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SUSTAINABILITY AND INSTITUTIONAL WATER RESOURCE REGIME IN THE GAZA STRIP

Z.K. Zoarob¹ and J.T.A. Bressers²

¹ Environment Quality Authority, Gaza, Palestine, zsoarob@gov.ps

² CSTM, University of Twente, Enschede, The Netherlands, j.t.a.bressers@utwente.nl

Abstract

The main source of water in the Gaza Strip is the groundwater where its quality and quantity are extremely deteriorated. Municipal water is managed by 25 municipalities. Agricultural water is managed by the Ministry of Agriculture. The Palestinian Water Authority is responsible of developing water policies and strategies. Water as an environmental resource is evaluated by the Palestinian Environment Quality Authority. A case study was carried out on the current situation of the institutional regime of water resources management in the Gaza Strip. The relation between the regime and sustainability was assessed via standard institutional indicators.

The study showed that the extent of the present institutional regime doesn't include all significant users. The internal coherence of governance elements is strong in many aspects. The coherence between problem perception and objectives is high. On the other hand the coherence between designated responsibilities of water departments and their available resources is relatively low. The impact of the institutional regime on the sustainability of water resource use is highly significant, especially the internal coherence of governance, the coherence between governance and property rights of the regime, and the extent of the regime.

Keywords: Integrated institutional water resource regime, Public governance, Sustainability, water management, Gaza, Palestine.

1 Introduction

The main source of water in the Gaza Strip is the shallow aquifer. The quality of the groundwater is extremely deteriorated in terms of salinity and nitrates. In addition there is over-pumping of more than twice of the safe yield, and consequently this leads to the deterioration of the groundwater qualityⁱ. It is clear that the mismatch between the needs of the population and the capacity of the resource is the main cause for it's deterioration. But even in this case, we hypothesize that the quality of the resource management regime can provide an important contribution. In this paper will emphasize this non-technical side of water management.

Sustainable use of water resource as a natural resource requires an optimum distribution of the use options among present and future users and use functions. The presence of rivalries between users and use functions can be considered as an indicator of insufficiently sustainable use of water resources. The type of water resource management regime has a vital role in achieving the sustainable use of the water resource by diminishing or preventing rivalries between users and use functions. The aim of this work is to evaluate the institutional regime of water resources in the Gaza Strip as well as the relation between the ecological sustainability of water resources and the current status of the institutional regime.

2 Theory and Definitions

Institutions are usually understood as sets of rules that structure the relationship between individuals by determining their range of actions in certain situations. Bressers and Kuks consider the institutions as both a result and an integral component of the political process (Bressers and Kuks, 2003)ⁱⁱ.

Sustainability of water resources can be examined by different types of criteria. For this reason one can distinguish between criteria for ecological sustainability and for institutional sustainability. Ecological sustainability refers to the achievement of a 'good status' for all waters by a set of criteria. It addresses the status of water quality and water quantity in terms of its availability and fitness for present and future demands (uses). Ecological sustainability especially refers to protecting the way in which water resources are needed for the ecosystem or for human health.

Ecological sustainability depends on institutional sustainability and sustainable management as preconditions. The institutional sustainability deals with the interaction between property rights and aspects of public policy and how this interaction could contribute to greater ecological sustainability.

