the water main. As it flowed to the city, it mixed with and sanitized the water. This chemical is expensive for the water department to add, and it has therefore been discontinued.

The issue of chlorination was divided, but generally people who complained about dirty water noticed that chlorine was no longer added and wanted it to be added again. Interestingly, some were told by their doctors that the water was safe and chlorinated, but in reality it had not been for about six years. This false belief that the water contained chlorine caused people to trust the water. “We just drink from the kolonka because we think there is chlorine in the water.”

Distribution System

The distribution system connects seventy kilometers of cast iron, cement/asbestos, steel, concrete, and wood pipes to businesses, government buildings, organizations, 2,555 homes, and fifty-two hydrants. Individual homes and hydrants do not have shutoff valves. Most pipes and connections were constructed in the 1960s and 1970s. The main
distribution system serves central Naryn and several hydrants in western Naryn. It also supplies several hydrants and buildings in Moskovsky, the only region of Naryn north of the river served by the main system. Other smaller systems are on the margins of the city and are supplied by wells. The city has long-term plans to connect all peripheral systems to the main system. These secondary systems are discussed in the following sections and do not meet the local demand for drinking water.

The main distribution system is failing. Pipe ruptures and leaks are commonplace and worsening. Degraded pipes result in reduced water pressure. During peak demand periods, homes in multistory buildings may lose all water pressure. An increase in pipe pressure could initiate further ruptures and leaks and is not recommended.

The distribution system is in need of major repair. The water department engineer estimated a need for eighty kilometers of new pipe, equivalent to a complete reconstruction of the water system at a cost of about 3 million USD. Normally, cities aim for a 100-year replacement cycle, but, due to the low quality of construction materials, Naryn’s replacement cycle would need to be more frequent. Naryn has not had the resources for pipe replacement.

Because of the inadequate main distribution system, people in Aral and Ak-Korgon face particular challenges in fetching their water. A man from Aral said,

"We take water from the kolonka. It is really far. I mean the water, clean water is really far. We take it from the other side of the river. We take it from the other side of the river! Sometimes the water stops."

People from this region may have to walk up to 400 meters with a cart to get water. Furthermore there was not even a hydrant, but a broken pipe protruding about twenty centimeters from the ground (Figure 5.6).

People in Ak-Korgon are severely under-serviced. One resident said, "Mostly we have no water. Mostly the kolonkas are turned off. We take the water from the river with a container and pull it home with a cart. Can you imagine in the region Ak-Korgon the water does not work, kolonkas do not work from 11-5pm everyday?" It is over 800 meters to the nearest hydrant on the main system. Residents of Ak-Korgon could get water from a closer hydrant in Zapadni, but they would have to walk uphill with their buckets.
Zapadni Well

Zapadni well in west Naryn draws water from an aquifer sixty meters below. Approximately 530,000 gallons of water can be produced per day by two electric pumps, but in 2004 one was inoperable and the other only operated at partial capacity. The water is sterilized by a UV sterilizer and pumped to a 750 m$^3$ storage (198,000 gallons) reservoir located above the hydrants (Figure 5.7). The tank pressurizes fifteen hydrants by gravity. Initially, the plan was to construct fifty kilometers of pipe, but only ten were completed. As a result some residential areas have never been supplied and people have to travel far to get water. For example, a twenty-seven year-old woman living in Zapadni had to pull her drinking water uphill in a cart. The quality of the water from the well was good and she affirmed that it was clean.

East Well

The electric pump of the East well produces about 37,000 gallons per day from an aquifer eighty meters below the surface. The infrastructure of this system is minimal and
consists of a small pump house, 2.5 kilometers of water pipe, and eight hydrants (Figure 5.8). Three of the hydrants were broken in 2004. The East well is the primary water source for residents of PTC and is inadequate. Electricity outages cause system failure and the entire neighborhood to be out of service. This region is facing the most urgent water problems in Naryn, and the impacts are felt by many people. PTC is a large region with many residents that are regularly without water. Alternate sources include runoff from Teke-Sekirik, Nefte-Baza spring, and the river.

Figure 5.8. Pump Station, Well, and Broken Hydrant of East Well System

PTC and Electricity Outages

Four out of five PTC residents mentioned that water problems were associated with electricity outages. Even residents from other regions of Naryn mentioned the severity of water shortages in PTC. When there is a power outage, the electric pump of the East well becomes inoperable and twenty-five percent of Naryn’s population does not have access to centralized, clean water. Power outages are common in Kyrgyzstan, and Naryn is no exception. It may be out a few times per week for hours at a time. If the East well water system utilized a reservoir such as the one described in Zapadni, water shortages would be reduced because there would be a reservoir of water that would gravity-feed when the power was out.

Testimonies of several residents of PTC describe the severity of the water shortages and the alternatives they take:

"In PTC there is a problem with the kolonkas. The water pumps do not work due to electricity failures. At that time we cannot take water from the kolonkas. We will go to the springs."

"In PTC it depends on electricity. When we have electricity, we have water. When it is off, we have no water because our kolonkas are sourced by water pumps."
Without the primary water source, people have to travel up to two kilometers to a spring, Teke-Sekirik, or a hydrant in central Naryn.

For some people such as this school teacher in her mid-30s other sources were too far and water from the river was the next alternative:

"In Naryn the region of PTC, the issue of water is really hard. Every second the kolonkas do not work. Sometimes they do not work when electricity is turned off. That is why we have to take some water from a river or canal for drinking. We have no choice."

A sixty-eight year-old woman in PTC did not mention the electricity issue, but she was clearly dissatisfied with water provision and was not able physically to get her own water.

"In Naryn there is no water. Hey, in Naryn there is no water!!! We live next to the mountain. We take water from a kolonka in Altamush-Turt. Even that one sometimes works sometimes not. Oh my little boy we always wait for someone to give us water, but no one gives water. We are just waiting and sitting. I live alone and sometimes I just give 5 som to some children in order to have them get water for me. Can you believe it?"

The nearest operable hydrant was over a kilometer from her home and if the water department fixed the existing broken ones, it would still be over 700 meters away.

PTC has multiple problems. Three of the seven hydrants of the neighborhood were broken or not working. Other residents complained about the added distance required to get drinking water, as one resident put it, "It is really bad because we have only one hydrant." Rather than fetch water from 180 meters, she had to take it from 900 meters.

**North Well**

The north well, Kizpiz Zabod, has two outlets and is 150 meters deep. Water from Ak-Bechel does not have enough pressure to gravity-feed to this location. Figure 5.9 shows the two outlets. The elderly woman we interviewed was very upset and emotional when asked her about water issues. Water pressure was lost during power outages. She had to take water from a far distance and wanted things to be better, but felt let down by city officials because they had promised to improve the situation in her
community. She said, "We are still waiting." When the water does not work, she has to travel about one kilometer to a hydrant on the main system.

Figure 5.9. Water Outlets of North Well

From on site assessments and testimonies of residents, it is clear that the water systems and infrastructure do not meet the basic water needs of residents. Naryn’s water systems are rapidly deteriorating and in urgent need of repair. Most pipes have reached their life-spans. Pipes are cracked and leak; many community water hydrants are broken; chlorine is no longer added; some homes have no water pressure; and at times the water from faucets is “muddy.” Residents frequently complain that they have no water near their homes and have to walk long distances or drive across town to a spring to get water.

The water department and local government are aware of many of these issues, but they lack the financial resources and capacity to meet the drinking water needs of the 42,000 residents. The loss of Soviet structure and the rise in corruption throughout the economy have exacerbated Naryn’s water problems.\(^\text{109}\) As a last resort residents take water from the Naryn River and undeveloped springs.

**ALTERNATE SOURCES**

Thirty-four percent of respondents periodically or regularly used alternate water sources. These residents mostly lived on the margins of the city and did not have access to the main water supply. They lived mostly in the eastern and western areas of the city.

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\(^{109}\) World Bank, *Small Towns Infrastructure and Capacity Building Project.*
such as PTC, Tash-Bulak, Zapadni, Alma-Bak, and Ak-Korgon, see Figure 5.11. This map shows the regions that are under-serviced and can be used in planning efforts.

**Springs**

Twenty-eight percent of Naryn's population regularly used undeveloped, alternate water sources. One spring is on the far west side of town in Tash-Bulak, another is in Zapadni, and the third is near PTC in Nefte-Baza. All are adjacent to the river. Two springs are piped, but the water flows out of the ground at Tash-Bulak spring (Figure 5.10).

![Figure 5.10. Nefte-Baza, Zapadni, and Tash-Bulak Springs, Respectively](image)

Tash-Bulak spring is especially difficult to access because it is far from residential areas and below a steep river bank. One respondent in her mid-30s uses Tash-Bulak spring because it is often her only choice. She would prefer to use the hydrant near her home, but it is often broken. It is farther and more troublesome to go to the spring; furthermore, she is upset that people do not take care of the spring and clean it. As for Zapadni spring, one resident complained that there was sand in the water and that her children got Hepatitis A from drinking from it. Residents were also concerned about the water quality of Nefte-Baza spring because of potential pollution by animals and people. The man who used it regularly chose it over the hydrant because the nearest hydrant was over 400 meters away. Residents also use the river as an alternate source.

