

POLYTECHNIC UNIVERSITY OF VALENCIA

FACULTY OF BUSINESS ADMINISTRATION AND MANAGEMENT

MASTER DEGREE IN BUSINESS MANAGEMENT, PRODUCTS AND SERVICES



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA



MASTER THESIS

Water as social and economic resource.

Resolving questions about sharing water in Central Asia.

By

Meerim Avazbekova

Thesis Supervisor: Professor Blanca de Miguel

Valencia, September 2014

ACKNOWLEDGMENT

I would like to express my sincere gratitude to my tutor Prof. Blanca de Miguel for the excellent guidance, continuous support of my Master Thesis, for her patience, caring, enthusiasm and immense knowledge. I could not have imagined having a better advisor and mentor for my Thesis and without her guidance it would be almost impossible to finish it as soon.

I would like also to express my gratitude to everyone who supported me throughout the course of this MBA within Polytechnic University of Valencia. I am thankful to my excellent professors who not only have taught me related subjects but also Spanish language and were always ready to help me, I am thankful for their aspiring guidance, invaluable constructive criticism and friendly advice during my whole Master Degree.

My sincere thank goes to my family for their support and love, and to my best friend, Ekaterine Elbakidze, for her patience during the whole Master studies.

ABSTRACT

Water scarcity in the World today is growing faster than expected and it is among the main problems of 21st century to be faced by the World.

Central Asia is considered like a region with enough water resources, however, an ineffective use of water, it's allocation, rapidly growing population, and lack of knowledge in sharing common basin among riparian countries could lead to serious consequences. In this work we wanted to analyse literature about water issues with the aim to understand when and how water disputes were occurring. For this purpose, we have used bibliometric analysis to define and look for better and reliable dates for the Thesis. All the dates and articles which were used for this work were taken from the Web of Science. Furthermore, thanks to VantagePoint and Social Networks Analysis we have got specific articles which were sorted and divided according to your preference, calculating measures of centrality to determine the importance of each keyword.

In following chapters we have also presented small research on the Central Asian example, and the role of Kyrgyzstan in water sharing is illustrated.

Keywords: Central Asia, Water Management, Kyrgyzstan, Basin, Syr Darya, Amu Darya, riparian countries, Aral sea, Water Sharing, Hydro Power Plants (HPP).

INDEX

Acknowledgement

Abstract

| | |
|--|----|
| 1. Objective..... | 8 |
| 2. Introduction..... | 9 |
| 3. Water conflicts. A review based on bibliometrics..... | 11 |
| 3.1. Data..... | 11 |
| 3.2. Method..... | 12 |
| 3.3. Analysis plan..... | 12 |
| 4. Results..... | 13 |
| 4.1. Central Asia in the Literature about water conflicts..... | 14 |
| 4.1.1. Measuring the importance of keywords using Social Network Analysis..... | 20 |
| 4.1.2. Water Management. Soviet Union Period..... | 44 |
| 4.1.3. Water Management. Post Soviet Period..... | 45 |
| 4.1.4. Water Management. Today..... | 46 |
| 4.1.5. Attempts to resolve water issues in the Central Asian region..... | 50 |
| 4.2. Kyrgyzstan in the Literature about water conflicts in Central Asia..... | 54 |
| 4.2.1. Russia’s participation in Central Asian Water management..... | 60 |
| Conclusion..... | 62 |
| References..... | 63 |

1. Objective

The aim of this Thesis is to analyze literature about conflicts in water resources focusing the analysis on Central Asia and summarize the solutions offered by authors. Then, these solutions will be analyzed for the specific case of Central Asian countries and exactly on the example of Kyrgyzstan.

The water conflicts occur on every continent but the problem grows harder when it comes to the relationships between two or more countries over river water as a result of the “internationalization” of a basin through political change. The importance of this paper is the lack of knowledge about causes which generate conflicts in some areas in the World and how they can be solved.

Water dispute is a matter that affects neighbor countries and regions along the World. Central Asia is one of the regions where these conflicts occur between countries which share water resources from their river basins. This is the case of Kyrgyzstan and other Central Asian countries, where finding solutions for better water share is a necessary challenge.

The main limitation in the project was the lack of data, as water conflict in Central Asia started to be studied later than in other continents (see Figure 3) it was almost difficult to get more up-to-date articles and papers to work with. The majority of bibliography is eastern and we had to look for qualitative database with the aim to get appropriate information about Central Asia Region. Regarding the practice part about Kyrgyzstan it was more than easier because research on water sharing in Kyrgyzstan was studied by us very clearly before.

2. Introduction

Water scarcity is among the main problems to be faced by many societies and the World in the 21st century. Water use has been growing at more than twice the rate of population increase in the last century, and, although there is no global water scarcity as such, an increasing number of regions are chronically short of water (Human Development Report, UNDP, 2006).

Nowadays on a global scale, it is used about 55-60% of the annual available reserve of fresh water, including the World resources of rivers and groundwater, including 70% of the world resources of rivers and groundwater is used for irrigation, 20% for industry and 10% for domestic needs (Danilov-Danilyan, 2008). At the current consumption rate by 2025, global demand for fresh water will increase by 60% and two-thirds of the world's population may face water shortages and ecosystems around the world will suffer (WWF, 2014). All above mentioned possible consequences will lead to new in-country and international conflicts over water and shows the need for research theoretical and methodological basis for the water market creation and identifying the basic laws of its functioning in the context of globalization.

In this paper we have performed a bibliometric analysis of water conflict research publications. The aim of this analysis was to reveal which are the conflicts that have been studied until now. Literature about water resources has given different solutions to cooperation in the dispute question. For example, Judkins & Larson (2010) review the use of a workgroup process in the conflict over the Colorado River. Teasley & McKinney (2011) use game theory to explain how cooperation would benefit to all countries implicated in the dispute.

Although literature shows the existence of water conflicts around the World, the topic needs to advance and include new solutions for a problem that is related to weak water management and inefficient infrastructures (Abdullaev et al. 2009). These deficits have been presented in the literature as an important

issue in Central Asia, a region where water resources are shared among countries which have different uses of water. Figure 1 shows the area in Central Asia in which we focus our study, and how water resources across borders.

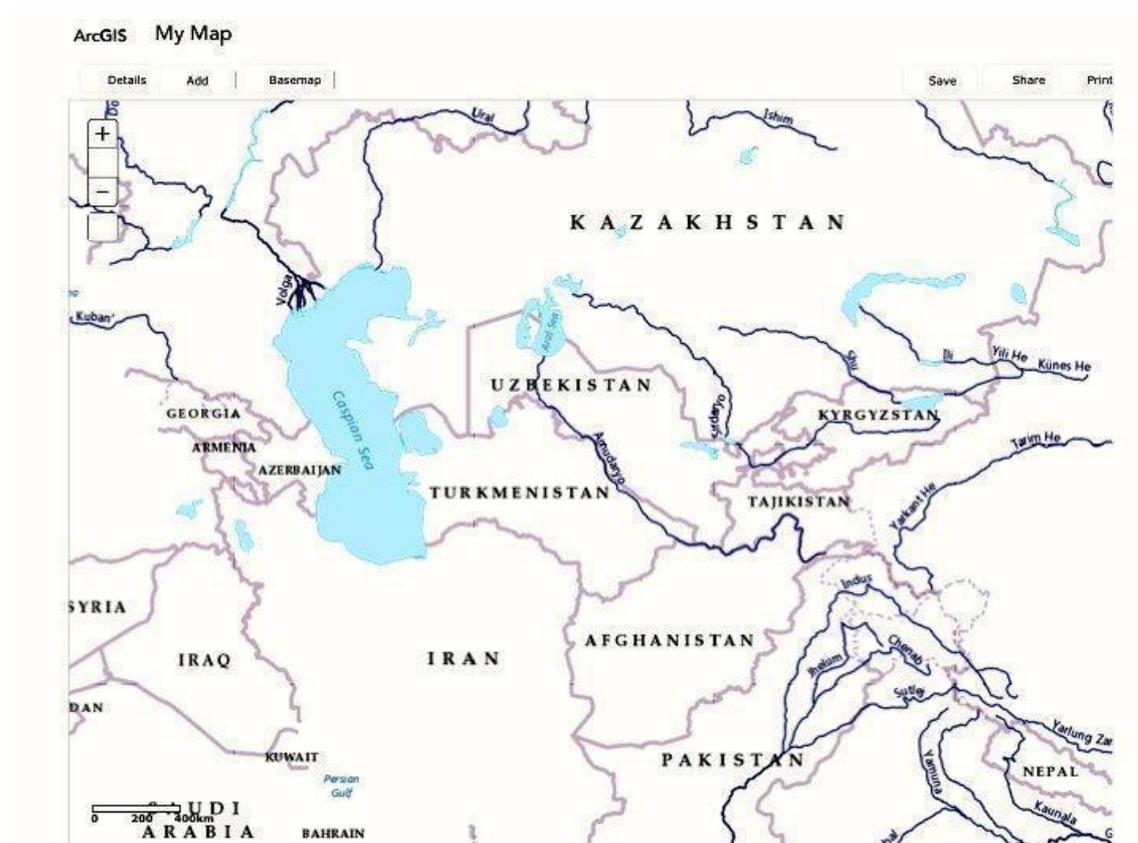


Figure 1. Water resources shared in Central Asia

Source: www.arcgis.com

This paper is structured as follows. After this introduction, Sections 3 and 4 include the literature review about water conflicts, from a World perspective to a Central Asia and Kyrgyzstan focus. Our conclusions can be found in Section 5.

3. Water conflicts. A review based on bibliometrics.

Threat to the security of Central Asian countries are interstate disputes over the nature of transboundary water resources, which do not cease for more than 20 years. But all attempts at international and regional levels to find a way out of a difficult situation, an end to grief. There is a joke in Central Asia saying if every researcher working on water issues in the region, brought a bucket of water, instead of writing an article on this topic, the problem would be solved.

The main aim of this project is to analyse literature about conflicts in water resources management and summarise the solutions offered by authors. Then, these solutions will be analysed for the specific case of Central Asian countries.

We focus on the background of water use in Central Asia and overview main regional water conflict/co-operation trends and highlights major hot spots in the Amu Darya and Syr Darya Basins and discuss the main findings of the study on the exact example of the Kyrgyzstan.

3.1. Data

The ISI Web of Science was selected as the database to extract academic papers related to water conflicts. The search was conducted on 22 March 2014, for papers, review and English-language articles. The search terms were "water" and "conflict", without date restriction, and a total of 937 titles were retrieved. Moreover, focusing the analysis in Central Asia and selecting papers which included only these countries, the number of papers reduces to 196. In this paper we have analysed both groups of papers separately, first the group about water conflicts in the World and second the group about key water problems in Central Asia.

