Introduction a Conceptual Model for Determination of Environmental Water Requirement for Bamdezh Wetland, Iran

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Abstract

Wetlands are valuable ecosystems that have economic, social, ecological and biological benefits and other values but the degradation of these natural systems around the world are increasing. Bamdezh wetland is one of the important wetlands in Khuzestan province. This wetland according to the definition of international Ramsar convention is riverine and palustrine wetland. Water quality of this wetland is fresh water and for purposes of temporal is permanent wetland. Bamdezh wetland has important role to control floodwater and over flow of Dez and Shavoor rivers. In addition, existence vegetation and different species of animals show important of management planning for conservation this wetland. In recent years this wetland envisage with problems such as; grazing livestock, entrance agricultural poisons and urban wastewater through Shavoor river, takings water by villagers and predation birds. These factors are minatory factors for the life of this wetland. Whereas water is main factor for life of wetlands and application of conceptual models in recent years in more sciences have been developed so, in this paper a conceptual model for determination environmental water requirement according to the natural conditions of Bamdezh wetland will be introduced.

Keyword: Conceptual model, Environmental water requirement, natural condition

Introduction

According to the definition of international Ramsar convention wetland is natural or artificial marshy, permanent or ad interim with fresh water, marginal water, or brackish water zones. Wetlands have area equal 856 million hectares, the areas of international wetlands are 75 million hectares, and the number of them is 1118. The wetlands areas of Iran are 2-2.5 million hectares and cover 1.5 percentage of the total area of Iran. The numbers of international wetlands of Iran are 20 with 1.3 million hectares areas.The most important factors that causes environmental crisis for wetlands in Iran are drainage, discharge wastewater, human encroachment, immethodical hunting, The results of these factors are decreasing of aquatics production, decreasing groundwater resources, decreasing quality of human environment and death of wetland. Wetlands have more advantage such as; direct recovery of water with people, securement and storage water in aquifer, regularization water flow especially flood flow, debarment of infiltrating saline ground and surface water, conservation articles of food, gene bank, sources for natural production of wetland.

The most important wetlands are in Khuzestan province in southwest of Iran; Shadegan, Hor-Alazim, Bamdezh and Miangaran (Jamee, 2002).

Bamdezh wetland was located on 40 km of northwest of Ahvaz-Dezful road. Kharkheh river located on west and Dez river located in east of Bamdezh wetland. This wetland located between 48^{0} $27^{'}$ to 48^{0} $42^{'}$ eastern longitude and 31^{0} $38^{''}$ to 31^{0} $55^{''}$ northern latitude. The area of this wetland is equal to 40 km^2 with 11 km of length and 4 km of width. Bamdezh wetland is a natural wetland, permanent fresh water marsh, and recharge with Shavoor River as surface water. Vegetation of this wetland consists of; hydrophytes, halophyte, xerophytes. Wildlife consist of; xenophile fowl, fishes, amphibian and reptilian. This area has an average annual precipitation of 260 mm, temperature of 24 degree centigrade and evaporation of 1900 mm (Jamee, 2002).

Bamdezh wetland is suitable ecosystem for birds, suitable place for growing plants, suitable place for fish of fresh water, flood control, creation microclimate that cause increasing relative humidity and decreasing temperature, natural landscape, (Bostanzadeh, 2003).

The input of Bamdezh wetland is Shavoor River and the outlet of this is Kharoor that after pass of Tavana canal discharge to Dez River. According to data of 2002 the mean, minimum and maximum input discharge of wetland respectively was 16.58, 14.60, and 18.90 ($m^3.s^{-1}$) without taking into account the different use such as agricultural use before enter to wetland. The mean, minimum and maximum of output discharge of wetland that has been obtain of balance equation respectively was 12.03, 6.54, and 15.05 ($m^3.s^{-1}$) (Afkhami, 2004). Figure 1 show the satellite image of Bamdezh wetland.