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110 See “Springs” of water-related illness section of chapter 5.
Figure 5.11. Periodic and Regular Alternate Water Source Users
Naryn River

People from various areas throughout Naryn drink water from the river. The water carries a lot of sediment and is not perceived to be clean, but some people use it for a water source because it is closer to their homes than other water sources. Turbidity is greatest in the spring and summer months during high runoff periods. There are no significant sources of pollution upstream from urban areas or industries, but DSE has found fecal coliforms in the water. The river is supplied by glacial melt and runoff from the very high and remote Tien Shan of eastern Kyrgyzstan. People will resort to drinking from the river when their primary sources are inoperable or because the nearest hydrant is too far away. A man in Afghan used the river as a primary source except during the spring and summer when turbidity was very high. In the spring and summer he walked a kilometer to Moskovsky to get water from a hydrant. Other residents relied on river water when there was no city water. For example, a school teacher in her mid-30s said, "We have to take water from the river or a canal for drinking. We have no choice."

Teke-Sekirik

Teke-Sekirik was an agricultural water diversion project to provide irrigation water to eastern Naryn. A local initiative raised 6,000 USD and completed the project in 2003. Interestingly, this has become a water source for some, especially when other sources fail. People who live in PTC or near will mostly use it, but there are cases when people will drive up to ten kilometers across town to get water when other sources are out of commission.

Teke-Sekirik is sourced by stream runoff. The aqueduct carries the water over a mile to a waterfall where it cascades into a pool below next to the road. Livestock frequent the watershed. They graze next to and defecate in the stream (Figure 5.12). Children play in this water and others come here for fresh drinking water. On the rock face next to the waterfall, the Kyrgyz proverb is written, "Water is the spring of life." People do not prefer to use these undeveloped water sources, but the challenges the water department faces in resolving the problems described above are monumental.
POST-SOVIEt CHALLENGES

Poor water infrastructure construction and lack of water supply maintenance have caused rampant water problems in Naryn. The Soviet collapse has brought severe economic collapse to Kyrgyzstan and Naryn, and people often referred to the Soviet period as a “better time.” Below are several quotes from residents that described the Soviet period as “better:”

“Everything was good. They took care of us and asked about our thoughts, everything was cheap.”

“We had good salaries and did not even think about water problems.”

“There were no financial problems. We just had to go to work and get our salary. We had everything provided. It was not capitalism. There was enough of everything, but now we have capitalism. Someone cared for us then. It was the perfect period. We were not worried about kidnapping and theft. We used to put a stick against the door of our yurts and people did not enter because they knew we were not home, but now they steal. What about respect? Younger generations used to respect older generations.”

According several residents, basic services are no longer provided at a level comparable to that in the Soviet period because officials no longer do their jobs. For example:

“There were really responsible persons who would take care of water and other things. Also local self managing worked very well. They always had issues like needing to build kolonkas in villages. They just had to do it. But now no one does it.”

“The water department does not fix the hydrants as they used to during the Soviet period. Now hydrants are broken.”
“At that time the [water] pressure was more [and now it is low]. The pipes were clean and now pipes are not clean. For example we have broken pipes in our building entrance and no one fixes them.”

“Now they do not add chlorine to water, but then they did. When we drink water there are some germs in it. There are no people who care about the water now.”

People were concerned about the integrity of elected officials and city administrators and accused them of “trying to make their pockets bigger.” Many people have lost hope because of the worsening economic conditions and continued failure of the systems. False promises by city and elected officials have compounded this distrust of the entire institution. People also distrust government officials because of corruption and tribalism, but the role of such factors in the management of the Naryn water supply is beyond the scope of this research.  

False Promises

Twenty percent of respondents referred to “false promises” made by city officials or deputies to improve water service near residents’ homes. Figure 5.13 shows the locations of the residents who referred to “false promises.” The spatial pattern and concerns of residents suggests that officials are aware of the under-serviced areas. Distrust of officials adds to the challenge of getting people to pay their water tariffs. The following quotes from residents illustrate this issue of false promises:

“It would be good if the government would help us. They said they would bring the water next to our house. They promised, but they did not do it. For example, there was a water pump and they said that they would fix it. Deputies promised us. There is still silence.”

“Deputies come here. We complain about water problems. They say they will build kolonkas here, but no results. We did not see them build kolonkas here.”

“People complain about water problems. They promised that they were going to build kolonkas, but they did not. In ARAL there is no kolonka! There were some older people who explained our problems to them [water officials], but no results.

“Three months ago they [the government] said they would build it [a new kolonka] and we are still waiting.”

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111 Kuchukeeva.
“It is really hard with water. For example, we do not know where we should go to complain. Sometimes candidates for deputy come and promise to build kolonkas and after they become deputies, they just forget about us. We do not find his footprints. We have not idea where he is. No trace…”

“A long time ago one candidate for deputy, Balbaev Morat, said ‘I am going to do it very well.’ He was going to make life better, but there is nothing now. We are still waiting.”

“We have no kolonka. When the river turns dirty we have to take water from Moskovsky. A lot of people come in the time of elections. They say to us we can solve your problems. They just disappear. There were two deputies who told us they would build kolonkas, but when they were elected, they forgot about us.”

Naryn must take necessary measures to improve water service to as many residents as possible. Without money, the water department cannot do anything. If residents distrust the government and water department, they are much less likely to pay their water tariffs. When the entire system is paralyzed, the need to develop and maintain trust and cooperation between residents and the government is critical.

**Drinking Water Tariffs**

In the former Soviet Union people paid nominal or no water tariffs because municipal water departments were heavily government subsidized. With the collapse

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\[\text{A resident of Naryn said in an interview that he paid only 0.40 USD per year for water in the Soviet period.}\]
of the Soviet government and Kyrgyz economy, came a loss of water supply subsidies. In post-Soviet Kyrgyzstan, residents must support the water department by paying water tariffs, but they are resistant to pay for water for a number of reasons. First, water was virtually free for Kyrgyz for nearly three quarters of a century during the Soviet period. Furthermore, prior to colonialism Kyrgyz were a nomadic people and they used water from springs and rivers without remuneration for centuries.\textsuperscript{113} Kyrgyz have lived with the belief that water is a gift from God/Nature/Earth and that it is not for sale. Second, Kyrgyz do not understand the economic changes the government and water department are confronting. Third, people face severe poverty and unemployment, and their ability to pay for water is impaired. A typical monthly water fee is about 1.5 percent of total income.\textsuperscript{114} Finally, a high percentage of residents distrust officials and municipalities. The director of the water department said the tariff collectors have to force and beg people to pay. Even hospitals, schools, and government offices are delinquent, and the water department has to beg them for money.

The delinquency rate is tragic. In 2004 the water department estimated that government and private organizations carried a balance close to 50,000 USD. Residents owed the water department over 30,000 USD and the bulk of the burden was on those who lived in condominia. The water department explains to their customers that water pipes and system infrastructure are very old and deteriorating and that there is no longer money for system maintenance due to the loss of government subsidies. The water department puts articles in newspapers and broadcasts the story on the radio and TV to reach people. The water tariff delinquency rate reached an all time low in 2002, but because of the efforts of the water department, more customers participated in 2003, see Table 5. The head accountant of the water department explained that people had money after 1991 from savings to pay their tariffs and by 2002 residents of Naryn had exhausted those savings. People are beginning to understand that paying for drinking water is expected and necessary.

\textsuperscript{113} People of the Middle Mountains of Nepal are also resistant to pay for water, especially price increases, see Merz.

\textsuperscript{114} Calculation based on GDP of 400 USD and 50-cent monthly water tariff.
Apart from the efforts to improve tariff collections, there are over 80,000 USD of accounts payable. The city cannot depend on these monies for pending projects. It will take millions of dollars to fix the entire water system of Naryn, and residents and local organizations cannot bear the financial burden. Naryn has been incredibly fortunate to work with the City of Great Falls as part of a Resource Cities Program. As a result of collaboration with Great Falls, Naryn has received grants from the Urban Institute and more recently, have received capital investment grants from the World Bank.

Table 5.1. Changes in Tariff Delinquency Rates from Soviet Period to 2003

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RECONSTRUCTING AND EXPANDING NARYN'S WATER SYSTEMS

The Urban Institute, the World Bank, and the City of Great Falls have administered and/or financed projects in order to improve water quality and infrastructure in Naryn. Great Falls became involved in 1999 and helped establish priorities and guidelines. The Urban Institute provided a grant to improve the head works of Ak-Bechel. The World Bank is currently administering and financing substantial projects ranging from infrastructure remediation to administrative mentoring. Naryn has been incredibly fortunate to receive international assistance which has been a product of their initiative and desire to provide better services to their residents and the Great Falls technical exchange program.