3.2. Method

Bibliometric analysis was adopted as the method for examining the literature about water conflicts. Bibliometrics is “a set of tools for analyzing publication data which defines it as the measure of texts and information” (Norton, 2001) and also “a type of a research method to utilize quantitative and statistical analysis to describe patterns of publication within a given field or body of literature” (Song et al. 2014). These patterns of publication can include the evolution in the number of articles in a field, the distribution of papers by country, the journals where authors published, the most frequent keywords, the analysis of authors and entities networks, and the analysis of references.

The Software VantagePoint (from Search Technology Inc) was used to clean the variables and elaborate lists and matrices with keywords (Porter and Cunningham, 2005). All the articles were analysed with the purpose of looking for locations where water conflicts were studied by literature. Therefore, the focus on the cleaning was the keywords included by authors on papers.

Social Networks Analysis (Jackson 2008) was used to statistical analysis of keywords matrixes, calculating measures of centrality to determine the importance of each keyword. For this purpose, the UCINET6 software and Netdraw were used to analyse and represent networks.

3.3. Analysis plan

Papers imported into VantagePoint were used to determine the following indicators:

a) To detect which conflicts about water resources have been analysed by literature. The indicators to work with are keywords given by authors in the papers. We clean keywords to work only with those referring geographic locations and water issues.

b) To analysed in a broad sense the conflicts that occur in a specific geographical area in Central Asia. We created a subset with papers that only include this area. The VantagePoint software keeps all the cleanings made in the complete database.

c) To present which are the titles which explain the conflicts and solutions for this area in Central Asia, indicating which are the core journals and the authors.

4. Results

In this section, we include results obtained from the bibliometric analysis. First, we indicate how important Central Asia is in the literature about water conflicts. For this purpose, we have elaborated some Figures (Figures 2 and 3) which represent the water conflicts that have been studied during the years. Secondly, we focus our results on Central Asia. These results include the area in Central Asia where we have focused our analysis, that is, that which share water resources from Aral Sea and the rivers which recharge in this Sea.

4.1. Central Asia in the Literature about water conflicts

Water conflicts occur in all the continents, as Figure 2 indicates, and although history shows that full-scale wars over water, proving to be neither strategically rational nor hydrographically effective, have never been fought (Wolf, 1998), water continues to be a source of intense disputes worldwide.

Water is the most politicised of all natural resources and it is more likely to become a source of armed conflict. It is no wonder therefore that such possibility has been widely discussed (Gleick, 1993; Gleditsch, 1997; Just and Netanyahu, 1998; Wolf, Yoffe and Giordano, 2003). Despite the growing literature on water and conflict, little work has been done to provide arguments for the common thesis that “growing conflict over water looms ahead” (Samson and Charrier, 1997). Generally, the Jordan and Nile basins are cited to give an example of international conflict prone basins. On the other hand, Wolf (1998) gave a historic evidence of co-operation between riparians and stated that the only recorded war over water was fought 4500 years ago between two Mesopotamian states, Lagash and Umma, in what is now southern Iraq. The same author pointed out at the “loose definitions” in the terminology of the literature about water and conflict where “terms such as conflict, dispute, tensions, and war are regularly used interchangeably” (Wolf, Yoffe and Giordano, 2003).

The problem grows harder when it comes to the relationships between two or more countries over river water as a result of the “internationalisation” of a basin through political change. The number of international basins has grown from 214 in 1978 to 263 today. These international basins cover 45.3% of total land surface, affect about 40% of the world’s population, and account for about 60% of global river flow. Nineteen basins are shared by 5 or more riparian countries, with only the Danube being shared by 17 riparians, whereas five

basins – the Congo, Niger, Nile, Rhine and Zambezi – are shared by between 9 and 11 countries (Wolf, 2001).

In such situation, long-negotiated instrument of international water law as the 1997 UN Convention on the Non-Navigational Uses of International Watercourses, is of little help as it provides for equally contradictory “equitable use” and “no significant harm” principles: while the former is favoured by upstream countries, downstream riparians insist on emphasising the latter because it protects their own rights. It is also difficult to enforce the Convention in the absence of any international enforcing mechanisms. More importantly, the Convention hardly weighs out a variety of political, social, economic, demographic and environmental factors that encompass each shared river basin.

Figure 3 shows that water conflicts in Asia were the first studied by authors, in 1995, and that conflicts in Central Asia are the most important in the literature since 2008. Moreover, conflicts with more papers are referred to basin rivers, including Syr Darya Basin, which is located in the area we analyse in Central Asia.

Conflicts over water in Central Asian region deteriorated since the late 1990s, when it became apparent that the old, established in the Soviet era and country fixed in the Agreement in 1992 (ICWC, 1992), the water distribution system, when the bulk of the water from the upper basin is used in the lower ceases to meet the needs of economic development of countries in the region, as a compensatory mechanism underlying this system does not work in the existing regional market economy (Rogozhina, 2014).

However, the literature about water conflicts can be divided into two groups. The first includes papers which analyse conflicts between countries sharing river basins (Wolf, 2001), while the second includes those papers which study conflicts in a country when water is scarce and different uses confront stakeholders (Gopalakrishnan, C., Levy, J., Li, K. W. & Hipel, K. W. 2005).

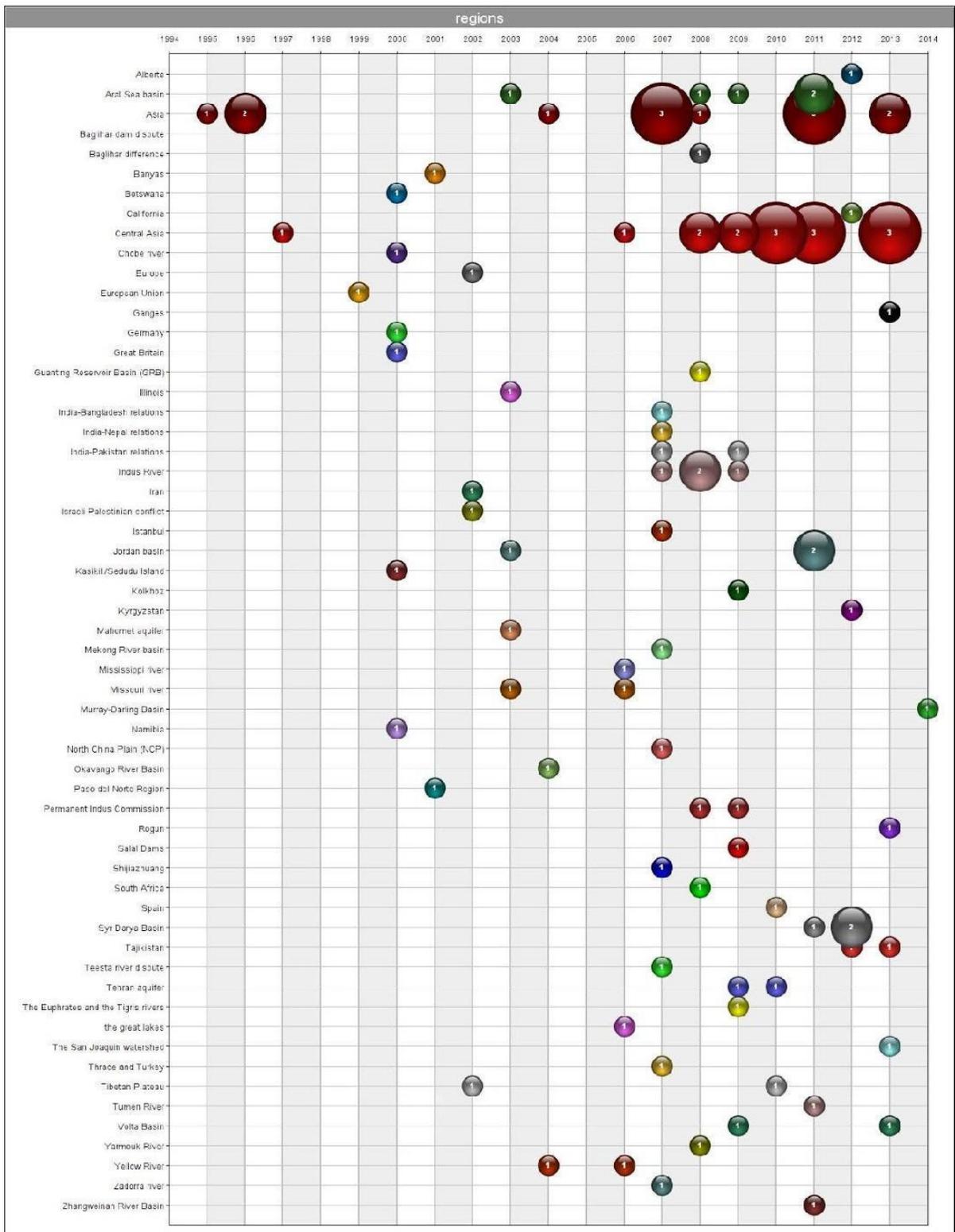


Figure 3. Literature about water conflicts by location and years

Source: Own elaboration (using software VantagePoint)

Water scarcity is growing faster than expected. Russia and the European CIS countries do not experience serious problems with the availability of water resources, which is not true of the states of Central Asia, where the "water issue" for the last 15 years has become a serious factor in bilateral relations and regional security (Kirsanov, 2006).

Central Asia lies in the heart of the Eurasian continent and is comprised of the five Ex Soviet republics – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. All these countries share basins of the two major rivers in the region: the Amu Darya and the Syr Darya which form the Aral Sea basin (See Figure 4).

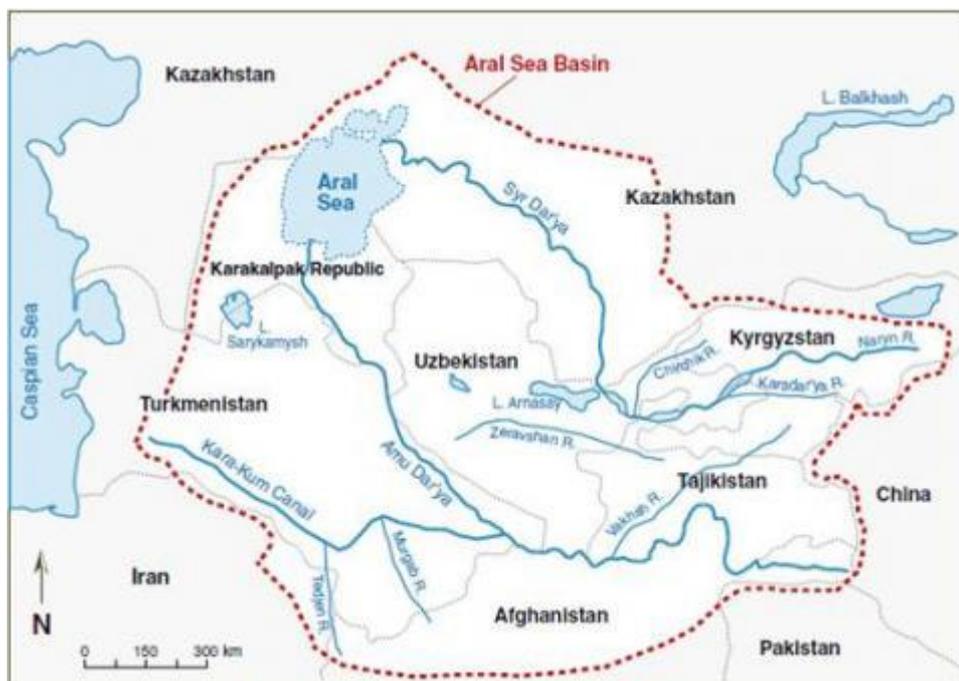


Figure 4. The Aral Sea Basin

Source: Micklin (2007)

The situation is that the Central Asian region is clearly divided into water-rich countries as Tajikistan and Kyrgyzstan and dependents on these countries are Uzbekistan, Turkmenistan and Kazakhstan. If Kyrgyzstan controls the Syrdarya river basin, the Tajikistan possesses the Amu Darya (Vinogradov, 1996; O'Hara, 2000).