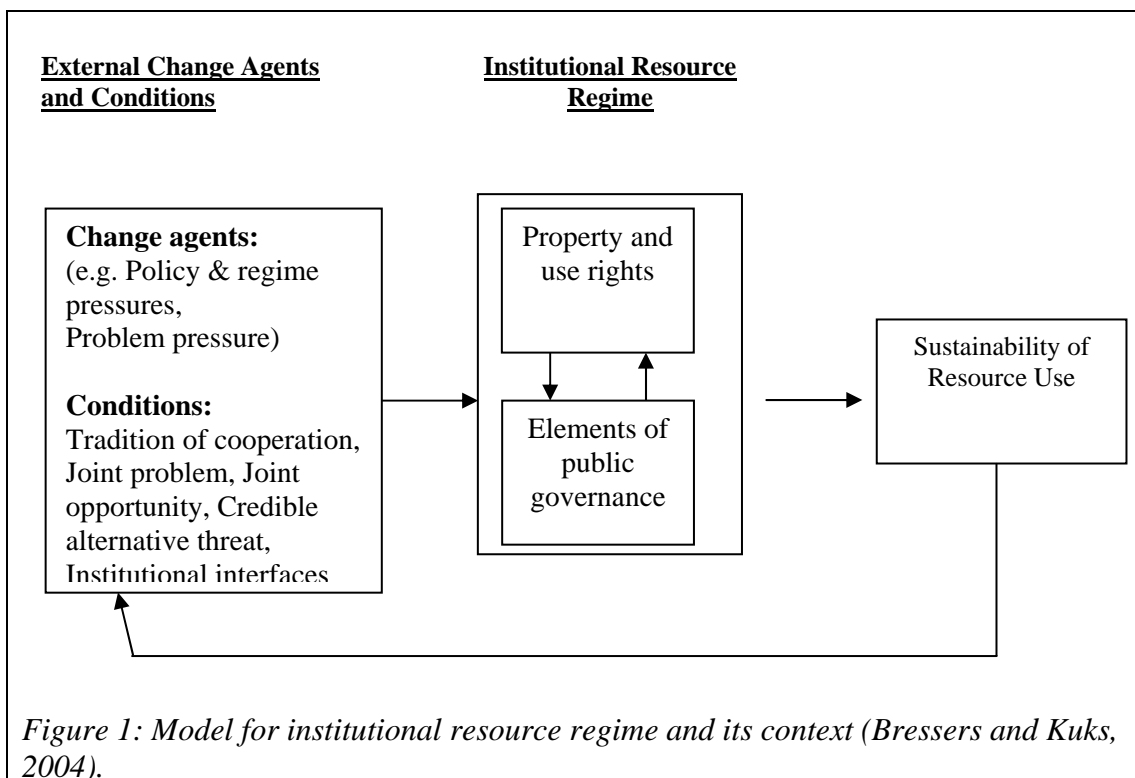
2.1 Institutional Resource Regimes and Sustainability

The relation between institutional resource regime and sustainability of natural resource use has been formulated in a model by Bressers and Kuks (2004)ⁱⁱⁱ. This model was developed from the institutional model by Knoepfel et al. (2001) and applied in the EU six country water management study Euwareness and later in an additional study on Greece (Kampa 2007). The model describes the relation between three groups of variables (see figure 1), which are: a) External change agents and

conditions, b) Institutional resource regimes, and c) Sustainability of water resource use.

The institutional water resource regime includes a public governance component and a property rights component. The combination of those components can be more or less integrated and this influences the sustainability of the use of the water resource. In turn, this regime, or rather its property rights and governance components, is influenced by external change agents that lead to regime change. The model illustrates these dynamics in order to know how far do more integrated water resource regimes lead to more sustainable resource use as well as what change agents and conditions cause shifts towards more integrated regimes.

The water governance model consists of five elements, which are: Levels of governance, Actors in the policy network, Problem perception and objectives, Strategy and instruments, and Responsibilities and resources for implementation. The Property rights arrangements form the second important component of an institutional resource regime. *Property rights* can be defined as social relations that define the titleholder with regard to something of value in relation to all others. These social relations involve benefit streams, rights holders and duty bearers. A *property rights system* could be regarded as a system with communicational vessels of claims and duties, which means a specific behavior to one actor implies a restriction on the behavior of another actor. *The assessment criteria* for the property and use rights are: a) the extent dimension which identifies the how many of the relevant uses and users have been regulated by property and uses rights, and b) the degree of coherence which tells us how well the rights of different users and owners have been coordinated.



2.2 Integration of Institutional regime and Sustainability

Not only the property and use rights, but the whole integration of regimes can be described in terms of extent and coherence. The extent of a regime is the scope of the uses and users that are regulated by one or more of the regime's elements. The coherence is about the degree to which these elements fit together. Simple regimes regulate only one resource use or user. A regime becomes more complex when more uses and scales are involved, more actors are involved, more perceptions of the problem and accompanying goals are involved, more instruments are part of the policy and more organisations share responsibilities for implementation. These changes increase the domain of the regime, which is called the regime's extent. While the growth of complexity in water management regimes seems a fairly straightforward part of a more general development in society, integration as a development is not. The simplicity and complexity of the institutional water resource regime depend on the extent of the elements of governance and property rights. When the extent of the regime is incomplete, implying that important uses and users go unregulated, the creates risks for the sustainability of the water resource.