Head Works of Ak-Bechel: Urban Institute

Figure 5.14 shows the old Ak-Bechel headwall. Water used to flood and spill over the small dam when snowmelt and runoff from rainstorms would cause the flow of the stream to peak. The flood water would inundate the filter and render it useless. Seasonally, water from the taps and hydrants was "muddy." Great Falls and the Naryn water department devised a plan to update several structures. The following objectives were proposed:

Data provided by the accounting office of the Naryn water department.
The new headwall will allow runoff during storm events to bypass the primary intake and prevent flooding of the headwall and filter.

The headwall will handle peak flows of 100-year storm events. Estimated peak flows were based on drainage size.

A concrete bypass will divert peak flows around and past the filter.

Figure 5.14. Old Headwall at Ak-Bechel (photograph taken by J. Reardon of Public Works Department of Great Falls).

Initially, the Naryn water department was reluctant to accept the head works project because they believed it was not feasible. Naryn’s initial response to the project was, "How can you expect us to do all of these things without equipment and money?"

On September 15, 2003, Naryn was awarded 161,970 som (4,000 USD) by the Urban Institute (funded by USAID) to reconstruct the headwall and bypass. Remarkably, the cities collaborated, the Naryn water department submitted a proposal to the Urban Institute and the project objectives were achieved in 2004 (the new headwall was shown in Figure 5.3). This story illustrates how an international partner can play a crucial role in mentoring and locating resources for projects that were at one time unforeseeable to water officials in Naryn.
The World Bank awarded Kyrgyzstan 10.6 million USD for urban infrastructure improvements in 2004 (see Table 5.2 for a list of World Bank awards to Kyrgyzstan). Naryn was one recipient of assistance among twenty-two other small towns to repair, replace, or upgrade water supply infrastructure. Most aid is through a specific investment loan and some is through a grant. By improving infrastructure services and building institutional capacity at the government level, problems will be overcome that thwart economic growth and poverty alleviation.\footnote{World Bank, Small Towns Infrastructure and Capacity Building Project.}

The services and systems (water supply, waste water treatment, solid waste, and roads) under the auspices of local self governments (LSGs) will be repaired, rehabilitated, replaced or upgraded. An additional 2.4 million will be put toward improving social infrastructure, preparing designs and documents, and providing technical supervision and studies. Funds will be distributed over a five-year period starting in 2005, most in the second, third, and fourth years.\footnote{Ibid.} The remaining discussion of the World Bank project will adhere to issues germane to water supply and establishing self-sufficient projects.

Objectives

- Increase availability of drinking water (hours/day)
- Improve water quality
- Increase water tariff collection rates
- Reduce accounts payable
- Reduce energy consumption per unit of water produced

By choosing technically sound and reliable investments, water quality and service delivery will be optimally improved. First, water sources must be developed either by improving the efficiency of the existing well systems by replacing old inefficient pumps with new high-efficiency pumps or utilizing the physical geography to develop gravity-fed production and distribution systems. Projects will minimize long-term operational

\footnote{World Bank, Small Towns Infrastructure and Capacity Building Project.}

\footnote{Ibid.}
costs and be the least-cost alternative. Long-term cost of electric pump operation will be compared to expensive initial investment to develop and/or improve gravity-fed facilities.

As mentioned earlier the state of infrastructure is severe and entire system reconstruction is not feasible due to budget limitations. Priority will therefore be given to regions of greatest need and projects that contribute to first stage, interim improvements. The World Bank requires technical designs of their projects to abide by Kyrgyz standards and international best practices.\textsuperscript{118}

Table 5.2. World Bank Infrastructural Development Awards to Cities in Kyrgyzstan

<table>
<thead>
<tr>
<th>Award in USD</th>
<th>Kyrgyzstan: Urban Infrastructure</th>
<th>Kyrgyzstan: Social Infrastructure</th>
<th>First Year Investment Program: Water Supply Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Recipients</td>
<td>10.6 million</td>
<td>2.4 million</td>
<td>394,000</td>
</tr>
</tbody>
</table>

Eligibility and Requirements

Great Falls and Naryn were partners in a technical exchange program administered by ICMA and the Resource Cities Program. These programs have been funded by USAID. Through these programs, Naryn and Great Falls established necessary development strategies and documents needed for Naryn to qualify for World Bank project funding. Together the cities devised a town development strategy (TDS) and fit the proposed infrastructure improvements into this. The World Bank requires all projects to be technically sound; the least-cost alternative; self-sufficient after initial investment; supported by at least a three percent financial contribution from the LSG or utility association; in accord with World Bank safeguards and guidelines; adhere to applicable Kyrgyz laws; and not conflict with investment activities of other organizations. Costs for project preparation and national and international consultants were covered through a grant.\textsuperscript{119}

\textsuperscript{118} Ibid.

\textsuperscript{119} Ibid.
First Year Investment Program in Naryn

The World Bank is mostly replacing worn-out pumps and installing chlorination systems in the seven cities participating in the first-year investment program. Naryn was awarded 394,000 USD to accomplish the following objectives:

- Guarantee water supply all year to twenty-five percent of the population in eastern Naryn, PTC. Replace freeze-prone (shallow and surface) pipes with deeper and protected structures.
- Reduce operating cost of water department by replacing two old, inefficient pumps. Construct a reservoir to effectively maintain water pressure and install flow control meters.
- Improve water quality by installing chlorination equipment.
- Restore waste water treatment for three condominia and student dormitories.

Water department personnel will also receive training in accounting. Computers and software will be installed in administrative offices in order to strengthen billing and tariff collection programs.\textsuperscript{120}

Subcomponent Grants

Urban infrastructure subcomponent grants are available on a competitive basis and are for repairing, replacing, and upgrading water supply structures and equipment. The Community Development and Investment Agency (ARIS) reviews subproject proposals. Proposals must include:

- Town Development Strategies
- Feasibility Studies
- A financing plan including a three percent cash contribution of total subproject cost
- A preliminary implementation plan
- Performance Improvement Action Plan (PIAP) with a time-bound plan of technical, managerial, and financial improvements.\textsuperscript{121}

\textsuperscript{120} Ibid.

\textsuperscript{121} Ibid.
SUMMARY

The purpose of this chapter was to analyze water system problems in Naryn from the vantage point of water officials and residents of Naryn and identify obstacles that prevent the Naryn water department from meeting the basic water needs of residents. Drinking water in Naryn comes from high, mountain springs, springs next to the river, wells, and the river itself. The water department estimates that 12,000 of Naryn’s 42,000 residents drink from unimproved springs and the river. Additionally, the primary municipal water source is unfiltered and turbid from runoff. Further, potassium hypochlorite is no longer added; thus, the water is delivered to the city without any sanitation.

Naryn’s water supply has been deteriorating and system infrastructure has not reached the populace of Naryn. Filtration, chlorination, and distribution systems are in need of major repair. Existing water service is unreliable because electric pumps are worn out and inefficient; there are regular power outages and broken pipes decrease water pressure. Because of these water supply deficiencies, residents have had to turn to distant, poor quality alternate sources such as the river and undeveloped springs.

Interestingly, people of the entire city are affected, but for different reasons. There are four different, independent systems that have different designs and separate water sources. In east Naryn, power outages put people out of service. In north Naryn, the distribution network does not reach all residents, and they have to walk long distances to get city water. In central Naryn, the water is seasonally dirty and sometimes people have no water pressure because of improper system design. In western Naryn the distribution systems do not reach all residents and many people have no choice but to take water from springs and the river.

Since the collapse of the Soviet Union, the water department has been unable to organize the necessary resources to keep up with system failures and increasing water demands. People on the city perimeter are facing the greatest need, and because the city has not fulfilled their needs, these residents distrust government officials and do not want to pay for water. If people do not pay for water, the system will continue to degrade and the water department will never be self-sufficient. With a capital investment to implement major improvements, residents may be willing to pay for their drinking water.
The City of Naryn and the water department have drawn on numerous resources to repair the water systems and meet the demands of residents. This process was initiated when Great Falls and Naryn partnered in an ICMA and a Resource Cities Program. They worked together to acquire a grant from the Urban Institute to make major repairs to the head works and worked together year after year to organize their planning and management strategies. This five-year partnership has culminated into substantial World Bank interest. The Naryn water department is on the path to making major changes to their water systems and hopefully the residents and local organizations will commend these efforts and better participate in the tariff program in order to help the entire municipality become self-sustaining.
CHAPTER 6
WATER QUALITY AND PUBLIC HEALTH:
KEY CONCERNS AND CONTROVERSIES

*If you take care of the water, it will take care of you. If you do not take care of the water, it will not take care of you.*

Kyrgyz Proverb

Water-related illness rates are extreme in the developing world and are the product of more than a billion people lacking access to clean drinking water and over two billion lacking proper sanitation measures. There are more people in hospitals suffering from these illnesses than any other ailment. More than 5 million people die each year from water-related diseases throughout the world. In 1990 water-related diseases were the cause of twelve percent of all deaths in Kyrgyzstan.

