The Concept of Socio Hydrology and Spatial Organization of Human Settlements (An Analytical Study of Rural Wasit District at Wasit Governorate)

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Abstract. The rural stabilizers in Iraq have a basic identity, which is the agricultural identity. Therefore, they depend on the hydrologic factor (directly or indirectly) in their formation and realization of the pattern. With the formation of the patterns and stability of the rural stabilizers, the interaction and mutual influence begins between society and hydrology with time, and given the emergence of the concept of global hydrology collectively as a new concept dealing with the study of the interrelationship between society and water with time. This concept was introduced in this study for the purpose of analyzing the rural situation of Wasit, and model of their design in 1976 where the agricultural Dujailah industrial project carried out. The project includes network reclamation and stations of dairy cows and plants. This leads to the main spatial indicators (population, cultivated areas, livestock, water resources, educational services, and health services), in this study we try to determine what is the most interactive and influential indicator on the society and thus on the formation of the patterns of rural stabilizers in Wasit region. It also discusses the impact and interaction of the rural society with the project of reclamation and analysis of the results and their discussion based on a spatial statistical method. The first model represents the social side and the second model represents the economic side. The results are analyzed to determine the importance of the concept of social hydrology in the process of rural development, it is important to introduce this concept in the spatial organization of the rural stability along with the service sectors to achieve a state of functional integration between the economic structure and service sectors of the study area.

Keywords: Socio Hydrology, Spatial Organization, society, engineering

1. Introduction:
Generally, the identity of rural stabilizers is often agricultural identity; it depends directly or indirectly on the hydrologist in the formation of patterns. The patterns and their stability begin to move from interaction and mutual influence between society and hydrology over time, competition for access and access to water, for a result to this competition, there is a change in the patterns of stabilizers constantly with the change of hydrological data in the basic form in addition to other factors. As a result of the development, especially with regard to rural development projects such as land reclamation, these projects were abstractly linked to the engineering dimension during the design and implementation process, resulting in patterns of irrigation networks that are supposed to affect the process of forming new patterns of human settlements within the scope of these projects without taking into consideration the rest of the available services or what spatial indicators are available and their social impact, therefore not take into account the spatial return of the development envisaged.
from the implemented project. The concept of socio hydrology was used as a new concept and the most prominent concept from which important spatial indicators can be derived, where the concept of socio hydrology deals with the study and understanding of interactions and feedback between human water systems and the understanding of the dynamics of joint development of human and water systems in order to achieve the rural settlement for the existing settlements. For the rural area of Wasit, because of the project of reclamation Dujailah industrial implemented in 1986 will be studied the social interaction hydrological time with the existence of spatial indicators (population, cultivated areas, animal resources, educational services and health services) and statistical data analysis using spatial statistical methods and results to be analyzed to determine the importance of the concept of socio hydrology in rural development, therefore the research problem (the weakness of linking the concept of socio hydrology in the formation of spatial indicators to translate the relationship between rural development plans and irrigation projects in Iraq), while the research hypothesis: (the concept of socio hydrology can make set of indicators that can clearly assess the shape of the rural development plan and add harmony between rural development plans and irrigation project plans in order to achieve optimum exploitation of the place).

1.1 Research objective:
Developing a strategy to rebalance the spatial stability of human beings in a manner commensurate with their developmental potential in association with the community services provided.

1.2 Socio-hydrology concepts:
Socio-hydrology is a multidisciplinary field and a new concept that studies dynamic interactions and feedback between water and people. To understand the dynamics of co-evolution of the common human and water system, natural scientists have for a long time ignored human factors as well as hydrologists, are no exception. In conventional hydrology, the relationship of human forces (human beings - the activities of managing the resulting water resources) of the forces or external influences on the dynamics of the water cycle is under constant assumptions. In the concept of social hydrology, human beings and their activities are an integral part of the dynamics of the water cycle. The goal is to predict the dynamics of common development. Both challenges of uncertainty in hydrology present major challenges such as data constraints, climate change, etc. Many hydrologists are working to background for decision-makers and politicians are based on evidence in terms of water planning and allocation. However, we note an increase in the conflict situation associated with water participation and sharing and the poor quality of water that affect the occupational practices of hydrologists [1].

