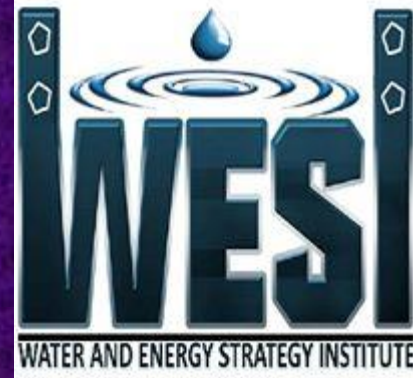


**Kurdistan Region Government – Iraq
Water and Energy Strategic Institute**



Game theory and Decision Support System Graph Model for Conflict Resolution “GMCR II” applications to Water Resources Conflict

Ramadhan Hamza Mohammed

(IWRM M.Sc)

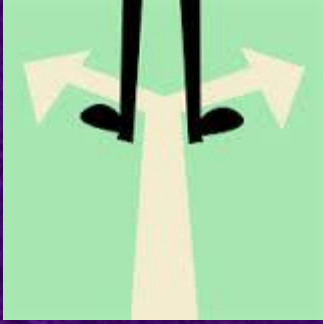
Water Strategies and Policies Senior Expert

2017

Aim of this Application



- The aim of this application is to examine in depth the potential conflicts over the transboundary rivers and how to model, analysis this conflict using the Graph Model for Conflict Resolution, GMCR II, applications, among the two countries Iraq and Turkey, for understanding the potential conflict, in addition to investigate the best solution for bilateral and tripartite negotiations that still is in progress.



Problem and Justification



The conflict investigations presented in this research study contain insights such as the followings:-

- First, unilateral development of water resources without the coordination and cooperation of other countries sharing the same water recourse may create conflict.
- Second, if one riparian country holds the geographical and military power, equitable agreements are difficult to achieve. For example, Turkey is upstream and most of the water originates in its territory. Moreover, it is the most advanced military power in region, giving it the upper hand in negotiations.
- Evolving conflicts can serve as a basis for methodology development. In addition, a more in-depth analysis may be carried out by mixing various approaches to conflict analysis.

Methodology



- The methodology of this study is based on the concept of transboundary rivers basins offered by studying the water policy in Iraq and the neighbouring countries (Turkey) from aspects of Water planning, Hydro politics, Water management as a sound foundation for transboundary river conflict research. For the purposes of this study, the Great Zab river basin is examined. Taking the basin as a unit of research, the proposed study offers the modelling and analysis of the potential conflict among Iraq and Turkey. Analysis of the potential conflict related variables options focuses on finding real world through various options of potential conflict, by exploring the following:
 - Context analysis (Data collection from related authorities and agencies maps, Images, laws and legislation),
 - Survey
 - Consulate with related government institutions.
 - Application of Graph Model for conflict Resolution GMCR II, software's programs to resolve the potential conflict over the Zab River basin, along with bankruptcy rules for fair water allocation.
 - Using tools such as (GIS software -ArcGIS10.2), Global Mapper, GPS, techniques.