In this chapter I discuss the issue of drinking water quality in Naryn and its potential impact on public health. Officials from the City of Great Falls tested the primary water sources extensively for contaminants to aid in water supply planning. I present and discuss the data of the following parameters that cause concern: arsenic, nitrate, turbidity, and microbial levels. Few additional data were available due to the limited water testing capacity of the Department of Sanitation and Epidemiology (DSE).

The next section provides quotations from health officials and experts and residents on water-related illnesses. Officials from the Ministry of Health provided information on epidemics in other regions of Kyrgyzstan and made comparisons to issues in Naryn. Additionally, I provide perspectives of an infectious disease doctor and pharmacists from Naryn. Finally, I present resident perspectives on water-related illnesses and compare them to officials’ and experts’ perspectives. This approach was

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122 Brown.


124 UN.
effective in bringing out multiple issues that contribute to an understanding of the problems associated with Naryn’s water supply.

WATER QUALITY

In Central Asia human health has been compromised by the destructive environmental practices of the Soviets. Air, soil, and water quality have been degraded by a myriad of destructive practices: nuclear, biological, and chemical weapons testing; military accidents such as chemical spills; soil and water pollution from poor monitoring of hydrocarbon and other mining activities often in remote areas; pollution from unregulated coal power plants; air pollution from automobile emissions; disposal of radioactive mine tailings near rivers and groundwater; industrial pollution near urban areas; use of banned agrochemicals such as DDT at high levels that have contaminated primary rivers and groundwater.\(^{125}\) In Kyrgyzstan many of the above practices occurred and water quality in some areas has been diminished. Contamination of drinking water from uranium mine tailings and agrochemicals have been major public health concerns.\(^{126}\) Officials from the City of Great Falls, therefore, tested the water sources of Naryn for pollutants.

Water analyses showed no evidence of mining, agricultural, or industrial pollution. However, arsenic levels in several springs were high because arsenic may be naturally abundant in the region. The level of arsenic in Naryn’s primary water source, Ak-Bechel was twice that of the acceptable level set by the United States Environmental Protection Agency (EPA) and the World Health Organization (WHO).\(^{127}\) An additional concern about water from this source was that much of it was from runoff and it was delivered, untreated to the majority of Naryn’s population.

\(^{125}\) Sievers.

\(^{126}\) UN.

The EPA and Naryn Oblast MCLs (maximum contaminant levels) are significantly different. Nitrates, turbidity, and microbial data were assessed because they can be correlated to water contamination and can be a potential human health risk. Nitrates and turbidity were measured in ppm (parts per million or milligrams/liter) and arsenic in ppb (parts per billion or micrograms/liter). Figure 6.1 shows water quality results from the City of Great Falls and the DSE in Naryn and MCLs.

**Arsenic**

Arsenic is a documented carcinogen. It is known to cause bladder, lung, and skin cancers when people drink water with greater than 50 ppb arsenic. Up to 1 in 100 to 300 fatalities has been correlated to such levels, but especially over long-term exposure. Effects of lower level exposure have been difficult to detect in epidemiological studies.\(^{128}\)

The current Naryn Oblast MCL for arsenic is the same as the documented carcinogenic level, 50 ppb (Figure 6.1). Interestingly, drinking water was tested for arsenic during the

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Figure 6.1. Nitrate and Arsenic Levels of Drinking Water Sources in Naryn

Soviet period. However, there is no longer arsenic testing of drinking water in Naryn due to insufficient money for proper testing equipment.

The Department of Sanitation and Epidemiology was not aware of high arsenic levels at 23 ppb in Ak-Bechel water. Arsenic levels in Naryn’s primary water source are over twice the EPA’s and WHO’s MCLs that is 10 ppb.\(^{129}\) Arsenic levels were, however, within the Naryn Oblast MCL, but the MCL is not safe. When assessing other water sources near Naryn, even higher arsenic levels were detected (34 ppb, Ilbirs spring). Arsenic levels are high in the region of Naryn. The literature suggests that the health impacts at such levels are inconclusive. The high MCL must be addressed, and Naryn should consider lowering it.

\textit{Nitrates}

All nitrate levels were within safe limits, but several trends pose a concern. DSE did mention that nitrate and ammonia levels of Ak-Bechel were higher in the spring during periods of high runoff. Nitrates and ammonia can be introduced into the water from livestock and animal feces. Animal waste may be the source of high nitrate levels of water during the spring. If there is dirt and dung in the water and it does not get treated, there could be microbial contamination as well.

Interestingly, nitrate levels of Zapadni well were twice that of East well (Figure 6.1). In addition, Zapadni’s nitrate levels may have increased from 2000 to 2003. Zapadni well is located on Naryn's downstream side. The issue arises because people primarily use unlined, shallow pit toilets and they are dispersed throughout Naryn. The shallow depth of the well, 60 meters, compounds the cause for concern. The soils that provide a barrier between Naryn and the aquifer are sandy and therefore permeable to leachate. The other wells in Naryn are upstream and significantly deeper, 80 and 150 meters (East and North, respectively), and suspected to reach separate aquifers based on mineral analysis of the water.\(^{130}\) There is significant potential that nitrate levels will continue to increase in Zapadni well. Although the risk may be minimal presently, nitrate levels

\(^{129}\) EPA, (accessed); WHO, (accessed).

\(^{130}\) City of Great Falls.
levels greater than 45 ppm have been associated with infant methemoglobinemia, a disease in which babies can suffocate due to a build up of nitrites in the body.\textsuperscript{131} Future planning will require nitrate levels to be closely monitored. In the event that nitrate levels exceed 45 ppm, the city may need to resort to an alternate water source.

Turbidity and Particulates

Turbidity is an important water quality parameter because it correlates to the presence of microbes (viruses, parasites, and bacteria).\textsuperscript{132} The probability of microbial contamination is greater when there are high suspended sediments in water. Sediment can provide a medium upon which microbes to thrive.

Turbidity is continually monitored by DSE. Well water is far from exceeding turbidity limits, but Ak-Bechel is of concern because of runoff water and an ineffective filtration system. The water is especially “dirty” in the spring from increased runoff from snowmelt and rain. Field observations confirmed other particulates such as insects and debris in the water after filtration. Others have witnessed insects and debris in water from faucets. In all seasons, runoff water is collected and piped to Naryn regardless of turbidity levels.

Naryn has met the total suspended sediment (TSS) MCL of 1.5 ppm (about 1.5 NTU “nephelometric turbidity units”). However, residents expressed concerns and seasonal complaints about visible sediment in their teapots and from faucets (see page 54 in sub-section on the Ak-Bechel filter). There have been periods when turbidity has exceeded the Oblast requirement. Moreover, numerous people have described their tap water at times being “muddy.” The water from Ak-Bechel was 1.1 ppm sediment (about 1.1 NTU) on April 14, 2000. The EPA requires that ninety-five percent of samples taken be at or below 1 ppm (approximately 1 NTU).\textsuperscript{133} The water has again exceeded EPA MCLs, but there were no data to quantify TSS during “muddy” periods. In any case the


\textsuperscript{132} EPA, (accessed).

\textsuperscript{133} Ibid, (accessed).
water is unfiltered and carries unacceptable sediment levels at different times of the year. Therefore, many health professionals and residents have been adamant about boiling water before drinking it.

**Microbes**

Microbial analyses may be the single most important measure to assess any immediate public health risks associated with Naryn’s water supply because much of the water is from undeveloped sources and consumed untreated. The microbiologist of DSE was confident that the water was safe and met all required specifications: heterotrophic plate count was at or below the MCL and no pathogenic bacteria or parasites were detected in the water supply. However, fecal coliforms (*E. coli*) have been found in the Naryn River, and some residents drink it untreated.

*Giardia* may present an additional microbial risk to residents in Naryn. Livestock and wildlife are prevalent in most watersheds near Naryn. *Giardia* enters the water from animal feces. Interestingly, DFID (Department for International Development) has found giardia to infect children at rates up to thirty-four percent in Naryn Oblast.\(^\text{134}\) Most of the studies on giardia were conducted in rural settings, but they add to the concern about health risks from drinking untreated water in the region.

Microbial data from DSE were very limited and the City of Great Falls did not administer microbial testing. Four regular water samples are taken and tested for microbes twice per annum by DSE. A major limitation to testing is a lack of finances which erodes the department’s ability to provide rigorous sample collection and analyses.

**Constraints on Testing and Monitoring**

DSE, under the Ministry of Health, is charged with testing drinking water in Naryn. The Ministry of Health guarantees them a contract and specific funding for monitoring municipal drinking water twice per annum. However, planning, research, and other agenda are not covered in the contract. The Ministry of Health is fully aware of the financial constraints of DSE. Officials from the Ministry of Health said,

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"Legally, they [DSE] have to have a laboratory. But they aren’t able to have it. There are no laboratories. This is why the contract budget also should include money for upgrading laboratories, making research contracts with other laboratories and paying employee’s salaries, for electricity and chlorine. No one works for free now."

