

**KYRGYZSTAN'S WATER RESOURCE MANAGEMENT,  
1991-2015**

*Dissertation submitted to Jawaharlal Nehru University  
in partial fulfilment of the requirements  
for the award of the degree of*

**MASTER OF PHILOSOPHY**

**POOJA KUMARI**



**CENTRE FOR INNER ASIAN STUDIES  
SCHOOL OF INTERNATIONAL STUDIES  
JAWAHARLAL NEHRU UNIVERSITY**

**New Delhi-110067**

**2016**



Date:

DECLARATION

I declare that the dissertation entitled “ **Kyrgyzstan’s water resource management, 1991-2015**” submitted by me for the award of the degree of **Master of Philosophy** of Jawaharlal Nehru University is my own work. The dissertation has not been submitted for any other degree of this University or any other university.

*Pooja Kumari*  
POOJA KUMARI

CERTIFICATE

We recommend that this dissertation be placed before the examiners for evaluation.

*S Thapliyal*  
PROF. SANGEETA THAPLIYAL

Chairperson  
Centre For Inner Asian Studies  
School of International Studies  
Jawaharlal Nehru University  
New Delhi - 110067

*S Thapliyal*  
PROF. SANGEETA THAPLIYAL

Centre For Inner Asian Studies  
School of International Studies  
Jawaharlal Nehru University  
New Delhi - 110067  
Supervisor

*Dedicated to*

*My Parents*

## ACKNOWLEDGEMENTS

*The success of this dissertation would not have been complete had it not been the support of some people who helped me throughout my journey of writing it. I take this opportunity to express my gratitude to them who have been instrumental in the successful completion of this research. I would like to express my deepest appreciation to my supervisor Prof. Sangeeta Thapliyal who continually and convincingly guided me through the research and her constructive criticism helped me in doing better. Her valuable comments made me do the important changes in the research of which I am sure that this final one is the best.*

*I also want to extend my gratitude to other faculty members of the Inner Asian Studies department whose discussions in the class immensely helped me in writing the dissertation. I also thank the librarians of JNU for providing the essential resource materials for the work. I am no less indebted to M/ s. Sanjay Photostat for their determination in helping the students for years.*

*My accomplishments and hardships would not have been rewarded so but for the blessings of the almighty and the love and support of my parents. I would thank to my Senior Mr. Pravesh Gupta, who helped me a lot to do this work. I am also grateful to my friends specially Sarita, Sancheta, Samir Meher, Garima, Gourav and Shephali who have constantly supported me and at times criticized me which helped me to strive towards the better.*

*Place: New Delhi*

*Date: 26 July 2016*

*Poojakumari*

POOJA KUMARI

# Contents

Page No.

*Acknowledgement*

*Abbreviations*

*List of maps*

*List of tables*

*List of figures*

## **1. Introduction**

**1-16**

Water and its management

Geographical locations of Central Asia

Major water source in Central Asia

Historical context of water management in Central Asia

Geographical locations and its importance of Kyrgyzstan

Policies, Programmes and Projects in Kyrgyzstan

Impact on downstream countries

## **2. Water resources in Kyrgyzstan**

**17-34**

Geographical location of Kyrgyzstan

*Mountains*

*Climate*

Hydrography of Kyrgyzstan

Surface water

*Glaciers*

*Rivers*

*Lakes*

*Reservoirs*

Groundwater

Transboundary nature of River Basin

### **3. Policies on water usage and Management**

**35-48**

Water Demand and Usages

*Agriculture*

*Industries*

*Domestic*

*Hydropower generation*

Problems of water usage and Management in Kyrgyzstan

*Lack of fund*

*Rapid population growth*

*Out-dated infrastructures*

Water Policies and programmes in Kyrgyzstan

### **4. Impact on downstream countries**

**49-76**

Water withdrawal of Kyrgyzstan and its Impact on downstream countries

Uzbekistan

Kazakhstan

The construction of Kambarata-2 hydroelectric plant

Impact on climate change

Impact on Aral Sea

Reaction of downstream countries

Impact of water Issues on Border disputes

Regional and International Efforts

International Law Practices and Intergovernmental Agreements in Central Asia

*Almaty Agreement*

*Nukus Declaration 1995*

*Kyzyl Orda Agreement*

*Agreement on the Use of Water and Energy Resources of the Syr-Darya Basin*

*Ashgabat Declaration*

*Chu-Talas Joint Rivers Commission*

The International Fund for Saving the Aral sea

Integrated Water Resources Management

Central Asian Countries Initiative for Land Management

World Bank

European Union

Special Programme for the Economies of Central Asia

Shanghai Cooperation Organization

Conclusion 77-82

References 83-101

## List of Maps

Map 1 Physical Map of Central Asia	page no.4
Map 2 Political Map of Kyrgyzstan	page no.18
Map 3 rivers in Kyrgyzstan	page no.24

## List of Tables

Table 1 Major Rivers of Kyrgyzstan	page no.25
Table 2 Reservoirs of Kyrgyzstan	page no.27-28
Table 3 Renewable surface water resources (RSWR) by major river basin	p- 31
Table 4 Syr darya river basin: Distribution of water reservoirs in Uzbekistan by administrative boundaries	page no.53

## List of Figures

Figure 1 Volume of Reservoirs	page no.29
Figure 2 Trends showing irrigated land and water intake used for irrigation in Uzbekistan, 1990–2020	page no.52
Figure 3 Uzbekistan cotton production and share of world market trade, 1970-2012	page no.55



# Abbreviation

AC: Alternating Current

ADB: Asian Development Bank

AusAID: Australian Agency for International Development

BCM: Billion Cubic Metre

BWA: Basin Water Management Association

CACILM: Central Asian Countries Initiative for Land Management

CASA: Central Asia-South Asia

CASAREM: Central Asia-South Asia Regional Electricity Market

CIS: Commonwealth of Independence States

CPSU: Communist Party of the Soviet Union

DC: Direct Current

DFID: Department for International Development

EU: European Union

GDP: Gross Domestic Product

GEF: Global Environment Facility

HVDC: High Voltage Direct Current

ICAS: Interstate Council for Addressing Aral sea crisis

ICWC: Interstate Commission for Water Coordination

IFAS: International Fund for Aral sea

IWRM: Integrated Water Resource Management

KV: Kilovolt

MW: Megawatt

NCWC: National Committee on Water Strategy

NGO: Non-governmental organization

NWS: National Water Strategy

RSWR: Renewable Surface Water Resource

SCO: Shanghai Cooperation Organization

SIC: Scientific Information Centre

SPECA: Special Programme for the Economies of Central Asia

UNDP: United Nations Development Programme

UNECE: United Nations Economic Commission for Europe

UNEP: United Nations Environment Programme

UNESCO: United Nations Educational, Scientific and Cultural Organization

UNO: United Nations Organization

USAID: United States Agency for International Development

USSR: Union of Soviet Socialist Republic

WB: World Bank

WTO: World Trade Organization

WUA: Water User Association

XUAR: Xinjiang Uyghur Autonomous Region

# CHAPTER-1

## Introduction

Water in liquid form covers over 71% of earth's surface yet it is a scarce and valuable resource. Majority of the water found on earth is ocean water, which is not fit for purposes such as domestic, agriculture, industries and generation of hydroelectricity Overall 97.5 percent of existing water on earth cannot be utilised and only 2.5 percent can utilized from different sources like glaciers, ice caps, lakes, rivers and ponds. Glaciers and ice caps contain 1.8 percent, groundwater contains 0.64 percent and other sources of water like rivers and lakes contain 0.01 percent. Thus, the availability of water for human being is less than 1 (Cech 2010: 28-29).

.Water is considered as a blue gold all over the world because every country's development depends on agriculture and industries and expanding economies require more resources for .Uneven distribution of water among the countries is a serious challenge for the 21st century .Water has emerged as a serious issue for many reasons: the environmental issues like climate change and damage of hydrological cycle, economics issues like high demand and low supply of water, political issues like corruption and mismanagement, population growth and pollution (Gurjar et al. 2008). Therefore, these issues are becoming a serious concern for human survival.

Water security is becoming a national security concern because the transboundary rivers countries try to retain maximum water for their own benefit and as a result water sharing at time, leads to strained relations between the countries. The sharing of transboundary rivers basin have been a source of constrained relations between many countries and at times have lead to serious wars. In recent years, water resource induced conflicts have been seen between Turkey, Syria and Iraq for Euphrates and Tigris basin and Israel, Lebanon and Syria for Jordan basin (Young et al. 1994: 20) Water not only created conflict between the countries but also within the state. (Elhance 1997: 207-218). Therefore, proper water resource management is required to resolve the conflict between and within the states and the state pays a pivotal role.

Water resources management means taking action of planning, developing, distributing and managing the best use of water resources. It is also regarded to competing requires for water and seeks to allocate an equitable basis to satisfy all user demands. Water resource management is composed of various elements such as water sharing, river basin planning, stakeholder participation, pollution resistor, monitoring, financial and information management (GWP 2010). There are three stages of water resources management like the regional, national and global level. At the regional level, the countries make an agreement for sharing water. At the national level, every country make laws, programmes, policies and maintain infrastructures for water. At the global level, international organizations like the United Nations and the World Bank help to maintaining water facilities and promote for water sharing (Young et al. 1994: 153-160).

For the efficient use of water resources, various management approaches have been introduced which emphasise on cooperation and integration between the states. There are four distinct perspectives of water resource management approaches such as the territorial sovereignty, territorial integrity, equitable utilisation and the common management approaches. According to the “territorial sovereignty” approach, all state which is situated on the banks of a river can alter the value of water as per their desire. As per the “Harmon Doctrine”, this approach is advantageous to the upstream countries. According to the territorial integrity approach, each nation has full right over its quality and quantity of water. Thus, the upstream countries are in hegemonic position because it is their choice whether they will share or not their water’s resource with the downstream countries. According to equitable utilisation approach, every nation has the rights to enjoy complete autonomy of navigation with no affecting the rights of other countries. The common management approach emphasises on the long time appointment by every interested group (David 2014: 78-79).

Integrated Water Resources Management (IWRM) approach is an organized method for supervising, sustainable development and share of water for economic, social and environmental purposes. It is a process which promotes the management of water, land and related resources in an equitable manner; and also assists to care for

the sustainable agricultural growth, world's environment, promote economic development and to improve human health (GWP 2008:1).

The IWRM centres on the better distribution of water to diverse water user groups and gives priority of allowing all interested group in the decision making procedure. It also supports on the integration of water supply and use with the waste management, sewage and groundwater protection (GWP 2010)

. The development of Integrated Water Resource Management was primarily advocated at the Dublin principles in 1992. IWRM refers to three principles such as the social equity, economic efficiency and ecological sustainability. The social equity refers to equal access for all users particularly marginalised and poor groups to an adequate quantity and quality of water necessary to sustain human being. Economic efficiency means bringing the greatest benefit to the greatest number of users possible with the available financial and water resources. Ecological sustainability means aquatic ecosystem are acknowledged as users and that adequate allocation is made to sustain their natural functioning (Ibid.).

In recent year, the Integrated Water Resources Management approach has been accepted internationally for their efficient, equitable and sustainable development. Many countries are facing water crisis because of poor management, poor infrastructure, adverse political relations etc. The obligation and political interest; financial stability, check and evaluation and sufficient investment are required for the smooth functioning of Integrated Water Resource Management. Since 1991, Central Asian Republics have been facing crisis like distribution of water and its resources.

## **Geographical locations of Central Asia**

Central Asia is a land locked and mountainous region which share borders with China to the east, Caspian sea to the west, Russia to the north and Afghanistan to the south. It is situated between the Tien Shan mountain to the east, the Ural mountain to the north and the Hindu Kush to the south. It is also known as Eurasia because it is situated in the heart of the Europe and Asia. It comprises five countries such as Kyrgyzstan, Tajikistan, Kazakhstan, Uzbekistan and Turkmenistan (GWP 2014).

Central Asian region is geopolitically more significant due to strategic location and huge reserve of natural resources such as oil and natural gas. Uzbekistan is the largest producer of cotton; Kazakhstan is the largest producer of oil and gas; Turkmenistan has huge natural gas and Tajikistan and Kyrgyzstan are rich in water resources (International Crisis Group 2007)

### **Map 1 Physical Map of Central Asia**



Source: <http://www.freeworldmaps.net/asia/central/physical.html>

### **Major water source in Central Asia**

The glaciers in Pamir and Tien Shan mountains are source of two major rivers of Central Asia such as the Syr Darya and the Amu Darya. The Amu Darya river is also known as Oxus and is the largest river of this region. It flows from the head water of Panj to the southern Aral sea. The Syr Darya is the longest river of this region and flows from head water of Naryn to the northern Aral sea (Dukhovny and Schutter 2011: 11). The other rivers which flow in Central Asia are Hari, Murghab, Zarafshan,

Chatkar, Chu and Talas. The other basis of water resource in Central Asia includes the lakes and reservoirs. The lakes in Central Asia include the Issyk-Kul, Ayderkel and Balkhash and the reservoirs include the Chardhara, Charvak, Nurek, Toktogul and Tuyamuyun (Pak 2014: 7).

Water is a vital resource for the dry Central Asian states. Most of the land in Central Asia is dry and rough for farming. The dryness of this region makes the agriculture difficult and its remoteness is inaccessible from much of the trade (Bosworth 1999).

### **Historical context of water management in Central Asia**

Water resource management had played a crucial role in Central Asia during its transition period. The history of water resources in this region is reflected by the irrigation practiced. During the ancient times, the natives of this region believed that everyone had an equal right over water and nobody could monopolise it for its own use and considered water as god gift. Their society had instituted an ancient law called the shariat and its purpose was management of water resource which was administered at two levels Mirab and Ariq-aksakal. Both had worked on the village level of water allocation for land irrigation purpose (Hara 2000: 423-441).

In the beginning of Tsarist regime (1850-1870) water resource management was not given due consideration because their main objective was expansion of defence but in the latter half of the 19<sup>th</sup> century, Tsarist Russia was promoted to produce cotton due to the lack of cotton for their textiles industry. Tsarist Russia was largely dependent on USA and UK for raw material of cotton but due to the civil war in America there was shortage of cotton in world market (Dukhovny and Schutter 2011: 100-102).

After 1917, the Tsarist government was replaced by the communist and it was mainly focused on agricultural and economic development. The state planning committee, commonly known as Gosplan was established in 22 February 1921 which focused on the policy of economic regionalization. There were 21 economic regions in Central Asia where Uzbekistan was considered as a major cotton producing region.

Gosplan was responsible for central economic planning and originally was an advisory council to the government. Its roles were limited to control the level and direction of state savings and planning for rapid industrialization and decline of the private sector of the economy (Pak 2014: 16).

The Union of Soviet Socialist Republics (USSR) was established in 1922. It had transformed Central Asia into a new riparian administrative unit with new boundaries. This boundary was formally created in 1924 because their motive was to promote cotton cultivation and to strengthen its government. Therefore, they had created a common exchange system under integrated policy. As per this policy, during winter season the downstream countries such as Kazakhstan, Uzbekistan and Turkmenistan would supply coal and gas to upstream countries and during the summer season the upstream countries would supply water to the downstream countries. But, this policy was not properly implemented as a result conflict and competition was raised between them for allocation of water resources (Hara 2000: 423-441).

Nikita Khrushchev (1953-1964) was the first secretary of the central committee of the CPSU. He did initiate “Virgin Land” campaign which focused on growing of wheat and encouraged expansion on irrigation (Dukhovny and Sokolov 2003). The land areas were mainly countryside settlements with small populations. Its workers were employed and transferred to this lands which produced main food and housing shortages. The people who were involved to this land settlement were youth from villages, released prisoners and orphans, because their standards of living were poor. Due to the regular out-migration and poor living standards, there were deficiencies of workers on the new Virgin Land state farms (Durgin 1962: 255-280).

The water resources management of old Soviet system was well organized and favourable for all riparian countries. The establishment of large water allocation infrastructure in the Central Asian region had increased agricultural production and employment. To meet the irrigation demand, importance was given to even distribution of water and for this purpose several policies and plans were implemented such as: the inter-basin and inter-republican network plans, managerial structure and function plan (Wegerich 2004: 335-344).



The water distribution systems of Soviet that resolved all intra and inter republic water dispute was vanished with the disintegration of the USSR and left the Central Asian states with problems of uneven distribution and consumption and the large degree of interdependence of water resources. The clash between the upstream and downstream countries arose because the operation of dams that controlled for both energy generation and irrigation (Elhance 1997: 207-218). To overcome this conflict, these countries were signed the different agreement like the “Agreement on Cooperation in Joint Management, use and protection of interstate sources of water resources”. It was signed on 18 February 1992 by the presidents of all the five Central Asian states and confirmed the status quo of water allocation structure of the former USSR until the new forms and arrangements of water allocation were developed. To implement the provisions of the 1992 agreement, the presidents of all these countries formed the ICWC which became the key institution accountable for monitoring water share of the Amu Darya and Syr Darya rivers (Libert 2008: 9-20).

Since the disintegration of the USSR, Central Asian states have made little progress in changing the Soviet style of water resources management and some Central Asian countries try to keep the old and out dated systems. The situation became more complicated when the downstream countries stopped supplying mineral resources to upstream countries which were subsidized during the Soviet time. Therefore, the upstream countries could not have enough money to pay these world prices because these countries economy were largely dependent on the Soviet Union. These countries are also poor in natural resources except water and the political instability like the civil war in Tajikistan had greatly impact on its economy. The downstream countries had not supported financial assistance to the upstream countries for their maintenances of reservoirs, dam and canals as a result the upstream countries started to collect water for the period of summer and release water for the period of winter. This disagreement between the Central Asian countries was directly impact on their economy and put the whole region into the frame of conflict (Wegerich 2008: 71-88).

To understand conflicts arising out of resource obtain and distribution, the present study has try to analyse water resource and its management in Kyrgyzstan and its impact on downstream countries.

## **Geographical locations and its importance of Kyrgyzstan**

Kyrgyzstan is a landlocked and mountainous region. It is situated in the east of China, west of Uzbekistan, north of Kazakhstan and south of Tajikistan. It is located at the junction of the Tien Shan and the Pamir Mountain (World Bank 2007). Kyrgyzstan is known as the home of glaciers, rivers, lakes and groundwater. It has 8208 glaciers such as Sary Jaz, Zailiy ridge etc. and six rivers basin like Syr Darya, Amu Darya, Chu, Talas, Issyk kul and Tarim. Kyrgyzstan has more than 40000 rivers and streams with 150,000 kilometre length. The main and the longest rivers of Kyrgyzstan is the Narayan (535 kilometre), Chatkar (205 kilometre) and Chu (221 kilometre) with their annual flow is 583 cubic kilometre. It has 1923 lake and available large amount of groundwater (ADB 2013).

Kyrgyzstan is officially named as the Kyrgyz Republics. Bishkek is the capital and largest city of Kyrgyzstan. Kyrgyzstan got independence from Soviet Union on 31 August, 1991. The constitution of Kyrgyzstan was adopted on 5 May, 1993. Kyrgyzstan adopted the unitary and parliamentary republican form of government where the prime minister is the head of the government and the president is the head of the state. The legislative power is used by the unicameral parliament or Zhgorku Kenesh with seventy five members. The executive power is used by the government. Kyrgyzstan is divided into seven administrative provinces or oblasts. The oblasts consist of twenty five towns and cities, twenty eight settlement of urban types such as Chu, Batken, Talas, Djalal Abad, Naryn, Osh and Issyk Kul and 40 districts or rayons (UNFCCC 2009: 32) and 440 village communities or aiyl aimak comprising of 1834 villages (Topbaev 2015: 18).

The above political system of Kyrgyzstan shows that its political system is participatory in nature and it gives equal opportunity to their citizen, non-governmental organizations (NGOs), civil society and academia; not only in the

decision making of political process but also in the field of water resources management.

After independence, Kyrgyzstan has quickly carried out market reforms like land reforms and improving the regulatory system. Kyrgyzstan is the first CIS country to be recognized into the WTO. It has been known as the most development nation in the region in terms of privatization, liberalization, transition towards market economy, restructuring of agricultural sector and reformation of financial sector (Dukhovny and Schutter 2011: 240).

Kyrgyzstan's economy is dominated by hydropower and agriculture. Although, wool, cotton, tobacco and meat are the major agricultural products, only cotton and tobacco are selling abroad in any quantity. The other exports are mercury, gold, natural gas, electricity and uranium. The water demanding agricultural products like cotton, vegetables and cereal. The production of vegetables and cereal had risen over 2005-2009, whereas the production of cotton had declined significantly from 118100 tonnes in the year 2005 and 49200 tonnes in the year 2009 (OECD 2013: 23).

Kyrgyzstan requires foreign investment to develop hydroelectric potential. Its economy also rely on remittances from migrant workers mainly in Russia. The Gross Domestic Product (GDP) of Kyrgyzstan expanded 3.50 percent in 2015 (National Statistical Committee of Kyrgyz Republic). Agriculture contributed only 21 percent of GDP in 2010 and plays a crucial role for the economy development (USAID 2013: 10-30).

Water has played a significant role in the growth of agricultural sector. Therefore, the government of Kyrgyzstan has introduced hierarchical structure for water resource management.

In Kyrgyzstan, the policy formulation and agenda setting are dominated by the president. The parliament is not a major actor in the making of water policy. The hierarchy of water resources management organizations at the national, provincial and district levels carry out managing of water resources in their areas of administrative jurisdiction. The national level of the organizational hierarchy mainly effects

regulatory and governance functions in the water sector. The parliament is the legislator and makes decisions on the legal framework for the managing of water resources. The president makes decisions the country's water policy and is engaged in the procedure of law making. The president who is supported by the guidance of the NCWS, scientists and skilled water professionals decides the water policy and is engaged in the procedure of law making (UI Hassan et al. 2004: 8-10).

The Government of Kyrgyzstan, Ministry of Agriculture and Water Resources and Food Processing Industry, National parliament, Ministry of Emergency Situations, State Agency on Geology and Mineral Resources, State Agency for Nature Protection, Ministry of Health Care, State Inspection on Standardization and Metrology the National Committee on Statistics, Ministry of Justice and Ministry of Foreign Affairs are carried out guideline of water relationships. The local state governments also take part in water resources management which carry out on their own territories of the following functions: allocation of land for water fund, protection of water user rights and restriction of water use rights in justified cases. Therefore, a number of state bodies with their own terms, instructions and norms deal with water resources management (GWP 2006: 5-10).

The Ministry of Agriculture and Water Resources and Food Processing Industry plays an important role in water resources management. It takes away function and repairs of irrigation systems and sends water to water users (Ibid.).

The Ministry of Agriculture and Water Management jointly work on the three related areas like agriculture, processing industry and water management. The major departments are the Water Resources and Water Use Department, Irrigation Systems Maintenance Department, Economics, Finance and Registration Department and the Project Management Department. The Water Resources and Water Use Department is accountable for share and supply. The Irrigation Systems Maintenance Department is responsible to manage the physical repairs of the system. The Economics, Finance and Registration Department is accountable for manages the allocation of financial resources and the Project Management Department take accountability in the development projects like the World Bank and the On-Farm Irrigation Management Project (Kazbekov and Qureshi 2011: 45).

