

*Numerical indexing method of risks  
of conflicts around the  
transboundary water resources*

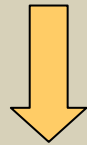
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# Risk of Conflict is defined by an INDEX

Indicators of risk having weights proportional to their relative importance

Combination

Rates which traduce local conditions of these Indicators



A partial index of risk (multiplication of weight by rate)



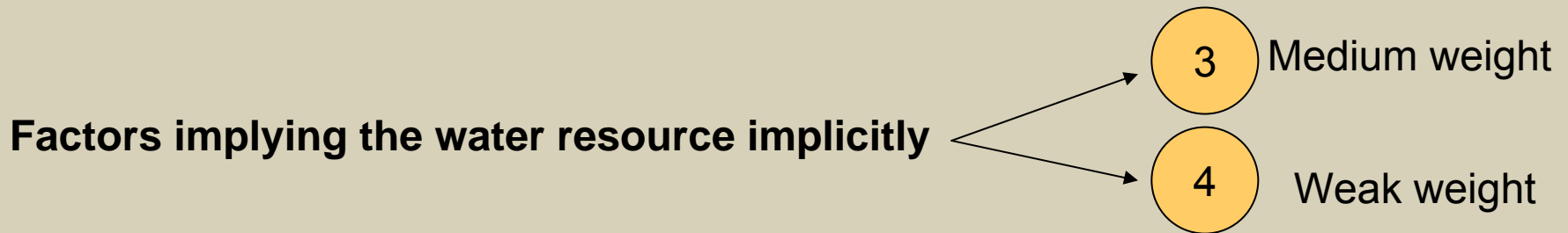
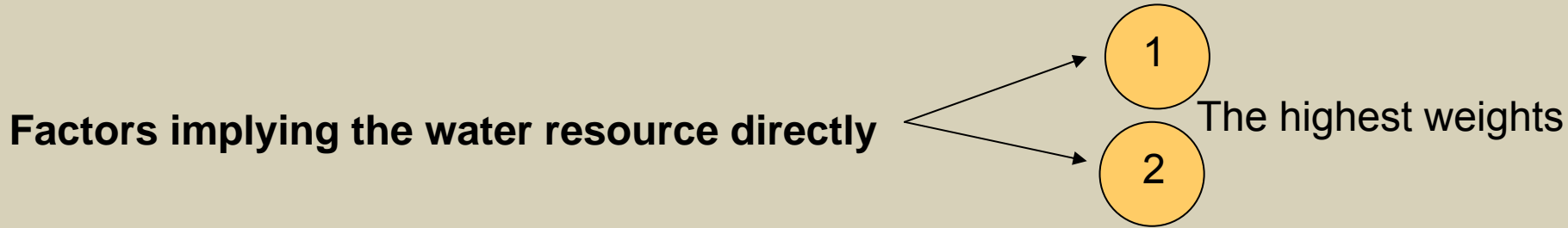
The sum of these partial indices gives the global index of risk of conflict for a given region.

## Risk Indicators and their respective weights

- Degree of dependence to the transboundary water resources → 5
- Satisfaction degree of the water needs → 4
- Geopolitical context of the zone of conflict → 3
- Geographical position in relation to the water resources → 2
- Water governance by parties in conflict → 2

The **various factors**, which in certain situations can be redundant, are evaluated separately and in an independent way because it is question of evaluating **their intrinsic influences**

**Relative weights assigned to proposed indicators can lead to discussion however the following remarks guided this choice:**



The water governance is of local influence initially, but can act in a favourable and implicit way on the transboundary water resources. This factor is directly influenced by the development level of a country.



## Rating intervals of the indicators of risk

According to the local conditions  
the indicators of risk take values varying between 1 and 10

The highest dimensions indicate a high risk of tension and conversely

Ratings must be established for each country  
concerned by the transboundary water resources

$$(IPR = I_{iw} \cdot I_{ic})$$

IPR: partial index of risk

$I_{iw}$ : indicator fixed weight

$I_{ic}$ : indicator rate (variable) reached in the studied case

# Ratings intervals of the dependence degree to the transboundary water resources

## Variation intervals

## Cotes

### Total dependence

10

Partial dependence with difficulties of satisfaction of the needs by other resources (natural and technical difficulties)