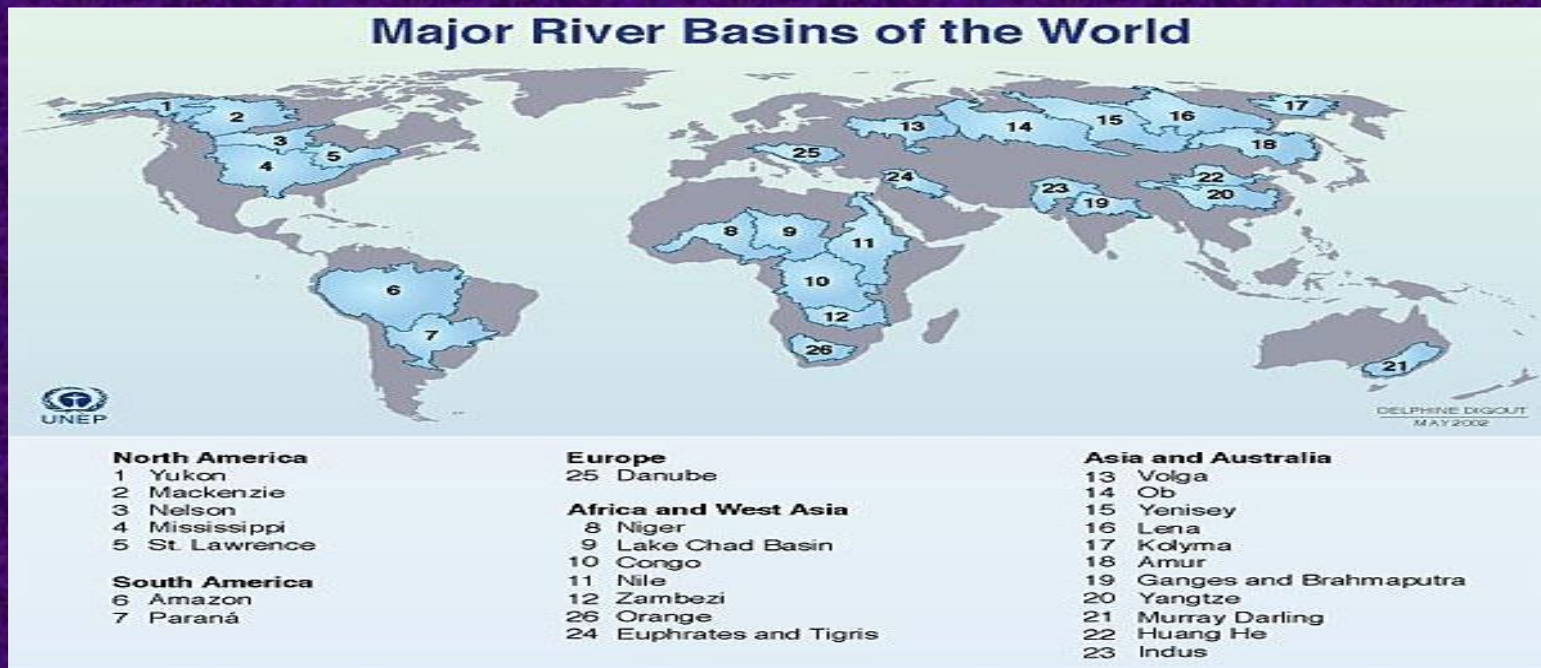
Contribution to Knowledge (Fundamental Insights)



- The study attempts to provide comprehensive and thorough analysis of the present situation, along with to facilitate predictions of conflict evolution, resolutions that predictions of conflict evolution and resolutions that might result in the future.
- Iraq has earlier been opposed to the conception of the Twin Rivers forming a single watercourse, and it is not clear whether any plan for future cooperation will examine the two rivers, jointly or separately. A third party intervention can play vital role in conflicts

International Transboundary Waters

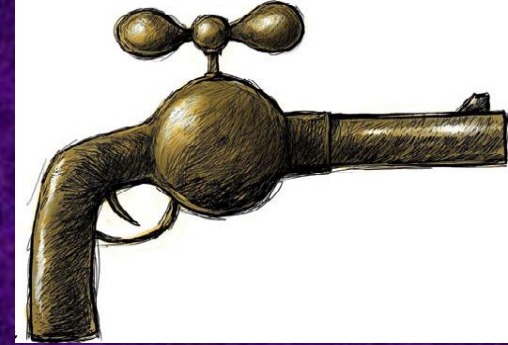
- Extent: 260 “river” basins shared by 2+ nations
- Culture: river/society, pride, sovereignty
- Jurisdiction: no entity unless negotiated
- Politics: ‘anarchy’ of international relations
- Principles: UN Convention foundation
- Tensions: longstanding, always, growing with demand, ‘water wars’.



Great Zab Basin



‘New Strategy of Conflict Applying DSS interactive computer-based systems ’



“Possible flashpoint for resource conflict”

“Water systems & aquifers

- Jordan
- Nile
- **Tigris – Euphrates**
- Amu Darya
- Indus
- Mountain Aquifer (W. Bank/Israel)”