Syr Darya - the first length and the second conductivity river in Central Asia. The river is 3019 km, basin area 219 thousand. Sq. km. The main part (75.2%) Syr Darya is formed on the territory of Kyrgyzstan, 15.2% of the territory of Uzbekistan, Kazakhstan, 6.9% and 2.7% in Tajikistan (Kirsanov, 2006).

Length another waterway - the Amu Darya - is 2540 km, basin area 309 thousand. Sq. km. How and Syr Darya downstream loses a lot of water for irrigation. The main flow of the Amu Darya (74%) is formed on the territory of Tajikistan, 13.9% of the territory of Afghanistan and Iran, and 8.5% on the territory of Uzbekistan (Smith, 1995).

4.1.1. Measuring the importance of keywords using Social Network Analysis

Through the use of Social Network Analysis (Jackson 2008), we calculate which keywords are more important in the literature about water conflicts. Centrality degree (Table 1) shows that keywords which appear more frequently with other keywords are "water planning and management", "international Waters", "transboundary water issues", "conflict resolutions" and "water law". However, if we see the eigenvector value, the higher value is for "water planning and management" and "transboundary water issues". Therefore, the links related to these two keywords have a better quality, which is demonstrated in cliques, where both keywords appears more frequently.

An interesting result included in Table 1 is betweenness, which indicates that keywords like “water law” and “International Court of Justice” are among those which connect both with central nodes and with peripheral nodes.

Table 1. Centrality measures

| Keyword | Degree | Closenes | Betweenness | Eigenvector |
|-------------------------------|-------------|----------|-------------|-------------|
| water planning and management | 23,7 | 9,0 | 24,5 | 51,8 |
| Water resource management | 6,6 | 8,9 | 2,9 | 24,9 |
| Conflict resolution | 17,1 | 9,0 | 20,1 | 38,2 |
| Transboundary water issues | 17,1 | 9,1 | 16,4 | 50,8 |
| Central Asia | 5,3 | 8,5 | 0,0 | 14,9 |
| water crisis and conflict | 11,8 | 8,8 | 6,4 | 28,5 |
| Asia | 5,3 | 8,4 | 0,1 | 14,1 |
| River basin management | 10,5 | 8,9 | 4,7 | 35,0 |
| international river basins | 11,8 | 9,0 | 15,5 | 37,2 |
| INTERNATIONAL | 19,7 | 8,9 | 23,3 | 35,0 |

| | | | | |
|--|-------------|-----|------|------|
| WATERS | | | | |
| Water user group | 7,9 | 8,5 | 2,3 | 16,9 |
| Transboundary river basins | 7,9 | 8,6 | 5,9 | 14,6 |
| water law | 14,5 | 8,9 | 15,2 | 31,8 |
| Aral Sea basin | 6,6 | 8,5 | 0,2 | 15,6 |
| conflict management | 5,3 | 8,7 | 2,3 | 17,4 |
| Nash bargaining | 5,3 | 8,4 | 6,8 | 5,8 |
| water resources planning | 1,3 | 8,4 | 0,0 | 7,4 |
| water transfers | 3,9 | 8,5 | 0,2 | 11,9 |
| International Court of Justice | 11,8 | 8,6 | 9,7 | 20,4 |
| Property rights | 3,9 | 8,4 | 0,0 | 8,2 |
| Syr Darya Basin | 9,2 | 8,7 | 2,7 | 20,4 |
| water dispute | 5,3 | 8,3 | 4,6 | 7,1 |
| Water rights | 2,6 | 8,4 | 0,2 | 9,5 |
| water use conflicts | 1,3 | 8,4 | 0,0 | 7,4 |
| International Centre for Settlement of Investment Disputes | 5,3 | 8,1 | 2,3 | 4,1 |

| | | | | |
|--------------------------------|-----|-----|-----|------|
| International Joint Commission | 2,6 | 7,8 | 2,3 | 1,0 |
| public dispute resolution | 2,6 | 8,5 | 0,0 | 11,4 |
| reservoir | 1,3 | 8,3 | 0,0 | 5,4 |
| riparian states | 6,6 | 8,4 | 2,3 | 13,5 |
| shared rivers | 7,9 | 8,8 | 2,4 | 24,2 |
| Tajikistan | 5,3 | 8,5 | 0,0 | 14,8 |
| Trans-boundary water conflicts | 7,9 | 8,3 | 2,3 | 10,7 |
| transboundary aquifer | 3,9 | 8,3 | 0,0 | 7,0 |
| water conservation | 1,3 | 1,3 | 0,0 | 0,0 |
| water governance | 7,9 | 8,7 | 2,0 | 22,7 |
| water sharing | 3,9 | 8,4 | 0,2 | 10,7 |
| agreements | 3,9 | 8,4 | 0,0 | 11,2 |
| Basin management | 1,3 | 1,3 | 0,0 | 0,0 |
| basin-wide water markets | 1,3 | 8,3 | 0,0 | 5,4 |
| boundaries | 2,6 | 8,4 | 0,0 | 8,2 |
| Boundary river management | 1,3 | 7,8 | 0,0 | 0,8 |

| | | | | |
|---------------------------------------|-----|-----|-----|------|
| boundary rivers | 3,9 | 8,1 | 0,0 | 4,1 |
| Boundary Waters Treaty | 1,3 | 7,3 | 0,0 | 0,1 |
| conflict prevention | 1,3 | 8,3 | 0,0 | 5,0 |
| Conflict theory | 2,6 | 7,8 | 0,0 | 1,0 |
| Cooperation over Indus River | 1,3 | 1,3 | 0,0 | 0,0 |
| Cooperation over international rivers | 1,3 | 1,3 | 0,0 | 0,0 |
| COURT DECISIONS | 6,6 | 8,3 | 0,0 | 10,5 |
| Delta | 2,6 | 8,3 | 0,0 | 6,3 |
| freshwater resources | 1,3 | 8,0 | 0,0 | 2,1 |
| international cooperation | 3,9 | 8,4 | 0,0 | 11,2 |
| international freshwater agreements | 3,9 | 8,4 | 0,0 | 8,2 |
| international groundwater law | 3,9 | 8,3 | 0,0 | 7,0 |
| JURISDICTIONAL CONFLICTS | 6,6 | 8,3 | 0,0 | 10,5 |
| Kyrgyzstan | 5,3 | 8,5 | 0,0 | 14,8 |

| | | | | |
|--|-----|-----|-----|------|
| participatory irrigation management | 1,3 | 7,9 | 0,0 | 2,4 |
| Permanent Court of Arbitration | 3,9 | 8,1 | 0,0 | 4,1 |
| Prisoner's dilemma | 2,6 | 8,3 | 0,0 | 6,3 |
| Reservoir capacities | 1,3 | 1,3 | 0,0 | 0,0 |
| resource scarcity | 2,6 | 1,3 | 0,0 | 0,0 |
| riparian water rights | 3,9 | 8,7 | 0,0 | 17,9 |
| shared aquifers | 1,3 | 8,3 | 0,0 | 5,0 |
| SHIFTING WATER BOUNDARIES | 6,6 | 8,3 | 0,0 | 10,5 |
| social values | 2,6 | 1,3 | 0,0 | 0,0 |
| The Delta game | 1,3 | 8,1 | 0,0 | 2,5 |
| the World Bank | 1,3 | 7,5 | 0,0 | 0,6 |
| Transboundary Freshwater Dispute Database (TFDD) | 1,3 | 8,4 | 0,0 | 7,2 |
| USER EXCLUSIONS | 6,6 | 8,3 | 0,0 | 10,5 |
| water administration | 3,9 | 8,3 | 0,0 | 9,8 |
| water consumption | 1,3 | 1,3 | 0,0 | 0,0 |
| Water historical | 2,6 | 7,8 | 0,0 | 1,0 |

| | | | | |
|-----------------------------|-----|-----|-----|------|
| allocation | | | | |
| water resource conflicts | 1,3 | 7,8 | 0,0 | 1,9 |
| water saving policies | 1,3 | 8,2 | 0,0 | 4,1 |
| Water scarce economies | 1,3 | 7,7 | 0,0 | 1,5 |
| water war | 2,6 | 1,3 | 0,0 | 0,0 |
| water-sharing treaties | 3,9 | 8,6 | 0,0 | 17,1 |
| World Commission on Dams | 5,3 | 8,4 | 0,0 | 13,2 |

Source: Own elaboration

A clique is “a maximal completely connected subnetwork of a given network (Jackson 2008). Cliques’ analysis gives a total of 30 cliques, which represent that each keyword in the clique has ties with the rest of keywords which form the clique. If we observe the area analysed in Central Asia (Aral Sea basin, Syr Darya Basin, Tajikistan and Kyrgyzstan), keywords representing it appear in four cliques. All of these cliques include the keyword “water planning and management”. However, we can observe a difference in the cliques. when “Syr Darya Basin” is included in the clique, the term which appear is “water user group”, while the keyword “agreements international cooperation” appears when “Aral Sea basin” is included in the clique. The reason may be that literature about Syr Darya basin explain the conflict between countries because some of them use water for irrigation and others for hydropower energy. In the

case of Aral Sea basin, international agreements are related to the possibilities of exchange among countries, that is, energy for water.