Furthermore, an official from DSE stated, “There is not enough money for equipment. We cannot test all things necessary. It is impossible. In the Soviet Union, there was enough money, even for testing arsenic. We have now stopped testing for most chemicals.” Without adequate testing facilities and revenue, the capacity of DSE to follow regulations is tenuous:

“The drinking water regulations come from the Kyrgyz government and the water department follows some of these, and sometimes they [DSE] do not follow all of them. Why? It is not their fault. I do not blame them. It is a problem with money and old equipment.”

The inability of DSE to sufficiently test drinking water due to lack of finances strongly suggests that lack of finances degrades the capacity of other sectors to fulfill their duties.

WATER-RELATED ILLNESSES

АККАН СУУДА АРАМ ЖОК
There is no evil in moving water.

Kyrgyz Proverb

People in the City of Naryn drink unboiled water from runoff, springs, and the river. From the limited microbial data from DSE, health risks from drinking unboiled water were inconclusive. In this section I provide extensive quotations from health officials and experts and residents to illustrate the following issues:

- Lack of health data on water-related diseases;
- Financial constraints cause residents to avoid consultation with doctors;
- Diverse views on health problems associated with unclean water;
- Mixed concerns of residents about water-related illnesses;
- Increased risk of infection due to use of alternate sources: springs and river.
Perspectives of Officials and Experts

Regarding disease epidemics, Kyrgyzstan is faced with them every year. In 2004 the Ministry of Health was dealing with a typhoid outbreak in Batken Oblast (southwest region). Three hundred people were hospitalized and 150 of them were confirmed with typhoid. In Osh Hepatitis A is becoming prevalent. It has increased 300 percent and is especially infecting school children. In Jalal-Abad there was another outbreak, about forty-three people were hospitalized. Officials of the Ministry of Health said the cause of the epidemics was the absence of good water supply and water pollution and that there was not enough water for hygienic and other needs. Only about 70 percent of the people in the south have access to city water, 30 percent take it from canals and springs. But in Naryn, according to the Ministry of Health, about 95 percent of the population takes water from the central system.135

The Ministry of Health did not have any records of epidemics in Naryn and officials explained that the lack of records was due to a lack of water-related illnesses and intestinal infections in the community:

"The geographic condition and climate of Naryn Oblast predisposes them to less disease. First, it’s a small populated area. Secondly, they live at the top of a clean water resource where dirty water doesn’t exist. They live in the place where the water is the cleanest. Furthermore, there are no industries which could pollute their water. But I won’t say that it is completely no problem. Even good water needs to be washed and disinfected because it can be a danger to health.”

Officials of the Ministry of Health did point out that broken water pipes were associated with Hepatitis A outbreaks in Naryn Oblast in villages such as Kochkor and Jumgal:

"They [water-related diseases] are related to broken water pipes. People also drink water from irrigation ditches when they are broken. This is the main problem. When water pipes are broken, people drink from irrigation ditches. And of course it makes problems. In Naryn they are related to the water supply system. If there is no electricity, then the water pump doesn’t work, so people again begin to drink water from irrigation ditches. And it is immediately noticed. Intestinal infections will appear.”

A Ministry of Health official explained that the water in Naryn is clean, but that it is contaminated due to broken pipes and backflow:

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135 The Naryn water department calculated that 70 percent of the population used centralized water.
"The water that enters the system is clean. It's spring water. Also, there is clean water which comes from underground. There are no sources of water pollution. But, if water pipes have reached their lifespan, they begin to crack and break. They crack and water leaks out. If the electricity turns off, water leaks out of the system. When the power turns on, that water will run back into the system. This is an absorption into system. And then, when the new water is delivered there is strong suction. All this [dirty] water, which was sucked into system [through the cracks], will spread to the population. This can be a danger if water pipes are not checked and fixed. Anyway, the water pipes are the object of danger. It can be dangerous for a large number of people at once. This is the danger. In some places there exist emergency cases, from absorption. They are all registered or should [emphasis added] be registered. And they should be discovered, removed, fixed, etc. But if there are not any finances, we cannot do anything."

Overall, Naryn is not the most severe case in Kyrgyzstan, but the infrastructure problems are a key issue. The water becomes contaminated because of pump failures and broken pipes and people do become ill. Health officials and experts based in Naryn provided additional insight into water-related diseases.

There were hospital records of Hepatitis A and Intestinal Colitis cases from Naryn. However, these records did not accurately represent disease rates in Naryn because people only make a hospital visit when their illnesses become very serious or life-threatening. According to an infectious disease doctor from a hospital in Naryn:

"I know many people that when they get a disease they go to the pharmacy to buy medicine, but I think this is wrong! Because they do not know exactly what disease they have. We need to give an exam and diagnose it and then give a prescription. If they go to the pharmacy without a prescription, it is wrong! Maybe they will have another unknown disease, and it will then go untreated."

The data in the graph below (Figure 6.2), although interesting, are therefore unreliable and do not accurately represent disease prevalence in Naryn. Most infectious disease patients were treated for brucellosis in 2003, 167 cases of mostly adults, but this disease is transmitted through non-pasteurized milk and meat.

A doctor visit is cost prohibitive to most people; thus, pharmacies are preferred. Children less than sixteen years old have government medical insurance (OMC). It is much cheaper for a doctor visit with the insurance and costs around 500 som versus 1000 som (13 and 25 USD, respectively). Adults pay 800 som (about 20 USD) without insurance and 530 som with insurance. To put this in perspective, a university instructor

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in Naryn makes about 35 USD per month. A single visit will cost from thirty-five percent to more than half of a person's monthly salary. Over eighty percent of people in Naryn live below the poverty line and the unemployment rate is over forty percent. Even with insurance, people do not have the money to go to the hospital and if they do not, there will be no public record of these disease cases.

Furthermore, the above diseases can also be contracted by eating contaminated food and not washing properly. Measuring the actual water-related disease rates in Naryn is improbable, but interviews of several local pharmacists provided valuable information about their experiences with these diseases and their perceptions of water quality and health issues.

There are thirty-two pharmacies in Naryn. The map below depicts them and their distribution across Naryn (Figure 6.3). Unfortunately, only three of the pharmacists
consented to an interview.\textsuperscript{136} Many were fearful that their superiors would be upset and were not willing to risk losing their jobs. As mentioned before, Naryn’s population is 42,000. The pharmacy density is one for every 1,300 residents. In Missoula, Montana there is only one for every 3,500 residents.

Figure 6.3. Pharmacies of Naryn

The medical doctor confirmed that drinking contaminated water could cause several diseases. On the other hand, several pharmacists were dubious about such diseases. The following quotation from a pharmacist with a degree from the medical institute confirms the inconsistent opinions of health professionals about water related-diseases: \textit{"The first time I heard about water-related illnesses is from you. You know, I don’t think that water can cause illness."} People come mostly for medicine for influenza and headaches. Sometimes a female client might come and say, \textit{"My children ate unwashed fruits and they are having stomach problems."} Diarrhea cases are most prevalent during the summer and early autumn. \textit{"I might give them antibiotics or analgesics such as Tetracycline, Levomecetin or Linex."} People do not come here asking for medicines to treat typhoid, dysentery, or Hepatitis A. Many will treat themselves at home and not go to the hospital.

\textsuperscript{136} All pharmacists interviewed were located in or near the city center. Therefore, residents who came to these pharmacies were those who used water primarily from Ak-Bechel.
Another pharmacist confirmed that there were not any issues related to water-related diseases in Naryn. Rather, she emphasized the severity of inadequate water supply delivery:

"Water that is clean and safe to drink is in Naryn. We have clean water everywhere. I think it is safe water because I have never met person who had a water-related disease. As for myself, I do not boil it before drinking. It does not need to be boiled or filtered before drinking it. I know other problems. My brother in Alma-Bak has no hydrant. He takes water from far away. And the water in my home has really low pressure."

According to the first pharmacist, eating unwashed fruits and/or vegetables, rather than drinking unboiled water was the culprit of diarrhea and stomach problems. There were dysentery cases which were most frequent in late summer, but improper washing was the believed cause of illness. When asked if dysentery could be transmitted through contaminated water, the pharmacist replied, "I am not sure."

In the same region of Naryn serviced by Ak-Bechel water, a pharmacist with over thirty years of experience had a much different outlook.

"Mostly in summer, in hot seasons like June, July, August, early September, people come mostly to take medicines for diarrhea. People here come for kids and adults. Also in spring months, people come for medicine for liver diseases, for example Hepatitis A (Saryk). Water can really cause illness! If water is not clean, then it really can cause. Even all diarrhea can be caused by water. Diarrhea from dysentery, cholera, and hepatitis can be caused by water."