1.3 Types of coupling within the socio-hydrological system:
Socio-hydrology requires a combination of and feedback between elements of the water cycle, society and the ecosystem under study. In this sense, social hydrology isolates a set of specific processes within a socio-ecological system (SES) that includes resources, users and related subsystems Community [2]. The isolation of social hydrological components in the social ecosystem (SES) is complicated because water resources affect many other resources within SES. The effect (the first type of conjugation, unidirectional coupling), which has a direct hydrological social relationship - for example, a direct relationship between low welfare and water scarcity [3]. The second type of pairing is bi-directional coupling. The indirect effect, for example, is the relationship between the economic output from the quality of fisheries and water. Changes in flow systems can affect the richness of fish species, may become sensitive to hydrological changes by affecting the fish rather than the amount of water [4]. Essentially, the existence of multiple paths of water-community coupling, the possibility of indirect pathways and the impact on other components of the system suggest that the study of social hydrology is a typical model of complex system science. For example, there may be a mismatch in spatial space between small farmers’ perception of the effects of their irrigation activities on a large-scale hydrological change in the region [5], and dynamic communication (the third type of correlation) that sets a presumed sequence of development of the human-water-associated system. If human water requirements exceed local water supply, this will lead to the development of infrastructure to stabilize and enhance local supply. Over time, water requirements will grow beyond infrastructure capacity,
leading to new infrastructure, which embodies non-local supply. Studies suggest that this leads to shifts in psychological and social systems, which involves spatial and sectoral reconfiguration of water demands in response to water availability. Assumptions of this sequence allow for dynamic interconnection with system switching between one-way and two-way feedbacks, supply and demand, and the rate of evolution of the sensitivity, as the extent of social water response due to this sensitivity is strongly mediated by society [6].

1.4 Spatial structure:
The spatial structure includes a number of human stabilizers and the pattern of these stabilizers is not fixed on the basis of fixed or stable phenomena. On the contrary, it is a complex environment consisting of volatile particles in nature, combined by the lines of communication and curves between the sites of housing, work, and recreation [7]. The stages of the spatial structure follow the emergence beginning of the movement leading to the transport network generation through which the contracting entity that will grow will be transformed into a hierarchical form that would then support a relative spread of services according to the spatial size of the stabilizers. The comparison of the spatial structure of the region (which is built by economic relations) is more complex when it is dependent on the factor of history or time in the composition of this structure [8].

1.5 Patterns of rural stabilizers:
The pattern is a term frequently used in scientific studies and is used to determine the distribution and shape that is organized under the uses of the different land. The pattern reflects the distribution of rural centers and the system they take in distribution. As rural settlements differ in size, they differ in their distribution. Some of the villages take regular geometric forms, some of them irregularly dispersed, some of which take the form of central assemblies, some of which are distributed along roads and rivers [9]. In general, rural human settlements can be classified into two main categories [10]:
1. Planned rural settlements: these are the stabilizers whose designs have been engineered and planned and implemented by different parts of the state to housing the agricultural families in various agricultural projects in many areas of the country.
2. Unplanned rural settlements are those established by society, according to the environment or geography of the area to which they belong, the State or the various governmental units have no authority in determining their dimensions and design.

The two categories above include most subcategories which can be summarized as follows:

1.5.1 Diffusion pattern:
A pattern that does not have a specific distribution but has a total dispersion of points to dispersion and spread, which is the most common patterns, as it is determined according to the natural conditions of the regions and relations between the location of the village and its activity from the nature, economic resources, natural and non-natural of the region. According to the number and size of the villages, the nature of the potential available in that region is attributed to the emergence of this pattern to build the peasant dwelling on the land of their farms, as this pattern spreads in areas where private ownership prevails and large individual agriculture [11].