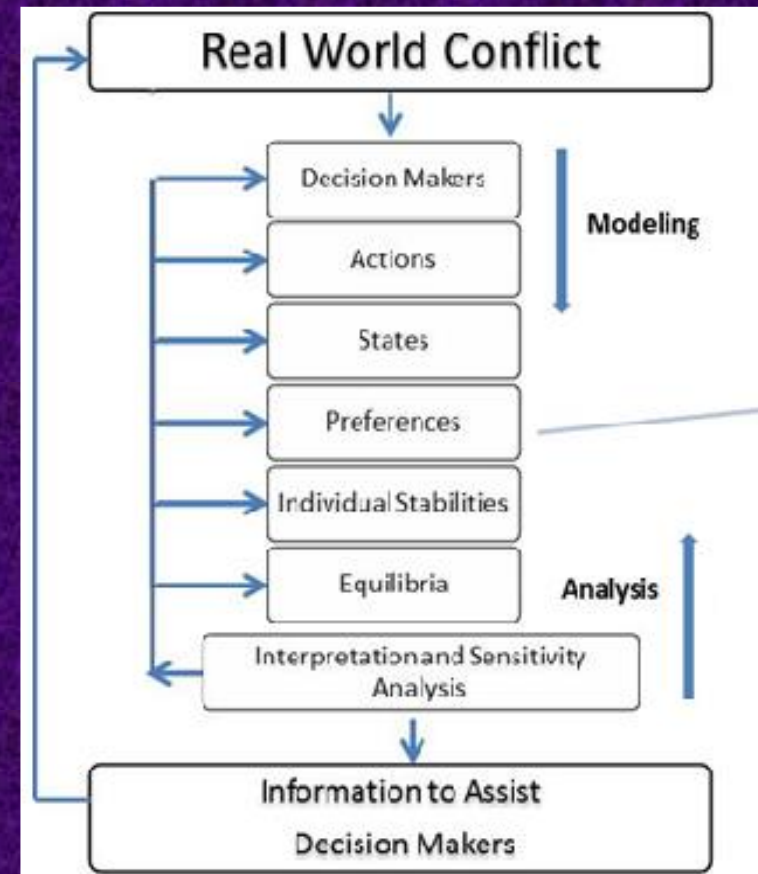
Game Theory and Nature of Conflicts over Water Resources-GMCR II Applications

- Game theory is the mathematical analysis of situations of conflict and cooperation, among players make decisions strategically when the costs and benefits of each decision depend on the decisions of other players.
- Conflict is a natural disagreement resulting from individuals or groups differing in attitudes, beliefs, values, or needs. Conflicts in water management often involve interactions between various factors, water subsectors, and stakeholders in the water resources management process. Conflicts resulting from water sharing problems may jeopardize the economic and social order both within and between countries

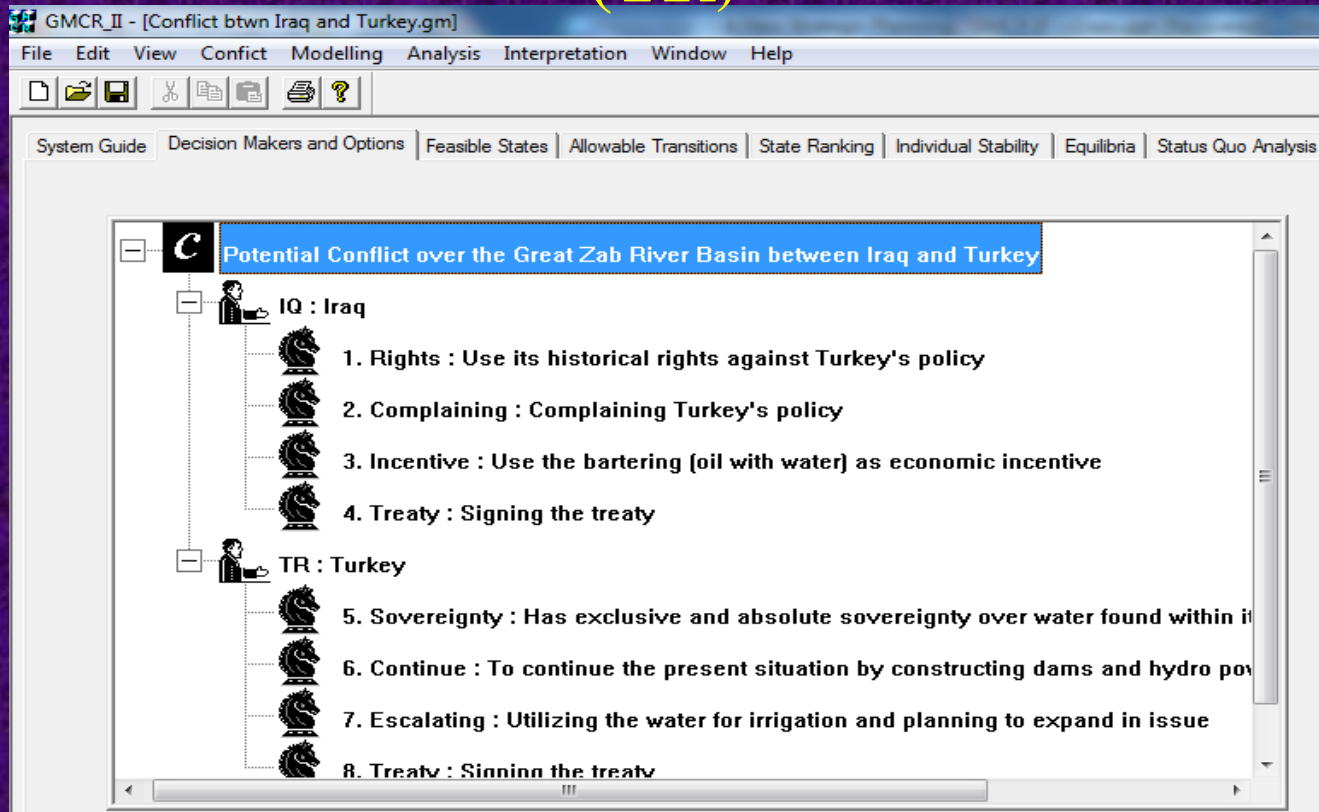
Theoretical Foundation of the Decision Support System