To treat her patients with Hepatitis A, she gave them vitamins A and C. She felt Hepatitis A medications such as Rebaksin, Glukominovaya kislota, Gemades, and Klukoza were best prescribed by a doctor. As for diarrhea, she mostly prescribed antibiotics (Levomecetin, Linex, Rinfampitsin, Gentomitsin, and Tetracycline). If the diarrhea cases were more severe and include stomach pain and vomiting, she still prescribed antibiotics.

It is not just children that need medicine for water-related illnesses; people of all ages including adolescents, adults, and elderly come to pharmacies. People come in the spring for Hepatitis A. They come with diarrhea through the summer and into the fall. She did not feel strongly that water-related diseases were severe in Naryn because other regions in Kyrgyzstan had greater problems with water quality and public health.

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The pharmacist with over thirty years of experience gave a detailed description of dirty water and water in Naryn:

"Dirty water is the water which has dust, sand, and sometimes I can’t even determine what garbage is in the water. It is dirt. For example, we have the same water from the tap. It has dirt in it. We need to let it settle before drinking it. From water pipes, water is dirty too. We had no such dirty water before. I don’t know what has happened. Maybe only my region, Altymysh-Turt, is like that. Also, in spring time water is really dirty. It’s brown water. It’s not safe to drink! I advise to boil it before drinking because I think it is not safe. To drink water from the tap or hydrant is not correct. It should be boiled or filtered. On the other hand, it is clean in the winter. I think it is safe then."

Not only was the above statement about water-related diseases contrary to the beliefs of other pharmacists, but her description of water in Naryn also contradicted that of a former pharmacist who said, "Water that is clean and safe to drink is in Naryn. We have clean water everywhere." Interestingly, although two of the pharmacists had different beliefs about the causes of diarrhea (water-related vs. related to unwashed food), they both prescribed antibiotics.

It is surprising that the beliefs of health officials and experts about water issues and water-related diseases were so varied, especially given that they all were served by Ak-Bechel water. One might expect health officials and experts to be equally sensitive to water quality and health issues, but perhaps diverse levels of experience affected their attitudes about water. This issue is complex and because of the varied attitudes, experience, and training of pharmacists, many infectious diseases may go misdiagnosed.

To further assess water-related illnesses and their spatial distribution, I turn the discussion to the resident interviews.

*Perspectives of Residents*

In this section I describe residents’ perceptions of diseases and water handling behaviors to further identify and evaluate water problems in Naryn. Spatially representing disease perception and boiling water patterns proved to be a useful technique for identifying specific areas of concern.

Boiling water is a way to kill existing microbes that could harm one’s health. If people boil their water, it may indicate the belief that the water contains harmful germs.
Boiling it would then be a method of sanitizing drinking water. Culturally, many Kyrgyz drink tea and jarma, but little cold water. Jarma is a sour, viscous beverage made by cooking and fermenting wheat. The vast majority of Kyrgyz attain their primary source of water through tea, especially black tea, although some drink green tea. Water must be boiled to make tea. Eighteen percent of respondents (n=7) mentioned that they boil water for tea, even though residents were not asked about tea. A woman in her fifties said, "We boil it to drink tea. We do not drink water unboiled. I make jarma for drinking when we are thirsty. I do not give water to children." This cultural practice may inadvertently reduce risk of people becoming infected with a water-related disease.

The issue of boiling water as a health precaution was divided. One-third of the interviewees (n=13) said they always boiled their water, and they understood the risk of drinking unboiled water: "For the sake of our health, we boil it before drinking." Another third were unconcerned and did not boil it based on experience: "I am accustomed to the water. I sometimes boil, but I do not get sick. It doesn't matter if I boil or just drink it." The other third would sometimes boil it and were unsure of the risk:

"Sometimes children drink unboiled water, but we try to boil it before drinking. There are people who say it can cause illness; I have heard it from the TV and radio. But I do not think water from kolonka can cause illness. I think they [the water department] do disinfection and something else."

As people have mentioned, experience and knowledge are factors that affect their attitudes toward water. But for closer investigation, how does boiling water relate to illness perception?

All residents who boiled their water (never drank unboiled water) believed it could cause illness (37 percent, n=14) with the exception of an elderly woman in central Naryn who always boiled her water to make tea, but was unsure about water-related illnesses. "We boil it for tea. We just boil it and drink it. I have never heard about illness." The following combinations of boiling water and illness perception were arranged and mapped to illustrate the high variation of concern about water-related illnesses: those who boil their water and believe it can cause illness; those who do not boil their water, but believe it can cause illness (8 percent, n=3); those who do not boil their water and do not believe it can cause illness (21 percent, n=8); those who sometimes
boil their water, but believe it can cause illness (8 percent, n=3); and finally those who sometimes boil their water and do not believe it can cause illness (10 percent, n=4). Sixteen percent of residents (n=6) interviewed did not know if water could cause illness (Figure 6.4).

Springs

In this analysis I found each water source to have unique problems and resident users to have varied beliefs about water-related illnesses. Moreover, specific regions have specific water-related illness problems. A woman who lived in Zapadni had just returned from the hospital with four sick children at the time of the interview. She used primarily Zapadni Spring because of location and discussed issues about the water:

"We can drink from the spring, but actually I believe it is not good. If you go down to the spring in that spring you can see sand. There is a lot of sand in the water and it is bad for our organism. I think it will give damage for us. Even children have such disease, Hepatitis A. For example, four of our children have this disease. They came from the hospital just today. Three of them were in the hospital. One we will treat in the house. All of these were caused by water."

Another woman who lived in the area and used Zapadni Spring also believed the water could cause Hepatitis A. It is very likely that there is a water quality problem there.

Also in west Naryn, a woman in her mid-30s was very upset about having to take water from Tash-Bulak Spring:

"People who live here do not clean this spring. We take and drink and do not clean it. We again broke the spring and it is dirty. I think some people do not have the minds to care about this stuff. They do not care about the water... The water can cause illness. We have to boil the water just to clean it."

Furthermore, people who used other springs such as Nefte-Baza Spring also stressed the importance of boiling this water before drinking it because it could potentially cause illness. For example, one respondent stated, "Of course we boil it before drinking because it can cause illness. However, we have not had such incidents."

Other people from PTC have to use Nefte-Baza spring when the primary well system is out of service. "It can cause illness. If we take water from the spring there are a lot of animals and they have a lot of disease. They can influence our health."
Figure 6.4. Patterns of Boiling Water and Water-Related Illness Perceptions
Finally, the two women who discussed springs in the interviews from central Naryn also believed this water could cause illness. For an elderly woman, the spring was closer than the hydrant. She used the spring even though the water could cause illness, but was sure to boil it before drinking.

Many people in Naryn use springs for their primary drinking water. They prefer city water from a hydrant or faucet because it is typically cleaner and safer. Because the hydrants are far and sometimes broken, residents have no choice but to take water from springs. All residents who frequently used spring water boiled it because they believed it could cause illness. This finding illustrates the urgency of investigating spring water quality, taking measures to improve it, and educating the public about health risks.

River

Drinking water from the river can be a last resort when other sources are unavailable or out of service. However, people’s attitudes about water-related illnesses from drinking river water were varied. A retired couple who worked for the water department lived in a condominium with a faucet, but that faucet was not always reliable. They preferred to get water form Teke-Sekirik, but it was on the other side of town, ten kilometers from their home. At times they had no choice but to use the river:

"We drank from the river because there were a lot of problems with our water. When we could not go to Teke-Sekirik, we just went to the river. We boil water to drink tea and do not drink it from taps without boiling it because it can cause diseases of the stomach and others. We have only one child. We do not allow him to drink unboiled water."

Downstream from the inoperable wastewater treatment plant, another family used the river due to unreliable city water. They explained their situation:

"Mostly we have no water. Mostly the kolonkas are turned off. We take the water from the river with a container and pull it home with a cart. Can you imagine in the region Ak-Korgon the water not working? Kolonkas do not work from 11-5 p.m. daily.\(^{137}\) We do not boil it before drinking. We just drink it. We boil it to drink tea but not with the purpose of just drinking. We just drink it, and I do not know if it can cause illness. Maybe..."

\(^{137}\) This man’s wife was present during the interview. She was embarrassed and told her husband to not talk about the river and just say they got their water from the kolonka.
Also in regards to using the river as an alternate source, a school teacher in her mid-30s from PTC stated:

“In Naryn in the region of PTC, the issue of water is really hard. Every second the kolonkas do not work. That is why we have to take some water from a river or canal for drinking. We have no choice. All of us are educated people and boil our water because it can cause illness. It can cause dysentery and Hepatitis A.

Finally, a man in his early twenties used the river when turbidity was low, but used a distant hydrant when the water was too dirty. He lived in southeast Afghan. Of all interviewees, he was the only resident who used the river primarily for drinking water. He said:

“We have no kolonka. When the river turns dirty we have to take water from Moskovsky. Now the river is dirty and intense. We wait for it to turn clean and then we take water from the river. We do not boil our water before drinking. When we are thirsty we just come and drink. I do not know if it can cause illness. Maybe it will, maybe it won’t. For example, in our region there are no people who have become ill from the water.”