8

Partial with possibilities of supplying by other resources but with a high capital cost

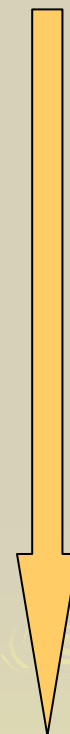
6

Partial with possibilities of supplying by other resources with an advantageous capital cost

3

Partial to weak with an effective supply by other resources

2

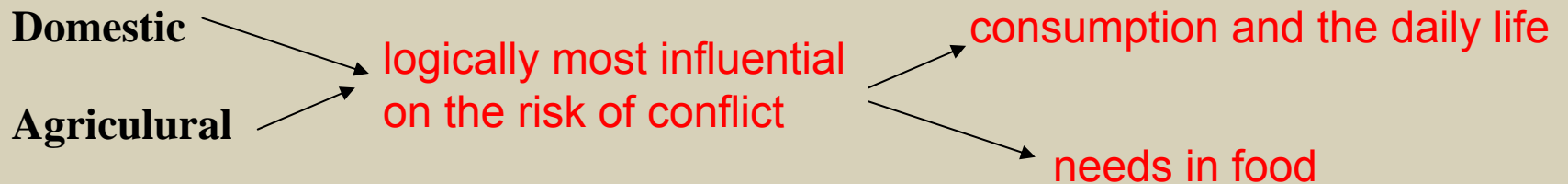


Partial index of minimum risk (PIR min) = fixed weight. Minimum rate =  $5 \cdot 2 = 10$

Partial index of maximum risk (PIR max) = fixed weight. Maximum Rate =  $5 \cdot 10 = 50$

# The needs satisfaction degree

Rating of the variation intervals of this indicator rests on the evaluation of the satisfaction degree of the needs of the concerned countries in **the traditional categories of uses:**



**Industrial** → It can in certain situations involve **a fast reaction**, for example in the case of the **lack of water for a hydroelectric station**, all the more if the problem is posed in **a frontier context**

**The diversity of the situations**



**same weight to these sub indicators : i.e. 4**



The partial index for this indicator =  $\sum I_p$  relating to the three uses / 3

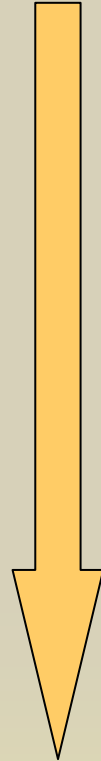
However, in regions where industry is almost non-existent (poor countries), the weight of this factor is removed. The partial index is then obtained by dividing by 2 the indices relating to the two uses (agricultural and domestic).

**The standards of international institutions (WHO, FAO, UNO....) and the results of research works were taken into account in the development of the ratings intervals of the various uses.**



## Ratings intervals of the domestic use (l/p/d)

$< 50$	<b>10</b>
$50 < x < 100$	<b>8</b>
$100 < x < 200$	<b>6</b>
$200 < x < 300$	<b>5</b>
$300 < x < 400$	<b>4</b>
$400 < x < 500$	<b>2</b>
$x > 500$	<b>1</b>



**Partial index of minimum risk (PIR min) = 4. 1 = 4**

**Partial index of maximum risk (PIR max) = 4. 10 = 40**

**Ratings intervals of the agricultural use are expressed  
as a percentage of surface to irrigate**

**Ratings intervals of the satisfaction degree of the industrial  
needs are expressed in percentage of the needs**

**Partial index relating to the 3 uses :**

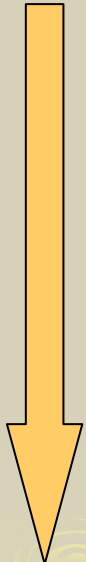
**Partial index of minimum risk (PIR min) = (3.4)/3 = 4**

**Partial index of maximum risk (PIR max) = (3.40)/3 = 40**

# Geopolitical context of the conflict zone

## Rating intervals

Variation intervals	Cotes
Zone of war	10
Zone of diplomatic tension	8
Zone of ethnic tension	6
Normal relations between states	4
Zone related to a community space (ex European Community)	1



**Partial index of minimum risk (PIRmin) = 3**

**Partial Index of maximum risk (PIRmax) = 30**

## The geographic position of the belligerent countries

*For example, a country which is located in the upstream part of a river benefits better from this situation, either by its natural position or by a provoked way.*

### Variation intervals

### Rate

Existence of a provoked dominant position

(Occupation by force, polluted water discharges, water derivations,...)