1.5.2 Collective pattern:
This pattern exists in regions with limited natural resources, which makes the concentration of the primary population around certain resources or factors that were natural or abnormal, such as dams or industrial complexes. The most important characteristics are making the peasant houses and their services connected to each other centrally Sufficient, easy and fast performance [12].

1.5.3 Triangle villages:
These villages are usually in the mountainous areas or on the slopes of the mountains as they are base downwards towards the valleys and the lower the houses whenever we go to the top because of the roughness of the area [13].
1.5.4 Star villages:
These villages are located at the crossroads of the roads or at the branches of the rivers and the residential units of such villages scattered in the form of groups so it is noted that a network of random roads are formed and the loss of large areas of village land [14].

1.5.5 Round villages:
The most important factors leading to the emergence of this type of villages is the concentration around a pond or lake water or provide protection to its inhabitants as they are usually adjacent, winding roads, agricultural land, orchards outside the village limits and spread most of these villages in the flat areas [7].

1.5.6 The pattern of villages, strip or linear:
Where the farmers build their homes along the main transport routes or along the river and thus the village takes linear form, and usually the fields are behind the houses, Al-Azzawi agrees however that the river or the main road of the village is called the longitudinal axis [15].

2. Building the mathematical model:
By identifying indicators affecting the study area, which are: (population, cultivated areas, livestock, water resources, educational services, and health services) and collecting their data for several years, as shown in Table 1.

Table 1. Represents Wasit data and information for years (1977, 1987, 1997, 2007, 2010, and 2016)

| Details                                      | 1977  | 1987  | 1997  | 2007  | 2010  | 2016  |
|----------------------------------------------|-------|-------|-------|-------|-------|-------|
| The rural population in the area             | 11289 | 18183 | 20709 | 28754 | 26175 | 29518 |
| Area cultivated with winter crops (1,000 dunums) | 45    | 147   | 154   | 137   | 66    | 100   |
| Water resources (rate of irrigation discharges in the Dujailah column) m³ / s | 11    | 22    | 27    | 19    | 12    | 15    |
| Livestock in Wasit (sheep, cattle, goats, and buffaloes) | 52384 | 93187 | 119784 | 83317 | 69636 | 45722 |
| Number of primary and secondary schools in Wasit district | 10    | 17    | 20    | 33    | 39    | 47    |
| Health Services / Number of Health Centers in Wasit District | 1     | 2     | 2     | 2     | 3     | 4     |

Source: Directorate of Education Wasit Governorate / School Buildings / 2017, Wasit Governorate Health Directorate / Planning and Follow-up 2018, Department of Planning and Development in Wasit Governorate 2017, Directorate of Agriculture Wasit Governorate / Department of Planning and Follow-up 2017 Wasit District / Land Division 2017, Directorate of Water Resources in Wasit / Department of Supervision and Follow-up 2017, Water Resources Division in Wasit District / Technical Section 2017.

In this study, the multiple linear regression equation was adopted as a spatial statistical method to express the relationship between the indicators as the data were entered and the results were obtained through the (SPSS 10) (Statistical Package for the Social Sciences program). Two mathematical models were built depending on the nature of the specific indicators. The first mathematical model is the social aspect, as the population index as a variable (Y1) and the indicators (water resources X1, health services X2 and educational services X3) as independent variables. The second model deals
with the economic aspect by adopting the population index as a variable (Y2) and the indicators (water resources X1, an area of cultivated land X4, and livestock X5) as independent variables.