The degree of integration of the institutional regime depends not only on the extent but also on the coherence of public policies and property rights. Three forms of coherence could be discerned: 1) the internal coherence of the public governance component of the regime, 2) the internal coherence of the property rights component of the regime, and 3) the external coherence between the public governance and property rights components. When the coherence is low the various regulative actions may weaken each other.

The sustainability of water resources can be examined by different types of criteria. These criteria are: the protection of natural resources and environmental quality, the economic development consequences of the ecological situation and the measures taken, and the social development consequences.

2.3 Conclusion

The level of integration of the institutional water resources regime could be assessed via evaluating its indicators (e.g. Extent and Coherence of the regime). Table 1 presents these indicators as well as the indicators of sustainability of the water resource.

Indicator	Code
Regime Assessment	RA
Overall Extent	Ext
Extent of all users	Ext1
Extent of all uses	Ext2
Extent of confine uses and users to sustainable resource use	Ext3
Internal coherence of property rights	IntCPr
Internal coherence of public governance	IntCGv
Internal coherence of levels	IntCGv1
Internal coherence of actors	IntCGv2
Internal coherence of perceptions	IntCGv3
Internal coherence of measures	IntCGv4

Internal coherence of responsibilities & resources	IntCGv5
Internal coherence of all governance elements	IntCGv6
External coherence of pr. & p.g.	ExtC
<i>Sustainability</i>	<i>Sus</i>
Natural resources & environment	Sus1
Economic development consequences	Sus2
Social development consequences	Sus3
General assessment implications	Sus4

3 Data collection and analysis method

The data used in the analysis are compiled from the twenty five municipalities in the Gaza Strip. The data are collected via a questionnaire which contains the indicators of the institutional regime and sustainability of the water resource (see table 1). Questionnaires are completed by interviewing responsible persons in municipalities. Answers are transformed to ordinal value scale (from 1 to 5). The value of (1) means that the indicator status is the most unfavorable value. The value of (5) means that the indicator status is the most favorable value. The decision about the value of each question is given by the municipal person according the situation of the municipality area conditions. Statistical analysis is done using SPSS software.

4 Results and Discussions

In the following sections we will discuss first the status of the integration level of the institutional water resource regime in the Gaza Strip. Secondly the correlations between the integration level of the institutional regime of water resources and the observed sustainability of the water resource will be examined

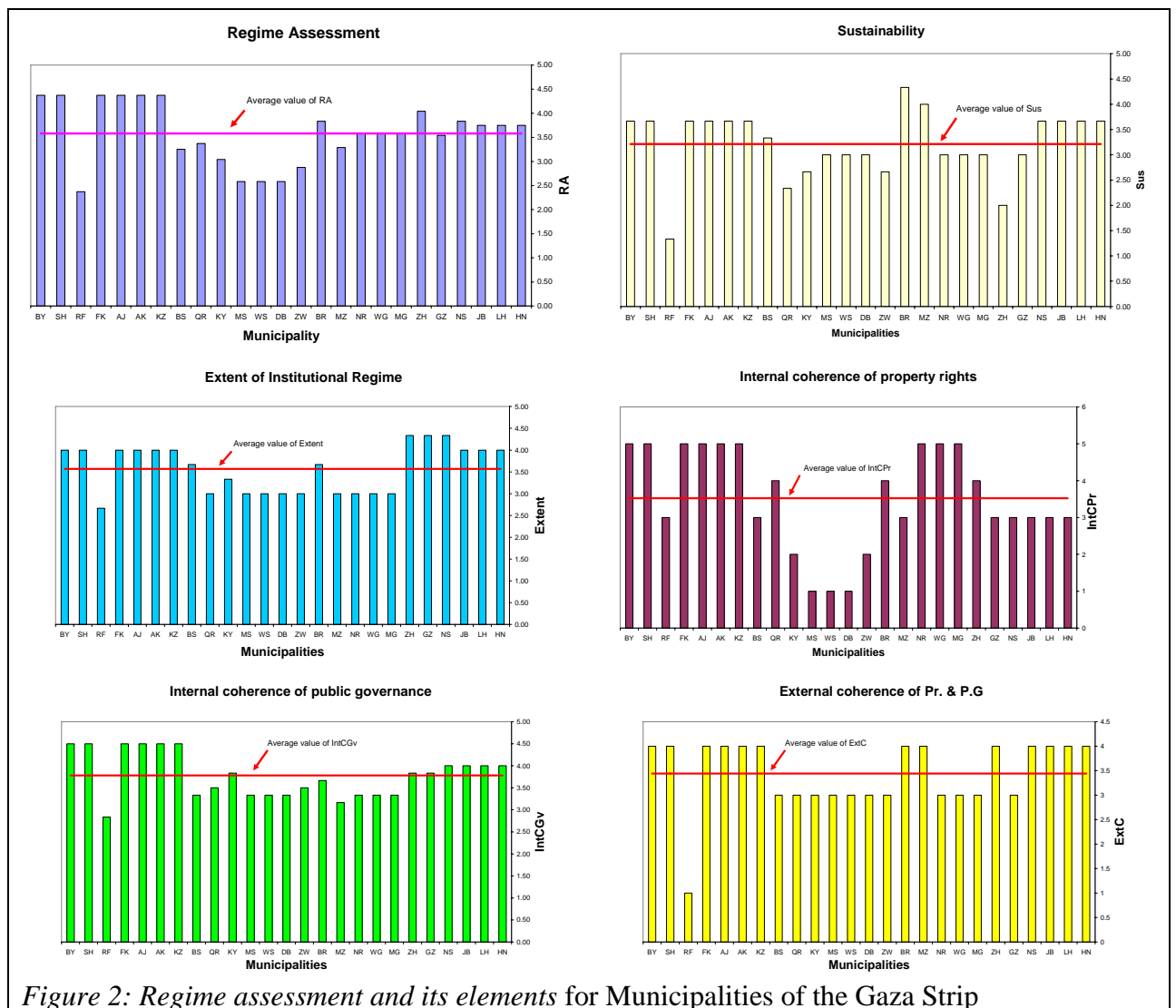
4.1 Assessment of Institutional Regime indicators