1: water planning and management, Conflict resolution, Transboundary water issues, River basin management

2: water planning and management, Transboundary water issues, water crisis and conflict

3: water planning and management, Transboundary water issues, conflict management, water-sharing treaties

4: water planning and management, Central Asia, Aral Sea basin, Syr Darya Basin

5: water planning and management, Central Asia, Water user group, Syr Darya Basin

6: water planning and management, Water user group, Syr Darya Basin, Tajikistan, Kyrgyzstan

7: water planning and management, River basin management, water law

8: water planning and management, Aral Sea basin, agreements, international cooperation

9: water planning and management, water crisis and conflict, public dispute resolution

10: Water resource management, Transboundary water issues, water crisis and conflict, water governance

11: Water resource management, Conflict resolution, Transboundary water issues

12: Water resource management, Transboundary water issues, INTERNATIONAL WATERS

13: Asia, water law, water governance, water administration

14: Asia, River basin management, water law

15: Conflict resolution, Transboundary water issues, River basin management, international river basins

- 16: Conflict resolution, Transboundary water issues, international river basins, riparian water rights
- 17: Transboundary water issues, international river basins, INTERNATIONAL WATERS, shared rivers
- 18: River basin management, international river basins, water law
- 19: international river basins, INTERNATIONAL WATERS, International Court of Justice, shared rivers
- 20: international river basins, International Court of Justice, boundaries
- 21: INTERNATIONAL WATERS, International Court of Justice, riparian states shared rivers, World Commission on Dams
- 22: INTERNATIONAL WATERS, Transboundary river basins, Property rights, international freshwater agreements
- 23: INTERNATIONAL WATERS, water dispute, transboundary aquifer, international groundwater law
- 24: Nash bargaining, Conflict theory, Water historical allocation
- 25: Conflict resolution, River basin management, water transfers
- 26: River basin management, water transfers, water sharing
- 27: International Court of Justice, International Centre for Settlement of Investment Disputes, boundary rivers, Permanent Court of Arbitration
- 28: water law, Transboundary water conflicts, COURT DECISIONS JURISDICTIONAL CONFLICTS, SHIFTING WATER BOUNDARIES, USER EXCLUSIONS
- 29: Conflict resolution, Delta Prisoner's dilemma
- 30: resource scarcity, social values, water war

As cliques showed in the analysis of keywords for all the conflicts in the World, Table 2 presents which are the keywords that appear jointly with Aral Sea basin and Syr Darya basin. These keywords are "water planning and management" for both basins, but "water user group", "agreements" and "international cooperation" for Aral Sea, and "water user group" and "transboundary river basin" for Syr Darya. Table also indicates that the first keyword is the most

important question in water conflicts, that is, the problem is related to the absence of a good planning and management.

Table 2. Records of keywords and co-occurrence of keywords in Central Asia

| | Records | 15 | 13 | 5 | 3 | 2 | 1 |
|----------------|---------------------------------|---------------------|-------------|-----------------------|------------------------|-------------------|-------------------|
| Records | Co-occurrence of Records | Central Asia | Asia | Aral Sea basin | Syr Darya Basin | Tajikistan | Kyrgyzstan |
| 37 | water planning and management | 2 | | 1 | 1 | 1 | 1 |
| 11 | River basin management | | 1 | | | | |
| 8 | Water user group | 2 | | | 1 | 1 | 1 |
| 7 | Transboundary river basins | | | | 1 | | |
| 6 | water law | | 1 | | | | |
| 2 | water governance | | 1 | | | | |
| 1 | agreements | | | 1 | | | |
| 1 | international cooperation | | | 1 | | | |
| 1 | water administration | | 1 | | | | |

Source: Own elaboration

In Table 3 we have included a summary with the papers which include some aspects of water management and planning in the area of the Aral Sea basin or Syr Darya river basin. We have included a column with the conflict or solution related in these papers. This summary in the column shows that conflict reasoning is the differences in the use of the water among countries which

share the basins, uses that are intensive in water (irrigation and energy) which causes a competition for the water. Respecting the solutions, we can observe that authors reflect about the importance of using those technologies (like GIS) which allow to better measure the level of water, to predict changes and to induce a better management and planning in the use of the resources.

Table 3. Title of papers, authors and conflicts/solutions

| Paper Title | Auth ors | Centr al Asia | Asia | Aral Sea basin | Syr Darya Basin | Tajikistan | Kyrgyzstan | Conflict |
|---|--|---------------------|------|----------------------|-----------------------|------------|------------|--|
| Calculating the Benefits of Transboundary River Basin Cooperation: Syr Darya Basin | TEASLEY, R. L. & MCKINNEY, D. C. (2011) | 1 | | 1 | 1 | | | conflict: competition for water among countries which share the river |
| Can "integrated water resources management" silence Malthusian concerns? The case of Central Asia | KIPPING (2008) | 1 | | 1 | | | | conflict: competition for water among countries, some of them focus on irrigation and the others ion hydropower generation |
| Climate Change in a Small Transboundary Tributary of the Syr Darya Calls for Effective Cooperation and Adaptation | STUCKER, D., KAZBEKOV, J., YAKUBOV, M. & WEGERICH, | | | | 1 | 1 | 1 | Solution: cooperative adaptation strategies at the local community level |

| | | | | | | | | |
|---|------------------------------|---|--|--|--|---|--|---|
| | K. 2012. | | | | | | | |
| Geostatistical approach for the assessment of the water reservoir capacity in arid regions: a case study of the Akdarya reservoir, Uzbekistan | RAKHMATUL LAEV et al. (2011) | 1 | | | | | | Solution: use GIS for better management of water resources |
| Groundwater resources use and management in the Amu Darya River Basin (Central Asia) | RAKHMATUL LAEV et al. (2010) | 1 | | | | | | Conflict: difficulties in transboundary agreements for groundwater use and management |
| Hydro-hegemony in the Amu Darya Basin | WEGERICH, K. (2008) | 1 | | | | | | Conflict: hydro-hegemony of Uzbekistan in the use of water resources of the basin |
| Hydrologic impact of regional climate change for the snow-fed and glacier-fed river basins in the Republic of Tajikistan: statistical downscaling of global climate model projections | KURE et al. (2013) | | | | | 1 | | Solution: to use better techniques for measure and predict water level fluctuations |

| | | | | | | | | |
|--|--|---|--|---|---|--|--|---|
| Institutions and transition: does a better institutional environment make water users associations more effective in Central Asia? | GUNCHINMA A, T. & YAKUBOV, M. (2010) | 1 | | | | | | Solution: a well-defined and enabling institutional framework/environment |
| Modelling the impact of Global Change on the hydrological system of the Aral Sea basin | BEEK, T. A. D., VOSS, F. & FLORKE, M. (2011) | | | 1 | | | | Solution: better models to measure different impacts on the water levels (ie. climate change, irrigation) |
| Of transboundary basins, integrated water resources management (IWRM) and second best solutions: the case of groundwater banking in Central Asia | KARIMOV (2012) | | | | 1 | | | Conflict: trade-off between hydro-power and irrigation |
| On Pumps and Paradigms: Water Scarcity and Technology Adoption in Uzbekistan | OBERKIRCHER (2011) | 1 | | | | | | Conflict: short-term planning dominates over sustainability concerns |
| Participatory water management at the main canal: A case from South | ABDULLAEV et al. (2009) | 1 | | | | | | solution: include water users in water |

| | | | | | | | | |
|--|--|---|---|---|--|--|--|--|
| Ferghana canal in Uzbekistan | | | | | | | | management |
| Strategic decision support for resolving conflict over water sharing among countries along the Syr Darya River in the Aral Sea Basin | NANDALAL, K. D. W. & HIPEL, K. W. 2007 | | 1 | | | | | conflict: disputes for the water |
| The Aral Sea basin - Rumors, realities, prospects | DUKHOVNY, V. A. 2003. | | | 1 | | | | Solution: cooperation and collaboration between countries, and between the state and the water users |
| WATER FOR FOOD AS FOOD FOR THOUGHT: CASE STUDY OF APPLYING THE PODIUMSIM MODEL TO UZBEKISTAN | YAKUBOV, M. & MANTHRITH ILAKE, H. 2009 | 1 | | 1 | | | | Conflict: different uses of water in the country |
| Water reservoirs, irrigation and sedimentation in Central Asia: a first-cut assessment for Uzbekistan | RAKHMATUL LAEV et al. (2013) | 1 | | | | | | Solution: New technologies and methods for the prediction of the |

| | | | | | | | | |
|---|-----------------------|---|--|--|--|--|--|--|
| | | | | | | | | water availability |
| Water, Food, and Energy Security: An Elusive Search for Balance in Central Asia | JALILOV et al. (2013) | 1 | | | | | | Solution: a constrained economic optimization operation of the Dam |

Source: Own elaboration

In Table 4 we have included the 11 names of Journals where authors have published papers about the specific problems in water management in the countries around the basins of Aral Sea and Syr Darya river. For the 17 papers in Table 3, the core journals with 3 papers about this item are: Water Policy, Irrigation and Drainage, and Environmental Earth Sciences.

Table 4. Source of papers for Central Asia water conflicts

| | Records | 15 | 13 | 5 | 3 | 2 | 1 |
|---------|----------------------------|--|------|--|-----------------|------------|------------|
| Records | Source (Journal) | Central Asia | Asia | Aral Sea basin | Syr Darya Basin | Tajikistan | Kyrgyzstan |
| 27 | WATER INTERNATIONAL | 1 Can "integrated water resources management" silence Malthusian concerns? The case of Central Asia | | 1 Can "integrated water resources management" silence Malthusian concerns? The case of Central Asia | | | |
| 17 | WATER RESOURCES MANAGEMENT | 1 Water, Food, and Energy Security: An Elusive Search for Balance in Central Asia | | | | | |
| 16 | WATER POLICY | 2 | | | 1 | | |

| | | | | | | | |
|---|-------------------------|--|---|---|---|--|--|
| | | <p>Hydro-hegemony in the Amu Darya Basin</p> <p>Institutions and transition: does a better institutional environment make water users associations more effective in Central Asia?</p> | | | <p>Of transboundary basins, integrated water resources management (IWRM) and second best solutions: the case of groundwater banking in Central Asia</p> | | |
| 9 | IRRIGATION AND DRAINAGE | <p>1</p> <p>WATER FOR FOOD AS FOOD FOR THOUGHT: CASE STUDY OF APPLYING THE PODIUMSIM</p> | 3 | <p>2</p> <p>The Aral Sea basin - Rumors, realities, prospects</p> <p>WATER FOR FOOD AS FOOD FOR</p> | | | |

| | | | | | | | |
|---|---|---|---|---|---|--|--|
| | | MODEL TO UZBEKISTAN | | THOUGHT: CASE STUDY OF APPLYING THE PODIUMSIM MODEL TO UZBEKISTAN | | | |
| 8 | JOURNAL OF WATER RESOURCES PLANNING AND MANAGEMENT-ASCE | 1 Calculating the Benefits of Transboundary River Basin Cooperation: Syr Darya Basin | 1 Strategic decision support for resolving conflict over water sharing among countries along the Syr Darya River in the Aral Sea Basin | 1 Calculating the Benefits of Transboundary River Basin Cooperation: Syr Darya Basin | 1 Calculating the Benefits of Transboundary River Basin Cooperation: Syr Darya Basin | | |
| 7 | PHYSICS AND CHEMISTRY OF THE EARTH | | 1 | 1 Modelling the impact of Global | | | |