2.1 Linear correlation:

The term correlation is used to mean the linear correlation or the linear relationship between two variables. It is therefore used as a statistical measure to determine the type and strength of the relationship between the variables. The correlation coefficient value between (-1) and (+1). The negative value indicates a negative correlation. The positive value indicates a positive correlation, but if the correlation coefficient is zero, this indicates the lack of correlation between the variables [16]. Table 2 shows correlation coefficient values between the study area indicators using (SPSS10) program.

|                          | area    | populati'n | resource | livestock | health | educatio'n |
|--------------------------|---------|------------|----------|-----------|--------|------------|
| area                     | Pearson | .090       | .939**   | .786      | .020   | -.041-     |
| Correlation              | Sig. (2-tailed) | .865     | .005    | .064    | .970    | .939       |
| N                        | 6       | 6          | 6        | 6        | 6      | 6          |
| Population               | Pearson | .090       | -0.94-   | -1.92-   | .862*   | .976**     |
| Correlation              | Sig. (2-tailed) | .865     | .859    | .716    | .027    | .001       |
| N                        | 6       | 6          | 6        | 6        | 6      | 6          |
| resources                | Pearson | .939*      | -0.94-   | 1        | .903*   | -         |
| Correlation              | Sig. (2-tailed) | .005     | .859    | .014    | .798    | .638       |
| N                        | 6       | 6          | 6        | 6        | 6      | 6          |
| livestock                | Pearson | .786       | -1.92-   | .903*    | 1.368-  |           |
| Correlation              | Sig. (2-tailed) | .064    | .716    | .014    | .531    | .473       |
| N                        | 6       | 6          | 6        | 6        | 6      | 6          |
| health                   | Pearson | .020       | .862*    | -1.36-   | -.324-  | 1         |
| Correlation              | Sig. (2-tailed) | .970     | .027    | .798    | .531    | .009       |
| N                        | 6       | 6          | 6        | 6        | 6      | 6          |
| education                | Pearson | -.         | .976**   | -.247-   | -.368-  | .920**     |
| Correlation              | Sig. (2-tailed) | .939    | .001    | .638    | .473    | .009       |
| N                        | 6       | 6          | 6        | 6        | 6      | 6          |

*Correlation is significant at the 0.05 level (2-tailed).  
**Correlation is significant at the 0.01 level (2-tailed).
2.1.1 Multiple Linear Regression Equation / Social Side of the Area (Model 1):
The population was adopted as a dependent variable in this equation (Y1), (Water resource variables X1, Health Services X2 and Educational Services X3) as independent variables. The result of the process of building the first model was as follows:
\[ Y_1 = -1087.147 + 420.38X_1 - 4517.816 X_2 + 1.291.566X_3 \]  
(1)

2.1.2 Multiple Linear Regression Equation / Economic Side of the area (model 2):
The population was adopted as a dependent variable in this equation (Y2). The variables (water resources X1, area of cultivated land X4 and livestock X5) were considered independent variables. The result of the second model was as follows:
\[ Y_2 = 41503.401 -3103.788X_1 + 0.446X_4 -0.044 X_5 \] 
(2)

From the above, we can find that the number of rural population in the equation (2) of the economic side is directly related to the area of the cultivated land and vice versa with the water resources (hydrology) and livestock, this indicates that the interaction between the rural community and the area of Wasit with Hydrology is an indirect interaction (bi-directional coupling) where the agricultural areas depend on the water resources (hydrology) in the expansion or contraction.