7

Existence of a natural dominant position

3



This concept is not exhaustive to rivers but also relates to groundwater and it integrates in an implicit way the environmental aspect.

**Partial index of minimum risk (PIR min) = 6**

**Partial index of maximum risk (PIR max) = 14**

## **The water governance by parties in conflict**

**The rating intervals proposed here, rest on factors which are inspired, among others, by the criteria of effective water governance proposed by the IWRM Toolbox of the GWP (2001)**

**Which gather tools at the same time for diagnosis and for assistance to an effective Governance which is based on cases studied throughout the world.**

**For this indicator the mode of calculation suggested is to decrease the dimension attributed to each factor when this one exists**

# Ratings intervals of the water governance

## Variation intervals

Cotes

- Coherence and efficiency in the water resource management, transparency in the attribution of markets, equity,...by water resources agencies (public in general) and their directions (Ministries) **1.5**
- Criteria which are linked to the knowledge degree of the resources: databases updated. Identified and modelled water reserves... **1.5**
- Planning concerted with the users within agencies of basins for example, communication with the users... **1.5**
- Benefit of international programmes of support (the World Bank, UNESCO, the IMF, FAO...) for projects tied to infrastructure, formation, protection of the environment... **1.5**
- Existence of structures which treat the regulation aspect of territorial or use conflicts and the respect of the ethics of the use of water (dialogue and cooperation) **1.5**
- Consented efforts in the exploitation of alternative resources and respect of the environment in a perspective of a sustainable development. **1.5**

**The weakest dimension for this indicator is obtained as follows:**

$$[10 - 6(1.5)] = 1$$

**Indeed, each time that one of the conditions of good governance is filled, the risk decreases obviously, until reaching the minimum dimension which is equal to 1, because the optimum governance in the field of water is never reached**

**Partial index of minimum risk (PIR min) = 2**

**Partial index of maximum risk (PIR max) = 18**

## GIR : Global Index of Risk of Conflict around Transboundary Water Resources

It is the sum of the partial indexes:

➤  $GIR = \sum PIR = \sum I_{iw} * I_{ic}$

- According to this procedure, the global index of minimum risk of conflict is 25, whereas the maximum index is 160.



# Example of the transboundary water resources of the Jordan river basin



The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

population  $\approx$  7 millions

$\approx$  1.4 Millions

Israël
Total dependence Evolve to partial dependence (desalination : 500-750 millions $m^3/y$ next years $C = 10$ --- $C = 6$ <b><math>I_p = 50</math></b> ----- $I_p = 30$

Ghaza
Total dependence $C = 10$ <b><math>I_p = 50</math></b>

$\approx$  20 millions

<i>Indicators of conflict</i>
<i>1 - Dependence Degree to the transboundary water resources (<math>W = 5</math>)</i>

Syria
Partial with possibilities of supplying by other resources (dependence=70 % Euphrate, Oronte) $C = 6$ <b><math>I_p = 30</math></b>

$\approx$  6 Millions

Jordan
Total dependence $C = 10$ <b><math>I_p = 50</math></b>

The West Bank
Total dependence $C = 10$ <b><math>I_p = 50</math></b>

$\approx$  2.4 millions

Lebanon
Partial to weak $C = 2$ <b><math>I_p = 10</math></b>

$\approx$  4 millions

## Israël

Domestic:  $200 < x < 300$  l/p/d C  
= 5 Ip = 20

Agriculture: 50 % of the arable  
lands are irrigated:

C = 6 Ip = 24

Industry: > 90 % satisfied

C = 1 Ip = 4

**Total Ip =  $48/3 = 16$**

## Ghaza

Total < 50 l/p/d

C = 10

Ip = 40

Total Ip = 40

## Syria

Domestic : > 500 l/p/:  
(Theoretical surplus)

C = 1 Ip = 4

Agriculture : 16% of the  
arable lands are irrigated :