The regime assessment (RA) of water resource management for each municipality in the Gaza Strip is determined by calculating the average of its sub-indicator values (e.g. Extent of regime, Internal coherence of property rights, Internal coherence of governance and External coherence of the regime). *The regime assessment* values give an indication for the integration level of the institutional regime of water resource management at local level (e.g. municipalities). The average value of the regime assessment (RA) for all municipalities is 3.58 (see Figure 2). This implies that the integration level of the institutional regime assessment is acceptable in many aspects of integration in many municipalities. The following sections investigate the results of the sub-indicators of regime assessment indicator.

Table 2: Descriptive statistics of Institutional regime Assessments Results

Indicator	Mean	Standard Deviation	Range	Minimum	Maximum
<i>RA</i>	3.58	0.63	2	2.38	4.38
<i>Ext</i>	3.57	0.55	1.67	2.67	4.33
Ext1	3.64	0.57	2	3	5
Ext2	3.44	1.23	4	1	5
Ext3	3.64	0.64	2	2	4
<i>IntCPr</i>	3.52	1.39	4	1	5

IntCGv	3.78	0.51	1.67	2.83	4.5
IntCGv1	3.88	0.88	3	2	5
IntCGv2	4.04	0.73	3	2	5
IntCGv3	4.36	0.64	2	3	5
IntCGv4	3.92	0.4	2	3	5
IntCGv5	3	0.91	2	2	4
IntCGv6	3.48	0.59	2	2	4
ExtC	3.44	0.71	3	1	4
Sus	3.21	0.67	3	1.33	4.33
Sus1	3.00	1.12	3	1	4
Sus2	3.28	0.84	4	1	5
Sus3	3.36	0.81	4	1	5



4.1.1 Evaluation of the Extent of regime

The existing situation of the *Extent* of the water resource regime of municipalities represents the current situation of available institutions that regulate water users and uses in each municipality. The average value of *Extent* of the regime is 3.57 (see Figure 2). This means that the complexity of the regime is medium. *In other words there are still significant users and uses that are not regulated and/or have no input*

or impact on the water management regime. The local community is not represented in the management regime of water resources in all municipalities of the Gaza Strip. The users may have the right to claim for good service of water supply and wastewater disposal but the decisions that relate to water resources management are taken only by the municipality. However many users have illegal wells as a private water resource because of the lack of enough water quantity supplied by municipalities. Though “illegal” and thus formally regulated, it is not regulated in practice since implementation is lacking. So the current institutions need to be modified in order to control these illegal behaviors. *All in all, the entire current institutional regime may need to be modified in terms of number of regulated users and uses in order to enhance the integration level of the institutional regime of water resources in the Gaza Strip.*