The Basin Water Management Department works on the regional level. The region manages the actions of the districts with regard to water sharing, water utilizes and performance of allocation plans, approval of activity plans and maintenance and repairs. Its goal is to ensure fair distribution of the existing resources. It gathers data on all management activities from the district and combines the data on financial requirements, expenditures and allocation for submission to the Water Management Department. The region upholds interprovincial affiliations with neighbours concerning the operation and maintenance of divided canals. They resolve troubles and deal with cross boundary issues like water repair and deliveries through the negotiation. Besides, the region put into practice the rehabilitation plans of the Republican Department and employs manufacture companies for big projects (Dukhovny and Sokolov 2005: 35-53).

The District Water Management Department are the execution departments for all water managing functions in the common canal systems. The Water Use Department is lead by a chief engineer or hydro technical engineer who is in charge for the operation and maintenance of the irrigation system; in particular the allocation of water to users and distribute to the on-farm canals off takes. The department also obtains engaged in the regulation of conflict situations among both water users and staff (Ul Hassan et al. 2004: 8-10).

### **Policies, Programmes and Projects in Kyrgyzstan**

Water has been playing an important role in Kyrgyzstan for various activities such as irrigated agriculture, industry, generation of hydroelectricity and drinking but its management has remained a neglected area of concern. The indiscriminate diversions of water for agriculture, industry, over tapping and unchecked discharge of waste have resulted in reduced the flow of water and poor ecological health. The poor conservation and lack of scientific management practices have also a cause of suboptimal utilization of water resources. Therefore, Kyrgyzstan's economy has declined and creates several problems such as food insecurity, poverty, unemployment, migration, shortage of energy, political instability and corruption (World Bank 2007: 3-16).

Therefore, to mitigate these above problems the government of Kyrgyzstan has initiated number of programmes and policies such as the Water law 1994, Water User Associations (WUA), Water code 2005 etc. The other various measures are also taken by the collaboration of different international organizations and the government of Kyrgyzstan such as the Almaty agreement 1992, Interstate Commission for Water Coordination (ICWC), International Fund for Aral Sea (IFAS), Interstate Council for Addressing Aral Sea Crisis (ICAS), Integrated Water Resource Management (IWRM), United Nations for Education, Scientific and Cultural Organisations (UNESCO), World Bank (WB) and United Nations Development Programme (UNDP). Their main objectives are to improve water resources management for multi-perspective sustainability such as the social, economical, political and environmental (UNDP 2011: 1-16).

Kyrgyzstan had passed the “Law on international use of water objects, water resources and water management facilities of the Kyrgyz republic” in 2001 and it is commonly associated with Turdukan Usulbaliev, the first secretary of the Kyrgyzstan Communist Party and the member of parliament. The law is also called the “Law of Mr. Usulbaliev”. This law defines that water as an economic good and those who will use it must be pay. It also says that, Kyrgyzstan has the rights of all water resources which are began on its territory. Thus, Kyrgyzstan has the right to utilize as much water for present and future needs (Sehring 2005: 44).

Kyrgyzstan had passed the law on “Water User Associations” in 2002 which is a membership based, non-governmental and non-commercial organization. It aims is to managing water resources at the farm level, operating irrigation system and drainage infrastructures, ensuring fair, effective and timely distribution of water to the farm, collect payments for water supply and resolve minor water disputes but the WUA is not effective because it was established in a bureaucratic method without involving the local population, local farmers and farm workers. The local water administration does not give the decided amount of water due to lack of finance, poor infrastructure, illegal water withdrawal by the upper located farmers and the favoured allocation to friends and relatives of the village privileged (Alymbaeva 2004: 27).

The “Taza Suu” or clean water programme was introduced by the government of Kyrgyzstan in 2002 which aimed at rehabilitation and construction of rural water pipelines and growing right to use of secure drinking water to population. It includes the projects like infrastructure services at inhabited areas and rural water deliver and sanitation financed by the World Bank and the Asian Development Bank (UNECE 2009).

Kyrgyzstan had passed the “Water Code” in 2005 which is supported on the perception of Integrated Water Resources Management (IWRM). The Code covers the basic principles of institution of water resources management stand on hydrography, credit of the economic importance of water resources, involvement of water users in planning and management and consolidation of controlling functions over water resources within the framework of a newly set up specific state authority. The Water Code encourages clear legal relations between state authorities for the management of irrigation infrastructure and the newly set up and rising group of supportive users of irrigation water (UNDP 2010).

Kyrgyzstan has potential to generate hydropower. Therefore, it has started hydro project such as Kambarata-1 (1900 megawatt), Kambarata-2 (360 megawatt), DJilanaryk-1 (100 megawatt), Akbulun (200 megawatt) and Saryjaz (1200 megawatt). The Kambarata-1 hydro project has become a controversial issue from a geopolitical perspective because Uzbekistan opposed it. Kyrgyzstan has also a part of CASA1000. To more improvement the water sector, it requires to provide human resources, sustainable development and competence building which are intimately associated with direct ventures into infrastructures (Stobdan 2014: 108-109).

Therefore, the technical support, rehabilitation of infrastructure, capacity building and proper implementation of agreements are the necessary steps require for the sustainable water management in Kyrgyzstan.

### **Impact on downstream countries**

There are many policies and programmes have initiated by the government of Kyrgyzstan for their economy development and it has severely impacted on

downstream countries in various sectors like the social, economy, political and environmental.

The agriculture and cotton productions of downstream countries have declined due to the non release of water by Kyrgyzstan (Weinthal 2006). The storage of water by the upstream countries for generation of hydroelectricity and irrigation have severely impacted on the Aral sea; therefore the water level of Aral sea has declined that caused increased salinity, climate change and health problems to the local communities (FAO 2012: 1-20).

The purpose of construction of Dams by Kyrgyzstan is used as the instrument for human development, generation of hydroelectricity, irrigation, drinking water supply, flood control and navigation but on the other hand the construction of dam have also negative socio-economic impact on people such as the resettlement and migration, changes of size and structure of household, employment and income (Tullos et al. 2009: 203-207).

The solution of water distribution in Central Asian state is difficult because the upstream countries pursue their national importance and are unwilling to compromise into this potentially “zero sum game”. The large differences of water consumption become a source of disputes between the water abundant countries like Kyrgyzstan and Tajikistan and the water deficiency states like Kazakhstan, Uzbekistan and Turkmenistan (Spoor and Krutov 2003). The Strained relation is not only happening between the upstream and downstream countries but also happening within the downstream countries due to the lack of mutual cooperation and not properly implementation of agreements and policies.

The study will explain the availability of water resources in Kyrgyzstan such as glaciers, rivers, lakes, groundwater etc. and it will analyses on Kyrgyzstan’s water policies and management in various sectors. The study will find out the impact of Kyrgyzstan’s water policies and programmes on downstream countries. The study will examine how water resource is playing an important role in Kyrgyzstan dealing with the strained relations and it will find out how to resolve water related problems between the Central Asia states.



Two hypotheses have taken into consideration while conducting the research. The study will test the hypothesis that the utilization of hydropower by Kyrgyzstan has affected the economy of downstream countries such as Kazakhstan, Uzbekistan and Turkmenistan. It will also try to explore whether poor infrastructure facilities in water management has led to water crisis in Kyrgyzstan.

The present study is focused on “Kyrgyzstan’s Water resource Management, 1991-2015”. I have chosen the starting period 1991, because Kyrgyzstan got independence in this year. The proposed study will briefly review the geographical importance of Central Asian region and later focus on different components and aspects of water resources. The research will employ historical, descriptive and deductive methods. It will also make an attempt to draw the descriptive and causal inference based on the research. It will take into account the availability of the primary and secondary resources. The data required for the primary resources of the proposed research includes government reports, speech of political personalities, documents published by international organization like the UNO. The secondary sources comprising books, journals and magazines, newspapers, articles available on internet and other published resource materials will also be employed in this research. This will be supplemented by interviews with scholars who are interested in the topic of research or who have worked on the related topic, state representatives and ambassadors. If viable, a field trip will be undertaken to Central Asia in order to gather fresh data and first hand report on Kyrgyzstan’s water resource management.

The study will try to answer the research questions: What were the assessments of the Soviet’s water policies? What are the positive and negative aspects of water resource management in Central Asian region? How far Kyrgyzstan’s water policies impact on downstream countries? How far Kyrgyzstan’s control over water recourses affected to downstream countries? What are the major steps taken by the government of Central Asia to resolve the problems?

The present dissertation has tried to analyses Kyrgyzstan’s Water resource Management, 1991-2015. The research work has divided into five chapters. Chapter 1 contains the introduction which deals with the brief history and geographical location of Central Asian region.

Chapter 2 focuses on the available water resources such as glaciers, rivers, groundwater, lakes and reservoirs. It will also deal with the transboundary water nature of the river.

Chapter 3 deals with the government's policies and programmes on water usage for various sectors like irrigation, agriculture, industry and hydropower. It will also deal with various projects related to the water resource management.

Chapter 4 will highlight the impact of water usage by Kyrgyzstan on downstream countries like Uzbekistan and Kazakhstan and how does water is playing an important role in Kyrgyzstan dealing with strained relations.

The concluding chapter will discuss the findings of the study and test the hypotheses and answer the research questions.

## **CHAPTER -2**

### **Water resources in Kyrgyzstan**

Kyrgyzstan is a water rich upper riparian state. It produces large amount of water resources from glaciers, rivers, lakes and ground water. It is also known as Switzerland of Central Asia (Mamatov et al. 2007: 171). This chapter deals with the obtainability of water resources in Kyrgyzstan from the surface and ground water and the transboundary rivers.

The abundance of water resources in Kyrgyzstan depends on its geographical location and climate. Kyrgyzstan can be divided into two hydrological zones on the basis of topography; the first one, the flow generation zone and the second one is flow dissipation zone. The flow generation zone is a mountainous zone and has maximum precipitation and water storages. It is situated at the junction of Tien Shan and Pamir mountains which covered 171800 square kilometre area around 87 percent of the total land. The flow dissipation zone is a main valley, plains and dense area. It is situated in the north and South West of Kyrgyzstan which covered 26700 square kilometre area or 13 percent of land (FAO 2012: 4).

Climate is another important factor which affecting the water resources in Kyrgyzstan. Climatic conditions in a region can be affected firstly by the region's topography and distance from the sea level and secondly by the global conditions and human activities. The climate in Kyrgyzstan is continental, with cold winters, and warm and sunny summers. Precipitation is moderate in the west, while the east-central is arid. From the vast deserts of neighbouring countries stormy winds blow. Kyrgyzstan is crossed by several mountain ranges. Some of the main ones are Fergana Mountains, the Pamir and Alay, various branches of the Tien Shan.

## Map2 Political Map of Kyrgyzstan



Source: [www.nationsonline.org/maps/Kyrgyzstan-political-map.jpg](http://www.nationsonline.org/maps/Kyrgyzstan-political-map.jpg)

## **Geographical location of Kyrgyzstan**

Kyrgyzstan is a landlocked country. It is located in the core of Eurasian continent and North eastern part of Central Asia. It has covered total area of 199.9 thousand square kilometre. It borders with China (1049 kilometre) to the east and south east, Uzbekistan (1374 kilometre) to the west, Kazakhstan (1113 kilometre) to the north and Tajikistan (972 kilometre) to the south (Mogilevsky et al. 2005: 5). It has land border of about 4508 kilometre (UNEP 2006: 12).

The population of Kyrgyzstan was 5895100 million in 2015, where the rural population consisted of 3930066 which is two-third of the total population of Kyrgyzstan and an urban population comprised of approximately 1965033 which is one-third of the total population. The bulk of population resides in Osh and Jalalabad provinces due to nearby Fergana valley. The least density of population resides in Naryn and Talas provinces due to mountainous region (National Statistical Committee 2015).

The main cities are Bishkek (937.4 thousand persons), Osh (270.3 thousand persons), Karakol (70500), Tokmok (55800), Balykchy (44400), Uzgen (52100) and Karabalta (40400). The major provinces are Jalalabad (1122.4 thousand persons), Naryn (274.5 thousand persons), Batken (480.7 thousand persons), Issky-Kul (463.9 thousand persons), Chui (870.3 thousand persons) and Talas (247.2 thousand persons) (Ibid.).

The above data shows that, Kyrgyzstan is not the only country to occupied water resources due to its transboundary nature. The consumption of water resources is also increase due to their population growth in every year.

## **Mountains**

Kyrgyzstan is a mountainous country. It is situated between the two large mountains such as the Tien Shan and the Pamir. The Tien Shan and the Pamir mountains are located in the Northeast and South West part of Kyrgyzstan respectively and are covering 65 percent of land. Tien Shan is the largest mountain in

Kyrgyzstan and it is ranging from 7439 metre at Pik Pobedy (highest peak) to 394 metre in the Fergana valley near Osh (Kustareva and Naseka 2015: 149). The altitudes of Kyrgyzstan vary from 401 to 7439 metre above sea level. More than 40 percent of the territory is located 3000 metre above the sea level (Mogilevsky et al. 2005: 5).

Kyrgyzstan has some important valley like Chu and Talas, Fergana, Alay, Chatkal, Arpa and Kichi Kemin. The Chu and Talas valley is situated in the North West border of Kyrgyzstan. The Fergana, Alay, Chatkal and Arpa valley are situated in the South West part of Kyrgyzstan. The Kichi Kemin valley is situated in the east part of Chu valley in north Kyrgyzstan (World Bank 2008: 3). Valley is important because it is fertile area and maximum cultivation is done here. The valleys are the most fertile region of the country where most of the agricultural activities take place.

## **Climate**

The climate of Kyrgyzstan is affected by its geographical location and its distance from the sea levels because it is surrounded by mountains as a result it barriers of wind and altitude cause of low temperature. The distance of sea level make continental climate and insufficient water does not influence the weather. There are four vertical climate zones such as the low land, Middle Mountain, High Mountain and naval mountains. The low land varies from 500-600 to 900-1200 metre, the middle mountain varies from 900-1200 to 2000-2200 metre, the high mountain varies from 2000-2200 to 3000-3500 metre and the naval mountain varies from 3000-3500 metre above the sea level (UNFCCC 2003).

The climate of Kyrgyzstan differs from one region to another region due to topography and existence of the Issyk-Kul lake. It can be divided into four climate zones based on its geographical location such as the Northeast region, North West region, South West region and Inner Tien Shan region (UNFCCC 2009: 35-36).

The climate is marine in Northeast region due to the Issyk Kul lake basin which never freezes. The air temperature in this region is increasing at the rate of 1.04<sup>0</sup>C per hundred years. The amount of rainfall is slightly increasing in all weather stations. The Cholpon Ata town (0.6932 millimetre per year) receives the highest amount of

rainfall and maximum precipitation is held during the summer season (UNDP and UNEP 2012: 22-28).

The climate is warm and humid in North West region. This region comprises Chui and Talas valleys. The maximum temperature in this region is +44 degree Celsius. The air temperature in this region is increasing at the rate of 1.65 degree Celsius per 100 years. The precipitation trend shows that, the amount of annual rainfall is increasing except Talas weather station. “The rainfall is maximum in the spring season and early summer and moderate in the winter season. The valley remains dry in the second half of the summer season” (World Bank 2009: 28).

The temperature is warm and humid in South West region where the Fergana, the Alai and the Chatkal valley are situated. The minimum temperature in this region is -27<sup>0</sup> Celsius and maximum temperature is +44<sup>0</sup> Celsius. The average annual rainfall in this region fluctuates between 100 millimetre to 170 millimetre (Wegerich et al. 2012: 548-550). The rainfall is maximum in the winter season. The air temperature in this region shows an increment of 2.14<sup>0</sup> Celsius per hundred years. The annual precipitation is increasing in Batken weather station but it is not probably sufficient. However, in Jalal-Abad (0.3478 millimetre per year) and Osh (-0.0077 millimetre per year), there is a slight decrease in the amount of precipitation (UNDP and UNEP 2012: 22-28).

The climate is cold and humid in the Inner Tien Shan region. The average temperature is 0.6<sup>0</sup> Celsius for every 100 metres. The maximum temperature is +44<sup>0</sup> Celsius and the minimum temperature is -53.6<sup>0</sup> Celsius. The trends show here is an increment of 1.41<sup>0</sup> Celsius per hundred years. The annual precipitation has seen a slight increase in the Naryn (0.4344 milli metre per year) weather station (Ibid.). The maximum precipitation in this region is in the month of May, June and July (World Bank 2009: 29).

Therefore, the topography and climate plays an important role on the hydrography of Kyrgyzstan.

## **Hydrography of Kyrgyzstan**

In Kyrgyzstan, water resources have found in various forms like the surface water and the ground water.

### **Surface water**

The surface water is found on the surface of earth in fixed as well as flowing forms. The surface water is the glaciers, rivers, lakes and reservoirs. The snow caps and glaciers found on the high mountain areas are water in fixed forms and the rivers and lakes are found in the lower or plains areas are in the liquid form (Gurjar and Jat 2008: 30-31).

### ***Glaciers***

Kyrgyzstan has 8200 glaciers with the volume of 417.5 cubic metre. The glaciations area of the country is 8169.4 square kilometre which occupies 4.2 percent of the total area (Mamatov et al. 2007: 172). The important glaciers of Kyrgyzstan are Inylchek, Kayingdi, Korzhinevskogo, Mushketova, Semyenova, Lenin, Nalivkina, Keikal, Petrova, Abramova, Golubin, Kara Batkak, Suekzapadniy and Akshiirak.

The Inylchek is the largest glacier which is divided into two branches such as the northern and southern Inylchek (Lifton et al. 2014: 77-90). The northern Inylchek is situated between the two big mountains Saridjass and Tangritaag. Its length is 32.8 kilometre, area is 215.2 square kilometre and height of the lowest point is 3400 metre. The lake Merzbacher flows in this region (Glazirin 2010: 171-178). The southern Inylchek is the second largest in Central Asia after Fedchenko glacier which is located in the Pamir mountain. It is the largest glacier of Tien Shan mountain. Its length is 60.5 kilometre in East West direction, area is 500 square kilometre and height is 2880 metre. It is situated between the Tengry Tag and Kokshaaltau ridges. It started in Khan Tangry area and has 43.2 kilometre length, 2.2 kilometre width and falls upto 2800 metre. The ice thickness is 150-200 metre in bottom parts of its body. Its other



names are Starlet, Wild, Proletarian traveller and Komsomol. The river flows here is Inylchek (Shangguan et al. 2015: 704).

The Kayingdi glacier has 29.0 kilometre length, 97.2 square kilometre width and 1040 metre height above the sea level. The river which flows here is Kayingdi. The Korzhinevskogo glacier has 21.5 kilometre length, 99.4 square kilometre width and 1885 metre height above the sea level. It has a river named the Djanai Dartak. The Mushketova glacier has 20.5 kilometre length, 71.3 square kilometre width and 1050 metre height above the sea level. The Arir Ter river flows in this glacier. The Semyenova or Semenov glacier has 20.2 kilometre length, 64.5 square kilometre width and 1020 metre height above the sea level. The Saryjaz river flows in this glacier (Bekturov 2014: 15).

The Lenin glacier has 13.5 kilometre length, 58.1 square kilometre width and 1150 metre height above the sea level. It has a river named the Achik Tash. The Nalivkina glacier has 13.2 kilometre length, 19.5 square kilometre width and 1210 metre height above the sea level. The river Ai Tala flows in this glacier. The Keikal glacier has 12.9 kilometre length, 26.8 square kilometre width and 1030 metre height above the sea level. The river Terekti flows in this glacier (Ibid.).

The Petrova glacier located on the North Western slope of the Akshyirak range has 12.3 kilometre length and 69.8 square kilometre area (Jansky et al. 2008: 85-86). The Abramova glacier has 9.0 kilometre length and 25.2 square kilometre area. The Golubin glacier is situated in the Ala Archa valley in the northern Tien Shan mountain. It has 5.5 square kilometre area and has thickness an altitudinal range between 4400 and 3300 metre above the sea level (WGMS 2013: 63). The Kara Batkak, Suek Zapadnyy and Akshyirak glaciers are also located in the Tien Shan mountain (WGMS 2013: 3).

Due to the rising temperatures, glaciers have been melting as a result the water levels have increased. The increasing water levels have cause flood and its impact on human beings.

**Map 3 Map of rivers in Kyrgyzstan**



Source: <http://www.mapsofworld.com/kyrgyzstan/river-map.html>

## ***Rivers***

Kyrgyzstan has more than 3500 rivers which are fed by melting glaciers. The majors rivers are the Syr Darya, Naryn, Kara Darya, Chui, Talas, Chatkal and Chirchick (UNDP and UNEP 2012: 35-36).

**Table1 Major Rivers of Kyrgyzstan**

Name of the rivers	Length (km)	Catchment Area (square km)
Sya Darya	2212	219000
Naryn	578	59900
Kara Darya	180	30100
Chui (chu)	1186	22491
Talas	661	52700
Chatkal	217	7110
Chirchick	-	14240

Sources: UNDP and UNEP 2012

\*UNECE 2007

The above table shows that, the Syr Darya River is the lengthiest river in Central Asia. It has 2212 kilometre length and 219000 square kilometre catchment area. The Naryn river is a major river of Kyrgyzstan and head water of Syr Darya has 578 kilometre length and 59900 square kilometre catchment area. The Kara Darya river has 180 kilometre length and 30100 square kilometre catchment area. The Chu river has 1186 kilometre length and 22491 square kilometre catchment area. The Talas river has 661 kilometre length and 52700 square kilometre catchment area. The Chatkal river has 217 kilometre length and 7110 square kilometre catchment area. The Chirchick river has 14240 square kilometre catchment area (Ibid.).

## *Lakes*

There are 1923 lakes in Kyrgyzstan (Sarieva et al. 2008) which is the total surface area of 6836 square kilometre. The water stock in the lakes is estimated at 1745 cubic kilometre (Jailoobayev et al. 2009: 8) or about 71 percent of total national water reserve (UNDP and UNEP 2012: 34). The major lakes of Kyrgyzstan are “Issyk kul, Son kul, Chatyr Kul, Sarychelek, Petrov, Jardy Kaindy, Merzbacher and Buzulgansu”.

The Issyk Kul lake is the major and largest lake in Kyrgyzstan. It is one of the largest mountainous lakes in the world and originated through tectonic process. It is located in the northern Kyrgyzstan of Tien shan. It has 178-182 kilometre length, 58-60 kilometre width and 6206-6236 square kilometre surface area. Its depth is 702 metre (2303 feet) and having a volume of 1738 cubic kilometre (416 cubic miles). The lake does not freeze in winter season because it is a hot lake. The lake is situated at an altitude of 1606-1609 kilometre (5278 feet) and the lake is slightly brackish (Kustareva et al. 2015: 152). It is the second largest mountain lake after the South American Titicaca lake. The Issyk Kul lake is called “a pearl of Kyrgyzstan” (Mitchell 2008: 145).

The Son Kul lake is a tectonic originated lake and is the second largest lake of Kyrgyzstan. It has 2.66 cubic kilometre water volume, 273.3 square kilometre area and 3016 metre height above the sea level (Kustareva and Naseka 2015: 154). The Chatyr Kul lake is lies between the At Bashi and Kokshaal Too ranges near the border with China. The length of this lake is half about the size of Son Kul lake. It has 170.6 square kilometre area, 1050 square kilometre catchment area and 3530 metre above the sea level. The length of this lake is 23 metre, width is 10 metre and its maximum depth is 16.5 metre. The average depth is 3.8 metre. Its volume is 610 million cubic metre and surface area is 153.52 kilometre. This lake is salty and cold. It is not deep and is fishless (CAREC 2013: 37).