There were four people in this study who used the river as either a temporary or primary water source. Unlike the spring users, they did not always boil the water and believe it could cause illness. Interestingly, the river water tested positive for fecal coliforms. It is often muddy and might warrant the greatest concern for usage as drinking water, but in this study, spring water was of greatest concern, everyone boiled it and believed it could cause illness. In conclusion, residents resort to undeveloped water sources when the city supply is out of service. A public health issue emerges as a result of using alternate water sources due to unreliable, unavailable city water supply.

Ak-Bechel

Ak-Bechel is the main water source in Naryn. Fifty-six percent (n=22) of respondents used this source. Of the respondents who used Ak-Bechel as a primary water source, fifty percent (n=11) believed the water could cause illness. Many responded by saying, “Of course it can cause illness.” Others were more explicit in their responses. For example, “It can cause illness because the water from kolonkas is not clean. It comes from the water system and I am not sure if they filter it. Sometimes when
it rains, the water is dirty in the kolonkas.” For some, chlorine was a necessary component of clean water. Without chlorine some people believe it to be unsafe:

"Of course it can cause illness. In the Soviet period, when I came to Naryn, it was interesting to me that the water tasted like chlorine, but after the [Soviet] Union it did not taste like chlorine. I think they should filter the water at the beginning, but because they do not, we see some germs. It is really dirty. Maybe it can cause a kind of stomach ache."

If the water was not boiled, some believed that, “it might contain some microbes that could cause illnesses such as diarrhea and others.” Furthermore, several women were adamant about not giving unboiled water to children because it would cause them to get diarrhea.

Although the population of Naryn is 42,000 and the city has hospitals, paved streets, and centralized water, residents considered Naryn to be rural given its isolation in the Tien Shan. A middle-age woman associated Naryn with other rural places and believed Naryn to have “a lot of illnesses.” She also said, “People drink from canals. It can cause diarrhea. If you give unboiled water to children, they will get diarrhea.” A retired surgeon said, “Drinking unboiled water can cause dysentery and colitis.” Next, I examine water-related health perspectives of those who use well water.

Wells

Nine respondents used well-sourced hydrants for their primary water sources. Fifty-six percent (n=5) of those believed it could cause illness. These residents did not mention that the water was dirty, just that it could cause illness. The users of all other sources, including alternates, believed the water could cause illness because of its “dirty” appearance and lack of chlorine. Residents with medical and advanced degrees were more aware of poor water quality and health-related risks.

People who use well water in Naryn live away from the city center or near the margins of the city. Even though turbidity levels were very low and the water did not appear dirty, more than half believed it could cause illness. Location, infrastructure condition, and regular periods of no water affect people’s attitudes toward water and health largely because marginalized residents have to turn to alternate water sources of lesser quality. Figure 6.5 is a map of water users’ sources. This map shows the locations
of those who use alternate sources, springs and the river, in relation to those who primarily use centralized water. Additionally, many hydrants were broken or out-of-service in 2004. People who live closer to alternate sources are more likely to use them regardless of water quality when there is no centralized water. Broken water hydrants, shortage of water mains and hydrants, and poorly functioning systems marginalize residents and put these residents at greater risk of contracting a water-related illness.

SUMMARY

The purpose of this chapter was to present the analysis of the data on water quality and water-related diseases. In this analysis it is strongly apparent that health officials’ and experts’ and residents’ perceptions of water quality and diseases are diverse. Officials of the Ministry of Health compared Naryn to other cities in Kyrgyzstan with urgent epidemics. They did not emphasize water-related diseases in Naryn. However, officials of the Ministry of Health stated that contamination of water occurs in broken pipes due to backflow. People can become ill when they drink water from broken pipes, especially given the prevalence of shallow pit-toilets throughout the city. If people drink water from canals, it must be boiled before drinking because it is highly unsafe.

I investigated water-related disease rates through several methods and data sources, but found that the Ministry of Health, hospitals, and pharmacies lacked data that could be used to quantify the potential public health impact of contaminated water. Contributing to the problem of few data on water-related diseases, residents normally attain medicines directly from pharmacies due to the lower cost rather than going to the hospital where diseases are diagnosed and documented. Unfortunately, only several pharmacists were willing to participate in this research. The pharmacists did not have records of diseases, but provided vastly different opinions on the relationship between poor water quality and disease. Moreover, the belief of residents that water could cause illness was divided as well (53 percent, n=20). Interestingly, the belief that water could cause illness did not always transcend into safe water handling practices.

Water quality of springs was poor according to residents. Springs users always preferred to use water from hydrants because they believed centralized water was safer.
Figure 6.5. Water Users' Sources and Out-of-Service Hydrants
People who drink untreated spring water could be exposed to Hepatitis A and other water-borne pathogens and are at risk of becoming ill. But because there have been no microbial tests of spring water, spring water quality and the level of risk are unknown.

Location affected people’s beliefs about water quality because they use a multitude of water systems and sources in Naryn. Residents addressed concerns about spring water quality based on observed particulate matter and suspected causes of child disease. The well systems provided the highest quality water in Naryn, yet fifty percent of users believed it could cause illness. I argue that well users’ perceptions were based on having to resort to unclean alternate water sources during regular periods of no centralized water.

The main system, Ak-Bechel, on the other hand was widely known for seasonal dirty water. To reiterate, water from Ak-Bechel is partially from runoff and untreated. The reconstruction of the headwall at Ak-Bechel likely made a large impact on water quality, but this has not been measured. Debris, mud, sand, and insects in drinking water are unacceptable and tend to be associated with higher levels of pathogens. Ak-Bechel is the main water source for Naryn and improving its water quality needs to be a high priority.

As for other water contaminants, arsenic and nitrate levels were within limits specified by Naryn Oblast. However, arsenic is more than twice the allowable level established by the WHO. Policy makers need to be aware of recent epidemiological studies on arsenic and that the Naryn Oblast arsenic MCL is the same level, 50 ppb, as the level shown in the study to cause high death rates over long periods. Other water system problems and public health issues will be given priority over this concern. In long-term planning Naryn may want to consider relying more on the well systems for their superior water quality.

Nitrate levels of East well water may be increasing due to leachate from pit toilets contaminating the shallow aquifer below. Water quality monitoring is a critical method of assuring residents of safe water and good health. However, DSE does not have the resources to test the water more frequently.

Lack of financial resources impairs the ability of the Department of Sanitation and Epidemiology to maintain high standards of public health. Without proper funding they
cannot acquire the water quality data necessary to advise the public about water contamination. For example, water from springs has not been tested. This testing, especially microbial, is badly needed because children may be drinking contaminated water. Although many residents believed unclean produce to be the culprit of stomach aches and diarrhea, there are not any data to prove this claim. Likewise, data that shows residents are becoming ill from drinking unclean water are also unavailable. Drinking water must be tested to determine potability. And most importantly, residents must be informed of health risks associated with drinking municipal water.
CHAPTER 7
CONCLUSIONS AND RECOMMENDATIONS

ВОЙ ЭМУ БУЛАГЫ
Water is the spring of life

Kyrgyz Proverb

In this case study I synthesized qualitative data from interviews and/or documents received from residents, health experts, and water officials to address the following objectives:

(1) Describe and map Naryn’s water supply systems;
(2) Determine and spatially display areas of poor water service which put people at particular risk of becoming infected with water-related diseases;
(3) Identify correlations between water quality and public health;
(4) Determine the factors that have impacted and continue to degrade Naryn’s water supply;
(5) Gain a deeper understanding of how Kyrgyz interact with water resources.

In this chapter, I present the major findings as they relate to the above research objectives and argue that other mountain communities of former Soviet republics face similar issues given the similar geography and political and economic histories.

I described Naryn’s water supply systems (objective 1) in order to provide a comprehensive understanding of system and infrastructural design and problems. Using the map as a medium, I displayed major infrastructure issues. On the system base map, I mapped the areas of primary concern that were brought out in the resident interviews (objectives 2, 5). Residents primarily were dissatisfied about the lack of hydrants, unreliable water service, broken hydrants, and dirty water. These problems identified by residents highly correlated with the extent, design, and condition of system infrastructure. In other words, the lower the level of development or condition of the system, the more
marginalized residents felt. A key finding of this study was the pattern of marginal water service and its relationship to people’s choice of alternate water sources, specifically undeveloped springs and the Naryn River. People use the Naryn River and springs as last resorts when there is no other water. People who used the Naryn River did not all believe the water had to be boiled before drinking even though the Department of Sanitation and Epidemiology confirmed the presence of fecal coliforms in the water. On the other hand, all respondents who used springs boiled their water and were aware of the risks. Several springs had been purported to cause Hepatitis A, but infection and microbial data were unavailable. The highly variable practice of boiling water and beliefs about water-related diseases emphasize the need for further research and water analyses.