C=10 Ip=40

Industry : 80<x<90 %  
satisfied

C = 3 Ip = 12

**Total Ip =  $56/3 = 19$**

**2 - Satisfaction  
Degree of the  
needs (W=4)**

## Jordan

Domestique:  $50 < x < 100$  l/p/d  
C = 8 Ip = 32

Agriculture : 20<x< 40% of  
the arable lands are irrigated :

C = 8 Ip = 32

Industry : few developed  
except the tertiary sector  
(tourism)

**Total Ip =  $64/2 = 32$**

## West Bank

Domestic

$50 < x < 100$  l/p/d

C = 8 Ip = 32

Agriculture: 6% of the  
arable lands are irrigated:

C = 10 Ip = 40

Industry: unimportant

**Total Ip:  $72/2 = 36$**

## Lebanon

Domestic : > 500 l/p/:  
(Theoretical surplus)

C = 1 Ip = 4

Agriculture: 30% of the arable  
lands are irrigated: C=8 Ip=32

Industry : few developed

**Total Ip =  $36/2 = 18$**

## Israël

Zone of armed  
conflict and  
diplomatic  
tension:

$$C = 10$$

$$Ip = 30$$

## Ghaza

Zone of armed  
conflict

$$C = 10$$

$$Ip = 30$$

## Syria

Zone of  
diplomatic  
tension:

$$C = 8$$

$$Ip = 24$$

## Jordan

Zone of  
diplomatic  
tension:

$$C = 8$$

$$Ip = 24$$

*3 – Geopolitical  
Context:*

$$(W=3)$$

## West Bank

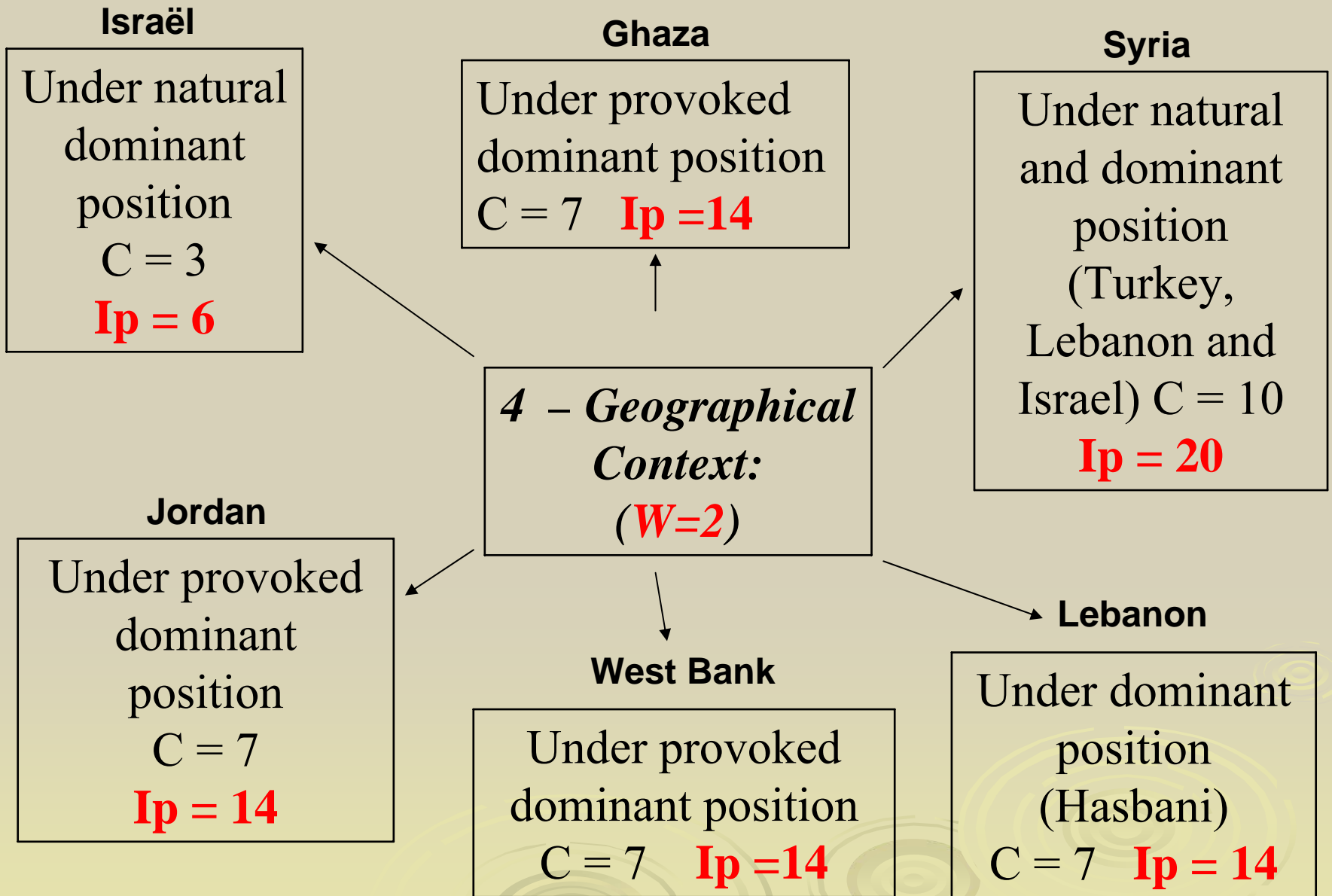
Zone of armed  
conflict or  
diplomatic tension