The Sary Chelek lake is a small and an oldest lake in Tien Shan mountain. It is situated in the territory of Sary Cheleksky biospheric reserve and it has 1876 metre height above the sea level in the northern part of Chatkalsky range. Sary Chelek lake is 7.2 kilometre long, 2 kilometre wide and 244 metre depth (Kustareva and Naseka

2015: 155). The Petrov lake situated on the North Western slope of Ak Shiirak in central Kyrgyzstan in the centre of the Petrov glacier is 3741 metre above the sea level. This lake is nourished by melt water from the Petrov glacier and from the glaciers hanging from the rock walls and side valleys (Sarieva et al. 2008: 85-86).

The Jardy Kaindy lake has themokarstic origin and is situated on the northern slope of the Kyrgyz ridge. The Merzbacher lake with a volume of water up to 130 million cubic metre is located in the juncture of the North Inylchek and South Inylchek glaciers. The Buzulgansu lake is located on the southern slope of the Kyrgyz ridge (Jansky et al. 2006: 136).

Due to climate change glaciers are melting and over flowing leading to floods. The frequent flood cause hazardous situation like damage of crops and infrastructure.

### ***Reservoirs***

Kyrgyzstan has twelve reservoirs like Toktogul, Kirov, Orto Tokoy, Papan, Tortgul, Ala Archa (channel based), Ala Archa (off channel), Naiman, Spartak, Bazarkorgon, Sokuluk and Karabura comprising the total volume of 21112 million cubic metre. The purpose of building reservoirs is for electricity generation and secure water supply of irrigation (UNDP and UNEP 2012: 38).

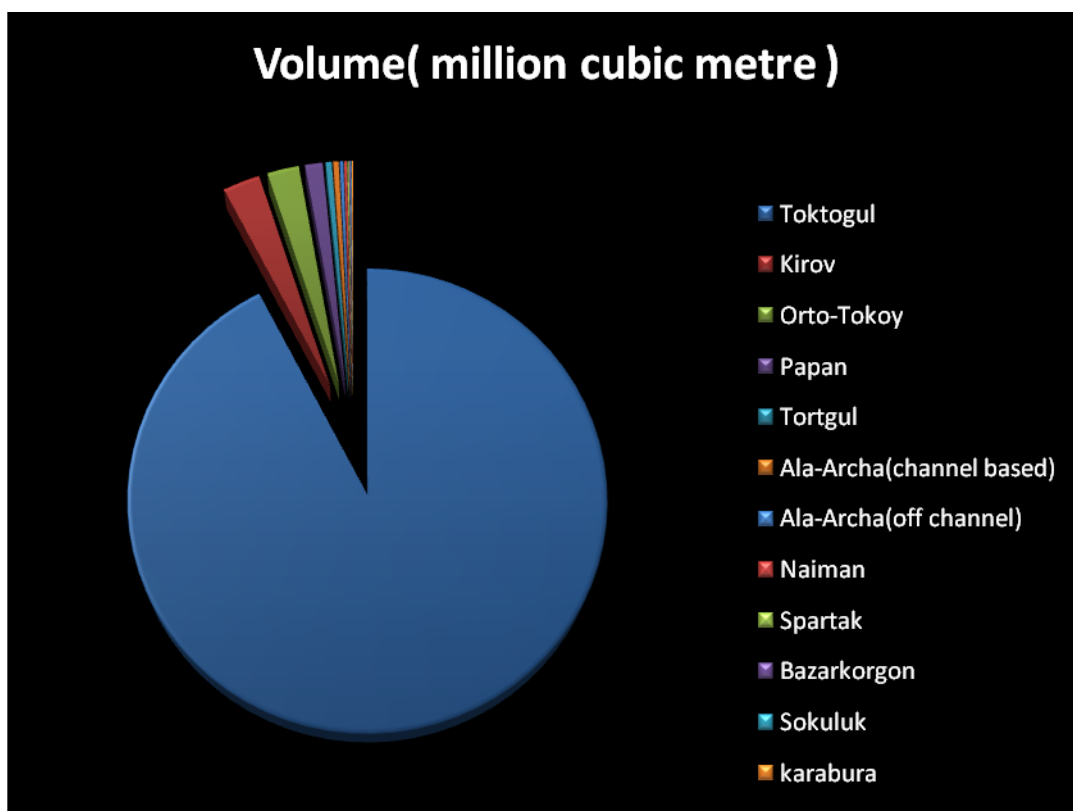
**Table 2 Reservoirs of Kyrgyzstan**

Reservoirs	Rivers	Volume (million cubic metre)
Toktogul	Naryn river	19500
Kirov	Talas river	550
Orto-Tokoy	Chu river	470
Papan	Ak-Bura river	260

Tortgul	Isfara river	90
Ala-Archa (channel based)	Ala-Archa river	80
Ala-Archa (off channel)	Chu River	52
Naiman	Abshirsay river	39.5
Spartak	Sokuluk river	22.0
Bazarkorgon	Karaunkyr river	22.0
Sokuluk	Sokuluk river	9.3
Karabura	Karabura river	17.0
Total		21112

Source: UNDP and UNEP 2012

Figure 1 Volume of Reservoirs of Kyrgyzstan



Source: UNDP and UNEP 2012

The above table shows that, Toktogul is the largest reservoir in Kyrgyzstan where 19500 million cubic metre of water is stored. It is build up on Naryn river. The Kirov reservoir has a total volume of 550 million cubic metre and it is build up on the Talas river. The Orto Tokoy reservoir is build up on the Chu river with 470 million cubic metre. The Papan reservoir is located on the Ak Bura river where 260 million cubic metre water has stocked. The Tortgul reservoir is situated on the Isfara river with the capacity of 90 million cubic metre. The Ala Archa (channe based) reservoir is build up on the Ala Archa river in Kyrgyzstan with 80 million cubic metre. The Ala Archa (off channel) reservoir is build up on the Chu river and has capacity of 52 million cubic metre. The Naiman reservoir has 39.5 million cubic metre of water stored build up on the Abshirsay river. The Spartak reservoir is build up on the Sokuluk river with volume of 22.0 million cubic metre. The Bazarkorgon reservoir is build up on the Karaunkyr river with capacity of 22.0 million cubic metre water storage. The Sokuluk reservoir has 9.3 million cubic metre build up on the Sokuluk river. The Karabura

reservoir is build up on the Karabura river with capacity of 17.0 million cubic metre (Ibid.).

## **Groundwater**

Groundwater is the water found under the earths surface in the breaks and spaces of soil, sand and rocks which is stored between and move slowly through geological developments of soil, sand and rock called aquifers. It is also used for many purposes like agriculture, industries and municipalities. Groundwater is inexpensive, more useful and less exposed to pollution than surface water. Therefore, it is usually used for community water supplies. Groundwater is the most widespread and highly used resource. It is of immeasurable value to the inhabitants of the dry region.

Groundwater pollution is generated from improper disposal of water or land. The chief source of pollution comprises the industrial and household, chemicals and garbage and excessive use of fertilizers and pesticides (Gurjar and Jat 2008).

Kyrgyzstan has an abundance of groundwater resources which makes the region wealthy in fresh water. It has potential of 13 cubic kilometre. Till now forty four deposit have discovered which makes up 10545.2 thousand cubic metre. The groundwater of Kyrgyzstan is also known as “Karasu”. In Kyrgyzstan there are more than 250 natural and artificial wells (UNDP and UNEP 2012: 36-37). Groundwater is major source of fresh water in Kyrgyzstan. It plays an important role such as agriculture, industries and household.

## **Transboundary nature of River Basin**

The Transboundary River is a river which crosses international boundary and at least one border between the states. There are six major river basins in Kyrgyzstan Syr Darya, Chu, Talas and Assa, South eastern Tarim, Issyk Kul, Amu Darya and Karkyra which are shared between Kyrgyzstan and other neighbouring countries.



**Table 3 Renewable surface water resources (RSWR) by major river basin**

River basins	Areas	Part of territory covered by kyrgyzstan (%)	Internal RSWR (cubic km per year)	Water share between countries	Outflow secured through agreement (km <sup>3</sup> /year)	Actual RSWR (cubic km per year)
Syr Darya (Naryn, Chatkal)	West	55.3	27.42	Uzbekistan and Tajikistan	22.33	5.09
Chu, Talas and Assa	North	21.1	6.74	Kazakhstan	2.03	4.71
Southeastern (Tarim basin)	Southeast	12.9	5.36	China	-	5.36
Rivers of the lake Issyk-Kul	Northeast	6.5	4.65	Endorheic and internal basin	-	4.65
Amu Darya (KyzylSuu)	Southwest	3.9	1.93	Tajikistan	1.51	0.42
Karkyra (lake Balkhash basin)	Northeast	0.3	0.36	Kazakhstan	-	0.36
Inflow from west slopes of Barluke mountain						0.558
Total		100	46.46		25.87	21.148

Source: FAO 2012

The Syr Darya river basin comprises 55.3 percent of the western part of Kyrgyzstan. It is shared by Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan. The annual flow of this river basin average is 37 cubic kilometre and ranges between 21 and 54 cubic kilometre (Wegerich et al. 2012: 549). Its tributaries are the Naryn and

the Kara Darya rivers. These tributaries are united in eastern Uzbekistan of Fergana valley and form the Syr Darya river. After flowing through Uzbekistan, it enters Tajikistan and come again Uzbekistan where it receive the Chatkal river. The left bank tributaries of Syr Darya rivers are the Isfairamsai, Shakhimardan, Sokh, Isfara and Khodjabakirgan (Ibid.). the right bank tributaries of Syr Darya are the Padshaata, Kassansay, Gavasay, Kekserrek and Chatkal flowing down from the South Western slope of the Chatkal range (UNDP and UNEP 2012: 35).

The Chu, Talas and Assa river basins form in Kyrgyzstan and flows into Kazakhstan where it cover 21.1 percent area of the northern part of the territory. The basins have included three rivers such as the Chu, Talas and Assa. The Chu basin comprises of 140 small rivers, the Talas basin has 20 small rivers and the Assa basin has 64 small rivers along with 35 lakes and 3 large water reservoirs (UNECE 2007: 84). The most of the northern territory of Kyrgyzstan is occupied by the Chu river basin with the volume of 1.15 cubic kilometre. The merger of the Kochkor and Dzhuanaryk rivers give birth to Chu river in the Kochkor valley. The Chon Kemin river is being one of the major tributary flows into the Chui river as the right hand tributary. The left tributaries of Chu river basin are Kichikemin, Shamsi, Issikata, Alaarcha, Alamedin and other rivers rolling down to the northern incline of the Kirgizskiy range (Kustareva and Naseka 2015: 151). In the Northwest, the Chu river basin borders with the Talas river basin and is bounded on the north and south by the Kyrgyz and Talas mountain ranges. The Talas river is made by the meeting of the Karakol and Uchkosha rivers (UNECE 2007: 87).

The Assa river basin which is the right tributary of the Ters river is located in the western part of the Talas valley and is known as Kurkureusu river basin. The Ters river when reaches on the plains stretch of Karatu range then it is called as Assa river (Kustareva and Naseka 2015: 153).

The Aksu, Aksay and Kek Suu are the important South eastern river basins that cover almost 12.9 percent of South eastern region: These river basins finally enters to china and drains in the Tarim basin. The Tamir river which formed in the Kyrgyz republic with flows into China with 1321 kilometre long and in the Xinjiang Uyghur Autonomous Region which is the entire southern part and here it covers an area of

1.02 million square kilometre having tributaries like the Akshay river, Chong Uzengikuush river, SaryJaz river and Keksuu river. The Sary river is the major river which flows in Tamir basin and it is raised by the snow and glaciers of the highest mountain ranges Kokshaal Too, Enilchek Too and the Ak Shyyrak range (Thevs 2011: 114)

The Issyk Kul covers 6.5 percent North eastern part of the territory. It has low salinity and it not used for irrigation purposes and municipalities. The lake and the adjacent rivers are drained into Kyrgyzstan. The North eastern part of Kyrgyzstan consists of endorheic basin of the Issyk Kul lake. The South east portion of Kyrgyzstan is bordering with China belongs to the hydrographic Lop Nor lake system (UNDP and UNEP 2012: 34-37).

The Amu Darya river basin emerges in Tajikistan which covers about 3.9 per cent of the Tajik territory to the south western part. The Amu Darya River originates mainly in Tajikistan but accepts a support from the Kyzyl Suu branch which emerges in the South West of Kyrgyzstan. The Kyzyl Suu river with the Muksuu river converted to Surkhob river when it flows south to Tajikistan (Ibid.).

The Karkyra River which emerges in Kyrgyzstan is a minor branch of the Ili river and runs to the Balkhash lake in Kazakhstan whereas Balkash lake covers 0.3 percent of Northeast part of the territory.

As per the earlier agreement of USSR, the average Renewable Surface Resource Water (RSRW) flow to Uzbekistan, Tajikistan and Kazakhstan through legal agreements. The 21.148 cubic kilometre per year of the internal surface water resource is retained by Kyrgyzstan. After independence, it was assigned according to five Central Asian states, until a new plan is introduced by Interstate Commission for Water Coordination (ICWC). The available water quantity is 21.148 cubic kilometre per year has not completely usable right of the Kyrgyzstan because the certain water quantity cannot include of which flows towards China and Balkhash lake basin in Kazakhstan. Since this run off arises in remote mountainous area, Kyrgyzstan is not able to use these water resources (FAO 2012: 4-5).

Out of the available water resources Kyrgyzstan has the right to use 20-25 percent of available water although the total usable limit in Kyrgyzstan including ground water and surface water is 11.9 cubic kilometre including the Syr Darya river basin (4.88 cubic kilometre), Chu river basin (3.85 cubic kilometre), Talas and Kurkureu river basins (1.0 cubic kilometre) and Amu Darya river basin (0.45 cubic kilometre) per year. The remaining share of water goes to the neighbouring countries like China, Kazakhstan, Tajikistan and Uzbekistan. Above 90 per cent of water is used for irrigation and agriculture purpose and 80-85 percent quantity of water is used during growing season (UNDP and UNEP 2012: 40).

The above data shows that Kyrgyzstan has huge amount of water resources. Due to the transboundary nature, Kyrgyzstan is shared their water resources with neighbour countries such as Uzbekistan, Kazakhstan and Tajikistan. But, in recent time Kyrgyzstan is not interested to share their water resources to neighbours because for using own purposes. Therefore, Kyrgyzstan is making various policies and programmes for water uses and management. These policies and programmes will be discussed in the next chapter.

## **CHAPTER-3**

### **Policies on water usage and Management**

In the second chapter, it had already discussed that except water resources, Kyrgyzstan does not have any other resource in huge quantity. Water is an important resource of Kyrgyzstan; because it influence on social, economic and political field. In the recent time, Kyrgyzstan has taken some necessary steps for the improvement of water usage and management. Water is included in article 12 of the constitution of Kyrgyzstan and gives legal status. Kyrgyzstan has introduced some policies and programmes on water usage for various sectors including irrigation, industries, domestic and hydropower.

Although, Kyrgyzstan has abundance water resource; it is facing water crisis due to the lack of fund, out-dated infrastructures and rapid population growth. To overcome these problems, Kyrgyzstan has signed several international agreements with the help of international organizations like the World Bank, Asian Development Bank and European Union (EU) which help in various projects for improving the water usage and management.

#### **Water Demand and Usages**

Water is an importance resource of Kyrgyzstan. It is used in different purposes such as agriculture, industries, domestic and hydropower generation.

##### ***Agriculture***

Agriculture is the main source of income in Kyrgyzstan's economy. It had contributed 21 percent Gross Domestic Product (GDP) in 2010. It plays an important role on employment's generation, food security and consumer price stability (USAID 2013: 10). Irrigation is a part of agriculture and is one of the most water consuming sector. Approximately 90 percent of surface and groundwater are used in irrigation purpose from the Chui, Talas, Amu Darya, Syr Darya, Tarim and Issyk Kul river basins (ADB 2013).

Agriculture is based on four major regions and confined to the main river valley of Kyrgyzstan like the Issyk Kul to the east, Chu and Talas to the north, Naryn in the central and Ferghana valley in the South West region. “For irrigation purpose, 80 percent water is supplied from the diverted rivers; 13 percent from artificial lake; 6 percent from pumping and 1 percent from groundwater” (FAO 2012: 1-20).

The major crops like wheat, maize, barley, sugar beets, vegetables, tobacco, cotton, oil seeds and potatoes are grown in Kyrgyzstan (ADB 2013: 5). In Kyrgyzstan, only 7 percent land is suitable for agriculture because of its mountainous topography (Herrfahrtd et al. 2006: 43). Cereals are the common crops which occupy 60 percent of cultivated area and wheat production is expanded for self-sufficiency. Sugar beet, a cash crop mainly used for lucrative sugar and vodka productions are produced in the northern Chui Oblast; whereas cotton, rice and tobacco are produced specially in the southern Ferghana valley (Ibid.).

Kyrgyzstan has taken decision to use maximum water on wheat production because the country imported it from the world market. The wheat price became raised due to drought in 2007 and caused food crisis in the world market. Therefore, Kyrgyzstan had not purchased wheat from the world market and decided to increase wheat production for food self-sufficiency.

### ***Industries***

Industry is the second major water consumption sector in Kyrgyzstan and consumes around 6 percent water for industrial activity. It has a major contribution to Kyrgyzstan's economy and has contributed almost 26.7 percent Gross Domestic Product (GDP) in 2014. Kyrgyzstan has the major industries like gold mining, coal mining, energy, food processing, textile and fishing (World Bank 2014).

Kyrgyzstan has started mining industry due to the huge reserves of mineral resources. The river and groundwater are polluted due to the exploration of mining industries and is a threat to the environment. The gold mining companies like Kumtor, Taldybulak, Levoberjnyi, Jerui and Chatkal have explored natural resources; as a result tension is created between the companies and the local people. Textile is the

second important industry after gold and is also affecting water resource due to huge need of water for its use (Zozulinsky 2007).

### ***Domestic***

Kyrgyzstan uses 3 percent water for domestic purpose like drinking, bathing, cleaning etc. In the year 2010, the household water consumption per capita was 40 cubic metre which is 1.6 times higher from 2006 (25 cubic metre per person). Its water consumption in others years are as follows in 2007 (30 cubic metre per person), in 2008 (26 cubic metre per person), in 2009 (35 cubic metre per person) and in 2010 (40 cubic metre per person); especially in the Chui and Osh region due to population growth (UNDP and UNEP 2012: 43). The household gets water from different sources like 59.9 percent rural population get water from the water supply system and the rest 40.1 percent population get water from ditches, rivers, channels, springs, water carriers etc. The limited access of water make difficult to the household for hygiene, washing, bathing, cleaning, washing etc. (UNDP 2014: 13).

### ***Hydropower generation***

Hydropower is a dominated sector in Kyrgyzstan because 90 percent electricity is generated through water resource. The country has 18 major power plants with installed capacity 3713 megawatt, out of which 2950 megawatt (79.5 percent) electricity is produced from 16 hydro power plants and 763 megawatt (20.5 percent) is generating through thermal power plants (UNIDO 2013).

The main source of hydropower in Kyrgyzstan is the Naryn river, because maximum hydropower plants are built on this river like the Toktogul (1200 megawatt), Kurpsai (800 megawatt), Tashkumyr (450 megawatt), Shamaldysai (240 megawatt), Uchkurgan (180 megawatt), Karbulak (149 megawatt), Karabulun (163 megawatt) and At Bashy (40 megawatt). The Toktogul is one of the most important reservoirs in Kyrgyzstan because it supplies 40 percent Kyrgyzstan's need. It is transported through the Chaldovar power transmission line which goes through Uzbekistan and Kazakhstan and afterward returns to Kyrgyzstan (Stobdan 2014: 110).

Hydropower sector is not only fulfilling the energy shortage in Kyrgyzstan but also it is playing a major role in the economy of Kyrgyzstan. Now a day, Kyrgyzstan is capable to exporting hydroelectricity to its neighbour (Zozulinsky 2007). Kyrgyzstan decided to install maximum hydropower plants because for their own profit. The country has initiated other major hydropower plants like the Kambarata-1 (1900 megawatt), Kambarata-2 (360 megawatt), DJilanaryk-1 (100 megawatt), DJilanaryk-2 (100 megawatt), Akbulun (200 megawatt) and Saryjaz (1200 megawatt). These hydropower plants are in the process of under construction (Ibid.).

The Kambarata-1 and Kambarata-2 hydropower plants are an emerging controversy in this region and are playing an important role in shaping the relationship between Kyrgyzstan and other Central Asian Republics. In the early 1980s, Kambarata-1 having the capacity of 1900 megawatt was planned by the Soviet Union. Although, the construction began in 2009 with a guaranteed of \$1.7 billion assisted by Russia and \$ 300 million supported by Kyrgyz's government; but this plant was not completed and was postponed by Russia; because Russia said that, it is an issue of environmental concern (Stobdan 2014: 112).

On the other hand, the Kambarata-2 hydropower plant is planned to have three units with the capacity of 120 megawatt each. The first unit produces 360 megawatt per year and was launched on August 30, 2010 with a cost of \$ 200 million. There are plan to build the second and third unit with the Chinese's support. China is interested to give assistance for this unit, because China wants to supply the hydro electricity during summer season to the Xinjiang Uyghur Autonomous Region (XUAR) through this power plant. Kyrgyzstan had built Datka Kemin substation line with a total capacity of 500 Kilowatt in 2013. The Chinese company Tebian Electric Apparatus Stock Co. Ltd. gave \$ 208 million loan to Kyrgyzstan for line construction. Kyrgyzstan has highlighted this project because of its economic development and energy independent (Ibid.).

The Central Asia-South Asia Regional Electricity Market (CASAREM) was launched in 2006 with the assistance of Asian Development Bank (ADB) to develop the sub-regional electricity market for promotion of trade between Central Asian and South Asian countries. The Central Asia-South Asia power assignment is known as



‘CASA-1000’ which is a \$ 1.16 billion project presently under structure and is likely to be finished by the end of 2018. This project would help the most effective use of hydropower resources in the region by facilitating them to transmission and selling electricity surplus during the summer season to the undersupplied countries in South Asia. This project would also balance the countries determinations to improve electricity access, incorporate and expand markets to increase trade and find ecological solutions to water resources management (The Express Tribune 2016).

The project will allow for the export of 1300 megawatt electricity during the summer season when the two upstream countries of Kyrgyzstan and Tajikistan experience additional electricity generation from hydroelectric dams. “High Voltage Direct Current (HVDC) converter stations will also be included as part of the project, as well as a 477 kilometre long, 500 kilovolt alternating current transmission line between Datka in Kyrgyzstan and Khujand in Tajikistan”. A 1300 megawatt AC or DC converter station will be built in the city of Sangtuda in Tajikistan, as well as a 300 megawatt converter station at Kabul in Afghanistan. A 750 KV High Voltage Direct Current (HVDV) line will be built between Sangtuda and Peshawar in Pakistan, via the Salang Pass and Kabul. “In Peshawar, 1300 MW converter station will be built and connected to Pakistan’s electric grid. Transmission lines are designed to transmit 1300 megawatt of electricity, with Afghanistan allotted 300 megawatt of electricity and Pakistan 1000 megawatt of electricity” (Daily Times 2016).

The CASA-1000 project is supported by the world bank and several other international organizations like Islamic Development Bank, Australian Agency for International Development (AusAID), United States Agency for International Development (USAID), , United Kingdom Department for International Development (DFID), US State Department and other donor communities (Ibid.).

The above shows that, Kyrgyzstan is used water for different sectors but it cannot be used properly due to some problems.

## **Problems of water usage and Management in Kyrgyzstan**

The policy made by Kyrgyzstan on water usage and management have not implemented properly due to some problems like lack of fund, rapid population growth and out-dated infrastructures; as a result it is facing water crisis.