So the economic impact of the index (cultivated land area) in the equation of the economic side is the most positive variable on the community promised the rural population in the note that there are other aspects of possible identified through multiple linear regression for equation of the social aspect (equation 1), which showed that the population (community) in this equation reacts directly proportional to the water resources (hydrology) and educational services and inversely with health services. From these results we can show that:
- The reverse interaction found in the equation between population and health services is the result of failure and weak government planning in the implementation of health projects and in a manner that is consistent with the size of the rural population growing continuously.
- The direct interaction between the number of population and educational services available through the availability of a number of schools covered in rural areas, although far from some small villages, but the presence of these schools positively affected the villagers, the stability of these villages and their communities.
- Information obtained from the relevant departments of the services provided or available in the countryside of Wasit, it is noted that most of the villages in the Wasit area, which includes a range of services such as electricity, drinking water, rural roads, educational services such as schools, has changed or contributed to change the basic function of a large number of villages, which is agriculture. Where many of the inhabitants of the villages do not care for agriculture, but they live in these villages and are engaged in public works or work in security devices or different state agencies. This change in the pattern of population living in Wasit rural community, made the percentage of rural people who are devoted to agriculture a small proportion to the rest of the professions which are practiced by the members of the rural community and thus we find that the number of people who left the area affected by agricultural hydrological change is relatively small to the number who settled in those villages.
- From the foregoing, and through the above data and results, it is clear that the concept of social hydrology is important in the process of planning for rural development in general. The process of implementation of the strategic projects must be consistent with the strategic or urban types, with the urban and rural plans and all the services for the purpose of reaching the desired results, as for the case of the implementation of projects or hydrological projects in general regardless of the reality and vision of other services in any region, this will conflict with the orientation of the population, culture and the extent of their future interaction with hydrology and thus the success of the concept of social hydrology and benefit from its role in the process of rural planning and rural development.

3. Conclusions:
1. Some municipal, educational or health services are available for most villages in the countryside of Wasit governorate which have reduced the identity of the villages to residential areas and reduced their agricultural identity because of the fact that many of the residents of these villages are subjected to civil and military occupations. Consequently, farmers become less and the hydrological community
interaction becomes negative for the hydrological changes do not effect on the nature of society and its stability and on existing housing patterns.

2- The lack of health services and distribution in accordance with the standards of rural housing affected the spatial distribution and population density of the rural society for the majority in the villages near the health service centers and therefore the effect of this to determine the center of gravity and direction of spatial distribution of the population in rural Wasit.

3- The hydrological fluctuation in the Dujailah column and the lack of strategic solutions to avoid shortages of water revenues and weak infrastructure projects supporting agricultural development from irrigation and drainage projects have created a state of mistrust in relying on agriculture as a constant economic resource for rural residents of Wasit. Many of them leave the profession of agriculture and join the various government functions, which led to the weakening of the countryside and the disappearance of the agricultural identity of many villages, spread over the area of rural areas in Wasit.

4- The planning process for the implementation of irrigation projects without taking into account the spatial and societal indicators as well as social services, this will make these projects not useful at the long term and lose the most important goal which is to achieve rural development and rural stability of the types of villages resulting from the implementation of these projects and achieve the economic basis successful and attractive to the population.

4. Recommendations:

1- Attention to the reclaimed land and follow up the process of reclamation of the following stages by following the correct planning methods, by studying all the economic, social and service indicators available in addition to the engineering and quantitative information for the purpose of the design of the network of reclamation and the project in general, with the prediction of the necessary infrastructure through which to achieve the desired development with community stability of patterns of rural stabilization.

2- Due to the stronger link between the community and the cultivated areas, it is necessary to encourage and support the government to use improved varieties of seeds for strategic crops, especially those suitable for the environmental conditions in Wasit area, to raise the productivity of the yield and to provide all conditions suitable for the cultivation of summer crops which considered to be an important economic source for the region generates income for the population of the region and thus will be a factor of attraction for the population to practice agriculture and return the agricultural identity of the area.

3- For the purpose of securing water quotas and avoidance of hydrological imbalance in the column of the Dujailah table and the network of reclamation, the maintenance and rehabilitation of irrigation systems, drainage and pumping stations should be considered periodically, which is positively reflected on the rural community through the state of confidence of the absence of hydrological problems and thus not overflow on the network.

4- Activating the role of cooperative societies, water user associations and agricultural extension, and training the staff working in it in a manner that qualifies them to contribute seriously in improving the rural reality through the possibility of raising awareness and proper dealing with natural resources to achieve the desired goals.

5- Adopting the concept of socio-hydrology in the studies of irrigation projects or studies related to the determination of river basin management policies or studies related to disaster avoidance (such as floods) because this concept is of little use in the Iraqi field of research.

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