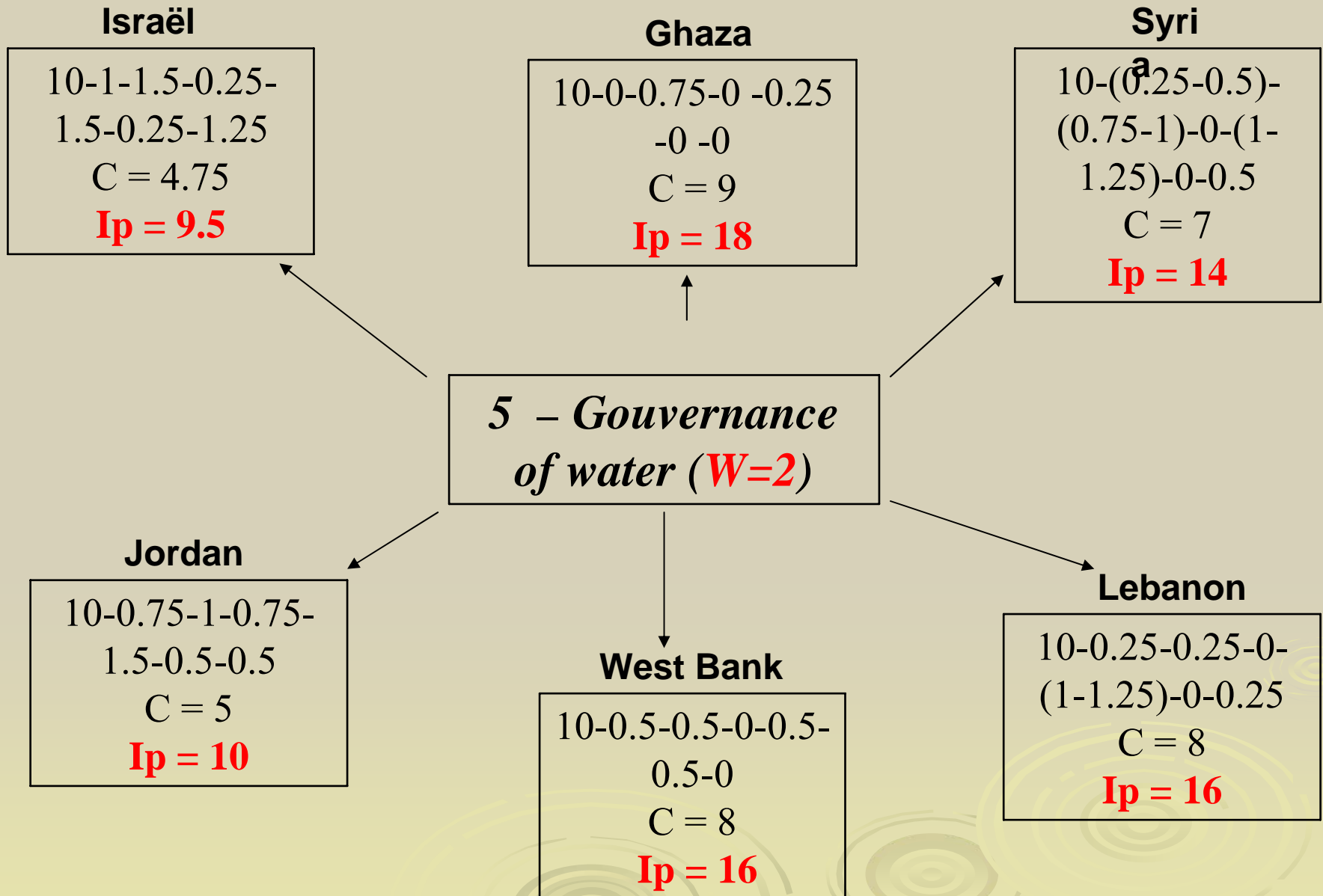
$$C = 8-10 (9) \quad Ip = 27$$

## Lebanon

Zone of armed  
conflict or diplomatic  
tension

$$C=8-10 (9) \quad Ip=27$$





## 2 difficulties:

- One relating to the data concerning the satisfaction of the water needs, with **confusions and differences between real, theoretical availability and real consumption**. In this case, the approach must be very critical and thorough.
- The other relating to the **lacks of data** concerning the state of the **water governance** in certain cases, which it was necessary to approach by estimation.

**GIR min = 25**  
**GIR max = 160**

**Ghaza**

**152**

**Lebanon**

**85**

**West Bank**

**143**

**Syria**

**107**

**Jordan**

**130**

***GIR***

**Israël**

**112 ----(92)**

For Israel, this index can evolve to 92 next years if the projects relating to Desalination of sea water are carried out. Those relate to a supplement varying between 500 and 750 million m<sup>3</sup>/y.



## Conclusion

- **The combination between weights and rates lead to the numerical expression of the risk of conflict around the transboundary water resources. This weighted method applied in the same way to all concerned parties decreases the risk of error on the final result.**
- **If the definition of certain ratings intervals can lead to discussion, the relative order of classification seems correct and the global index of risk of conflict around the transboundary water resources allows a classification of the zones relating to this risk and their cartography.**

**First application  
on a concret case**



**Correct estimation  
of the real situation**

- The databases of various organizations working in fields which are on relation with this context facilitate the acquisition of the majority of the data necessary for calculation of the various indices. These indices can be updated like the databases making it possible to follow the evolution of the global index of risk.
- It is obvious that this approach can not be applied, at least with difficulty, to all situations because conditions are much diversified, but it allows an approach of the most common situations.