4.1.2 Evaluation of the Internal coherence of property rights

The *Internal coherence of property and use rights* structure represents the degree of coherence between the available institutions that regulate the relation between water property and use rights in each municipality. The average value of *Internal coherence of property and use rights* of the regime is 3.52 (see Figure 2). The standard deviation is relatively large. So property and use right institutions that affect the water resources are in several municipalities not viewed as coherent. Even though there are several institutions that regulate the property rights of water resources, some users are not committed to these institutions and regulations. For example some users exploit their own wells without any restriction on the amount of the water abstracted from these wells.

4.1.3 Evaluation of the Internal coherence of Governance

The internal coherence of governance represents internal coherence of each element of governance (e.g. level of governance, actors of governance, problem perception and objectives, measures, and responsibilities and resources for implementation) as well as coherence between these elements. The average value of *Internal coherence of governance* of the regime is 3.78 (see Figure 2). So *Internal coherence of governance* are internally coherent on many of the important aspects. The internal coherence of between problem perception and objectives has the highest value (4.36) which means that the water problem in the Gaza Strip and water strategy objectives are highly coherent. On the other hand the coherence between designated responsibilities of water departments and the available resources for them is relatively low (3.00). This means that many municipalities have deficiency in their resources (e.g. financial), So they could not carry out their responsibilities toward achieving a sustainable water resource management.

4.1.4 Evaluation of the External coherence of Property rights and Public Governance

The External coherence of Property rights and Public Governance is the degree of coherence between governance structure (thesituation of all governance elements) and the situation of property and use rights. The average value of coherence is 3.44 (see Figure 2) which is relatively low, due to many 3's and even one 1. In other words

there are often institutions of property and use rights and governance elements that need to be improved in order to be more coherent with each other.

4.2 Assessment of Sustainability of water resources

The sustainability of water resources in this case study is the average of the following three sustainability indicators: a) Natural resources and environment, b) Economic development consequences, and c) Social development consequences. The mean value of sustainability for the 25 municipalities in the Gaza Strip is 3.21 (see Figure 2). This indicator represents the sustainability level of water resource use. The result indicates sustainability is limited to less than medium positive impact.

The indicator of Natural resources and environment has a low positive level (Sus1=3.00). This result is in agreement with the continuous deterioration of water quality and quantity in the Gaza Strip.

Both indicators of Economic development consequences and Social development consequences have values of less than medium positive level (Sus2=3.28, Sus3=3.36). These results are in agreement with the increase in water related diseases in the Gaza Strip, especially in the areas of low water quality. The relations between sustainability indicators and the elements of the institutional regime are presented and discussed in the following sections.

4.3 Relation between Institutional regime and sustainability

Regression analysis is performed with the general sustainability indicator as dependent variable and institutional regime indicators as independent variables. Table 3 shows the correlation analysis results between Sustainability (Sus) and the institutional regime indicators (e.g. RA, Ext, IntCPR, IntCGv and ExtC) for the Municipalities of the Gaza Strip. Sus is the average value of the three sustainability indicators : Sus1, Sus2 and Sus3.

The general regime assessment (RA) represents the general degree of integration of the institutional regime. RA is average value of the following indicators: Ext, IntCPR, IntCGv and ExtC (see table 1). For this case study the correlation between sustainability and the general regime assessment is relatively strong and highly significant (Correlation value is 0.702) (see Table 3). This result is consistent with the hypothesis of the relation between the level of integration of the institutional regime and the sustainability of water resource. This hypothesis assumes that increases in the level of integration of the institutional regime causes increases in the sustainability of the water resources use. So improving the integration level of the institutional regime of water sector could enhance the sustainability of the water resources use in the Gaza Strip. More discussion on the separate elements of the institutional regime is given below:

The extent of the institutional regime (Ext) represents the degree of complexity of the regime. Remember that this is as such not seen as negative, but even as essential because unregulated uses and users might pose a threat to sustainable use. The Extent is considered as the average value of the following indicators: Ext1, Ext2 and Ext3 (see table 1). For this case study the correlation between the extent of the institutional

regime and the sustainability is highly significant (Correlation value is 0.654). This means that for the municipality level, the extent of regulations of users and uses of water resources in the Gaza Strip has a clear relation with the degree of sustainability of water resource use. Given that the extent of the current institutional regime doesn't cover all significant users, there is a possibility to increase the sustainability of water resource use by increasing the extent of the institutional regime but while respecting the coherence aspects which is discussed as follows:

The internal coherence of public governance (IntCGv) represents the degree of coherence of the public governance which is consists of both internal coherence of each element and coherence between these elements. IntCGv is considered as the average value of the following indicators: IntCGv1, IntCGv2, IntCGv3, IntCGv4, IntCGv5 and IntCGv6 (see table 1). For this case study the correlation between the internal coherence of public governance and the sustainability is highly significant (Correlation value is 0.589).

This means that for the municipality level the degree of sustainability of water resource use is a function of the degree of coherence of the elements of the public governance of water resources management. In other words the improvement of the internal coherence of public governance enhances the level of sustainability of water resources use. As illustrated in section 4.1.3 the internal coherence of public governance is acceptable in many aspects but not in the coherence between responsibilities and resources of water departments. So increasing the resources of these departments is an essential issue. However, the pressures and conditions that affect this indicator will be discussed in details in next step of this research.

Table 3: Relation between general regime assessment items and sustainability (Sus)

Regime assessment items		Correlation R-value	Sig. (1 tailed)
RA	General Regime assessment	0.702	0.000
EXT	Extent of Regime	0.646	0.000
INTCPR	Internal coherence of governance	0.301	0.076
INTCGV	Internal coherence of governance	0.589	0.001
EXTC	External coherence of regime	0.934	0.000

The internal coherence of property and use rights has a weak correlation value (0.301) and almost insignificant (0.076) relation with the sustainability of water resource use. This situation could be explained as follow: The coherence of property and use rights is evaluated by Municipalities according their perspectives and conditions. The questionnaire results showed more diverse answers of the INTCPR than that of Sustainability. This is clear from the standard deviation of the internal coherence of property rights indicator which was much higher than that of sustainability indicator (see table 2).

In other words some Municipalities evaluated the internal coherence of property rights according the theoretical situation of property and use rights institutions though other Municipalities evaluated this indicator according the practical situation. For example the Palestinian Water Authority and most of municipalities in the Gaza Strip

developed the institutions of the property and use rights for the groundwater abstraction for different uses in the Gaza Strip long time ago. But in practice the groundwater is over pumped because of absence of enforcement tools that needed for applying the regulations (e.g. to prevent illegal wells). In addition the violation of institutions and regulations is a result of rivalries between water demand and the available water resource capacity in the Gaza Strip. In addition each municipality manages their water resource apart from other municipalities.

The external coherence of the institutional regime between public governance and property and use rights has the highest correlation value (0.923) with the sustainability of water resource use in the Gaza Strip. This implies that the coherence between the governing policies and the property and use rights has the highest positive impact on the sustainability of water resource at the municipality level. However it is worth to indicate that municipalities considered this indicator as most significant and important factor for developing more sustainable water resource use in the Gaza Strip.

As a conclusion it can be considered that the achieved sustainability level of water resources in the Gaza Strip is a function of the degree of the integration of the institutional regime of water resources in the Gaza Strip. This is consistent with the reported hypotheses of institutional regime governance models that are discussed in the beginning of this article.

5 Conclusions

- It is the first time to conduct a research about evaluation of the institutional regime for water resource management in the Gaza Strip by using standard indicators for comparison purposes.
- The data collected about the institutional regime of water resource management in the Gaza Strip represent the opinion of each municipality.
- The impact of the institutional regime elements (indicators) on the sustainability of water resource use is highly significant in terms of Internal coherence of governance 'INTCGV', External coherence of regime 'EXTC', and Extent of Regime 'EXT'.
- The impact of the Internal coherence of property rights 'INTCPR' is not significant on sustainability.

6 Recommendations

1. The current institutional regime may need to be modified in terms of Number of regulated users and uses in order to enhance the integration level of the institutional regime of water resources in the Gaza Strip.
2. Conducting a study to evaluate the impact of change agents and pressures on the state of the institutional regime of water resources in the Gaza Strip. This may help in improving the current institutional regime.
3. Conducting correlation analysis between the institutional regime indicators and quantitative measured data of water resource sustainability indicators.

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