### ***Lack of fund***

The lack of money has caused the deteriorated living standard of people, decrease the quality of water, worse health facility and increased water pollution. The majority of Kyrgyzstan water supply infrastructures were constructed between 1950s and 1980s in the Soviet time. Therefore, several irrigation and drainage systems are out dated and worse condition. During the period 1991-2012, water loss was increased up to 23-40 percent due to the unregulated water use and damage of canal line. The existing drinking water supply and sanitation infrastructures are also in critical condition; and most of the centralised water supply systems of the country are functioning inefficiently (UNECE 2013: 12).

### ***Rapid population growth***

The rapid population growth is another problem of water usage and management in Kyrgyzstan. During the last 15 to 20 years, the rural migration of people to urban areas is bigger owing to speedy population growth (UNDP and UNEP 2012: 42-43). The accessibility of drinking water facilities is poor in rural area whereas most of the urban people have more or less supplied drinking water. In many rural communities, there are lack adequate accesses to clean drinking water supply. In the recent year, 9 percent villagers have access water from a centralised water pipeline inside the house; whereas 9.5 percent take water from wells and 10.6 percent get drinking water from rivers, springs, open irrigation channels and 70.9 percent villagers get freshwater from the standpipes on the streets (Topbaev 2015: 1).

### ***Out-dated infrastructures***

The out-dated infrastructure is another problem that affecting the water quantity. Due to the out-dated infrastructure and improper maintenance of groundwater, the level of groundwater is decreasing. In the year 1990s, the extraction of water reached in 1.1 cubic kilometre per year. In the beginning of 1992s, it decreased from 900 million cubic metre to 300 million cubic metre. In the year 2009-2010, it is approximately 299-324 million cubic metre. The poor transportation, ineffective technologies, inefficient irrigation techniques, depreciation of equipment and poor water distribution system has caused the decrease of water quantity (UNDP and UNEP 2012: 42).

Due to the bad sewage system, the polluted and hazardous element is flowing into the rivers and canals and it contaminates the quality of water. “Many surface rivers like Chu, Alamedin, Chon Kemin, Issyk Ata, Kechi, Kemin, Naryn, Akbura, Kara Darya, Tar, Yassy and Kurshab have an increased level of ammonium nitrate, copper, zinc, oil and other harmful elements of toxic chemicals are polluting to these rivers”. The sources of groundwater like the Ala Archa and Orto Alysh are also affecting by nitrate pollution. Generally in the region of Osh(20 percent), Issyk Kul (16.9 percent), Chui (25.7 percent) and Jalalabad (14.7 percent), majority of the drinking water is affected by the microbiological constraints. The lacks of proper sanitary facilities are caused of the water related diseases like typhoid, dysentery, hepatitis and parasitic (WHOCC 2008: 3).

### **Water Policies and programmes in Kyrgyzstan**

Kyrgyzstan has introduced several policies and programmes at the national level. It has implemented many laws, regulations and planning on water sector for its effective use and management. This policies and laws are influenced by the Integrated Water Resource Management (IWRM) because it includes state holders and participators (NGOs and civil society). The following are the important water related laws, programmes and projects:

The “On Water Law” was adopted on 14 January 1994. Its main objective was to regulate and protect the water use and prevent harmful effect on environment. This law includes the use of water in different purposes including the agriculture (forestry, irrigation and aquaculture); domestic; industries; governance (social, political, economic and administrative systems that govern water management and conservation; decentralisation; good governance and good practices); infrastructure (water supply systems, hydropower systems, dams and irrigation systems); water resource management and water right (ownership and control of water resources; abstraction and diversion of water; allocation and quotas; riparian rights; priority of rights and free water use) and groundwater (fresh water resources located below the surface of the earth; aquifers; groundwater abstraction; well sinking; boreholes and hydrogeology) (Herrfahrdt et al. 2006: 49).

As per the article 27 of the constitution for agriculture water will be used on balance basis and article 40 envisages that any gain from water use will be the source of fund. The main emphasize of this law is that it will apply economic instrument for water use and pricing (Ibid.).

The “Regulation Concerning Water Protection Zones and Belts of Water Bodies” law was adopted in 1995 and it applies to the rivers, lakes, ponds, reservoirs and canals of riparian zones. The main purpose of this law was to established water protection zones, economic activities and use of lands that are part of the water protection zones as well as the responsibility for keeping them in good condition. It is not preventing sanitary zone for fish ponds and drinking water supply. The boundaries of water protection zones are established and it is allowing for the physical geography, soil, hydro-geological conditions and the nature of the relief as well as the interests of all water users (USAID 2013: 47-49).

In the year 1995, the government of Kyrgyzstan declared on the “Regulation Concerning Water Fund Monitoring in Kyrgyz Republic” that was based on water quality management (UNECE 2013: 13-14).

In the year 1996-97, Kyrgyzstan had passed the “Energy and Electricity Laws” which aim was to regulate the organisation, allow for private sector ownership, competitive market and the functioning of various companies operating in the energy sector (Kyrgyzstan Regular Energy Efficiency Review 2011: 7).

In the year 1996-1997, the government of Kyrgyzstan established the “National Water Strategy (NWS)” which objective was to introduce a long term approach for water usage. “The draft of NWS comprises an inventory part that covers water resources, the effectiveness of water usage, water quality, water and sanitation sector, irrigation, hydropower, fishery, water economization, technical facilities and monitoring”. It also marks the references for the future road and enhancements of water resource management in Kyrgyzstan with respect to domestic and transboundary waters (Ul Hassan et al. 2004: 10).

The fundamental recommendations of the draft strategy for domestic water policy is to restructuring the legal foundation in order to overcome flaws between laws and sub legislative acts; concretize rights, functions and competencies of involved bodies and identify guidelines and control; “to restructure the official arrangement by reorganizing and privatizing implementation functions so that the national agencies can concentrate on strategic planning, legal and economic regulation, coordination between ministries as well as between state and private bodies; to modernize the decision making system in order to overcome bureaucracy and corruption”; “to make participation of civil society and user groups a basis for effective water management; to make rehabilitation of infrastructure a priority in order to enhance effectiveness; to differentiate the payment for water usage in the long term; to reduce state funding in the long term and to strengthen state bodies for control, protection and monitoring” (Ibid.).

The principle of “Tariff policy for electricity and heat” was first implemented by the government of Kyrgyzstan in 1998. After that the government of Kyrgyzstan has changed this policy twice and there was a shift from the principal of “socially protected costs to the principle of profitability and efficiency”. The main aim of this

policy was to preparing the ground for further reforms in the power sector (Kyrgyzstan Regular Energy Efficiency Review 2011: 7).

In the year 1999, the government of Kyrgyzstan introduced the “Law on drinking water”. The purpose of this law was to develop and improve the quality of drinking water to the population with a long term and a long term plan to improve water supply and sanitation in the rural areas. To keep in view of rural development the government handed the water administration to the local government without any payment. These objects are directly accountable for obtaining and paying loans, for the use and maintenance of water pipelines. They also introduced water supply fees and list the work of water pipelines (UNECE 2009: 9).

The “Law on Environmental Assessment” was adopted by the government of Kyrgyzstan in 1999. “The main aim of the law was to protect the environment; ensure safe and efficient operation of water treatment facilities; installations and means of control, decontamination and disposal of waste; to initiate introduction of environmentally friendly technologies and industries; to implement protection and rational use of forests, restoration of natural resources, waters, air, mineral resources, flora and fauna and land” (USAID 2013).

In the year 2001, the government of Kyrgyzstan was established the “Sanitary-Epidemiological Wellbeing of Public law”. The main aim of this law was for the health purpose (UNECE 2013: 12-14).

In the year 2001, the government of Kyrgyzstan introduced the “Law on International Use of Water Objects, Water Resources and Water Management Facilities” which define water as an economic good and began the principle of payment for water use as a tool for interstate water relation. The law gave Kyrgyzstan the possession of all resources instigating in its territory and the right to use subsequent amount of water it needed. This law is the contribution of Turdukan Usulbaliev, the first secretary of the Kyrgyzstan and it was criticized by the downstream countries for many reasons (Sehring 2005: 44-45).

In the year 2002, the government of Kyrgyzstan passed the “Law on Water User Associations”. These associations were established to manage off-farm and on-farm irrigation systems instead of the dissolved government owned farms. This law regulates the legal status and administrative foundation for the establishment; and operation of unions of water users to function and continue irrigation systems in rural areas benefit of the public. “The WUA is established in accordance with this law as a non-commercial organization, that acts in the public interest for the purpose of operating and maintaining a specific irrigation system so as to provide the owners and users of agricultural land with irrigation water” (USAID 2013: 47-48).

The principal assignments of the WUA are to “operation and maintenance of irrigation system within the WUA service area and distribution water to the WUA members on the basis of annual agreements; distribution water on the contractual basis to individuals who own or use irrigated land within the WUA service area who are not members of the WUA; rehabilitation and improvement of irrigation systems within the service area of WUA and undertaking construction works as necessary”; buying irrigation water from a water provider on the basis of a agreement or taking water in the approved manner of self-diversion straight from natural water bodies such as rivers, lakes and groundwater in unity with the received water use license and regulating the water use and circulation within the WUA service; gaining, replacement, procedure and conservation of irrigation apparatus; avoidance of water pollution and undertaking land improvement works and training WUA members in advanced methods of irrigation and endorsing the use of new techniques and technology (Ibid.).

In the year 2002, the government of Kyrgyzstan established the “Taza Suu” or the clean water programmed which aimed is restoring and building rural water pipelines and increasing availability to safe drinking water to the population. It also takes the accountability of water industry for the quality of water and viable functioning of water pipelines. The main impulse for the Taza Suu project was that ‘70 percent of the Kyrgyz population did not have adequate access to clean drinking water; 1272 villages did not have regular access to clean water, while in 397 village resident use water from open sources’. International donors such as Asian Development Bank

(ADB) and World Bank (WB), Kyrgyz establishments and other national NGOs agreed on the significance of improving fresh water management (Isabekova et al. 2013: 3).

In the year 2005, the government of Kyrgyzstan introduced the “Water Code” which focussed on the administration of water relations in the field of supervision, conservation and improvement of water resources to pledge a sufficient and nontoxic supply of water to the population, environmental protection and sustainable improvement of the water fund of the country. In order to implement the Water Code, the basic principles of water resources management should be established for implementation, authority of state bodies in management of water resources and water facilities are strong-minded; a framework for expansion of national water strategies and plans for the usage of water resources are designed; ‘use of surface and groundwater and payment for their use is regulated; measures to protect water resources from pollution and reduction are identified; requirements for emergencies related to water resources and dam safety are announced’; ‘water management and irrigation sectors are planned; regulations on the use and ownership of lands of the water fund are established’; the state water inspectorate is established and the authority and duties of public water inspectors are defined; offenses in the use of water resources are determined; compliance of this Code with the obligations of the Kyrgyzstan under international law are defined (USAID 2013: 47).

As per the Article 21 of Water Code, “the use of water resources shall include: water intake from the surface or ground water bodies; transportation of water withdrawn to supply to other parties; the use of water for drinking and utility purposes; the use of water for irrigation and cattle watering; the use of waste waters for irrigation; the use of water for electric power generation; the use of water for industrial and agro-industrial purposes and the use of water for fishing and fish farming. It also define that the water users shall have right of water use with concerned to water provision” (Jailoobayev et al. 2009: 18-19).

The “Law on Renewable Energy Sources No. 283” was adopted by the government of Kyrgyzstan on 31 December, 2008. The law determined the legal, organisational, economic and financial bases and mechanisms for regulating the



relationship between the state, producers and suppliers. The main objectives of this law were to development and utilisation of renewable energy sources, energy structure improvement, diversification of energy resources and improvement of the social condition of population, ensuring energy security of Kyrgyzstan, environmental protection and sustainable development of the economy (Kyrgyzstan Regular Energy Efficiency Review 2011).

The “National Energy Programme of 2008-2010 and the Strategy of Fuel and Energy Complex Development 2025” had adopted by the government of Kyrgyzstan. The programme was approved by the declaration of the government of Kyrgyzstan on February 13, 2008 with a view to resolve the problems related to energy sector by means for development of its own energy base; reduced dependence on energy resource imports; improvement of energy efficiency; reduction of adverse environmental impacts; implementation of energy saving measures; elimination of cross subsidies for power production; improvement of price and tariff policies (Kyrgyzstan Regular Energy Efficiency Review 2011: 14-15).

According to the “National Energy Program of Kyrgyzstan for 2008-2010”, “92 new small hydropower plants having a total capacity of 178 megawatt are to be constructed and 39 existing but abandoned small hydropower plants with a total output capacity of 22 megawatt were restored”. ‘Besides, seven water turbines were connected onto surviving irrigation reservoirs with a total output of 75 megawatt’. In Kyrgyzstan, the people especially farmers in the mountainous areas in the country are still unaware of the grid connections. Therefore, mini and micro hydropower projects are run by individual efforts in rural mountain areas. This project is assistance by UNDP. With the support of international donor like UNO and WB, Kyrgyzstan has introduced other several programme related to hydro energy such as the “development of small hydropower plants in 2010-2015 and Strategic planning of small hydropower development in 2009-2013” (UNIDO 2013).

The “Technical regulations on safe drinking water” law was established by the government of Kyrgyzstan in 2012, which main aim was to improvement and ensure drinking water for Kyrgyzstan’s population. The International organisations such as Asian Development Bank (ADB), World Bank (WB), and Department for

International Development (DFID) were playing a leading role in developing several water related projects in the country to provide sufficient drinking water supply along with sanitation and hygiene in the rural sectors of the country. In the year 2000, the Community Based Infrastructure Services Sector Project; in the year 2002, the Rural Water Supply and Sanitation Project and Hygiene and Sanitation in Rural Area projects were assistance by the ADB, WB and DFID (UNECE 2013: 13-14).

There are several policies, programmes and projects are initiated by the government of Kyrgyzstan on water use and its management in different sector like agriculture, industries, domestic and hydropower and it policies are impacted on the downstream countries on socio, economic and political fields. In the next chapter, I will deal these impacts on downstream countries.

## **CHAPTER-4**

### **Impact on downstream countries**

After the collapse of the Soviet Union, transboundary water resource management has been emerged as a conflicting interest between the upstream and downstream countries of Central Asia; due to the unequal distribution of natural resource. The upstream countries like Kyrgyzstan and Tajikistan are poor in energy but rich in water resource and the downstream countries like Kazakhstan, Turkmenistan and Uzbekistan are rich in energy but poor in water. The upstream countries need water for power production and the downstream countries need it for agricultural production and industrial usage. But, they have not shared the resources with each other because of the equitable distribution of their national interest; as a result, natural resource has emerged as a cause of conflict.

This chapter will highlight the impact of water usage by Kyrgyzstan on downstream countries and why and how the water resource is playing an important role in Kyrgyzstan dealing with the strained relation with downstream countries; and it will also discuss the different steps initiated by the government and different organizations to resolve the problems.

### **Water withdrawal of Kyrgyzstan and its Impact on downstream countries**

Being a landlocked country, Kyrgyzstan faces difficulties of sharing its borders and water resources with other Central Asian countries like Kazakhstan and Uzbekistan and it requires coordination at local, regional and national level to manage its water bodies along with the internal and international participants. Kyrgyzstan's weakness of institutional measures and capabilities is multiplied by numerous reshufflings of sector organization regarding the Water management ([www.unwater.org](http://www.unwater.org)).

Therefore, "Kyrgyzstan's water related challenges include the making progress in developing and adopting a national water strategy, flood control, provision of safe

drinking water, contributing to improving food security, water quality and quantity monitoring and improving irrigation and drainage systems. In addition, the water availability in Kyrgyzstan represents another challenge due to a number of factors, including; competition for water between municipal, industrial/mining and agricultural uses, variations in the amount of snow fall in the alpine regions and negotiations with downstream countries on the sharing of the transboundary water resources. The extent of poverty in rural areas, where a large percentage of the population depend on agricultural production and irrigated areas, is much higher than in urban areas in Kyrgyzstan” (Ibid.).

Circumstantially, since 1990, Kyrgyzstan was forced to release a lesser amount of water in summer and it increased the volumes of its winter releases in order to produce more hydroelectric power to fulfil its growing demands during winters. Therefore, “during the 10 year period 1991-2000 the average release during summer fell to 45.6% of the annual releases (from 75% during the preceding 15 years) and the releases during winter increased from 25% to 55.4% of the annual releases”. This pattern of water release by Kyrgyzstan from Toktugal Reservoir to the downstream riparian states caused severe problems between the Upstream and Downstream countries. Moreover, these downstream countries faced insufficient Water supplies for irrigation purposes during summer while in winters, rivers and canals get frozen and they could not handle large amount of water resulting into the floods. Therefore the Uneven distribution of water resources and its unequal distribution among the central Asian countries have created serious troubles and international tensions (World Bank 2004: 3).

## **Uzbekistan**

### **Impact on Agriculture**

“Agriculture is the backbone of Uzbekistan’s economy, contributing almost one-third to the annual GDP. More importantly, agriculture provides the livelihood for most of the 60% of the population who live in rural areas. Agriculture is also a great consumer of the natural resources, and it accounts for 92%of Uzbekistan’s 56 billion

cubic metres (BCM) total water use, equivalent to 60% of all water use in Central Asia. Since the collapse of the Soviet Union, 80% of Uzbekistan's water supplies have come from neighbouring countries, primarily via the Rivers Amu Darya and Syr Darya" (Abdullaev et al 2009).

Cotton cultivation was an important sector in the agricultural sector in the Soviet Union and played an important role even after the independence. Expansion of irrigated agriculture in Uzbekistan, particularly Cotton has been caused into a number of water linked environmental problems such as the diminishing of the Aral Sea. Besides, it has also created difficulties of increasing salinity and water logging in the Amu Darya and Syr Darya river basins (Ibid.). Uzbekistan includes mostly arid regions with a minimal rainfall of less than 350 to 400 millimetre a year. It mainly depends on its neighbours like Kyrgyzstan and Tajikistan for the continuous supply of surface waters because it only contributes 10 to 15 percent of all water resources exploited in the country. "The share of water resources on its own territory includes 6 percent of the Amu Darya river basin, 16 percent of the Syr Darya river basin and about 8 percent out of the total water produce of the Aral Sea Basin".

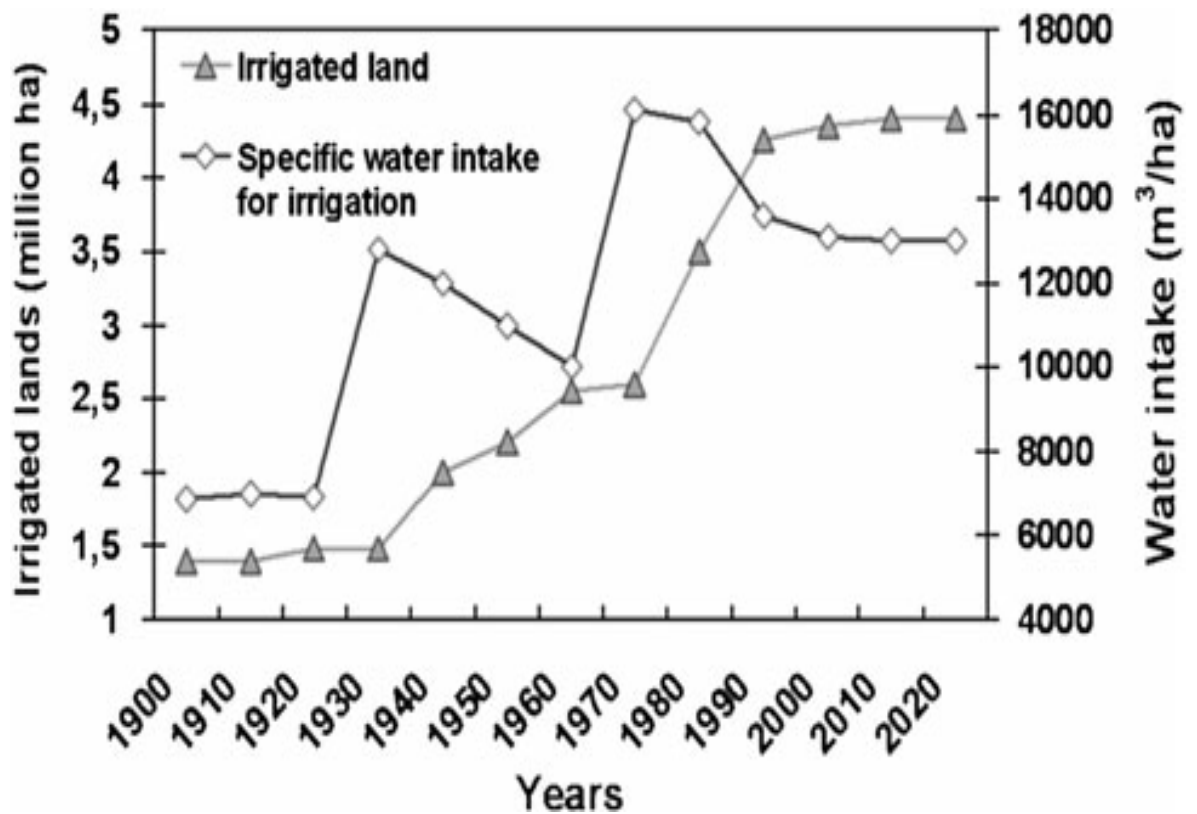
The flow of river basins passing through Kyrgyzstan and giving water to Uzbekistan for irrigation have been seriously decreased due to a number of Dams built by Kyrgyzstan to produce Hydroelectricity to meet its Power needs during winters. Therefore, some parts of Uzbekistan's Fergana valley region have faced serious problems of irrigation due to the lack of water. It is also understandable that , "With a yearly rainfall of 100 to 300 millimetre and evaporation of 1600 to 2200 millimetre, Uzbekistan has a continental climate of the dry mid latitude desert, distinguished by warm summers and frozen winters. Its climate is basically dry and its water resources are unequally distributed both in space and time. There is a large dependency on winter and spring rains and snow melt from the Tien Shen and Pamir mountains. Therefore, these mountains are key providers to the watersheds of Central Asian countries" (S. Rakhmatullaev et al. 2013).

Therefore, the agricultural production of Uzbekistan is primarily centred on irrigation and it creates irrigation water supply and management the major factors confining crop production in the region. "The complexity of water resource relations

in this region is related to the soviet inheritance of interconnected hydraulic infrastructure and to the trans-boundary origin of water resources” (Ibid.).

The figures given below define the Uzbekistan’s need of the water for irrigation for a specified Irrigated lands from the 1990 to the 2020. It also shows that the irrigated lands in Uzbekistan are gradually increasing but the demand of water to accommodate the irrigation of these lands is unfortunately decreasing (Fig 1). Uzbekistan is also facing trouble within its boundary due to the lack of irrigation water and table no.1 clearly shows the inequality in the number of water reservoirs found in the different provinces of Uzbekistan (in Syr Darya Basin) and also the capacities of these water reservoirs are really questioning.