**Thank you**

## This approach allows :



**Standardized qualification of the risk of conflict** around the transboundary water resources;



**Fast comparison** between different regions of the world exposed at this risk;



**Cartography** of the zones at risk.

**The dependence degree of a country to the transboundary water resources for the satisfaction of its various needs is a **decisive factor** of conflict even if the other indicators have rates of weak risk, i.e. :**



*If criteria's of effective governance exist*

*If it has normal relations with the concerned countries*

*If geostrategic problems do not arise*

**The transboundary water resources are perceived like a vital energy resource on which one has a right of ownership and about which one does not make any concession.**

## Satisfaction degree of the water needs

Rating of the variation intervals of this indicator rests on the evaluation of the satisfaction degree of the needs of the concerned countries in **the traditional categories of uses:**

The domestic and agricultural uses seem to be logically most influential on the risk of conflict because the first affects directly the consumption and the daily life of the population while the second affects its needs in food;

The non satisfaction of the industrial needs, whose effects on the populations are later and indirect can involve a faster intervention of the governmental authority. The lack of water for a hydroelectric station for example is a very alarming situation for a state and if the problem is posed in a transboundary context, it unquestionably constitutes a source of conflict.

**The diversity of the situations which can occur make that it is preferable to initially assign the same sub weight to the impact of each one of these uses, i.e. 4.**

The partial index for this indicator (the degree of satisfaction of the different uses) is obtained by dividing by 3 the sum of the indices relating to the three uses.

Nevertheless, in regions where industry is almost non-existent (poor countries), the weight of this factor is removed). The partial index is then obtained by dividing by 2 the indices relating to the two uses (agricultural and domestic).

The standards and the results of research of international institutions (WHO, FAO, UNO....) were taken into account in the development of the ratings intervals of the various uses.