Graph Model for Conflict Resolution - GMCR II

- GMCR Definition
- GMCR Capabilities
- GMCR II Structure
- GMCR Modelling
- Systematic Procedure for Applying GMCR II

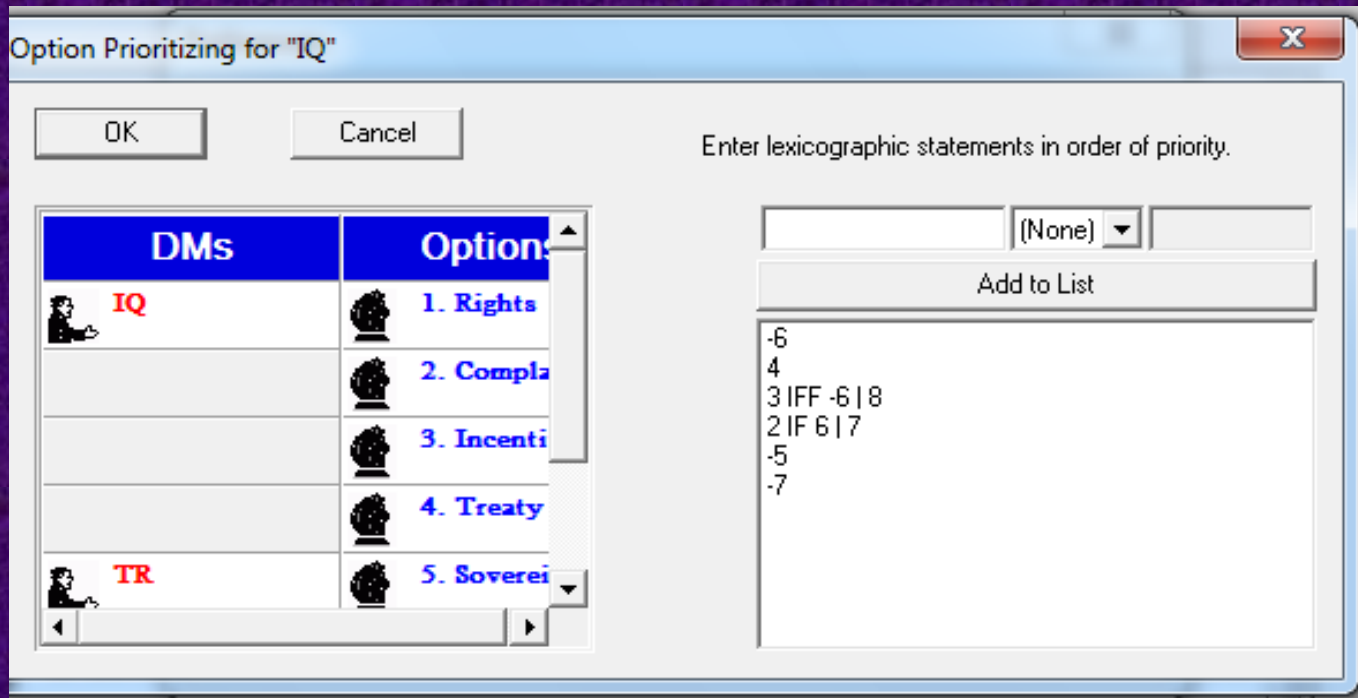


Great Zab River Basin options for Iraq (IQ) and Turkey (TR)



Decision-Maker (DM)	Strategies (Options)	Short
Iraq (IQ)	1. Use its historical rights against Turkey's policy.	Rights
	2. Complaining Turkey's policy.	Complaining
	3. Use the bartering (oil with water) as economic incentive.	Incentive
	4. Signing the treaty.	Treaty
Turkey (TR)	5. Has exclusive and absolute sovereignty over waters found within its territory.	Sovereignty
	6. To continue the present situation by constructing dams and hydro powers on the Greater Zab river.	Continue
	7. Utilizing the water for irrigation and planning to expand in issue.	Escalating
	8. Signing the treaty.	Treaty

Relative preferences of the two decision makers participated in Great Zab River basin, (Non- cooperative case)



Iraq	Preferences	Remarks
	-6	Iraq most prefers that Turkey does not continue the present situation by constructing dams and hydro powers.
	4	Iraq prefers signing a treaty with Turkey.
	3 iff -6/8	Iraq prefers employing economic incentive if and only if Turkey not continues the present situation by constructing dams and hydro powers and signing a treaty with Iraq.
	2 if 6/7	Iraq complains if Turkey continues the present situation and escalating it
	-5	Iraq does not prefer Turkey use exclusive and absolute sovereignty over transboundary rivers found within its territory.
	-7	Iraq prefers Turkey not escalating the situation.
Turkey	6	Turkey most prefers to continue the present situation by constructing dams and hydro powers on the Great Zab River.
	3	Turkey prefers Iraq employing bartering (oil with water) as economic incentive. (Incentive)
	-2	Turkey does not prefer Iraq to make complaints
	-1	Turkey does not prefer Iraq use its historical rights
	8 if -2/3	Turkey prefers signing treaty if Iraq does not complain and employing economic incentive