Figure 2 Trends showing irrigated lands and water intake used for irrigation in Uzbekistan (1990–2020)



Source: Rakhmatullaev et al. 2013: 991

Table 4 Syr Darya River Basin: Distribution of water reservoirs in Uzbekistan by administrative boundaries

Administrative areas	Number of reservoirs	Useful volume Of water capacity (km <sup>3</sup> )	
Andijan	3	1.7	
Tashkent	5	1.9	
Ferghana	4	0.25	
Namangan	7	0.23	
Jizzak	4	0.18	
Syrdarya	2	0.01	
Total	25	4.45	

Source: Rakhmatullaev et al. 2013

Uzbekistan is the leading consumer of water resources in the downstream states which is used for agriculture. The farmers of Uzbekistan have been using water that runs from the Amu Darya and the Syr Darya river to irrigate their water demanding cotton fields since the primordial times. But, in recent times there has been an incompatible deliver of water from the upstream countries makes the region more problematic and devastating their economy (Wehrheim et al. 2008). Turkmenistan is also facing the same problems as its downstream neighbour like Uzbekistan. The agriculture in Turkmenistan is mostly dependent on irrigation.

The downstream countries such as Uzbekistan, Kazakhstan and Turkmenistan have enlarged a high dependence on cotton production and irrigation for its agricultural sectors (Dunn 2010). The major problem of water in downstream countries is that a huge quantity of water is misplaced through ineffective use; outflow due to out dated infrastructure and pollution. All around the downstream

states nearly half of the pumps and public taps are closed permanently because that is damaged (waterwiki.net 2009).

Agriculture has been a secure contributor to the economy of Uzbekistan. “Cotton is the most important source of exports; and Uzbekistan is the world’s fifth largest producer of cotton and second largest exporter of the commodity. At the commodity level, cotton seed, cotton lint, wheat, cattle meat, cow milk, tomatoes and grapes made the most important contribution to the average value of agricultural production in Uzbekistan. Approximately 60 percent of the cost of agricultural production is originated from the yearly and perennial crop sectors, whereas the livestock sector produces the remaining 40 percent” (World Bank 2010: 4).

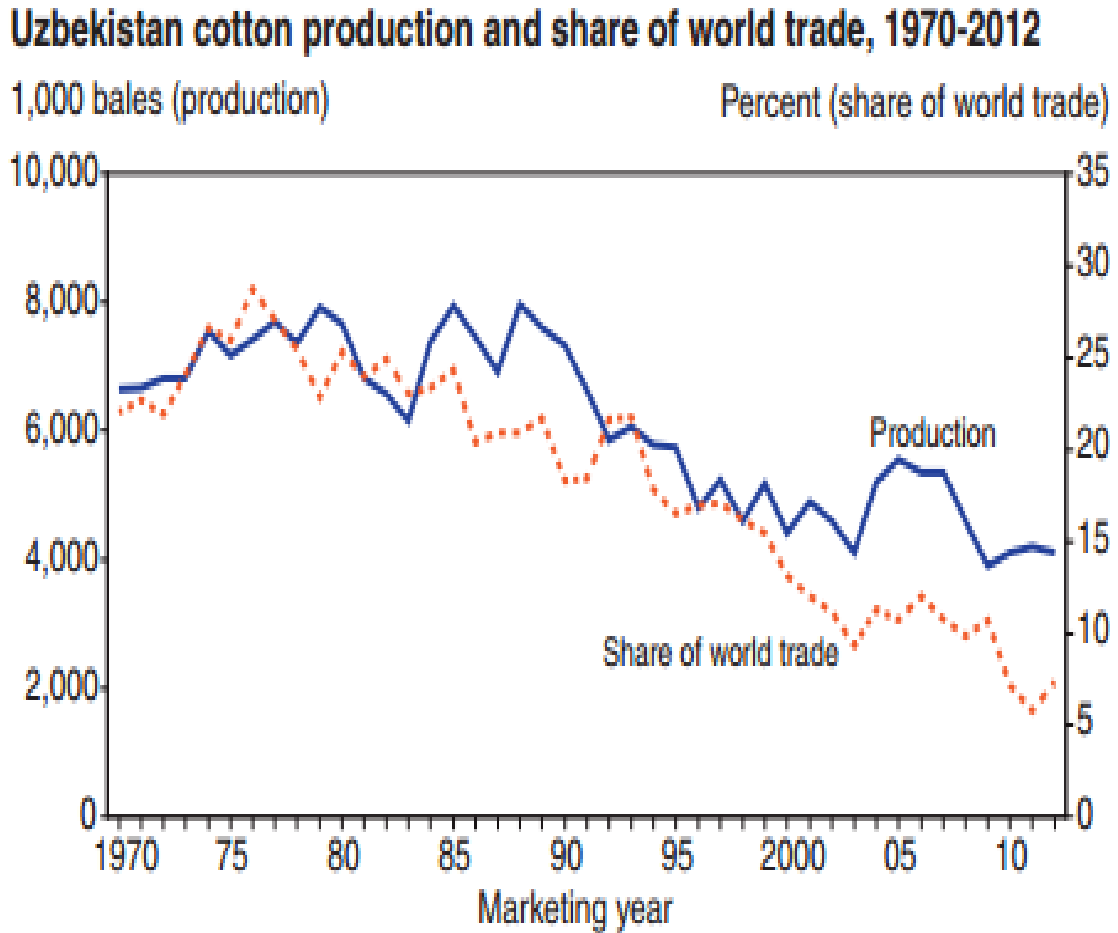
Although, “wheat and cotton are grown broadly and occupy a large percentage of the cropping land; other crops such as grapes, potatoes, tomatoes and apples create an important contribution to the value of agricultural production. The agricultural sector accounts for about 34 percent of total employment in Uzbekistan and more than 60 percent of the population resides in rural areas; whereas in rural areas, 93 percent earn less than \$ 5 per day and are helpless to any changes in agricultural income” (Ibid.).

In Uzbekistan 1991 to 2005, the cotton production has increased but after 2005 cotton productivity has been declining rapidly because upstream countries was not resealing water for Uzbek cotton cultivation. On other hand Uzbekistan has considered less availability freshwater as a serious environmental challenge therefore it was sifted own economic priority that mean Uzbekistan is growing maximum wheat rather than cotton. Cotton is a water consuming crops in the world. “Cotton is a key foreign currency earner and a main contributor of employment, especially in Kazakhstan, Turkmenistan and Uzbekistan. Cotton is an important and dominant crop in Uzbekistan agriculture; but the recent political and economic shifts and environmental problems often directly affected on Uzbek agriculture in general and cotton production in particular. Since the early 1960s, the random use of water for cotton production has been leading to the Aral Sea dry and is causing severe environmental problems like soil and water salinity, climate change, air and water pollution” (Asian Development Bank 2000). Therefore all these problems related to



the lack of proper irrigation has severely affected cotton production in Uzbekistan as it is clearly shown from the below figures.

Figure3



Source: MacDonald 2012

The ecological degradation has become critical impact on east of the Aral sea where Tashauz, Karakalpakstan and Khorezm regions are situated. The construction of dams and barrages and diversion of water mainly uses for irrigation have led to the decline of Aral sea water level and an increase salinity. “All this impact has led to changes in the aquatic environment as a result; fish production in the Aral sea has declined and the fishery in the lower Amu Darya river undergoes the maximum damage. In good years the Aral sea fishery produced close to 40000 ton of which the south Aral sea produced 25000 ton and about 98 percent of all fish output of Uzbekistan” (Pavlovskaya et al. 1968).

“The dams have ended fish migrations and the reservoirs have flooded natural produce and feeding grounds has caused lowered the reproduction rate which in turn has resulted in a decline in the riverine fish stocks and fish catches have also declined. The situation has been further make bad by the often permanent water uptake for human needs. Not only the large volumes of water are diverted for industries, irrigation and hydrothermal power stations but also uptakes have diverted most of the young fish onto irrigated fields or into industrial sites. The level of this harm is about the same as that caused to fisheries by dam construction and pollution. The maximum require for irrigation water is in summer when water is rich in young fish. It is estimated that in the irrigation canals of Karakalpakstan alone 5 billion young fish die annually” (Ibid.).

## **Kazakhstan**

Kazakhstan is the biggest Central Asian republic with a large amount of mineral resources including Oil and Gas to cater the need of its 16 million populations. Since independence, oil and minerals exports to the international consumers have played significant role in improving the Economy of Kazakhstan. In the present time, stable economy and Gross Domestic Product growth of country makes it less dependent on water flowing from upstream Kyrgyzstan. Though, water is still vital for agricultural and other necessities. “In 2010, Kazakhstan launched an economic blockade against Kyrgyzstan because of ongoing political events of that period in the country. In response, Kyrgyzstan was forced to block river flow to Kazakhstan. The action was a clear signal for Kazakh side to cease the economic blockade. After days from that event, Kazakhstan initiated a project of building a water reservoir in their own territory for preventing the involvement of water issue into interstate relations anymore. Except this case, there were no other major tensions between two neighbouring countries, though they still exist and country leaders often avoid the delicate topic” (Water Politics 2012).

It was really important for Kazakhstan to collaborate with the other Central Asian countries for water sharing and the problem of distribution is the main concern

of foreign policy, specifically because a significant part of the country is situated in the lower portion of Transboundary rivers such as Syr Darya and Chu and Talas. It was in the Soviet period that the distribution of water resources among the Central Asian states was based on the appropriate planning for the development and increase of water resources in the Amu Darya and Syr Darya river basins. Therefore, after independence of these republics, there was an urgent need to strengthen the water resource management in the region. “Based on the principle of equal rights and efficient use, passed in 1992, the parties entered into a number of agreements to regulate cooperation for joint management, protection and use of water resources. Moreover there occurred several disagreements amongst them. The most acute disagreement in the Syr Darya basin relates to the operation of the Toktogul reservoir in Kyrgyzstan, leading to a clash of interests between Kyrgyzstan, Uzbekistan and Kazakhstan. The two downstream countries are interested in maintaining storage for summer irrigation from the Toktogul reservoir, whereas winter energy generation from the reservoir is beneficial to Kyrgyzstan. A similar set of issues exist between Tajikistan and Uzbekistan regarding the management of Karikkum reservoir in Tajikistan. Change in the operations of the Toktogul reservoir have led to a number of negative developments in Kazakhstan” (www.fao.org).

### **The construction of Kambarata-2 hydroelectric plant**

In recent year, “Kyrgyzstan has not been having adequate power for the winter. The barter arrangements with neighbouring countries have broken down. In the 1998, Kyrgyzstan and Uzbekistan signed an “agreement to manage the Syr Darya water basin” and the agreement directed the Toktogol reservoirs which allowed Kyrgyzstan to produce electricity. To stop damaging water releases, a number of barter agreements were created to ship natural gas and coal to Kyrgyzstan in the winter. But, these agreements were not followed and Kyrgyzstan wanted to charge on the downstream nations the full use of the water which caused protests from the downstream countries” (Allouche 2007: 45-55).

In the year 2007, “Kyrgyzstan restarted the construction of the Kambarata-2 project and rejected in the 1990s rules. The project was able to draw on a \$300

million loan from Russia to assist restore the country's economy and infrastructure. The first unit of the Kambarata-2 hydroelectric project will allow Kyrgyzstan to produce an additional 500 million to 700 million kilowatt hours per year of electricity. The country currently generates about 14 billion kilowatt hours annually and the increase in power production is predetermined for export to Russia and China. Kyrgyzstan's desires to control the flow of its rivers in order to produce more hydroelectric power are of particular concern to Uzbekistan. Uzbekistan depends on rivers that go through Kyrgyzstan and Tajikistan to irrigate its dry cotton fields and farmland. The power plant has obtained critique from people inside Kyrgyzstan, especially energy experts who argue that the Kambarata dams are too costly and instead of dam Kyrgyzstan must look into developing its coal industry" (Radio Free, Radio Liberty 2010).

The purpose of construction of dams by the upstream countries is used as the instrument for human development, generation of hydroelectricity, irrigation, drinking water supply, flood control, navigation, recreation and others to meet the growing. But, on the other hand the construction of dam have a negative socio-economic impact on the people either intentional or unintentional such as the resettlement and migration, changes of size and structure of household, employment and income, way of using land and water resources and changes in community level as well as the potential psychosocial consequences of resettling people needs (Tullos et al. 2009: 203-207).

### **Impact on climate change**

The release from both the Syr Darya and Amu Darya rivers is focused mainly by snow and glacial melt. "The impact of a warming climate on these key hydrological processes is not adequately understood and no improvement and revision strategies are in place. Whereas alters in precipitation levels are hard to forecast into the future, there is a solid consensus that average global temperatures are rising. As a result, more precipitation will fall as rain in the upstream and the ice volume in the Tien Shan and Pamir ranges will likely shrink. The former will impact the seasonality of

the runoff whereas the latter will at least temporarily increase average annual flows” (Siegfried 2009: 2)

Due to the climate change the glacier is melted. The melting glaciers of upstream countries and the increasing temperatures in the downstream countries have severe impact on agricultural sectors and water crisis of downstream countries (Evans 2010). The rising temperature and water shortages of downstream countries might to cause damage the irrigation demanding crops like cotton. The small farmers and the rural poor are also affected by the extreme weather which has damaged many crops like cotton, wheat etc and killed the livestock. The reliance on oil and coal of Kazakhstan has made it a primary emitter of greenhouse gases with Turkmenistan and Uzbekistan (Oxfam International 2009).

Climate change is planned to have a negative consequence on the Aral sea crisis. “The rising temperatures and natural evaporation rates are caused to reduce the flow of rivers and less water is existing to refill the Aral sea. The reduce in rainy days has led the coastline to take out and speed up the rate of drought, thus revealing toxic salts on the seabed that are from the extreme use of pesticides and fertilizers. These salts are being carried by dust storms and causing high rates of harmful diseases like tuberculosis, anaemia, hepatitis, respiratory and eye diseases and throat cancer for the area’s population” (Fergus 1999: 35). “These dust storms are resulted of Aral sea no longer supply the moisture block required to prevent these winds from happening and also being affected the livelihood of those who are depended on the Aral sea as a source of income” (Spoor 1998: 409).

## **Impact on Aral Sea**

The Syr Darya and Amu Darya river basins are the single sources for water in the Aral sea. It is only reasonable for these rivers to reach to the Aral sea with high volumes of water if the upstream countries of Kyrgyzstan and Tajikistan release sufficient water instead of using it for their own hydroelectric projects. Therefore, while the Kyrgyzstan and Tajikistan wanted to use the water of these rivers for power generation and Kazakhstan and Uzbekistan face trouble for the intensive irrigation of their cotton crops. Therefore there is an instant need for the cooperation amongst

these countries in order to allocate the equal water supply and also to meet the concerns arising from the environmental disasters due to the shrinking of Aral Sea (Water Politics 2009).

“The level of water in the Aral sea started considerably declining from the 1960s onward. Therefore, it has caused the quick increase in salinity. The melting of glaciers, growth of population and an increasing trend of water usage will lead to less water flowing into the Aral and thus to an increase in salinity” (V.M. Lelevkin).

Several factors have influenced the desertification and decline in the groundwater level. “The decrease in the groundwater level in the Amu Darya and Syr Darya deltas contributed to the piling up of salt at the surface. This increase in salt content was later accompanied by a change in vegetative cover because the plants began to die away as a result of the increased salinity of the sea. As a result, vegetation in the region was reduced by at least 40 percent. A side effect of the decrease in the protective vegetation cover was intensified winds which led to more dust storms in the area. 6 million hectares of agricultural land were destroyed as a result of salinization and desertification” (Bosch 2007).

The dry air that accompanies high temperature, higher carbon dioxide concentration and water deficiency will all lead to crop losses of agricultural plants. High temperature will moreover reduce the amount of grass on the plain territories which in turn will lead to reduce in natural fauna and cattle breeding (Ibid.).

“The large differences in river water levels and large scale pollution caused the major environmental changes of Aral sea region. The expansion of agriculture and irrigation has been the main cause of environmental change” (Kasperson 1995). “The Karakalpakstan region which is at the epicentre of the crisis, there is a high level of maternity deaths watched about 120 women per 10000 births. Due to increased storm, dust and high concentrations of pesticides in the air and poor quality of water; rates of diseases like tuberculosis, parasites, typhus, hepatitis and paratyphoid severely increased” (Mahambetova 1999).

The impacts of cotton production on the environment are simply observable. “The Aral sea is an example of the consequence of water abstractions for irrigation from the Amu Darya and the Syr Darya; the rivers which supply the Aral sea to cultivate cotton in the arid region. The cotton production has three major negative effects: consumes huge amounts of water in ditch irrigation structure, needs more labour force due to the lack of financial capacity of farmers and pollutes water and the environment because of mixing used field water full with chemicals and fertilizers” (Chapagain 2005).

Agriculture in the Aral sea basin has been performed with a high level of inputs mainly fertilizers and pesticides and has resulted in the worsening of surface water and groundwater quality. There is also pollution from industrial and municipal waste particularly from metropolitan areas. As a result, concentrations of salts and minerals began to increase in the shrinking body of water causing severe soil salinity problems particularly in the downstream region (Murray Rust et al. 2003). “Due to the decreased in size of Aral sea, its climate modifying function has been lost. The climate around the sea has changed becoming more continental with shorter, hotter, rainless summers and longer, colder and snowless winters. The local communities face terrible health conditions. In Karakalpakstan, drinking water supply is too saline and polluted. The high content of metals such as strontium, zinc and manganese cause diseases and prevent iron absorption, causing anaemia” (UNDP 2004).

The environmental outcomes of extreme cotton production cause a threat to people throughout Central Asia. Yet, nowhere has the impact been more heightened than in Karakalpakstan an autonomous region home to an estimated 1.5 million people (Ataniyazova 2003). “Indigenous Karakalpaks have lived on the beaches of the Aral sea for over 2000 years and have observed as their livelihoods have disappeared in less than a generation with the basis of their former livelihoods missing, unemployment is estimated to have heightened at 70 percent. As a result, an estimated 50 to 70 percent of Karakalpaks have been pushed into poverty, with 20 percent living in severe poverty” (ADB 2001). Recently, the complication of Aral sea problem has not only an environmental but also a social, economic and demographic impact of environmental consequences.

## **Reaction of downstream countries**

Tajikistan and Kyrgyzstan are the two weakest economies of the Central Asian region and presence of abundant natural resources are considered to be the eternal gift to compliance with the material poverty. However, the balance of resources among the Central Asian Republics is far from the reality. There are some Kyrgyz policymakers who tried to play with the idea of curtailing the flow of water bodies to Uzbekistan, when it has cut the gas supplies to Kyrgyzstan's southern city of Osh. However, "Uzbekistan's decision to cut Osh's gas may well have its origins in a long running water dispute. Officials in Tashkent, the capital of Uzbekistan, are aghast at Kyrgyz and Tajik plans to build giant hydroelectric dams upstream of the Syr Darya and Amu Darya rivers. Uzbekistan relies on these water sources for its strategically vital agricultural sector, and fears the dams will provide difficult neighbors with the leverage to delay the release of water. Therefore, In 2012 Uzbekistan's president, Islam Karimov, warned that moving forward with these plans without regard for downstream states like Uzbekistan and Kazakhstan could lead to a full-blown war" (Savintsev 2014).

Uzbekistan has also warned Kyrgyzstan and Tajikistan for building several hydroelectric projects with the help of Russian federation and it has also suggested that mutual understanding between them is compulsory to reach on any agreement intended toward cooperation on water sharing. According to Karimov, "there should be a common agreement on building of new hydro-electric plants along the rivers passing through Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan, else, hydro-energy problems could intensify so much that it would not only cause serious conflicts, but even wars. Islam Karimov has repeatedly appealed to the United Nations with a demand of carrying out an inclusive international expertise before starting to build, or before signing hydroelectric power station construction agreements with some great states, referring to the Russian Federation and Kyrgyzstan" (World Bulletin 2015).

In 2001, Kyrgyzstan has implemented a set of regulations in order to classify the water as a product similar to oil and gas. This move of Kyrgyz governments



considered to be a way to indicate that the downstream countries have to pay for the maintain ace of the water reservoirs in Kyrgyzstan. However, Uzbekistan contemplates that the water is a free and public good to be used by all. This view of Uzbekistan was suggested by Marxist-Leninist philosophy. Moreover, It also claims that water comes from the Almighty, and can thus not to be put on sale. Uzbekistan's attitude on the laws made by Kyrgyzstan indicated that it is unwilling to pay Kyrgyzstan for water. As a result, "fundamental disagreements over whether water is a tradable commodity, and the fact that regional hydropolitics is linked with domestic power struggles, have prevented sustainable cooperation. Violent conflict has only been prevented by ad hoc solutions proposed by national leaders and a relative abundance of water. Given the rapid melting of glaciers that feed central Asian rivers, however, leaders cannot count on this level of water supply indefinitely. More water is predicted to flow into the basin over the next 20 years, but to decline rapidly and unprecedentedly after that. An agreement is urgently needed" (kraak 2012: 1)

Kyrgyzstan being an upstream country produces majority of the water flow in Syr Darya river basin. It is also in a favourable position regarding the sharing of water flow centred on the principles of sovereignty allowed by the international law. But at the same time it has to follow the "principle of 'fair and reasonable share of the productive use of international waters within its territory', and accordingly it is advised to release certain amount of water to downstream countries of Uzbekistan and Kazakhstan". Presently, Kyrgyzstan is consuming about 56% of water flow produced in its terrain. Kyrgyzstan finds itself in a secure position because the regional system of water managements which were used during Soviet times does not apply anymore and it has given leverage to Kyrgyzstan to use more and more water of its territory for its own use without concerning the needs of downstream countries. (Chotaev 2013: 4). Moreover, the idea declared by the President of Uzbekistan in 1990's that "the energy resources are belonging to the state and compose the product for sale, but water is god's gift to all the peoples and should be considered disregarding of the territory where it is generated', caused the reaction from Bishkek and Dushanbe. In this connection Kyrgyzstan adopted new amendment to the Water Law of 1995, which brought the principle of water payment for service of water intake and withdrawal, its distribution and transportation, and etc. (article 39). But, there are also

different principles of international use of water flow in article 66, which include ‘the rational use’, ‘sharing’, ‘environmental safety’ and other principles of international law. Article 70 of the document includes the provision requiring contribution for expenditures of dam exploitation, water intake, release, distribution and etc. of transnational water flow use” (ibid.) serious conflict also aroused due to the Naryn Syr Darya flow of dams in Kyrgyzstan because Uzbekistan has every year contended on discharging water from it to develop the agricultural production of its territory. There are several incidents where water conflicts resulted into the ‘verge of war’. For example, “In 1997, Uzbekistan deployed 130,000 troops on the Kyrgyz Uzbek border, near the Toktogul reservoir, to conduct military exercises aimed at seizure of a ‘well-guarded object’, using the armour and helicopters. Meanwhile, Kyrgyzstan, through media leak, hinted that in case the reservoir would be blown up, the resulting flood would sweep away Uzbekistan’s Ferghana and Zeravshan Valleys” (Grozin 2001).

“In 2009, the presidents of Kazakhstan and Uzbekistan proposed the resurrection of an old Soviet solution to central Asian water issues: to divert water from the Siberian Yenisei and Ob rivers to the Aral Sea and the wider region. The plan is financially unviable, and unlikely to be carried out. But if it was, it would unlikely address the real problems. Grand engineering schemes may provide legitimacy to unpopular regimes, but they fail to account for the fundamental political nature of water. Water management requires a political, not a technical solution. But the costs have been high. The Aral Sea, the terminal lake of the main sources of water in central Asia, the Syr Darya and Amu Darya rivers, has shrunk to almost nothing” (Kraak 2012).