| | | | | Change on the hydrological system of the Aral Sea basin | | | |
|---|----------------------------|-------|--|---|--|--|--|
| 5 | AGRICULTURAL MANAGEMENT | WATER | 2 Participatory water management at the main canal: A case from South Ferghana canal in Uzbekistan | | | | |
| 5 | ENVIRONMENTAL SCIENCES | EARTH | 3 Geostatistical approach for the assessment of the water reservoir capacity in arid regions: a case study of the | | | | |

| | | | | | | | |
|---|------------------------|---|---|--|--|---|-------------------|
| | | <p>Akdarya reservoir, Uzbekistan</p> <p>Groundwater resources use and management in the Amu Darya River Basin (Central Asia)</p> <p>Water reservoirs, irrigation and sedimentation in Central Asia: a first-cut assessment for Uzbekistan</p> | | | | | |
| 3 | HYDROLOGICAL PROCESSES | 1 | 1 | | | 1 | Hydrologic impact |

| | | | | | | | |
|---|-----------------------------------|-------------------|--|--|--|---|--|
| | | | | | | of regional climate change for the snow-fed and glacier-fed river basins in the Republic of Tajikistan: statistical downscaling of global climate model projections | |
| 1 | MOUNTAIN RESEARCH AND DEVELOPMENT | | | | 1 Climate Change in a Small Transboundary Tributary of the Syr Darya Calls for Effective Cooperation and Adaptation | 1 Climate Change in a Small Transboundary Tributary of the Syr Darya Calls for Effective Cooperation and Adaptation | 1 Climate Change in a Small Transboundary Tributary of the Syr Darya Calls for Effective Cooperation and Adaptation |
| 1 | SOCIETY & NATURAL RESOURCES | 1 On Pumps and | | | | | |

| | | | | | | | |
|--|--|---|--|--|--|--|--|
| | | Paradigms: Water Scarcity and Technology Adoption in Uzbekistan | | | | | |
|--|--|---|--|--|--|--|--|

Source: Own elaboration

4.1.2. Water Management. Soviet Union Period.

Within the Soviet Union, transboundary water resources were managed on the basis of water use plans which were developed by local Ministries of Land Reclamation and Water Management and then sent to Moscow to the Ministry of Land Reclamation and Water Management of the Soviet Union for approval. These plans and schemes provided for annual water withdrawal limits with respect to each reservoir or canal and the limits were calculated against annual crop requirements.

A number of agreements was signed between the republics to correct water allocation with the aim to control and manage water resources fairly among Republics (Kazbekov, 2009; Karimov, 2012). These plans and agreements still constitute the basis of current water management in the region (Gunchinmaa, 2010).

Under the Soviet Union's system of water allocation, water quotas imposed by Moscow favoured downstream countries at the expense of the upstream riparians: water-rich countries as Kyrgyzstan and Tajikistan were supposed to supply irrigated agriculture economies of Uzbekistan and Turkmenistan with water in spring and summer when water should be available for cotton fields. In autumn and winter, when Kyrgyzstan and Tajikistan experienced peaks in electricity demand, ideally, they were supplied with Turkmen and Uzbek gas and Kazakh coal to satisfy energy consumption. Furthermore, they received electricity from downstream countries during winter to be compensated for the hydropower produced in summer. Maintenance and operating costs of dams and reservoirs were covered totally by Moscow at that time.

4.1.3. Water Management. Post Soviet Period.

After Soviet Union's collapse, Central Asia has become a center of transboundary water disputes. Externally, the majority of the conflicts in Central Asia often have had an ethnic character, it is more look like a clash divergent interests of the various ethnic communities. But in fact, the deep foundation of such conflicts is not always the ethnic diversity as it seems. In the vast majority of situations the deep heart of the conflict is a struggle for resources. Before they were necessary for physical survival in the harsh conditions of war and natural disasters (McKinney, 2003). Nowadays the struggle for resources often has less to do with survival than with the desire for a more comfortable existence. In the context of globalization has increased the ability to compare the lives of different ethnic groups and states, including living side by side. For the same political elites struggle for resources has always been intrinsically linked to the struggle for receiving and retaining political power. In the Central Asian context it is both the political elites struggle for ownership and for economic benefits at the same time.

Water is critical resource in Central Asia and it "has more often been the source of competition rather than the focus of conservation" (Hogan, 2000). The absence of mechanisms to handle the water problems has already resulted in various accusations of improper water use. In a result, the whole region becomes the site of potential conflict that requires a framework which should incorporate a great many variables to identify the proneness to water conflict and to allow for the possibility of preventive diplomacy. Such method which has never been used towards the specific problem of Central Asian water disputes can provide solutions based on a more holistic approach to natural resources, while recognising the historical, geopolitical and natural characteristics of the region.

On September 20 of 1995 at an international conference in Nukus heads of Central Asia countries were proclaimed commitment to equality and inter-state

cooperation on water issues. In Nukus Declaration adopted by the presidents of the five countries in the region reaffirmed their "commitment to full cooperation at the regional level on the basis of mutual respect, good neighborliness and determination" on water and energy problems in Central Asia. This was followed by the Bishkek Declaration of the Heads of States May 6, 1996, which was first recognized the need to "accelerate the development of new strategies for water allocation and economic methods of management in the use of water and energy resources."

In 1998 was adopted other agreement "On cooperation in the field of environmental protection and rational nature" (Agreement, 1998), which highlighted the need to establish a Water and Energy Consortium for Central Asia. However, the creation of the Water and Energy Consortium (WEC), the countries of Central Asia are still inhibited. Disputes about "shares" in the consortium, unwillingness to compromise, a crisis of confidence and regional political rivalries interfere to realize this project.

4.1.4. Water Management. Today.

The difficulty lies in the fact that 80% of all water resources in Central Asia are owned by Kyrgyzstan and Tajikistan. The economic interests of these countries are associated with the use of hydroelectric power potential of the transboundary rivers Amu Darya and Syr Darya, in the absence of alternative sources of domestic energy. Kazakhstan, Turkmenistan and Uzbekistan are primarily interested in the use of the waters of these rivers for irrigation, and therefore are opposed to hydroelectric power plans of their neighbours, which would have an impact on their own economic interests.

When the downstream countries began to raise prices for oil and natural gas supplied in the upstream countries in exchange for water, Kyrgyzstan and Tajikistan faced with a choice - either pay international prices for energy

resources, and it would have imposed a heavy burden on their underdeveloped economy, or develop its hydropower. The choice was made in favor of the latter.

In the centre of the conflict, there were three countries – Kyrgyzstan, Tajikistan and Uzbekistan. Unlike Uzbekistan, Kazakhstan is also interested in ensuring a stable flow of trans-boundary rivers but it has taken a more moderate position, not openly entering the conflict. Uzbekistan is doing the contrary. It is demonstrating its unwillingness to tolerate possible threats by using various methods in trying to influence the leadership of its neighbours and standing the fact that water is God's gift and no one has to pay for it (Rogozhina, 2014).

Consequently, uneven distribution of water resources in Central Asia causes a conflict of interest of key water suppliers (Tajikistan and Kyrgyzstan) and its main consumers (Uzbekistan, Kazakhstan and Turkmenistan) (Kirsanov, 2006).

In particular, Tajikistan, Kyrgyzstan, together with interest to use water resources to generate electricity for their own needs and for export to third countries. They are opposed by Kazakhstan, Turkmenistan and Uzbekistan, which insist on the nature of the operation of the irrigation mainly as constructed during the Soviet era hydroelectric and planned new hydroelectric power plants (Cai, X., McKinney, D. C., and Lasdon, L. S., 2002).

The essence of the claims of Kyrgyzstan and Tajikistan to its neighbors is to get more financial compensation for the use of their hydroelectric power plants in the irrigation regime in the interests of Uzbekistan, Kazakhstan and Turkmenistan. Bishkek (Kyrgyzstan) and Dushanbe (Tajikistan) over the years point to significant costs on their part to maintain hydraulic infrastructure. Most active in this case is Kyrgyzstan, who offered to treat water as a kind of commodity and in the future to introduce a fee for water (now Kyrgyzstan receives partly compensation from Uzbekistan and Kazakhstan compensation for excess electricity produced). However, experts agree that water charging is uncertain idea in Central Asia due to the high risk of social and political

upheaval in all countries without exception (World Bank, 2004). The purpose of Bishkek and Dushanbe is to obtain a fair compensation for the services provided for the supplying of water. It is not correct to blame only Bishkek and Dushanbe in "energy egoism" as these countries had to solve the problems of poverty, and now water resources are for them a source of national economic development. The problem is how to integrate the local development strategy in regional sustainable development scenario, a win-win all countries and have no losers.

KYRGYZSTAN AND UZBEKISTAN

As you know, between Bishkek and Tashkent long been a fierce debate over water Naryn cascade hydropower stations in Kyrgyzstan. Tashkent annually insists on dumping of large masses of water from the Toktogul reservoir to improve water supply agricultural regions of Uzbekistan (GEF, 2002).

In winter of 2000 water-energy conflict in Tashkent and Bishkek almost went into the power stage when the Uzbek side has stopped the flow of gas to Kyrgyzstan. In response to generate additional electricity Kyrgyzstan began dumping water on the Toktogul reservoir. As a result of the cotton fields in Uzbekistan was waterlogged. Riley Tashkent in close proximity to the Kyrgyz-Uzbek border deployed military unit and conducted a series of exercises to capture the Toktogul using armored vehicles and helicopters. Kyrgyzstan, in turn, through information leakage explained that in the case of the explosion of the dam, the water flow "was to destroy the Ferghana and Zarafshan Valley" of Uzbekistan (Olsson, O, Gassmann, M, Wegerich, K, Bauer, M., 2010).

In November of this year, between Uzbekistan and Kyrgyzstan with a bang, broke another water-energy crisis. In particular, the Uzbek side has put forward a number of conditions for the supply of gas to Kyrgyzstan in 2007 at \$ 100 per thousand cubic meters. The main requirement was to provide the necessary amount of water for the needs of Uzbek agriculture. Under existing agreements, permits water to be compensated for the purchase of electricity in

Kyrgyzstan. The prices for it have been proposed Uzbekistan below market, established in 2006, that does not suit Bishkek. Parallel Bishkek Tashkent accused of trying to create an artificial shortage of irrigation water for the Uzbek agriculture (Olsson, O, Gassmann, M, Wegerich, K, Bauer, M., 2010).

KYRGYZSTAN AND KAZAKHSTAN

Some representatives of Kazakhstan government were against of construction of Kambarata hydropower plant in Kyrgyzstan, the reason for Kazakh part was that Kambarata "will inevitably upset the delicate balance in the electricity and water supplies across the region". However, Bishkek and Astana came to harmonize their water-energy needs. As a positive example of this cooperation is that Kazakhstan has agreed to co-finance (in the amount of \$ 20 million. Annually) operation of hydraulic facilities in Kyrgyzstan.