	5	Turkey prefer to have exclusive and absolute sovereignty over waters found within its territory

Stability analysis for non-cooperative behaving

States	11	12	13	18	19	33	34	35	47	50	58
R			√		√			√		√	√
GMR	√	√	√	√	√	√	√	√	√	√	√
SMR			√		√			√	√	√	√
SEQ			√		√			√	√	√	√
NM									√		
L2									√	√	√

Results –Discussions- Conclusions and Recommendations



1. GRMR II Applications

- The GMCR was applied to the potential conflict over the use of the Great Zab River water resources sharing and development. Stability results obtained indicate that there are eleven Equilibria states, six states (s13, s19, s35, s47, s50, and s58,) are ideal Equilibria for the Zab potential conflict because they are stable for both DMs, and the four basic solution concepts, R, GMR, SMR, SEQ, and the outcome results suggested that:
 - 1) Stability of the possible outcome is very sensitive to Turkey's preferences, and not very sensitive to Iraq's preferences;
 - 2) The status-quo is not stable; and
 - 3) Any unstable outcome includes prejudice by Iraq.
 - 4) Turkey's orientation towards absolute sovereignty was one of the salient features of the results and outputs of the Model.

Recommendations for future works

- A Regional Strategy for the utilization of shared water and aquifers is highly recommended as a win-win situation between riparian countries. Such strategy should include a regional monitoring network.
- Leveraging on data-sharing, research-sharing and joint project to build trust between countries sharing river basins, using the modern technology applications, for modelling, analysing, managing water resources in different sectors.
- It is necessary to take stock of past experiences in shared water governance on the global, regional, and local scales and review laws, regulations, community-based actions, and institutional structures.
- Enforcement of legislations, especially water quality protection regulations, should be given high attention.

Thank you