In August 2013, Central Asian countries joined the Dushanbe Forum to address and discuss the upcoming water crisis and issues surrounding it concerning two most important international rivers in the area which are the Amu Darya and the Syr Darya. These countries have discussed the disagreeing positions of Upstream and downstream countries concerning the insufficient usage of water by Uzbekistan and Kazakhstan and along with the discussion regarding the ‘fair and rational’ use of water by the Kyrgyzstan and Tajikistan. Uzbekistan and Kazakhstan have put their apprehensions about water scarcities caused by power plants in the upstream

countries. “Water and energy problems marginalized the previous 1992 agreement between the riparian states. In 2007-2008, when an unprecedented cold winter was followed by a dry spring and summer, a severe water crisis arose in the region. Kyrgyzstan extracted higher than normal levels of hydropower from its dams on the Syr Darya River to resolve its national energy crunch. As a result, it created water shortages in Uzbekistan and Kazakhstan, harming downstream farmers who depended on river water for irrigation in the spring and summer growing seasons. Even seven months before the meeting, Islam Karimov, the President of Uzbekistan, officially blamed upstream countries of the rivers. He aggressively argued that those in the upper stream such as Kyrgyzstan and Tajikistan should know that the Syr Darya and Amu Darya rivers are not their own property” ( Lee and Mitchell 2014).

The shrinking of Aral Sea has not only given impetus to the problem of environmental degradation but also to the reduction in the crop production due to the lack of proper irrigation. Therefore, “At present time, ‘the difficulty and complexity of the Aral Sea problem has not only environmental, but also social, economic and demographic impacts of planetary consequences’, from the speech of the President of Uzbekistan at UN Session Government of Uzbekistan believes that the states located in the basin of the transboundary rivers can and should promote regional cooperation in the water sector. Such interaction is the key to the development and achievement of the mutually acceptable solutions to the rational use of transboundary water resources. Committed to the international law and regulations Uzbekistan is the only country in the Central Asia, party to the both UN universal conventions that regulate transboundary water issues” (Abduraimov and Akhmadjonov 2013).

### **Impact of water Issues on Border disputes**

The regional tensions have erupted between Tajikistan and Kyrgyzstan on the one hand and Uzbekistan on the other. However, conflict is not limited to an upstream versus downstream dichotomy. Tensions among the upstream countries are also common. At the local level, water conflict in Central Asia is manifested in clashes at borderlines between inhabitants of the Fergana Valley, the most thickly inhabited area of Central Asia where Kyrgyzstan, Tajikistan and Uzbekistan meet. Efforts to define

the borders have failed to date particularly in the Fergana Valley which is home to several enclaves. It is widely believed that unsettled borders in the region are major reason for conflict. The artificial borders which do not respect ethnic historical lines expose Central Asian states to frequent clashes. The decreasing water supplies and pastureland further increase the risk of low level conflict (Hodgson 2010).

A series of incidents point up the potential for conflict when “Tajik border guards shot and executed an Uzbek counterpart in November 2011, Uzbekistan built up military hardware just outside Tajik territory. Four days after the shooting a mysterious blast at a bridge in Uzbekistan closed the major rail route to southern Tajikistan and even endangered humanitarian aid to Tajikistan”. While Uzbekistan blamed a terrorist attack some speculate that the Uzbeks committed the disruption themselves to enlarge their de facto financial blockade of Tajikistan. The row between the two states over Rogun intensified in September 2012, when Uzbek President Karimov warned that deterioration of water problems could result in serious confrontation, even in wars. Kyrgyz-Uzbek relations are also far from safe from conflict. On the contrary, ethnic conflicts between these ethnicities go back to 1990, when plans to build a cotton processing plant on an Uzbek dominated collective farm initiated a riot in Osh a city in Kyrgyzstan where the Uzbek population constitutes the majority which ended in some 300 deaths (Kocak 2015: 9).

Inter-ethnic tensions reached a climax in June 2010 when violence between Uzbeks and Kyrgyz again in Osh left at least 418 people dead. Frequent clashes including border shootings with casualties on the Kyrgyz-Uzbek borders continue to occur. For instance, Uzbek border guards shot and killed a Kyrgyz citizen on 13 November 2014 near a disputed segment of the Kyrgyz-Uzbek border. Tensions between Kyrgyz and Tajiks also arise along the borders of Fergana Valley in the provinces of Batken in Kyrgyzstan and Soghd in Tajikistan. Clashes over land rights and water resources along the largely un-delimited border with Tajikistan grow increasingly vicious. As Kyrgyz leave the Batken province for Bishkek or abroad, Tajiks buy properties in that region. The more Tajiks settle, the more the conflict escalates, turning Batken into a flashpoint. Water plays a significant role, evidenced by the fact that tensions increase when irrigation begins in spring (Ibid.).

One major reason behind these incidents is the fact that only 73 percent of the Kyrgyz-Uzbek borderline and slightly more than half of the Kyrgyz-Tajik and 86 percent of the Tajik-Uzbek border has been delimited. Since the territories of these countries are not clearly defined, challenging claims on lands and thus natural resources are frequent on each side. Coupled with inefficient border controls, the region's undefined borders encourage human, drugs and arms trafficking (Ibid.).

## **Regional and International Efforts**

There are many attempts has been made for the improvement of regional cooperation in Central Asia's water issues with the assistance of the international community and different international organizations. The following are the key efforts

### **International Law Practices and Intergovernmental Agreements in Central Asia**

There is not any possible arrangement on using international rivers in international law. Nevertheless, while discerning the development of international law practices on this issue one can definitely perceive different ideas such as, "Harmon Doctrine of 'absolute sovereignty' of upstream state, 'Historical rights' of preferable use of watercourse, and 'Limited sovereignty' doctrine and equal share distribution between watercourse states. Each state has the right to a fair and reasonable share of the productive use of international waters within its territory. These different doctrines represent different attitude to distribution of transnational waters and no one has the dominant position in international law but become the base for formatting the main principles of customary law. The strict rules on distribution of transnational waters generally are admitted by the states on each case through the bilateral or multilateral agreements" (CHOTAEV 2013:3).

There are many attempts has been made for the improved of regional cooperation in Central Asia's water issues with the help of the international community. The following are the key efforts. Central Asian states have engaged in numerous agreements with its neighbour on water resource management. "The important agreements are: the Almaty agreement, Nukus declaration, Kyzyl Orda,

Agreement on the use of water and energy resources of the Syr Darya basin, Ashgabat declaration and Chu and Talas agreement”.

### **Almaty Agreement**

“On 10-12 October, 1991, the ministers of five Central Asian states (N. Kipshakbayev from Kazakhstan, M. Zulpuyev from Kyrgyzstan, A. Nurov from Tajikistan, A. Ilamanov from Turkmenistan and R. Giniyatullin from Uzbekistan) met in Tashkent and discussed on the equivalent rights and accountability for ensuring rational use of water resources in the region. They know that, only joint actions in harmonization and management can assist to efficiently resolve the region’s water problems. On February 18, 1992, they would sign the agreement on cooperation in joint management and use and protection of interstate sources of water resources in Almaty” (UNDP 2011: 5).

“Article 1 of the Agreement shapes that “recognising the community and unity of the region’s water resources, the parties have equal rights for their use and accountability for ensuring their rational use and protection”. The agreement was based on equivalent right for water use and preserve quota system. “Thus, repeating the principles of the “Helsinki Rules” of 1966 and then 1992 United Nations and European Commission, “Helsinki convention” on the protection and use of transboundary watercourses and international lakes. The Interstate Commission for Water Coordination (ICWC) was established to implement the Agreement” (Khamzayeva 2009: 12).

The Interstate Commission for Water Coordination (ICWC), a joint committee was set up to help the enactment of allocations and to control the actions of the river basin initiatives. “The ICWC also runs a Scientific Information Centre (SIC), trains water officials and operates a comprehensive database that can be assessed by its member countries. The ICWC’s executive bodies, the Basin Water Management Association (BWA) and the Amu Darya and Syr Darya monitor the implementation of quotas” (Mosello 2008: 161).

## **Nukus Declaration 1995**

The “Nukus Declaration” was contracted by the heads of state of the Aral sea basin on 3 March 1995. This declaration specified that, the need for a “unified multi-sectoral approach and the development of cooperation amongst the states and with the international community”. It offers a promise to supportable development and be acquainted with water and biological resources as the basis for future sustainability; a need for a scientifically based system of agriculture and forestry; increased irrigation effectiveness; economically driven methods of water usage; better-quality technologies in irrigation and ecological protection; and inducements for long term land and water management” (McKinney 1996: 2)

The extreme need of water for irrigation from the Amu Darya and Syr Darya river led to drying of Aral sea and unparalleled influence on ecology. The growing deficiency of water and its worsening quality have caused degradation of lands, change in flora and fauna and decrease of irrigated agriculture (Ibid.).

## **Kyzyl Orda Agreement**

In the year 1996, the “Kyzyl Orda agreement” was signed among the Common wealth of Independence States (CIS) countries creating the interstate council for the Aral sea which focuses on the social, economic and environmental oriented projects. The agreement was extended between Uzbekistan, Kazakhstan and Kyrgyzstan in 1996, in which Uzbekistan and Kazakhstan will handover energy, coal or gas to Kyrgyzstan in the period of power shortage, to reimburse for the non-use of water for hydropower in the winter period (Pak 2014: 22).

“The disagreement in the Syr Darya basin relates to the action of the Toktogul reservoir in Kyrgyzstan is a conflict of interest between Uzbekistan, Kyrgyzstan and Kazakhstan. The two downstream countries of the Syr Darya basin are interested in maintaining storage for summer time irrigation from the Toktogul reservoir, whereas winter energy generation from the reservoir is helpful to Kyrgyzstan. Much money is required to keep the reservoir in operating condition, but Uzbekistan and Kazakhstan which are water recipients, pay nothing to maintain the Toktogul reservoir. A similar

set of issues may be observed between Tajikistan and Uzbekistan regarding the management of the Kayrakkum reservoir” (FAO 2012: 17-18).

The changes in the operation of the Toktogul reservoir have headed to undesirable enlargements such as inadequate water for irrigation; the population’s worsening social, economic and living conditions as well as overflowing of populated areas and agricultural land in Uzbekistan and Kazakhstan (UNDP 2004).

### **Agreement on the Use of Water and Energy Resources of the Syr-Darya Basin**

Uzbekistan and Kyrgyzstan had particularly contradictory history over the use of water from the Syr Darya. “Since independence, Kyrgyzstan faces serious economic problems mainly because of a shortage of energy supply from Russia, Kazakhstan and Uzbekistan. The primacy of energy production over the irrigation needs, downstream has already created a major discord between Uzbekistan and Kyrgyzstan (Klotzli 1994). The 1998 Syr Darya framework agreement between the two has been broken by both sides. The implementation of such barter agreement runs across one major problem and all barter agreements are delayed until the late spring when the downstream countries urgently need water for irrigation” (IGC 2002).

“ In the year 1998 the agreement On the Use of Water and Energy Resources of the Syr-Darya Basin was signed between the Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan. Article 4 of this agreement says that, water used for irrigation in the summer period in the Toktogul reservoir on the Naryn should be compensated with energy resources” (Khamzayeva 2009: 14).

“This agreement was concluded in Bishkek on March 17, 1998. The Agreement underlined a coordinated order of water and energy resources use in the Syr Darya river basin, which is a precondition for further social-economic progress of the countries and people’s welfare. The Syr Darya river basin is located in four countries and owns water and energy resources, which can support more development of economies and societies. The flow regulation of the Syr Darya river in long term was highlighted to be engrossed on proper use of water for the purposes of power



generation and irrigation. Though, it is vitally important to assure good ecological state of water resources and environmental safety. The coordinated conservation, use and management of water resources are to take into account remediation measures to prevent further development of the Aral sea crisis” (CA water info 2011: 10)

### **The Ashgabat Declaration**

The “Ashgabat Declaration” took place on 7 May, 1999 among the regimes of Uzbekistan, Kazakhstan and Kyrgyzstan on the usage of water and energy resources of the Syr Darya basin (FAO 2012: 21). “The declaration is concentrated on the Aral sea crisis concerns, which negatively affected the living standard of population in Central Asia. In common with international organisations and funds including considerable GEF support, major national attention was paid to the issues of water resource management in Central Asia. The five presidents of the Central Asian countries acknowledged to confess the position of complete solution of the problems, connected with standardization of social-ecological condition in Aral sea basin, strengthen both in the Central Asian States and in their representations abroad the activity to attract the attention of international community, means and abilities of donor countries, funds and organisations for implementation the programs and projects related to the Aral Sea basin problems, provide every kind of assistance and support to implementation of control on Water resources and environment in Aral sea basin project, being realised under the aegis of World Bank and GEF, give more consideration to the problems of mountain territories, realise a number of all round measures and priority projects on social protection of population living in Aral sea basin, brisk up the works against desertification and transboundary pollution of water bodies, assist to international organisations and institutions in their activity on implementation of the programs and projects related to the Aral sea basin problems, promote through educational and other programs rising of awareness of the population about urgent problems of nature protection, conservation and improvement of environment for present and future generations” (CA water info 2011: 11).

## **Chu-Talas Joint Rivers Commission**

In the year 2000, Kyrgyzstan and Kazakhstan signed an “agreement for joint management on the Chu river (Kyrgyzstan) and the Talas river (Kazakhstan) through the Chu-Talas Rivers Commission”. It became operative in 2006 and created a new level of collaboration between the two countries. According to this agreement, “Kazakhstan has agreed to pay for some of the costs of dams in Kyrgyzstan (Wergerich 2008). Kazakhstan now pays a reasonable cost for receiving water from the dams on the Chu River and thus it has moved away from Soviet era water quotas. The commission has been praised for providing reliable water predicts for irrigated agriculture. The Chu-Talas Rivers Commission is regarded as a breakthrough agreement by the United Nations Economic Commission for Europe (UNECE) and it is seen as a model for helping to resolve larger upstream-downstream water conflicts” (United Nations Economic Commission for Europe 2010).

## **The International Fund for Saving the Aral sea**

In the year 1993, the five Central Asian states came together to form the International Fund for saving the Aral Sea (IFAS), a group planned to expedite regional cooperation in order to discuss this crisis. Since its beginning, IFAS has contributed in a quantity of projects such as the 1993-1997 Aral Sea Basin Programme. “This main objective of this project were to focused on stabilizing and rehabilitating the surrounding area, developing better water management strategies and increasing the ability for regional and national organizations to advance their projects” (Bharghouti 2006).

It will be problematic for IFAS to encourage its objectives because the key difficulties such as the shattered infrastructure, climate change and agricultural practices are still creating obstacles in saving the Aral Sea. Although IFAS has had some good and bad points, it has assisted as a stage in encouraging regional cooperation between the five states in addressing the key issue that disturbs them all.

## **Integrated Water Resources Management**

“Integrated Water Resource Management is a management system of surface, ground and return water that takes into account the different economic sectors and hierarchical levels of water use, involves all stakeholders into decision-making and promotes efficient use of water, land and other natural resources for the sake of sustainable satisfying water requirements of eco-systems and human society” (UN News Centre 2010). This initiative outlooks regional cooperation as acute in addressing bigger demand for water, climate change and disagreeing interests for water usage. A large section of this approach is that public involvement is vital and that countries need to take a legitimate, monetary, all-inclusive and combined method to water management (Dukhovny et al. 2004).

## **Central Asian Countries Initiative for Land Management**

Central Asian Countries Initiative for Land Management has concentrated on land degradation, eco-system stabilization, sustainable agriculture, pastoral management and sustainable forestry. “It aims to increase private investment and make major improvements in degraded farmland, develop an integrated approach toward land-use planning and train more government workers and citizens in sustainable land management practices. Among the expected global environmental assistances of this initiative are decrease in the loss of soils from sand storms, the lessening of soil and pesticide runoff into rivers that run downstream and into Transboundary Rivers as well as improvements in water availability which should moderate the harsh climate related to desertification. The other environmental assistances include a reduction in the loss of carbon sinks in soils and forests and a reduction in greenhouse gases created by unsustainable agricultural practices. CACILM is a new initiative and it is too early to evaluate its success or failure but so far there are good indications of wide participation of all five countries in dealing with the legacy of poor irrigation practices resulting in salinization and water logging which has harm agricultural production” (ADB Report 2012).

## **World Bank**

The World Bank (WB) has launched a new initiative with the five Central Asian governments and regional institutions called the Central Asia Energy-Water Development Framework. “This program aims to show each state how to utilize their resources in a socially sustainable and environmentally-friendly manner with regards to each other’s national priorities and regional stability. This initiative has three specific aims: balance energy options while addressing winter energy shortages; strengthen investment in infrastructure to expand energy trade within and outside the region and work with regional organizations to encourage dialogue among the states and improve water usage for the energy and agricultural sectors” (World Bank 2010).

The World Bank has played a constructive role in gathering funds and addressing country particular issues in Central Asia. It is also involved in assistance to build the Kokaralsk Dam and the Aral Sea Basin Programme as these is just a few of its efforts in addressing the Aral Sea crisis.

## **European Union**

The European Union (EU) has been involved with the five central asian countries after their independence mainly on economic and security arena. “Central Asia’s energy resources are of particular interest as the EU is dependent on external energy sources in order to increase energy security. As a result of this development, in June 2007, the EU adopted the EU and Central Asia: Strategy for a New Partnership that marked an upgrade in the relations between the EU and Central Asia” (European Communities 2009).

As portion of its Central Asia Strategy, the EU-Central Asia Environmental Dialogue has been formed to raise environmental security and improved management of water resources. The EU has increasingly dedicated on working with the five Central Asian countries to develop the supervision of lands and forestry resources and supporting the equilibrium of the Aral Sea. “To promote and increase capacity building for renewable energy sources and improve energy efficiency, recent activities include the trainings and seminars of government officials and financing

feasibility studies regarding the installation of small sized hydropower stations and the use of renewable energy sources in the region. The EU is also trying to lighten the problems arising from the conflicting needs for water access and use between upstream and downstream countries by actively promoting efficient and economic usage of this resource. Several initiatives have been launched to tackle these issues such as the better use of resources, better management and rehabilitation of irrigation systems and energy transmission lines” (European Commission External Relations 2009).

### **Special Programme for the Economies of Central Asia**

Special Programme for Economies of Central Asia was established in 1998 by the presidents of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. “The main objective of SPECA is to support the Central Asian states in developing their cooperation, creating incentives for economic development and integration into the economies of Europe and Asia. It is working to provide a framework for dialogue and cooperation as well as for broader cooperative initiatives. Its activities include the development of Euro-Asian transport linkages, including the possible extension of railway and road networks into the region as well as the positive development of institutionalized cooperation between the government of Kazakhstan and Kyrgyzstan in the management of water installations on the Chu-Talas rivers” (UNECE and UNESCAP 2010).

### **Shanghai Cooperation Organization**

The Shanghai Cooperation Organization (SCO) is a permanent intergovernmental international organization established on June 2001 in Shanghai by the China, Russia, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. “The main goals of the SCO are to toughen relations among the member countries; promote effective collaboration in politics, trade and economy, science and technology, culture, education, energy, transportation tourism and environmental protection; make joint efforts to promote peace, security and stability in the region in accordance with the principles of non-alignment, non-targeting and openness” (SCO 2010). “The SCO has an important role to play regarding the water crisis in Central Asia for various

reasons such as with the exception of Turkmenistan, all of the Central Asian countries joined the SCO in an effort to promote good neighbouring relations and to strengthen regional cooperation mechanisms and all of the goals formulated in the SCO charter fall directly into place with the ongoing water crisis in Central Asia” (Marketos 2008: 324-325).

Since its commencement, the SCO has made numerous struggles to promote cooperation among the Central Asian states. But, the deviating benefits of its members and the absence of Turkmenistan in the SCO remain to represent an difficulty in the accomplishment of the SCO aims.

After the breakup of the Soviet Union in 1991, the newly independent states decided to follow their own differing national interests. Even though the countries decided to sign the 1992 Almaty agreement and preserve Soviet Union water quotas, which is now old-fashioned and inadequate in its efficiency. Regional and international efforts have been unsuccessful to find a permanent answer because of the suspicion and little political will to collaborate among the Central Asian regimes. The other important factors take account of poor infrastructure due to economic circumstances within the countries, imbalanced sharing of natural resources and climate change. The major problem lies in the lack of cooperation and discussion on regional water management are conflicting interests on how these water resources are to be used as for commodity or public good. The downstream countries such as Kazakhstan, Turkmenistan and Uzbekistan are reliant on on irrigated agriculture whereas upstream countries such as Kyrgyzstan and Tajikistan are fixated on increasing reservoir volume and hydroelectric power capacity.

The good relations and mutual cooperation among the states and proper implementation of policies are required to solve these problems between the upstream and downstream countries.

## **CHAPTER-5**

### **CONCLUSION**

Water is an important and vital source of life. Without water, human life is not possible. Water has never ending impact on human beings, like socio-economic and political areas. Not only water has a strong hand in the development of many civilizations but also it has destroyed many too.

On the social level, water is used for many purposes like drinking, bathing and cleaning but on the economic level, it is an easy and cheaper mode to increase the GDP of any nation, similarly, on the political level it is also somewhere responsible for the co-ordination and the negotiation between two or maybe many more.

Water is becoming as a non-traditional security threats, due to the rapid growth of population, increase industrial activities and global warming. Therefore, to solve these issues various management approach have initiated in different levels like at international, national and regional. Water resource management is the best way of water resources in the unbiased utilization. Integrated Water Resource Management (IWRM) approach is following the equitable utilization of water resources. This approach promote at the above three levels, because it gives equal opportunity to all people and community; and it gives important to sustainable development. It discusses the importance of water and its management approach and also deals with historical policies of water management in Central Asian States.

Since 1991, water resource management has been a major challenging issue in Central Asian states, because of its historical legacy. During the soviet period, Moscow government focused on economic development and promoted cotton cultivation and ignored environment issues. As a result, it impacted on the Aral sea for a long time. After the disintegration of the Soviet Union, Central Asian countries lost financial status and faced problems of management of natural resources because Central Asian states were in a transition period and had lack of money. Therefore, they adopted market economy for national development and through market economy they exported their natural resources to world market prices. It gives up the regional

interest and focused national interest like sovereignty of natural resources. The study focused on Kyrgyzstan's water resource and its step taken by Kyrgyzstan government for water management.

The second chapter deals with the water resources of Kyrgyzstan. Among the five Central Asian countries, Kyrgyzstan and Tajikistan are two major upstream countries which are abundant in water resources and play a very important role for the downstream countries like Uzbekistan and Kazakhstan. On the basis of topography, Kyrgyzstan's hydrological zones is distributed into two parts, the flow generation zone and flow dissipation zone. The flow generation zone is a mountainous zone and has maximum precipitation and water storages. As a mountainous country, it has many sources of water like glaciers, rivers, lakes, reservoirs and groundwater. The world's largest mountain is located here like the Tien Shan and Pamir. Glacier is an important source of river and ground water is an important source of fresh water free from pollution. But, today due to global warming, climate is changing and glaciers are melting. As a result, reservoirs and rivers water level is increasing creating and leading flood, which has a huge impact on local communities, damage of crops and emergence of several diseases. The topography of the country varies from high mountains to low valleys which had a major impact on its climatic diversity. Therefore Kyrgyzstan experiences an extreme trend of climatic variations ranging from high temperatures to very low temperatures in some regions which play an important role in its hydrography. In Kyrgyzstan, water resources have found in various forms like the surface water and the ground water. Surface water includes glaciers which is the main source of the rivers in the country.