TURKMENISTAN AND UZBEKISTAN

Since independence, Turkmenistan and Uzbekistan took place friction on the joint use of water in the lower reaches, as Turkmenistan is a huge selection of water Karakum Canal. Turkmenbashi plans to create an artificial "Lake of the Golden Century" only reinforce fears water Tashkent (Kirsanov, 2006). Existing rivalry between Uzbekistan and Turkmenistan in the distribution of water downstream may be exacerbated if the increased demand for water in Afghanistan in connection with the development of irrigated agriculture.

According to expert estimates, the population growth in Central Asia will inevitably increase the demand for water in the coming twenty years by 40%. Such a situation can serve as catalysts for interstate conflicts, which requires managers to the Central Asian states of political maturity and will for a just

solution to water-energy problems (Froebrich, J., Bauer, M., Olsson, O., Normatov, I. & Petrov, G., 2006).

Economic damage caused by unresolved the problem shared by all countries in the region. According to the UNDP (UNDP Report, 2005), Unresolved problem of exploitation of water resources in Central Asia, annual losses of \$ 1.7 billion due to poor water management.

The paradox is that there is enough water in Central Asia. Excessive loss of water use in Central Asia due to the archaic system of agriculture, when water consumption per unit of production in three, and sometimes ten times the world total. According to specialists, the transition to modern agricultural technology and water management will save up to half a year transboundary rivers in the region. The problem is that the modernization of the Central Asian agriculture requires huge internal funds and external investment.

4.1.5. Attempts to resolve water issues in the Central Asian region

As these countries are not able to solve independently the water problem in Central Asia, they hope that international mediation can become a guarantor of this region's security.

The World Bank has actively joined in attempting to solve this issue. It is examining the economic feasibility of the Rogun HPP (Hydro Power Plant) and evaluating its impact on the environment. At the same time, it is doubtful that under the attitudes of Tajikistan's and Uzbekistan's presidents, they will agree with any arguments and recommendations of the World Bank. They made it clear that they would stay their courses regardless of the bank's conclusions.

The European Union (EU) is offering donor assistance to Central Asian countries in the implementation of water projects, but at the same time the EU policy is not directed towards the establishment of cooperation between these countries

regarding the water issue. On the contrary, the EU is openly supporting Uzbekistan. According to Tajikistan, the EU support is explained by European plans for the implementation of the Nabucco gas pipeline project.

On February 2012, the European Union expressed its disapproval of a Russian \$1.7 billion loan (Muzalevsky, 2010) to Kyrgyzstan for construction of the Kambarata hydropower station, which can be regarded as an attempt to counter the growing influence of Russia in the region.

Until today, Russia remained apart from the water issues in Central Asia. However, due to historical and geopolitical reasons, Russia cannot remain neutral on this problem in Central Asia. The country is interested in solving water conflicts that threaten its interests and national security. Nowadays, Russia's interest in Central Asian water resources is primarily associated with the use of their hydroelectric potential. There are many considerable risks in this very profitable activity Russia is always in the centre of an building rivalry between the countries of this region, vying for control of transboundary water resources (Rogozhina, 2014).

Regarding the Kambarata Hydropower station construction, the Russian president, during his visit to Kyrgyzstan in 2012, clearly stated that Russia's participation in this project is not directed against any country and it is interested in such cooperation on the control and distribution of water resources, which takes into account the interests of all stakeholders (Rogozhina, 2014). Moreover, he added that the building of hydroelectric power projects is only possible with the participation of Uzbekistan and Kazakhstan. Besides this, Russia expressed a desire to have an international organization assess the project and that it opposed offering Uzbekistan the right to veto this project, in case of a positive assessment.

Russia is able to assist Central Asian countries in overcoming their water crisis through the financial provision and technical assistance in their transition to

resource conservation. This would be conducive to further promotion of investments and equipment on their markets.

The problem of transboundary water resources goes largely political in nature. This problem is determined by the complex nature of relations between the countries of Central Asia, and primarily between their political elites, their unwillingness to make concessions, their national egoism, which is fuelled by political rivalry of these countries, living in conditions of political and economic instability.

Nevertheless, certain optimism about the water situation in Central Asia is being preserved. This optimism is explained by the fact that, as history shows, water conflicts eventually become solved. Moreover, the path to solving these problems is through *cooperation and economic integration*.

In September of 2006, Astana hosted an informal summit of the leaders of the Central Asian countries, where he again addressed the problem of regional water resources. However, no practical action was taken, the parties only once again to declare the need for a coherent addressing the use and consumption of water at the international level.

According to international organizations and experts, the main problems between the countries of the region in the regulation of water and energy relations remain the same:

- recommendatory way of making decisions and the absence of any responsibility for their implementation;
- disunity of action at the regional and national levels of governance structures between water and energy;
- contradictions between the interests of controlling water resources and consuming them;
- lack of efficient inter-state structures empowered to co-management of water and energy resources;

- the absence of any party concerned between the conflicting parties with the capabilities of the real impact on the settlement of disputes.

Up today, in the region there was an adverse situation in the regulation of water use. During the past fifteen years on a regular basis were discussed the projects of international agreements on the use of water, held regional conferences, summits, but the situation has not changed for the better.

4.2. Kyrgyzstan in the Literature about water conflicts in Central Asia

Water is the most critical resource in Central Asia and it “has more often been the source of competition rather than the focus of conservation” (Hogan, 2000). Today's confrontation in the field of water resources is a consequence of the process of reduction of the watercourse throughout Central Asia and the increase in water consumption.

Kyrgyzstan is well endowed with water resources and has a great water potential comparing to its riparian countries. In the context of climate change, growing water scarcity, the rising impact of water sector on economy, water has become one of the key aspects of sustainable development in Kyrgyzstan. Kyrgyzstan has started to be studied in Water issues recently and the literature about water conflicts in Kyrgyzstan is scarce as it is shown in the Figure 5.

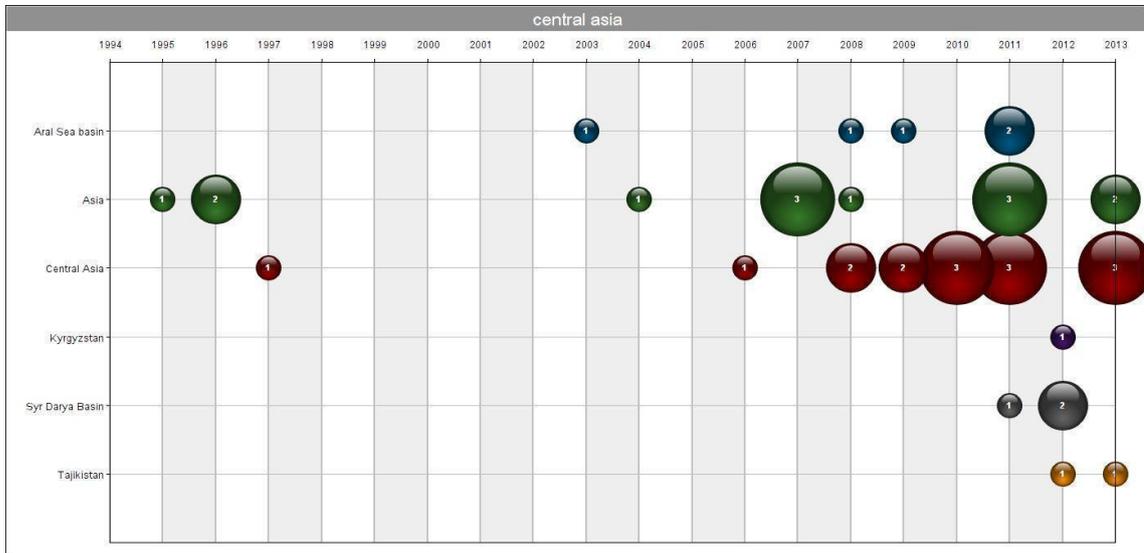


Figure 5. The increase in papers referred to water conflicts in Central Asia area.

Source: Own elaboration (using VantagePoint)

Conflicts in Kyrgyzstan basically are related to the share of water resources with other riparian countries of the Syr Darya basin (Kyrgyzstan, Uzbekistan, Tajikistan, and Kazakhstan; see Fig. 2).

After Soviet Union Breaking up every country of Syr Darya basin became independent and the management of water resources became more difficult as every country wanted to maximize its own benefits without thinking about consequences (Teasley, 2011). As it is one common basin and the Syr Darya river flows through 4 countries, to alleviate the developing water-sharing problems in the basin, the riparian countries signed the "Agreement on the Use of Water and Energy Resources of the Syr Darya Basin" in 1998 (1998 agreement) that outlined water- and power-sharing among the countries (ICWC 1998).

The largest water storage facilities are the Toktogul Reservoir in Kyrgyzstan controlling the flow of the Naryn river, and the Nurek Dam on the Vaksh river in Tajikistan, dubbed "the largest earth-fill dam in the world". Juust only the Syr Darya basin has 22 operating reservoirs (Toryanikova and Kenshimov, 1999), including the Naryn-Syr Darya cascade of dams which consists of five reservoirs: three upper reservoirs with the over-year regulation - the Toktogul, the Charvak, the Andijan and also two channel reservoirs with the seasonal regulation - the Kairakkum and the Chardara (Teasley, 2011), with the aggregate active storage capacity of 24.1 km³ (Khamidov et al, 1999). Before 1991 the basin was part of the Soviet Union and was managed by a single, central government that emphasized large-scale agricultural production (primarily cotton), resulting in a large demand for spring and summer irrigation water and today the basin presents unique transboundary water management challenges (Weinthal 2002).

Unilateral decisions to embark on new water projects are not uncommon in Central Asia. While providing for national solutions, such decisions and further actions are among key drivers of potential water conflict. Trying to find a way

out of the existing situation, some Central Asian governments were forced to develop plans for building more infrastructure to get control over water resources.

The Aral Sea (Figure 6), terminal lake of the Syr Darya and Amu Darya Rivers has shrunk to less than 10 per cent of its 1960 volume. The consequences are dire: desiccation, polluting dust storms and declining life expectancies in the area immediately surrounding the lake. The setbacks for the Uzbek and Kazakh economies have never been precisely measured, but they appear to have been enormous. By taming the rivers and controlling nature, ruling elites in Moscow and Tashkent created one of the worst man-made environmental disasters in history.