The Department of Sanitation and Epidemiology are unable to perform optimally due to budget constraints. They are charged with testing water quality and are limited to biannual sampling. Furthermore, data are very limited and water from springs is not tested, yet springs are important drinking water sources in Naryn, especially because the water supply is unreliable and residents’ choices for water are limited.

Not only was there a lack of water quality data, but there was also a lack of water-related illness data (objectives 3, 5). People normally do not go to the doctor or hospital when ill because of the high cost of treatment. Therefore, hospitals do not have accurate records of infectious diseases in Naryn. Without public health records, epidemiologists cannot assess illness rates and work to resolve potential epidemics.

Rather than seek treatment from hospitals, people with illnesses such as dysentery or stomach aches go to pharmacists for medicine. Pharmacist diagnoses are based on symptoms, and furthermore, medical professionals in Naryn disagree that untreated drinking water can cause illness. This again calls attention to the importance of conducting rigorous water quality tests and public health surveys. Tenuous public health education may be a factor in the diverse beliefs about water-related illnesses and should be addressed.

In 1991 Kyrgyzstan lost former Soviet subsidies that once supported public utilities such as water supply and rigorous drinking water quality monitoring (objectives 4, 5). Centralized government control also ended and water departments had to assume responsibility of administering and managing their utilities. The new democratic nation
had to seek new revenue to maintain basic infrastructure, and water tariffs became the sole source of revenue. In Naryn, residents, businesses, organizations, and government offices have been largely delinquent in their payments, and the water department has continued to struggle to maintain water service and the basic infrastructure of the water supply. Further compounding lack of water service has been city expansion without water system expansion. In a city in which over eighty percent of the population lives below the poverty line, the outlook for increased participation in the water tariff program is grim. Other factors such as distrust of government institutions and a long history of "free" drinking water also inhibit people from paying tariffs.

Residents of Naryn are impoverished and at times must walk long distances to fetch water. In large regions such as PTC, there is little water due to regular power outages, and people must drink water from undeveloped sources including the Naryn River. Sometimes the water from Ak-Bechel is "muddy" and potentially contaminated with pathogens. Residents from all regions of Naryn have complained about the water and have lost faith that the water department and government officials are trying to remedy the situation. Also contributing to citizens' distrust of officials are false promises made by government officials to resolve issues of residents stricken with the most urgent problems. Not only have these marginalized residents asked, "Why should I pay for water?," but they have also spoken adversely about officials, "They do not care about us. They only care about themselves." Water users, therefore, do not trust officials nor do they want to pay for substandard service. The service was much better during the former Soviet period because the infrastructure was maintained, but "free" for residents. Many residents do not understand why they are now charged for service that became much worse. As a result of these issues of poor service and distrust, overall participation in the water tariff program has been inadequate to support the water department. The water department must generate income to carry out its duties; without money the utility is severely impaired. The magnitude of water problems in Naryn has attracted international attention.

Foreign institutions have played integral roles in improving water supply in Naryn. The City of Great Falls, Montana mentored the City of Naryn on water supply management and aided Naryn in devising strategies to improve water service to residents.
With support from the City of Great Falls, the cities prepared a clear plan on how to reconstruct the head works of the main water source and acquire project revenue. The Naryn water department completed the project with a grant from the Urban Institute. The path Naryn has taken in managing the water supply has transformed from hopeless to proactive. The City of Naryn has also collaborated with the World Bank. The improved management practices and resource allocation skills of city and water officials has brought the utility a World Bank grant for capital water infrastructure reconstruction.

Capital infrastructure improvements, better water service, and improved city management will help the water department become a self-sustaining utility. Furthermore, when residents and other organizations in Naryn feel the effects of improved water service and participate in the process of transformation, trust of city officials will begin to grow. This growth will encourage water customers to become paying stakeholders for a vital service.

Finally, the findings of this case study of Naryn represent issues other mountain communities of the former Soviet republics face given the similar geography and political and economic histories. The effects of political and economic collapse are significant in the Central Asian Republics and this case study on the water supply sector clearly illustrates the implications of the enormous political, economic, and social transformations and losses on a local scale.

RECOMMENDATIONS

I developed numerous recommendations based on this research which shed new light on Naryn’s water issues and expand on recommendations from the City of Great Falls and the World Bank. Because of the World Bank support, some of the recommendations below are currently being addressed. The World Bank planned to begin reconstruction in PTC because the region was the greatest impacted by power outages and crumbling and poorly designed infrastructure. However, the use of the term “marginal” in this paper was intended to bring important awareness to districts of Afghan, Aral, Ak-Korgon, Zapadni, and Tash-Bulak. This is a comprehensive list in no particular order that can serve as a set of long-term planning objectives.
In addition to continuing to seek local, national, and international assistance, the officials of the City of Naryn must work to gain trust with the residents. Not only will accountability increase as the water system changes are implemented, but the city must make an effort to encourage community participation and involve residents in development activities. Public meetings should be held to involve residents in decision-making processes when possible and inform people of public health and water quality issues. The reconstruction of the water system will require a labor force and residents of Naryn should be given high priority to these jobs. With a rise in employment, improved water service, and involvement in community issues, citizens of Naryn will build trust with city and water officials and the prospects of water supply becoming a community-supported, self-sustaining utility will grow.

Infrastructure Improvements

Ak-Bechel
- Drill a well near Ak-Bechel and pipe only freshwater to the distribution network. This will eliminate the need for a new filter.
- Connect regions not served by other water systems with distribution network and install appropriate number of hydrants.
- Locate and replace broken water mains with pipes of appropriate diameter.
- Fix or replace broken hydrants.

East Well System and PTC
- Evaluate electric pump for efficiency and potentially replace.
- Construct a reservoir above the area for water storage that will gravity-feed PTC distribution network to prevent water system failures in times of electricity outages.
- Install new hydrants in place of existing, broken structures.
- Construct new distribution network with adequate number of hydrants for residents in PTC.

Zapadni Well System
- Replace inefficient and broken electric pumps.
- Finish distribution network and service to Tash-Bulak, Ak-Korgon, and Alma-Bak.
- Install number of hydrants.

North Well System and Afghan
- Evaluate electric pump for efficiency and potentially replace.
- Install new hydrants in place of existing structures.
- Construct adequate number of hydrants and distribution pipe network to meet needs of residents in Afghan region.

Springs
- It is urgent that the water be tested for microbes and viruses and that Naryn take measures to ensure safe drinking water from all springs in Naryn.
- Post signs so people know that the water is unsafe and must be boiled before drinking.

Water Quality Testing
- Water of all systems must be carefully tested for microbial contaminants, especially during spring.
- Monitor nitrate levels of water from the Zapadni well.
- Acquire local, national, and international support to improve water quality testing and monitoring.

Community Participation
- Involve residents in development activities pertaining to the water supply.
- Hold public meetings as a venue for residents to participate in decision-making processes.
- Inform residents in community meetings of public health and water quality issues.
• Employ residents of Naryn in water reconstruction projects as a means of growing the local economy and building trust.

**Water Tariffs**

• Establish a reasonable tariff for residents based on type of water service: home faucet, home hydrant or community hydrant.

• Consider other alternatives before installing meters and shutoff valves to control water usage. Community hydrants could not be turned off because of several delinquents in a region. On the other hand, water to a household could be turned off only if it did not affect neighboring users.

• Improve tariff collection system administered by the water department.

• Consider implementing an income tax that will supplant the water tariff collection system in the event of low participation.

**Public Education**

• Devise and distribute brochures to residents on safe water handling and health practices.

• Post signs at water hydrants and springs that warn of the dangers of drinking untreated water.

• Strengthen health education in schools.

• Inform public of water-related health risks through newspapers, TV, and radio.
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APPENDIX 1. TEMPLATE FOR INTERVIEWS OF WATER DEPARTMENT, CITY, HEALTH AND MEDICAL PERSONNEL

Tell me about the work you do in your department as it relates to drinking water?
What are your primary responsibilities?
Are there any limitations that restrict your capacity to carry out your duties?
Tell me about the drinking water in Naryn?
What are some specific issues the residents face?
How is your department confronting these issues?
Do people in Naryn get water-related illnesses?
Are residents of Naryn educated about water issues and public health? Describe?
How was the water during the Soviet Period?
How is the water in your home (only for those from Naryn)?
Do you boil it before drinking (only for those from Naryn)?

APPENDIX 2. TEMPLATE FOR RESIDENT INTERVIEWS

Tell me about the water in Naryn. Do you have any concerns about the water?
Where does your drinking water come from? Does it always work?
Do you boil it before drinking?
Can it cause illness?
What would you do if it caused illness?
Who is responsible for the quality of your water?
Do you have the right to safe and clean drinking water?
How much do you pay for water?
Would you be able to pay if they increased the price?
Tell me about health education of clean food and water.
Tell me about the water during the Soviet period.
What is the biggest social issue in Naryn?
Who can help?