The third chapter deals with the policies on water usage and management in the country, where Kyrgyzstan has initiated several policies to secure and develop its socio, economy, and environment. Through this policy, Kyrgyzstan has decided to use of water to which sector and how and has charged the fees for water for maintenance of its water infrastructure and creating awareness among the people. Although, Kyrgyzstan has abundance water resource; it is facing water crisis due to the lack of fund, out-dated infrastructures and rapid population growth. Agriculture is the main source of income in Kyrgyzstan's economy. Irrigation is a part of agriculture and is



one of the most water consuming sector. Approximately 90 percent of surface and groundwater are used in irrigation purpose from the Chui, Talas, Amu Darya, Syr Darya, Tarim and Issyk Kul river basins. Industry is the second major water consumption sector in Kyrgyzstan and consumes around 6 percent water for industrial activity. Kyrgyzstan has started mining industry due to the huge reserved of mineral resource. The river and groundwater are polluted due to the exploring of mining industries and is a threat to the environment. Textile is the second important industry after gold and is also affecting water resource due to huge need of water for its use. Kyrgyzstan uses 3 percent water for domestic purpose like drinking, bathing, cleaning etc. The household gets water from different sources like 59.9 percent rural population get water from the water supply system and the rest 40.1 percent population get water from ditches, rivers, channels, springs, water carriers etc. The limited access of water make it difficult to the household for hygiene, washing, bathing, cleaning, washing etc. Hydropower is a dominated sector in Kyrgyzstan because 90 percent electricity is generated through water resource.

The lack of money has caused the deteriorated living standard of people, decrease the quality of water, worse health facility and increased water pollution. Therefore, several irrigation and drainage systems are out dated and in worse condition. The rapid population growth is another problem of water usage and management in Kyrgyzstan. Due to the bad sewage system, the polluted and hazardous element is flowing into the rivers and canals and it contaminates the quality of water. Many surface rivers like “Chu, Alamedin, Chon Kemin, Issyk Ata, Kechi, Kemin, Naryn, Akbura, Kara Darya, Tar, Yassy and Kurshab” have an bigger level of ammonium nitrate, copper, zinc, oil and other harmful elements of toxic chemicals are polluting to these rivers.

The fourth chapter deals with Kyrgyzstan’s policies on water with impact on the downstream countries. The policies that had initiated by Kyrgyzstan have impact on different field like irrigation and fishing industries. The storage of water by Kyrgyzstan has also impacted the downstream cotton production because downstream countries are not getting sufficient water for cotton cultivation. It also had an impact

on the Aral sea. Maximum land of Uzbekistan is covered by the Aral sea basin. Due to the Aral sea shrinking, Karakalpakstan's fishing industry is highly impacted.

After the collapse of the Soviet Union, trans-boundary water resource management has been emerged as a conflicting interest between the upper riparian and lower riparian countries of Central Asia because of the unequal distribution of natural resources. The upstream countries like Kyrgyzstan and Tajikistan are poor in energy resources but rich in water resources and the downstream countries like Kazakhstan, Turkmenistan and Uzbekistan are rich in energy but poor in water resources. The upstream countries needed water for energy production and the downstream countries need it for agricultural production and industrial usages. But they have not shared the resources with each other because of the equitable distribution of their national interest. Natural resource has emerged as a cause of conflict. The lack of mutual cooperation and regional dialogue between the upper and lower riparian countries is also a cause of conflict for the region. Downstream country of Uzbekistan is the biggest consumer of water resources primarily used for agriculture. Uzbekistan's farmers are using water that streams from the Amu Darya and the Syr Darya river to water their cotton fields since the ancient times. But, recently there has been an varying supply of water from the upper riparian countries which makes the region more problematic and devastating their economy.

In Uzbekistan 1991 to 2005, the cotton production has increased but after 2005 cotton productivity has been declining rapidly because upstream countries was not resealing water for Uzbek cotton cultivation .On other hand Uzbekistan has considered less availability freshwater as a serious environmental challenge therefore it was sifted own economic priority. The republic of Karakalpakstan, the Khorezm region of Uzbekistan and the Tashauz region of Turkmenistan are situated near the aral sea where it a direct impact of water resource management of rivers, building of dams and barrages and deviation of water mainly uses for irrigation which led to decline in the Aral sea water level which promoted in increasing salinity of the lake. All this impact had a huge effect in changing the aquatic environment which resulted in decreasing fish production in the Aral sea and the fishery in the lower Amu Darya

river also suffered the extreme loss which is affecting the all over economy of the area.

With the ongoing political crisis in Kyrgyzstan in 2010, Kazakhstan issued an economic blockade on Kyrgyzstan. On contrary Kyrgyzstan blocked river flow to Kazakhstan. After the crisis Kazakhstan introduced a project of construction a water reservoir in its country for avoiding the participation of water issues between them. The purpose of construction of dams for example Kambarata dam by the upstream countries is used as the instrument for human development, generation of hydroelectricity, irrigation, drinking water supply, flood control, navigation, recreation and others to meet the growing. But, on the other hand, the construction of dam have a negative socio-economic impact on the people either intentional or unintentional such as the resettlement and migration, changes of size and structure of household, employment and income, way of using land and water resources and changes in community level.

Future climate change poses additional challenges. The melting glaciers of upstream countries and the increasing temperatures in the lower riparian countries have severe influence on agricultural economy and water crisis of downstream countries. The small farmers and the rural poor are also affected by the extreme weather which has damaged many crops like cotton, wheat etc and killed the livestock. The temperature is rising creating natural evaporation rates which is causing a certain decrease in the flow of the rivers where less water is obtainable to fill-up the Aral Sea. Less rainy days has led the coastline to move away and increase the rate of drought, thus revealing toxic salts on the seabed that are from the extreme use of fertilizers and pesticides which resulted in increase of several diseases in the adjoining regions.

Water crisis in the region between the states sometimes became heated between the upstream and downstream countries. In 2001, Kyrgyzstan approved a set of laws, classifying water as a same value to oil and gas, which means that the downstream countries Uzbekistan and Kazakhstan will have to recompense for the water accumulation and storage costs. On the contrary Uzbekistan considers water a free, public good, shared by all and cannot be traded like Kyrgyzstan considered.

Uzbekistan also disagrees to pay Kyrgyzstan for water which led to several disagreements among the countries linking to hydro politics with domestic power struggles. The conflict can only be prevented by intergovernmental solutions provided by the national leaders of the region. The countries are also disagreeing on the issues on how the Toktogul should be functioned. Repeated disagreements over the dam led to severe water scarcities in the summer of 2008-2009 and affected all three disputed countries, with water scarcities in Uzbekistan and Kazakhstan and prolonged power cuts in Kyrgyzstan.

The policy is also created border disputes due to ethnic groups of Fergana valley because the ethnic group of this valley wants water for cultivation. But, the sufficient water of Syr Darya river is not reached to this people. As a result Uzbekistan and Kazakhstan opposed this policy and Uzbekistan took aggressive reaction against Kyrgyzstan and sent his army to Kyrgyzstan border. Therefore, water is a serious issue in Central Asia. Thus, to resolve this issues the Central Asian countries made agreement on regional levels like 1992 Almaty agreement, 1998 Syr Darya basin agreement and 2000 Chu and Talas agreement.

The study analyzes two hypotheses where the first one deals with the economic aspect of hydropower is impacting the downstream countries. The answer to this extent lies in the fourth chapter where it is critically analyzed how Kyrgyzstan as an upstream country is playing an upper hand role in controlling the economy of the downstream countries. The second hypothesis deal with the poor infrastructure of the country which is finally impacting in water management and water problem analyzed in the third chapter of the dissertation.

Water will continue to play a dominant role in the central Asian region. Hydro politics can be a serious challenge in future between the upstream and downstream countries, which needed to solve through regional cooperation, mutual trust, willingness of the government to cooperate among the states.

## **REFERENCES**

( \* indicates a primary source)

“UN Water Kyrgyzstan, UN-Water Country Brief” Accessed on 2 May 2016, URL: [http://www.unwater.org/fileadmin/user\\_upload/unwater\\_new/docs/Publications/KG\\_pagebypage.pdf](http://www.unwater.org/fileadmin/user_upload/unwater_new/docs/Publications/KG_pagebypage.pdf).

\*“Uzbek President Karimov on the Soviet legacy and territorial disputes” The Times of Central Asia. January 30. 2013.

Abdullaev, Iskanda and Yakubov, Murat et al. (2009) “Agricultural Water Use and Trade in Uzbekistan: Situation and Potential Impacts of Market Liberalization”, International Journal of Water Resources Development, 25 (1): 47-63.

Abduraimov, Mansur and Vokhid Akhmadjonov (2013) “National Consultations on Water in the Post-2015 Development Agenda” CWP-Uzbekistan Coordinator and Head of Water Balance Division, Ministry of Agriculture and Water Resources, Uzbekistan

\*ADB (2001), “Proposed grant assistance financed by the Japan fund for poverty reduction to the Republic of Uzbekistan for the supporting innovative poverty reduction in Karakalpakstan project” Asian Development Bank

\*ADB (2012), “Regional: Central Asian Countries Initiative for Land Management (CACILM) Multicounty Partnership Framework Support Project” Accessed on 13 May 2016, URL: <http://www.adb.org/projects/38464-012/main>.

Alibekov, Ibragim (2003), “Clashing Approaches Becloud Central Asia’s Water Future”, EurasiaNet, Accessed on 28 May 2016, URL: <http://www.eurasianet.org/departments/environment/articles/eav052803.shtml>.

Allouch, Jeremy (2007), “The governance of Central Asian waters: national interests versus regional cooperation”, Disarmament forum: 45-55.

Alymbaeva, Aida (2004), "Institutional development of Water Users Associations in Kyrgyzstan", Rochester Institute of Technology, Accessed on 2 February 2016, URL: <http://www.scholarworks.rit.edu/theses>.

\*Asian Development Bank (2000), "Country Economic Review, Uzbekistan", Accessed on May 20 2016, URL: <http://www.adb.org/countries/uzbekistan/country-documents?page=2>.

\*Asian Development Bank (2008), "Republic of Uzbekistan: Water Resource Management Sector Project", Accessed on 18 May 2016, URL: <http://adb.org/sites/default/files/projdocs/2008/40086-UZB-RRP.pdf>.

\*Asian Development Bank (2013), "Kyrgyz Republic: Developing water resources sector strategies in Central and West Asia", Accessed on 8 December 2015, URL: <http://www.adb.org/sites/default/files/project-document/79760/45353-001-tacr-01.pdf>

Ataniyazova, O. (2003), "Health and Ecological Consequences of the Aral Sea Crisis", Prepared for the 3rd World Water Forum Regional Cooperation in Shared Water Resources in Central Asia Kyoto.

Bekturov, Adilet (2014), Risk Assessment of Petrov's Glacial Lake Outburst Floods (Kyrgyzstan), Department of Chemical and Nuclear Engineering at Polytechnic Valencia: University of Valencia.

Bharghouti, Shawki (2006), An independent evaluation of the World Bank's support of regional programs: Case study of the Aral Sea water and environmental management project. Report No. 39284, Washington, D.C.

Bosch, K. et al. (2007), "Evaluation of the toxicological properties of ground and surface-water samples from the Aral Sea Basin", *Science of the Total Environment*, 374: 43-50.

Bosworth, C.E. (1999), *The Appearance of the Arabs in Central Asia under the Umayyad and the establishment of Islam*, Paris: Motilal Banarsidass publications.

Bucknall, Julia and Irina Klytchnikova et al. (2003), "Irrigation in Central Asia: Social, Economic and Environmental Considerations", World Bank Report, Accessed on 21 May 2016, URL: [http://siteresources.worldbank.org/ECAEXT/Resources/publications/Irrigation-in-Central-Asia/Irrigation\\_in\\_Central\\_Asia-Full\\_Document-English.pdf](http://siteresources.worldbank.org/ECAEXT/Resources/publications/Irrigation-in-Central-Asia/Irrigation_in_Central_Asia-Full_Document-English.pdf).

CA Water Info (2011), "The Aral Sea Basin: Central Asians Discuss Water Distribution", RFE/RL News line.

CAREC (2013), "KGZ: CAREC Transport Corridor 1 (Bishkek-Torugart Road), Project 3 (Km 479-539)", Environmental Impact Assessment Report, Project Number: 42399-02, Accessed on 14 February 2016, URL: <http://www.adb.org/sites/default/files/project-document/156487/42399-023-eia-08.pdf>

CechThomas, V. (2010), *Principal of water resources: History, Development, Management and Policy*, United State of America: John Willy and Sons.

Chapagain, A. K. (2005), "The Water footprint of cotton consumption", UNESCO-IHE, The Institute of Water Education.

Chow, Edward and Leigh Hendrix (2010), "Central Asia's Pipelines: Field of Dreams and Reality", The National Bureau of Asian Research, Special Report no. 23.

Daily Times (2016), "CASA-1000 formally inaugurated", Accessed on 14 April 2016, URL: <http://www.dailytimes.com.pk/opinion/17-May-16/casa-1000-formally-inaugurated>.

Daly, Dr. John C. K. (2010), "Central Asia's Most Precious Resource Water, Not Oil" Accessed on 22 May 2016, URL: <http://www.safehaven.com/article/15475/central-asias-most-precious-resource-water-not-oil>.

David, I. (2014), *Water conflict in Central Asia: Is there potential for the desiccation of the Aral sea or competition for the waters of Kazakhstan's cross-border Ili and Irtysh rivers to bring about conflict; and should the UK be concerned?*, UK: Routledge Publication.

Dukhovny, V.A. and Sokolov, V.I. (2005), “Integrated Water Resources Management: Experience and Lessons Learned from Central Asia towards the Fourth World Water Forum” Accessed on 4 February 2016, URL: [http://www.cawater-info.net/library/eng/gwp/dukhovny\\_sokolov\\_e.pdf](http://www.cawater-info.net/library/eng/gwp/dukhovny_sokolov_e.pdf).

Dukhovny, Victor A. and Schutter, Joop de (2011), Water in Central Asia: past, present and future, London: Taylor and Francis Group.

Dukhovny, Victor A. and Sokolov, Vadim (2003), Lessons on cooperation building to manage water conflicts in the Aral sea basin, Paris: UNESCO.

Dukhovny. V et al. (2001), “Assessment of the Social-Economic Damage under the Influence of the Aral Sea Level Lowering for South Aral Sea Coast”, Scientific Information Centre of Interstate Coordination Water Commission (SIC ICWC).

Dunn, Arthur (2010), “Way to Solve the Problem”, Accessed on 8 May, 2016, URL: <http://www.eurodialogue.org/eu-central-asia/Way-to-solve-the-problem>.

Durgin, Frank A. (1962), “The Virgin Lands Programme 1954-1960”, Soviet Studies (JSTOR), 13 (3): 255-280.

\*Economic and Social Commission for Asia and the Pacific (2010), “SPECA background information”, Accessed on 21 May, 2016, URL: <http://www.unece.org/speca/welcome.html>.

Elhance, A. P. (1997), “Conflict and co-operation over water in the Aral sea basin”, Studies in Conflict and Terrorism, 20 (2): 207-218.

Emerson and Jos Boonstra, Nafisa Hasanova, et al. (2010), “Monitoring the EU’s Central Asia Strategy”, EUCAM, Accessed on 23 May 2016, URL: [http://www.eucentralasia.eu/fileadmin/user\\_upload/PDF/Final\\_Report/EUCAM\\_Final-Report.pdf](http://www.eucentralasia.eu/fileadmin/user_upload/PDF/Final_Report/EUCAM_Final-Report.pdf).

\*Energy Information Administration (2009), “Turkmenistan data profile” Accessed on 24 May 2016, URL: <https://www.eia.gov/beta/international/country.cfm?iso=TKM>.



Eurasia net (2010), “Kyrgyzstan: Melting Glaciers Threaten Central Asia’s Ecology and Energy Future”, Accessed on 26 May 2016, URL: <http://www.eurasianet.org/node/62177>.

\*Eurasian Development Bank (2008), “Water and Energy Resources in Central Asia: Utilization and Development Issues”, Industry Report, Accessed on 24 May 2016, URL: [http://eabr.org/general/upload/docs/Report\\_2\\_water\\_and\\_energy\\_EDB.pdf](http://eabr.org/general/upload/docs/Report_2_water_and_energy_EDB.pdf).

Eurasian Transition Group (2009), “Central Asia’s electricity system falls apart”, Accessed on 25 May 2016, URL: <http://www.eurasiantransition.org/files/21065726fae7bcc47ab5b9ae873a7d83-251.php>.

European Commission External Relations (2009), “Environment and Water-The EU and Central Asia: Strategy for a New Partnership”.

\*European Communities (2009), “The European Union and Central Asia-A New Partnership in Action”, Accessed on 27 May 2016, URL: [https://ec.europa.eu/research/iscp/pdf/policy/2010\\_strategy\\_eu\\_centralasia\\_en.pdf](https://ec.europa.eu/research/iscp/pdf/policy/2010_strategy_eu_centralasia_en.pdf).

Evans, Alex, (2010), “Resource Scarcity, Climate Change and Risk of Violent Conflict”, background paper for World Development Report, Accessed on 29 May 2016, URL: <http://web.worldbank.org/archive/website01306/web/climate%20change.html>.

\*FAO (2012), “Irrigation in Central Asia in figures”, AQUASTAT Survey, Accessed on 16 February 2016, URL: <http://www.fao.org/docrep/018/i3289e/i3289e.pdf>.

\*FAO (2012), “The Aral sea transboundary river basin”, AQUASTAT Survey, Accessed on 8 February 2016, URL: [http://www.fao.org/nr/water/aquastat/basins/aral-sea/aral.sea-CP\\_eng.pdf](http://www.fao.org/nr/water/aquastat/basins/aral-sea/aral.sea-CP_eng.pdf)

Fergus, Michael (1999), “The Aral Sea environmental crisis: Problems and a way forward” Asian Affairs, 30 (2): 35.

Glantz, Michael (1999), *Creeping Environmental Problems and Sustainable Development in the Aral Sea Basin*, Great Britain: Cambridge University Press.

Glazirin, G. E. (2010), "A century of investigations on outbursts of the ice-dammed lake Merzbacher (central Tien Shan)", *Austrian Journal of Earth Sciences*, 103 (2): 171-178.

Gurjar, R.K. and Jat, B.C. (2008), *Geography of Water Resources*, Jaipur: Rawat Publication.

GWP (2006), "The Kyrgyz Republic National Report" Accessed on 28 March 2016, URL: [http://www.cawater-info.net/ucc-water/pdf/ucc\\_water\\_report\\_kyrg\\_en.pdf](http://www.cawater-info.net/ucc-water/pdf/ucc_water_report_kyrg_en.pdf).

GWP (2008), "Integrated Water Resources Management", Accessed on 27 January 2016, URL: <http://www.sswm.info/category/concept/iwrm>.

GWP (2010), "Water Resources Management" Accessed on 12 January 2016, URL: [http://www.gwp.org/the\\_challenge/water-resource-management](http://www.gwp.org/the_challenge/water-resource-management).

GWP (2014), "Integrated Water Resources Management in Central Asia: The challenges of managing large transboundary rivers", Accessed on 15 January 2016, URL: <http://www.gwp.org>.

Hara, S. L. (2000), "Central Asia's Water Resources: Contemporary and Future Management Issues", *Water Resources Development*, 16 (3): 423-441.

Hara, Ssarah and Tim Hannan (1999), "Irrigation and Water Management in Turkmenistan: Past Systems, Present Problems and Future Scenarios", *Europe-Asia Studies*, 51 (1): 21-41.

Herrfahrdt, Elka and Kipping, Martin et al. (2006), "Water Governance in the Kyrgyz Agriculture Sector: On its Way to Integrated Water Resource Management?" Accessed on 2 April 2016, URL: [https://www.die-gdi.de/uploads/media/Studies\\_14.pdf](https://www.die-gdi.de/uploads/media/Studies_14.pdf).

Hodgson, Stephen (2010), “Strategic Water Resources in Central Asia: in search of a new international legal order”, Policy Brief, EUCAM: EU-Central Asia Monitoring, Accessed on 29 May 2016, URL: [http://aei.pitt.edu/58489/1/EUCAM\\_PB\\_14.pdf](http://aei.pitt.edu/58489/1/EUCAM_PB_14.pdf).

Horsman, S. (2008.), “Afghanistan and transboundary water management on the Amu Darya: a political history”

\*International Crisis Group (2002), “Central Asia: Water and Conflict”, Asia report no. 34, Brussels, Accessed on 30 May 2016, URL: <http://www.crisisgroup.org/en/regions/asia/central-asia/034-central-asia-water-and-conflict.aspx>.

\*International Crisis Group (2007), “Central Asia’s energy risks”, Asia Report, Accessed on 17 January 2016, URL: <http://www.crisisgroup.org>.

\*International Crisis Group (2014), “Water pressures in Central Asia”, Europe and Central Asia Report, Accessed on 16 February 2016, URL: <http://www.crisisgroup.org>.

Isabekova, Gulnaz and Ormushev, Kubanychbek et al. (2013), “Leaking projects: Corruption and local water management in Kyrgyzstan”, Accessed on 20 April 2016, URL: <http://www.u4.no/publications/leaking-projects-corruption-and-local-water-management-in-kyrgyzstan/downloadasset/3249>.

Jailoobayev, A. and Neronova, T. et al. (2009), “Water quality standards and norms in Kyrgyz Republic”, The Regional Environmental Centre for Central Asia, Accessed on 20 February 2016, URL: [http://www.carecnet.org/assets/images/Kyrgyzstan\\_angl.pdf](http://www.carecnet.org/assets/images/Kyrgyzstan_angl.pdf).

Jansky, Bohumir and Engel, Zbynek et al. (2008), “The evolution of Petrov lake and moraine dam rupture risk (Tien-Shan, Kyrgyzstan)”, Springer, Accessed on 18 February 2016, URL: <http://www.link.springer.com/article/10.1007/s11069-008-9321-8#/page-1>.

Jansky, Bohumir and Sobr, Miroslav et al. (2006), “Typology of high mountain lakes of Kyrgyzstan with regard to the risk of their rupture”, *Limnological Review*, (6): 135-140.

Kazbekov, J. and Qureshi, A. S. (2011), *Agricultural extension in Central Asia: Existing strategies and future needs*, Colombo, Sri Lanka: International Water Management Institute.

Khaydorov, Nizamiddin (2016), *Land tenure reforms and cross-border water rights in Uzbekistan: mixed effect and future consequences*, Tashkent: Financial Institute, Uzbekistan.

Kocak Konur Alp Kocak (2015), “Water disputes in Central Asia Rising tension threatens regional stability”, *European Parliamentary Research Service*: 9.

Kraak, Eelke (2012), “Central Asia: A Dam Debacle”, Accessed on 1 June 2016, URL: <https://www.chinadialogue.net/article/4790-Central-Asia-s-dam-debacle>.

Kustareva, L. A and Naseka, A. M. (2015), “Fish diversity in Kyrgyzstan: Species composition, fisheries and management problems”, *Taylor and Francis*, 18(2): 149-159.

Kyrgyzstan Regular Energy Efficiency Review (2011), “Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects”, Accessed on 16 April 2016, URL: [http://www.energycharter.org/fileadmin/DocumentsMedia/EERR/EERR-Kyrgyzstan\\_2011\\_en.pdf](http://www.energycharter.org/fileadmin/DocumentsMedia/EERR/EERR-Kyrgyzstan_2011_en.pdf).

Lelevkin, V. M. “International Fund for the Aral Sea (IFAS) and the UN Environment Program (UNEP)”, Accessed on 3 June 2016, URL: <http://enrin.grida.no/aral/aralsea/index.htm>.