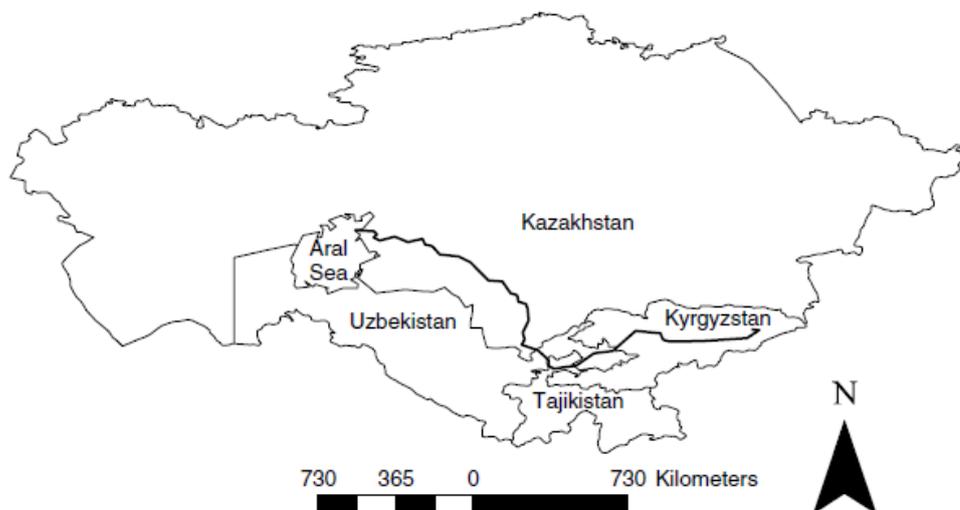


Figure 6. The upwards and downstream in the Syr Darya basin

Source: Teasley and McKinney (2011)

The government of Kyrgyzstan has embarked on an ambitious hydropower development programme on the transboundary Syr Darya River, which has provoked strong opposition from downstream Uzbekistan. The programme is driven by the alignment of actual energy concerns with interests of the national

hydraulic elites and the global politics of project finance, which provides a logic for dams that may exacerbate existing geopolitical tensions across the region. Academics, diplomats, and national energy experts have raised serious questions about the value of these dams. At the moment, the Kambarata-II (Photo 1) is operating at only a third of its capacity, because two out of three turbines can only be installed when the larger dam upstream is completed to regulate the river flow. Meanwhile, financing the latter has proved problematic given prohibitive costs and doubtful balance between costs and benefits. The entire dam-building project of the Kyrgyz government has raised numerous questions. What is the logic that drives the desire for these dams? Who would pay the excessive costs of the new dam, given the rather low economic viability? But the most critical question remains: what will the new dams mean for the geopolitics of the Syr Darya River, and in particular the tension between Uzbekistan and Kyrgyzstan?



Photo 1. Kambarata Hydro Power Station

Source: www.azattyk.org

The Kambarata cascade is by no means the first hydraulic intervention in the Aral Sea basin of which the Syr Darya covers half the drainage area. Hundreds of dams have been constructed since the 1930s as well as a plethora of reservoirs, irrigation canals, and other water management structures. These developments were part of the Soviet hydraulic mission, a modernization plan that made the conquest of nature an ideological imperative. By taming the wild Syr Darya and Amu Darya Rivers, it was thought, agricultural output could be greatly increased.

The operation of the Kyrgyz Toktogul (Photo 2) dam and reservoir – the largest in the river system until Kambarata-I is completed – has been the central problem. It has multiple functions: it is both the main supplier of water for

irrigation in Uzbekistan and the source of more than 90 per cent of Kyrgyzstan's electricity. The problem is that Kyrgyzstan wants to discharge water from the reservoir in winter to generate power when demand for electricity is highest, whereas Uzbekistan wants the water to be discharged in summer, when it is needed for irrigation.



Photo 2. Toktogul Dam

Source: www.novostienergetiki.ru

At first sight it seems that the new Kambarata dams just upstream of the Soviet-era Toktogul dam have the potential to satisfy both the Uzbeks and Kyrgyz. Former President Kurmanbek Bakiyev said during a regional summit in 2009: "implementation of [the Kambarata project] not only satisfies our republic's energy needs but will also allow the Toktogul to operate in an irrigation regime which our regional partners are interested in." According to economic analysis conducted by the World Bank, a win-win solution is actually possible without the expensive construction of more dams: recognising the

economic value of water allows for the optimisation of existing dam operations. Kyrgyzstan could discharge water for Uzbek irrigation in summer, in exchange for nominal payments to cover the costs of an alternative electricity supply in winter. Either way, the solution depends on political cooperation.

In fact, the Kambarata plans seem to have aggravated tensions between the riparian states. The regional cooperation process that aims to formulate a binding legal framework has been deadlocked over disagreement on basic principles. Uzbek officials accuse Kyrgyzstan of wanting to sell the water of an international river. Indeed, the rather unsubstantiated fear downstream is that Kyrgyzstan will not use the Kambarata dam to foster cooperation, but will attempt to extend its control over the river flow and blackmail the downstream states.

If we look from one part Kyrgyzstan is satisfied by hydropower from Toktogul Reservoir releases and the Naryn Cascade (McKinney and Kenshimov 2000; World Bank 2004). However, in cooperative sense, countries work together to increase their collective benefits and seek gains beyond what they could get if they act independently. Syr Darya Agreement proposed revisions entailing sharing water (both releases and storage) and reaching a compensated compromise (on the basis of energy transfers) between summer irrigation and winter hydropower uses of the water. No cooperative game theory methods have been used to evaluate agreements among the riparian countries in the Aral Sea Basin (Bennett et al. 1998; Abbink et al. 2005; Nandalal and Hipel 2007).

4.2.1. Russia's participation in Central Asian Water management

Due to historical and geopolitical reasons, Russia cannot be out of the problem field of Central Asia. With the inclusion of the Eurasian Economic Community of Central Asian Cooperation Organization (CACO) and the subsequent accession

of Uzbekistan to the community issues of water control passed to the integration of the organization where Russia plays a key role. Russia has been actively investing in hydropower in Central Asia - is involved in the construction of Sangtuda-1 and Rogun hydropower in Tajikistan. In April 2006, the Government of Kyrgyzstan turned to Russia with a proposal to renew the partnership in the field of power and continue to work on the construction of Kambarata hydropower- 1 and 2 (the required investment is \$ 2.3 billion.). The need for Russia's participation in solving the problems of energy and water use in Central Asia is caused by increased activity of other international players (USA, EU), offering to mediate.

Russia has developed smooth and partnerships with all the Central Asian states (which, of course, does not rule out discussions in the framework of bilateral relations). In the long term, this means that Russia has the opportunity to play the role of "honest broker" for the solution of water and energy disputes in the region. It is also important that the Russian experts have accumulated during the Soviet era unique knowledge about the specifics of the region's hydropower.

5. Conclusion

This paper analysis literature about water conflicts in an area of Central Asia where countries share water resources. These resources include the Syr Darya river basin and its mouth in the Aral Sea. Countries necessities of water have been increasing during the past decade, but being a limited resource, the competition for it has reinforced the need for new solutions.

However, the problem of transboundary water resources goes beyond the scope of a purely resource issue, and is largely political in nature. This problem is determined by the complex nature of relations between the countries of Central Asia, and primarily between their political elites, their unwillingness to make concessions, their national egoism, which is fuelled by political rivalry of these countries, living in conditions of political and economic instability. All above mentioned lead to inefficient water management which can be resulted in sooner water scarcity for all Central Asian countries. That is why it is very important to borrow other riparian countries experience and use it as a basic model changing it with specific needs of each country.

Through the use of a bibliometric analysis we have detected which causes of conflict have been exposed by authors, but also some of the solutions proposed by them. Causes reflect the scarce of a good integrated project to manage and planning the water resources.

Solutions explained by authors tend to be related to an specific country or area. However, when problems arrive from multiples actors, solutions should include these multiple participants. Implications of all the agents in all the countries are essential for good solutions and implementation.

REFERENCES

AGREEMENT between the Government of the Republic of Kazakhstan, the Kyrgyz Republic and the Government of the Republic of Uzbekistan on cooperation in the field of environmental protection and conservation. Bishkek, 17 March 1998.

Bertrand, A. (2009), "The Home Project" movie, <https://www.youtube.com/watch?v=7hFivbgIEqk&list=UUsO1AOwtvyPFWnxDNy9pMqw>

Dublin International Conference on Water and the Environment. (1992). The Dublin Statement on Water and Sustainable Development. World Meteorological Organisation. Geneva, Switzerland.

Interstate Commission for Water Cooperation (ICWC). (1992). "Agreement between the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan and the Republic of Uzbekistan on Cooperation in Interstate Water Sources." Water Resources Use and Protection Common Management, Almaty, Kazakhstan.

Human Development Report 2006. UNDP, 2006. "Coping with water scarcity. Challenge of the twenty-first century". UN-Water, FAO, 2007. Water Scarcity, Threats, WWF (2014), <http://www.worldwildlife.org/threats/water-scarcity>

Global Environment Facility (GEF). (2002). "Basin national and regional water and salt management plans. Section 6. Regional development scenarios."

Joint Rep. No. 2, Sub-component A1, Water and Environmental Management Project, Aral Sea Basin Program, Washington, DC.

UNDP, 2006. UNDP Project Proposal for the Zarafshan Valley Initiative, 2006–2008.

<[http://www.undp.tj/files/project_profiles/CP/3%20DFID_Zaravshan%20Valley_Proposal%20\(8Mar06\).doc](http://www.undp.tj/files/project_profiles/CP/3%20DFID_Zaravshan%20Valley_Proposal%20(8Mar06).doc)>(accessed 24.04.09).

World Bank Report. (2004). "Water energy nexus in Central Asia: Improving regional cooperation in the Syr Darya Basin." Europe and Central Asia Region, The World Bank, Washington, DC.

Abbink, K., Moller, L. C., and O'Hara, S. (2005). "The Syr Darya River conflict: An experimental case study." Center for Decision Research and Experimental Economics Discussion Paper 2005-14, The University of Nottingham, U.K.

ABDULLAEV, I., KAZBEKOV, J., MANTHRITILAKE, H. & JUMABOEV, K. (2009). "Participatory water management at the main canal: A case from South Ferghana canal in Uzbekistan". *Agricultural Water Management*, 96, 317-329.

Bennet, L. L., Ragland, S. E., and Yolles, P. (1998). "Facilitating international agreements through an interconnected game approach: The case of river basins." *Conflict and cooperation in transboundary water resources*, R. Just and S. Netanyahu, eds., Kluwer Academic, Dordrecht, Netherlands, 61–85.

Bhatia, R. and Falkenmark, M. (1993). "Water resource policies and the urban poor: innovative approaches and policy imperatives". Paper presented at the Dublin Conference on Water and Environment 1992. Water and Sanitation Division, The World Bank. Washington, DC.

Briscoe, J. (1997). "Water as an Economic Good: the Practical Implications of Varying Environmental Conditions". Draft of paper for 1997 ICID Europe Conference on Water as an Economic Good, Oxford, UK.

Cai, X., McKinney, D. C., and Lasdon, L. S. (2002). "A framework for sustainability analysis in water resources management and application to the Syr Darya Basin." *Water Resour. Res.*, 38(6), 1085–1099.

Danilov-Danilyan, V. (2008). "Global problem of fresh water's scarcity", *Age of globalization*. Issue №1 / 2008.

Dukhovniy, V.A., Sokolov, V.I., (2005). "Integrated water resources management: experience and lessons Central Asia". GWP CACENA Report. 95 pp. (in Russian).