Libert, B. (2008), “Water and Energy Crisis in Central Asia”, *China and Eurasia Forum Quarterly*, 6 (3): 9-20.

Libert, Bo, Erkin Orolbaev, and Yuri Steklov et al. (2008), “Water and Energy Crisis in Central Asia”, *China and Eurasia Forum Quarterly* 6(3): 9-20.

Lifton, N. and Beel, Casey et al. (2014), “Constraints on the late Quaternary glacial history of the Inylchek and Sary Dzaz valleys from in situ cosmogenic eastern Kyrgyz Tian Shan”, *Quaternary Science Review*, 101: 77-90.

MacDonald Stephen (2012), “Economic Policy and Cotton in Uzbekistan”, United States Department of Agriculture”, Accessed on 4 June 2016, URL: <http://www.ers.usda.gov>

MacKay, Joseph (2009), “Running dry: International law and the management of Aral Sea depletion”, *Central Asian Survey*, 28 (1): 17-27.

Mamatov, N. E. and Cusupov, M. K. et al. (2007), “Water Resources Problem in Kyrgyzstan”, Accessed on 22 February 2016, URL: [http://www2.dsi.govt.tr/English/congress2007/chapter\\_3/86](http://www2.dsi.govt.tr/English/congress2007/chapter_3/86).

Maral Madi (2004), “Turkmenistan and Uzbekistan Friends Indeed or Friends in Need? Central Asia Caucasus Analyst, Accessed on 5 June 2016, URL: [http://www.cacianalyst.org/view\\_article.php?articleid=2875](http://www.cacianalyst.org/view_article.php?articleid=2875)>.

Marat, Erica (2009), “Controversy Intensifying Over the Construction of Dams in Central Asia”, *Eurasia Daily Monitor*, 6 (88).

Marketos, Thrassy N. (2008), *China’s Energy Geopolitics: The Shanghai Cooperation Organization and Central Asia*, Oxon & NY: Routledge.

Mitchell, Laurence (2008), *Kyrgyzstan the Bradt Travel Guide*, USA: The Globe Pequot Press.

Mogilevsky, R. and Atamanov, A. et al. (2005), “Regional Cooperation in Central Asia: A View from Kyrgyzstan”, *Problems of Economic Transition*, 48 (8): 5-61

Murray-Rust and Abdullaev, I. et al. (2003), “Water productivity in the Syr Darya river basin”.

National Statistical Committee (2015), “Population of oblasts, rayons, cities and urban settlements of the Kyrgyz Republic in 2013”, Accessed on 25 February 2016,

URL: <http://www.stat.kg/media/publicationarchive/0a8bd96b-bf75-47b9-9559-ec65ea75e7b9.pdf>.

Nourzhanov, K. (1995), “Turkmenistan: Halfway through the Golden Age? *Central Asia Monitor*, (1): 13.

OECD (2009), “National Policy Dialogue on Financing Urban and Rural Water Supply and Sanitation in the Kyrgyz Republic”, Accessed on 27 February 2016, URL: <http://www.oecd.org/env/outreach/4174359.pdf>.

OECD (2013), “Improving the use of economic instruments for water resource management in Kyrgyzstan: The case of lake Issyk Kul basin”, Accessed on 10 February 2016, URL: [http://www.oecd.org/env/outreach/2013\\_Kyrgyz%20report%20on%20Eis%20for%20WRM%20Eng%20Web.pdf](http://www.oecd.org/env/outreach/2013_Kyrgyz%20report%20on%20Eis%20for%20WRM%20Eng%20Web.pdf).

\*Oxfam International, (2009), “Reaching Tipping Point: Climate Change and Poverty in Tajikistan”, Accessed on 7 June 2016, URL: <https://www.oxfam.org/en/research/reaching-tipping-point-climate-change-and-poverty-tajikistan>.

Padowski, J. and J. Jawitz. (2009), “The Future of Global Water Scarcity: Policy and Management Challenges and Opportunities” *The Whitehead Journal of Diplomacy and International Relations*, 10 (2): 99-114.

Pak, Mariya (2014), *International river basin management in the face of change: Syr Darya basin case study*, Oregon: Oregon State University.

Pearled, Renant (2008), “Climate Change in Central Asia: Development and Transition”,

Radio Free, Radio Liberty (2010), “Kyrgyzstan Launches new Hydro-Electric Power Plant”, Accessed on 10 June 2016, URL: [http://www.rferl.org/content/Kyrgyzstan\\_Launches\\_New\\_Hydroelectric\\_Power\\_Plant/2141289.html](http://www.rferl.org/content/Kyrgyzstan_Launches_New_Hydroelectric_Power_Plant/2141289.html).

Rakhmatullaev, S. et al. (2013), “Water reservoirs, irrigation and sedimentation in Central Asia: a first-cut assessment for Uzbekistan”, *Environment Earth Science*, 68: 985-998.

Rakhmatullaev, Shavkat et al. (2010), “Facts and Perspectives of Water Reservoirs in Central Asia: A Special Focus on Uzbekistan”, 2 (2): 307-320.

Sarieva, M. and Alpiev, Mukhtar et al. (2008), “Capture fisheries and aquaculture in the Kyrgyz Republic: current status and planning”, FAO Fisheries Circular. No 1030, Accessed on 2 March 2016, URL: <http://www.fao.org/docrep/011/i0229e/i0229e00.htm>.

Savintsev, Fyodor (2014), “Conflicts in Kyrgyzstan: Foreshadowing Water Wars to Come”, *Creative Time Reports*, MOSCOW, RUSSIA, 17 June, 2014

Sehring, Jenniver (2005), *Water User Associations in Kyrgyzstan: A case study on institutional reform in local irrigation management*, University of Gießen: Zentrum für International eEntwicklungs and Umweltforschung der Justus Liebig.

Shangguan, D. H. and Bolch, T. et al. (2015), “Mass changes of Southern and Northern Inylchek Glacier, Central Tian Shan, Kyrgyzstan, during 1975 and 2007”, Accessed on 4 March 2016, URL: <http://www.the-cryosphere.net/9/703/2015/>.

\*SIWI. (2010), “Regional water intelligence report Central Asia”, *Stockholm International Water Institute*.

Small, Ian, and Noah Bunce (2003), “The Aral Sea disaster and the disaster of international assistance”, *Journal of International Affairs*, 56 (2).

Sokolov, V. (2009), “Future of irrigation in Central Asia, IWMI-FAO Workshop on trends and transitions in Asian irrigation. What are the prospects for the future?”

Spoor, M. and Krutov, A. (2003) “The power of water in a divided Central Asia”, Accessed on 21 January 2016, URL: [http://www.maxspoor.files.wordpress.com/2011/07/pgdt\\_2-3-4\\_593-614.pdf](http://www.maxspoor.files.wordpress.com/2011/07/pgdt_2-3-4_593-614.pdf).

Spoor, Max (1998), "The Aral Sea basin crisis: Transition and environment in former Soviet Central Asia", *Development & Change*, 29 (3): 409.

Stern, D. (2008), "Tajikistan hopes water will power its ambitions", Accessed on 20 June 2016, URL: <http://www.nytimes.com/2008/09/01/world/asia/01tajikistan.html>.

Stobdan, P. (2014), *Central Asia: Democracy, Instability and Strategic Game in Kyrgyzstan*, New Delhi: Institute for Defence Studies and Analyses.

The Express Tribune (2016), "CASA-1000: Tajikistan to export 1000 MW hydel electricity", Accessed on 12 April 2016, URL: <http://www.tribune.com.pk/story/1024352/casa-1000-tajikistan-to-export-1000mw-hydel-electricity/>.

\*The Shanghai Cooperation Organization (2010), "Brief introduction to the Shanghai Cooperation Organization", Accessed on 21 June 2016, URL: <http://www.sectSCO.org/EN/brief.asp>.

Thevs, Niels (2011), "Water Scarcity and Allocation in the Tarim Basin: Decision Structures and Adaptations on the Local Level", *Journal of Current Chinese Affairs*, 40 (3): 113-137.

Thurman, Mike (2001), "Irrigation and Poverty in Central Asia: A Field Assessment", World Bank", Accessed on 29 June 2016, URL: <http://documents.worldbank.org/curated/en/2002/01/7154734/irrigation-poverty-central-asia-field-assessment>.

Topbaev, Oktiabr (2015), *Problems of Rural Drinking Water Supply Management in Central Kyrgyzstan: A Case Study from Kara Suu Village, Naryn Oblast*, PhD Thesis, Berlin: Freie University.

Tullos, D. and Tilt, B. et al. (2009), "Introduction to the special issue: Understanding and linking the biophysical, socio-economic and geopolitical effects of dams", *Journal of Environmental Management*, 90 (3): 203-207.



Ul Hassan, M. and Starkloff, R. et al. (2004), *Inadequacies in the water reforms in the Kyrgyz Republic: An institutional analysis*, Colombo, Sri Lanka: International Water Management Institute.

\*UN Water (2010), “Status Report on Integrated Water Resources Management and Water Efficiency Plans”, Accessed on 10 June 2016, URL: [http://www.unwater.org/downloads/UNW\\_Status\\_Report\\_IWRM.pdf](http://www.unwater.org/downloads/UNW_Status_Report_IWRM.pdf).

\*UNDP (2010), Final report on support to IWRM and investment strategies, plans and financial policies in Kyrgyzstan, New York: UNDP, Accessed on 30 January 2016, URL: [http://www.fao.org/nr/water/aquastat/countries\\_regions/kgz/index.stm](http://www.fao.org/nr/water/aquastat/countries_regions/kgz/index.stm).

\*UNDP (2011), “Overview of regional transboundary water agreements, institutions and relevant legal policy activities in Central Asia”, Accessed on 6 February 2016, URL: [http://www.cawater-info.net/bk/water\\_law/pdf/water-agreements-in-central-asia-2011.pdf](http://www.cawater-info.net/bk/water_law/pdf/water-agreements-in-central-asia-2011.pdf).

\*UNDP (2014), “Global Water Solidarity: Improving Water and Sanitation through Decentralized Cooperation in the Republic of Kyrgyzstan”, Accessed on 6 March 2016, URL: [http://www.wecf.eu/download/2014/May/Kyrgyzstudyfinal\\_eng.pdf](http://www.wecf.eu/download/2014/May/Kyrgyzstudyfinal_eng.pdf).

\*UNDP and UNEP (2012), “The National Report on the State of the Environment of the Kyrgyz Republic for 2006-2011”, Accessed on 8 March 2016, URL: [http://www.kg.undp.org/content/kyrgyzstan/en/home/library/environment\\_energy/the-national-report-on-the-state-of-the-environment-of-the-kyrgyz.html](http://www.kg.undp.org/content/kyrgyzstan/en/home/library/environment_energy/the-national-report-on-the-state-of-the-environment-of-the-kyrgyz.html).

\*UNDP (2004), *Water resources of Kazakhstan in the new millennium*, New York: United Nations Development Programme.

\*UNECE (2007), “Our Waters: Joining hands across borders”, First Assessment of Transboundary Rivers, Lakes and Groundwater”, Accessed on 10 March 2016, URL: [http://www.unece.org/fileadmin/DAM/env/water/blanks/assessment/assessmentweb\\_full.pdf](http://www.unece.org/fileadmin/DAM/env/water/blanks/assessment/assessmentweb_full.pdf).

\*UNECE (2009), “Second meeting of the AHPFM, 1st July 2009, Geneva proposal submitted by Kyrgyzstan”, Accessed on 19 January 2016, URL: [http://www.unece.org/env/.../meetings/ahpfm/meeting/Project\\_proposal\\_Kyrgyzstan\\_e.do](http://www.unece.org/env/.../meetings/ahpfm/meeting/Project_proposal_Kyrgyzstan_e.do).

\*UNECE (2013), “National Policy Dialogue on Integrated Water Resources Management”, Accessed on 12 March 2016, URL: [http://www.unece.org/fileadmin/DAM/env/water/publications/NPD\\_Publication\\_2013/NPD\\_IWRM\\_KG\\_2013\\_en.pdf](http://www.unece.org/fileadmin/DAM/env/water/publications/NPD_Publication_2013/NPD_IWRM_KG_2013_en.pdf).

\*UNEP (2006), “National implementation plan for the Stockholm Convention on persistent organic pollutants”, Accessed on 14 March 2016, URL: <http://www.chm.pops.int/Portals/0/download.aspx?d=UNEP-POPS-NIP-Kyrgyzstan-1.English.pdf>.

\*UNEP (2006), “World Water Development Report: Water a shared responsibility”, *Coastal and Freshwater Ecosystems*.

\*UNFCCC (2003), “First National Communication of the Kyrgyz Republic under the UN Framework Convention on Climate Change”, Accessed on 18 March 2016, URL: <http://www.unfccc.int/resource/docs/natc/kyrnc1.pdf>.

\*UNFCCC (2009), “The Kyrgyz Republic’s Second National Communication of to the United Nations Framework Convention on Climate Change”, Accessed on 16 March 2016, URL: <http://unfccc.int/resource/docs/natc/kyrnc2e.pdf>.

\*UNIDO (2013), “World Small Hydropower Development Report 2013”, Accessed on 10 April 2016, URL: [http://www.unido.org/fileadmin/user\\_media\\_upgrade/What\\_we\\_do/Topics/Energy\\_access/WSHPDR\\_2013\\_Executive\\_Summary.pdf](http://www.unido.org/fileadmin/user_media_upgrade/What_we_do/Topics/Energy_access/WSHPDR_2013_Executive_Summary.pdf).

\*United Nations Economic Commission for Europe (2010), “Activities in the framework of the working group on institutional and legal strengthening and the development of Aral Sea basin programme”, Accessed on July 1 2016, URL: [http://www.unece.org/env/water/cadialogue/wg\\_en.htm](http://www.unece.org/env/water/cadialogue/wg_en.htm).

\*United Nations Economic Commission for Europe (UNECE) and United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) (2010), “Strengthening Regional Cooperation in Central Asia: A contribution to long-term stability and sustainable development of Afghanistan”, SPECA Economic Forum, Accessed on 2 July 2016, URL: [https://www.unece.org/fileadmin/DAM/SPECA/documents/ecf/2010/background\\_note\\_10\\_ecf\\_e.pdf](https://www.unece.org/fileadmin/DAM/SPECA/documents/ecf/2010/background_note_10_ecf_e.pdf).

\*USAID (2012), “Water project helps reduce ethnic conflict”, *Case study. United States Agency for International Development*.

\*USAID (2013), “Conflicts on Irrigation Water in the South of the Kyrgyz Republic”, Accessed on 23 January 2016, URL: <https://www.usaid.gov/sites/default/files/documents/1861/COMTACA%20Irrigation%20Water%20Conflict%20Sources%20Report-%20English.pdf>.

Waltham, Tony and Ihsan Sholji (2001), “The demise of the Aral Sea an environmental disaster” *Geology Today*, 17 (6).

Water politic (2009) Central Asia Water Wars: Turkmenistan to Join Kazakhstan & Uzbekistan vs. Kyrgyzstan & Tajikistan”, Accessed on 5 July 2016, URL: <http://www.waterpolitics.com/2009/04/12/centralasiawaterwarsturkmenistantoinkazakhstanuzbekistanvskyrgyzstantajikistan/>.

Water politic (2012), “Central Asia: A Dam Debacle”, Accessed on 6 July 2016, URL: <http://www.waterpolitics.com/2012/03/02/centralasiaadamdebacle/2/>.

Water Politics (2012), “Water in Central Asia: Past, Present, And Future”, Accessed on 7 July 2016, URL: <http://www.waterpolitics.com/2012/10/17/waterincentralasiapastpresentandfuture/>.

Water politics (2014), “Conflicts in Kyrgyzstan: Foreshadowing Water Wars to come? Accessed on 8 July 2016, URL: <http://www.waterpolitics.com/2014/06/17/conflictsinkyrgyzstanforeshadowingwaterwarstocome/>

Water Politics (2015), “Uzbek Leader Warns Of Water Wars”, Accessed on 9 July 2016, URL: <http://www.waterpolitics.com/2015/10/17/uzbekleaderwarnsofwaterwars/>

waterwiki.net (2009), “Kazakhstan: national Integrated Water Resources Management and Water Efficiency Plan”, Accessed on 10 May 2016, URL: [http://www.waterwiki.net/.../Kazakhstan\\_National\\_Integrated\\_Water\\_Resources\\_Management\\_and\\_Water\\_Efficiency\\_Plan](http://www.waterwiki.net/.../Kazakhstan_National_Integrated_Water_Resources_Management_and_Water_Efficiency_Plan).

Wegerich, K. (2004), “Coping with disintegration of a river basin management system: multi-dimensional issues in Central Asia”, *Water Policy*, (6): 335-344.

Wegerich, K. (2006), “Illicit Water: Un-accounted but Paid for. Observations on Rent-seeking as Causes of Drainage Floods in the Lower Amu Darya”, *paper presented at CERES–IWE research seminar, News from the Water Front: Alternative Views on Water Reforms*.

Wegerich, K. (2008), “Hydro-hegemony in the Amu Darya basin”, *Water Policy*, 10 (52): 71-88.

Wegerich, K. (2009), “The new great game: Water allocation in Post-Soviet Central Asia”, *Georgetown Journal of International Affairs*, 117-123.

Wegerich, K. and Kazbekov, Jusipbek et al. (2012), “Is It Possible to Shift to Hydrological Boundaries? The Ferghana Valley Meshed System”, *International Journal of Water Resources Development*, 28 (3): 545-564.

Wehrheim, Peter and Martius, Christopher et al. (2008), “Continuity and Change: Land and water use reforms in rural Uzbekistan, Socio-economic and legal analysis for the region Khorezm”, Accessed on 6 May 2016, URL: [http://www.iamo.de/dok/sr\\_vol43.pdf](http://www.iamo.de/dok/sr_vol43.pdf).

Weinthal, Erika (2006), “Water Conflict and Cooperation in Central Asia”, UN Human Development Report, Accessed on 12 February 2016, URL: <http://www.hdr.undp.org/en/content/water-conflict-and-cooperation-central-asia>.

Weinthal, Erika and Luong, Pauline Jones (2001), "Prelude to the Resource Curse: Oil and Gas Development Strategies in Central Asia and Beyond", *Comparative Political Studies*, 34: 367-399.

Weinthal, Erika and Pauline Jones Luong et al. (2006), "Combating the Natural Resource Curse: An Alternative Solution for Managing Resource Wealth", *Perspectives on Politics*, 4 (1).

WGMS (2013), "Glacier Mass Balance Bulletin No. 12 (2010–2011)", Accessed on 24 March 2016, URL: [http://www.wgms.ch/downloads/wgms\\_2013\\_gmbb12.pdf](http://www.wgms.ch/downloads/wgms_2013_gmbb12.pdf).

WHOCC (2008), "Water and Risk", WHO Collaborating Centre for Health Promoting Water Management and Risk Communication, Accessed on 18 April 2016, URL: [http://www.ihph.de/dokumente/whocc-news/Water\\_and\\_Risk\\_Vol\\_13.pdf](http://www.ihph.de/dokumente/whocc-news/Water_and_Risk_Vol_13.pdf).

\*World Bank (2003), "Irrigation in Central Asia: social, economic and environmental considerations", *Washington DC*.

\*World Bank (2004), "Water and Energy Nexus in Central Asia: Improving Cooperation in the Syr Darya Basin", Washington D.C., USA, Accessed on 23 June 2016, URL: [http://siteresources.worldbank.org/INTUZBEKISTAN/Resources/Water\\_Energy\\_Nexus\\_final.pdf](http://siteresources.worldbank.org/INTUZBEKISTAN/Resources/Water_Energy_Nexus_final.pdf).

\*World Bank (2004), "Water energy nexus in Central Asia: improving regional cooperation in the Syr Darya basin", Accessed on 4 May 2016, URL: [http://siteresources.worldbank.org/INTUZBEKISTAN/Resources/Water\\_Energy\\_Nexus\\_final.pdf](http://siteresources.worldbank.org/INTUZBEKISTAN/Resources/Water_Energy_Nexus_final.pdf).

\*World Bank (2007), "Integrating Environment into Agriculture and Forestry progress and prospects in Eastern Europe and Central Asia", Kyrgyz Republic Country Review, Accessed on 25 January 2016, URL: <http://www.worldbank.org/eca/pubs/envint/Volume%20II/English/Review%20KYR-final.pdf>.

\*World Bank (2008), “Innovative approaches to ecosystem restoration: Kazakhstan’s Syr Darya Control and Northern Aral Sea”, Phase I Project. Water feature stories. Issue 23, Washington DC.

\*World Bank (2008), “Integrating Environment into Agriculture and Forestry Progress and Prospects in Eastern Europe and Central Asia”, Accessed on 20 March 2016, URL: <http://www.openknowledge.worldbank.org/bitstream/handle/10986/6551/457840PUB0Inte101OFFICIAL0USE0ONLY1.pdf?sequence=1>.

\*World Bank (2009), “Adapting to Climate Change in Europe and Central Asia”, Accessed on 10 July 2016, URL: [http://www.worldbank.org/eca/climate/ECA\\_CCA\\_Full\\_Report.pdf](http://www.worldbank.org/eca/climate/ECA_CCA_Full_Report.pdf).

\*World Bank (2009), “Improving weather, climate and hydrological services in Central Asia”, Accessed on 22 March 2016, URL: [https://www.gfdr.org/sites/gfdr.org/files/Improving\\_Weather\\_Climate\\_HydrologyDelivery\\_CentralAsia.pdf](https://www.gfdr.org/sites/gfdr.org/files/Improving_Weather_Climate_HydrologyDelivery_CentralAsia.pdf).

\*World Bank (2009), “Kyrgyz Republic: Recent economic and political developments”, Accessed on 9 July 2016, URL: <http://www.worldbank.org/en/country/kyrgyzrepublic/overview>.

\*World Bank (2010), “Country partnership strategy for the republic of Tajikistan”, Report number: 50769-TJ, Accessed on 25 June 2016, URL: [http://siteresources.worldbank.org/TAJIKISTANEXTN/Resources/Tajikistan\\_CPS.pdf](http://siteresources.worldbank.org/TAJIKISTANEXTN/Resources/Tajikistan_CPS.pdf).

\*World Bank (2010), “Uzbekistan climate change and agriculture country note”, Accessed on 11 July 2016, URL: <http://www.worldbank.org/eca/climateandagriculture>.

\*World Bank (2014), “World Bank Group-Kyrgyz Republic partnership program snapshot”, Accessed on 4 April 2016, URL:

<http://www.worldbank.org/content/dam/Worldbank/document/Kyrgyzrepublic-Snapshot.pdf>.

\*World Bank (2016), “Paper prepared for presentation at the World Bank conference on land and poverty”, *The World Bank, Washington DC*.

World Bulletin (2015), “Uzbek leader warns of war on waters”, Accessed on 18 July 2016, URL: <http://www.worldbulletin.net/haber/165294/uzbek-leader-warns-of-war-on-waters>.

Young, Gordon J. And Dooge, James C. I. et al. (1994), *Global Water Resource Issues*, United Kingdom: Cambridge University Press.

Zozulinsky, Artyom (2007), “Kyrgyzstan: Mining Industry Overview”, Accessed on 8 April 2016, URL: [http://www.bishkek.usembassy.gov/uploads/images/lzXO-ytUAKSiRn8QQojRTg/KG\\_07\\_Mining\\_Report.pdf](http://www.bishkek.usembassy.gov/uploads/images/lzXO-ytUAKSiRn8QQojRTg/KG_07_Mining_Report.pdf).