Elagina, V., (2011). "The concept of water use in a globalizing economy", "Economic theory and practice: Global Challenges", St. Petersburg State University, Faculty of Economics, 424-433.

Haftendorn, H. (2000). "Water and international conflict". *Third World Quarterly*, 21, 51-68.

Hahn, G., Just, A., Dudykevych, D., Frerichs, I., Hinz, J., Quintel, M. & Hellige, G. (2006). "Imaging pathologic pulmonary air and fluid accumulation by functional and absolute EIT". *Physiological Measurement*, 27, S187-S198.

Hogan, B. (2000). "Decreased water flow threatens cotton crop, peace in region". *EurasiaNet Environment Report*.

Gafurov, A., Kriegel, D., Vorogushyn, S. & Merz, B. (2013). "Evaluation of remotely sensed snow cover product in Central Asia". *Hydrology Research*, 44, 506-522.

Gaidos, E. J., Gudel, M. & Blake, G. A. (2000). "The faint young Sun paradox: An observational test of an alternative solar model". *Geophysical Research Letters*, 27, 501-503.

Gleick, P.H. (1993). "Water in crisis, a guide to the world's freshwater resources". New York and Oxford: Oxford University Press.

Gleditsch, N.P. (ed.) (1997). "Conflict and the Environment". Dordrecht: Kluwer Academic

Gopalakrishnan, C., Levy, J., Li, K. W. & Hipel, K. W. (2005). "Water allocation among multiple stakeholders: Conflict analysis of the Waiahole water project, Hawaii". *International Journal of Water Resources Development*, 21, 283-295.

Gunchinmaa, T. & Yakubov, M. (2010). "Institutions and transition: does a better institutional environment make water users associations more effective in Central Asia?". *Water Policy*, 12, 165-185.

Froebrich, J., Bauer, M., Olsson, O., Normatov, I. & Petrov, G. (2006). "Improved dam operation in the Amu Darya Basin including transboundary aspects. In *Dams and Reservoirs, Societies and Environment in the 21st Century*". Berga, L., Buil, J. M., Bofill, E., De Cea, J. C., Garcia Perez, J. A., Manueco, G., Polimon, J., Soriano, A. & Yague, J. (eds). Taylor & Francis Group, London, pp. 97–103.

Jackson, M. O. (2008). *Social and Economic Networks*. Princeton University Press. New Jersey.

Jacobs, J. W. (1999). "Comparing river basin development experiences in the Mississippi and the Mekong". *Water International*, 24, 196-203.

Jacobson, M. Z. (2009). "Review of solutions to global warming, air pollution, and energy security". *Energy & Environmental Science*, 2, 148-173.

Jalilov, S. M., Amer, S. & Ward, F. (2013). "Water, Food, and Energy Security: An Elusive Search for Balance in Central Asia". *Water Resources Management*, 27, 3959-3979.

Johannessen, A. (2003). "Summary and conclusions from the SIWI Seminar for Young Water Professionals - Water and sustainable development - how to ensure development without compromising sustainability?" *Water Science and Technology*, 47, 211-213.

Johnson, K. A., Dana, G., Jordan, N. R., D, K. J., Kapuschinski, A., Olabisi, L. K. S. & Reich, P. B. (2012). "Using Participatory Scenarios to Stimulate Social Learning for Collaborative Sustainable Development". *Ecology and Society*, 17.

Judkins, G. L. & Larson, K. (2010). "The Yuma desalting plant and Cienega de Santa Clara dispute: a case study review of a workgroup process". *Water Policy*, 12, 401-415.

Judkins, G. L., and K. Larson (2010). *Water Policy* 12. "The Yuma desalting plant and Cienega de Santa Clara dispute: a case study review of a workgroup process".

Just, R., and Netanyahu, S. eds. (1998). "Conflict and Co-operation on Trans-Boundary Water Resources". Dordrecht: Kluwer Academic.

Karimov, A., Giordano, M., Mukherji, A., Borisov, V. & Djumanov, J. (2012). "Of transboundary basins, integrated water resources management (IWRM) and second best solutions: the case of groundwater banking in Central Asia". *Water Policy*, 14, 99-111.

Kazbekov, J., Abdullaev, I., Manthrithilake, H., Quresh, A. & Jumaboev, K. (2009). "Evaluating planning and delivery performance of Water User Associations (WUAs) in Osh Province, Kyrgyzstan". *Agricultural Water Management*, 96, 1259-1267.

Kerachian, R. & Karamouz, M. (2007). "A stochastic conflict resolution model for water quality management in reservoir-river systems". *Advances in Water Resources*, 30, 866-882.

Kern, K. & Gawel, E. (2011). "Water Charges for Hydro Power - Legal and Economic Requirements". *Wasserwirtschaft*, 101, 28-31.

Khamidov, M. Kh., Kipshakbayev, N. K., Navruzov, S. and B. Yusupov. (1999). "Assessment of the Current Situation in the Syr Darya Basin Water Resources Use". USAID Environmental Policies and Institutions for Central Asia (EPIC). University of Texas Aral Sea.

Kirsanov, I. (2006). "The fight for water in Central Asia". *The Eurasian Heritage* №12

McKinney, D. C. and Kenshimov, A. K., eds. (2000). "Optimization of the use of water and energy resources in the Syrdarya Basin under current conditions." Technical Rep., Environmental Policies and Institutions for Central Asia (EPIC) Program, U.S. Agency for International Development, Almaty, Kazakhstan.

McKinney, D. C. (2003). "Cooperative management of transboundary water resources in Central Asia." In the tracks of Tamerlane—Central Asia's path into the 21st century, D. Burghart and T. Sabonis-Helf, eds., National Defense University, Washington, DC, 187–220.

Micklin, Ph. (2007). "The Aral Sea Disaster". *Annual Review of Earth and Planetary Sciences*. Vol. 35: 47-72.

Muzalevsky, R. (2010). "Shifting Regional Dynamics Force Russia to Suspend Promised Loan to Kyrgyzstan". *Eurasia Daily Monitor* Volume: 7 Issue: 50.

Nandalal, K. D. W., and Hipel, K. W. (2007). "Strategic decision support for resolving conflict over water sharing among countries along the Syr Darya River in the Aral Sea Basin." *J. Water Resour. Plann. Manage.*, 133(4), 289–299.

Norton, M.J. (2001). *Introductory Concepts in Information Science*, New Jersey.

Nurkhanov, D. (2001). "Tajikistan, Kyrgyzstan seek to bolster power generating capacity, break energy dependence". Euroasianet 02/08/2001. Available at: <http://www.eurasianet.org/departments/business/articles/eav080201.shtml>

O'Hara, S. (1997). "Irrigation and land degradation: implications for agriculture in Turkmenistan", *Central Asia Journal of Arid*

Environments, 37(1), 165–179.

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

Olsson O, Gassmann M, Wegerich K, Bauer M., (2010). Identification of the effective water availability from streamflows in the Zerafshan river basin, Central Asia. *Journal of Hydrology* 390(3–4):190–197.

Paul, S. and Charrier, B. (1997). "International Freshwater Conflict: Issues and Prevention Strategies". A Green Cross International publication available at: <http://www.gci.ch/greencrossprograms/waterres/gcwater/study.html>

Poddar, R/, Qureshi, ME, Syme, G. (2009). "Comparing irrigation management reforms in Australia and India—a special reference to participatory irrigation management". *Int J Irrig Drain* 58:1–14.

Porter, A. & Cunningham, S.W. (2005). *Tech Mining. Exploiting New Technologies for Competitive Advantage*. John Wiley & Sons. New Jersey.

Qureshi, ME, Shi, T., Qureshi, SE, Proctor, W. (2009). "Removing the barriers to facilitate efficient water markets in the Murray Darling Basin of Australia". *Agric Water Management*, 96(11):1641–1651

Rogozhina, N., (2014). "Water conflicts in Central Asia and Russia's position", *New Eastern Outlook*

Salen, K., Zimmerman, E. (2004). *Rules of play: Game design fundamentals*. MIT Press, Cambridge, 688 pages

Souza, M., Tatemoto, L. (2009). "Shared waters: from global principles to regional agreements". *WIT Trans Ecol Environ* 124:375–386.

Sharma, R.H., Shakya, N.M., (2006). "Hydrological changes and its impact on water resources of Bagmati watershed, Nepal". *Journal of Hydrology* 327, 315–322.

Smith, D.R. (1995). "Environmental Security and Shared Water Resources in Post-Soviet Central Asia". *Post-Soviet Geography and Economics*, 36(6): 351-370.

Song, M., Heo, G.E. & Lee, D. (2014) Identifying the landscape of Alzheimer's disease research with network and content analysis. *Scientometrics*, in press.

Teasley, R. and McKinney, D. M. (2011). "Calculating the Benefits of Transboundary River Basin Cooperation: Syr Darya Basin", *American Society of Civil Engineers*.

Toryanikova, R.V. and Kenshimov, A.K. (1999). "Current Status of Water Quality in the Syr Darya River Basin". USAID EPIC report. University of Texas Aral Sea Studies.

Vinogradov, S. (1996). "Transboundary Water Resources in the Former Soviet Union: Between Conflict and Co-operation". *Natural Resources Journal* 36 (2): 393-415.

Wegerich, K. (2007). "A critical review of the concept of equity to support water allocation at various scales in the Amu Darya basin. Irrigation and drainage systems". 21, 185–195.

Wegerich, K., Olsson, O. & Froebrich, J. (2007). "Reliving the past in a changed environment: hydropower ambitions, opportunities and constraints in Tajikistan". *Energy Policy*, 35(7), 3815–3825.

Weinthal, E. (2001). "Sins of omission: constructing negotiating sets in the Aral Sea Basin". *Journal of Environment & Development*, 10(1), 50–79.

Weinthal, E. (2002). "State making and environmental cooperation: Linking domestic and international politics in Central Asia." MIT Press, Cambridge, MA.

Wolf Aaron T. 1998. Conflict and Co-operation Along International Waterways. *Water Policy*, 1(2): 251-265.

Wolf Aaron T. 2001. Transboundary Waters: Sharing Benefits, Lessons Learned. Thematic Background Paper, International Conference on Freshwater, Bonn, available at: http://www.water-2001.de/co_doc/transboundary_waters.pdf

Wolf Aaron T., Yoffe Shira B. and Mark Giordano (2003). "International waters: identifying basins at risk". *Water Policy*, 5: 29-60.

Yakubov, M., Matyakubov, B., Abdullaev., I. (2004). "Report on survey of water users along pilot canals of IWRM FV project". IWMI-Central Asia sub-office. Tashkent.

Yakubov, M., (2007). "Mainstreaming Rural Poor in Water Resources Management: Preliminary Lessons of a bottomup WUA Development Approach

in Central Asia". In *Journal of Irrigation and Drainage*, vol. 56: pp. 261–276,
John Wiley & Sons, UK.