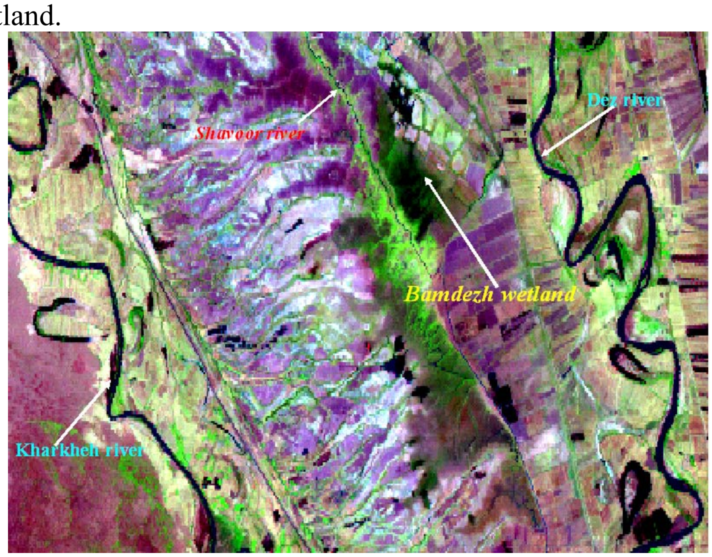

Figure 1. Satellite image of Bamdezh wetland

Each hectare of Khuzestan wetlands according to the calculation of experts of environmental organization has economic value equivalent 14000 $. If this index is applied for Bamdezh wetland and social index such as benefit of abiders of 36 villages near wetland from agriculture, ranch and fishery add to economic value, this wetland profit more than 14000$ benefit annual or the Bamdezh wetland has this potential. However, interference on water resources and wetland border by people that live near them has cause decreasing production of them (Rahmati et al, 2007). In addition, this wetland has important role in control of flood and over flow of Dez and Shavoor River. Because this wetland in act as storage tank to store overflow water and in summer discharged water to Dez River.

One of the most important problems that related to the pollution of Bamdezh wetland is grazing in wetland that has not done anything about that. Desiccated wetland and change the application of it to agricultural land is another problem of the Bamdezh wetland. Discharge wastewater by Shavoor River in to the wetland and overdraft of water by villagers are degrading factors of this ecosystem (Bostanzadeh, 2003).

Therefore, for decreasing the serious effects of interference in wetland with the intention of management programming, evaluation of wetland is necessary. One of the most important management parameter in wetland that related to life of the wetland is environmental water requirement.

On the other hand, development conceptual models for determination difference variable in natural environment are one method that current nowadays. Conceptual models start simple sketches although in their final form they may be detailed three-dimensional diagrams (Rushton, 2005).

In this method by drawing simple diagram of phenomena, parameters that effect on phenomena identity then quantity the effect parameter finally conceptual relation between them determine.

In this paper for determination environmental water requirement of the Bamdezh wetland, will be introduce a conceptual model. About determination environment water requirement and conceptual model much research has been done such as; modeling net water requirement for wetland in semi-arid regions (Zhonghua and Wan, 2006), a conceptual for the assessment of depressional wetlands in the prairie pothole region (Rosen et al, 1995), the use of conceptual ecological models to guide ecosystem restoration in south Florida (Ogden et al, 2005), A conceptual hydrologic model for a forested Carolina bay depressional wetland on the coastal plain on south Carolina, USA (Pyzoha et al 2007), A conceptual basis for the wise use of wetlands in northern Australia-linking information needs, integrated analysis, drivers of change and human well-being (Finlayson 2005), concepts and controversies in tidal marsh ecology (Weinstein and Kreeger, 2000).

In Iran and especially on Bamdezh wetland has been done research such as; determination environmental water requirement of Bamdezh wetland for management and monitoring water quality (Afkhami, 2004), Water and pollution management of Bamdezh wetland (Bostanzadeh, 2003) and Determination ecological characteristic and value of Bamdezh wetland (Nabavi, 2002).

The General Methods of Modeling

Three main methods of modeling are mechanistic, empirical, and conceptual method. Mechanistic models base on physics process. Empirical model base on experiment and the situation that data measurement. However, conceptual models base on realization of model maker of physical basic process. These models represent concept of actuality and use of that for solve problems (Woolhise and Brakensiek, 1982).

In other classification according to engineering application can divided modeling to three method, physical, mathematical and conceptual modeling. In physical models real sample of phenomenon with 1:1 scale or less than is make. However, experiment in model with 1:1 scale is very expensive or sometimes impossible. In addition, if using of model with less than scale the results maybe not have suitable sensibility and cannot generalization the result from model to main model. These limitations are decreased usefulness the experiment result (Water resources management, 2007).

Mathematical models have equation structure. The bases of these equations are variables. Realization mathematical models in spite of brief than other models are more difficult and need expert knowledge (Hamidizadeh, 2000). Mathematical models are base on relation of phenomena. Therefore, phenomena can be model that the mathematical relations of that are determined and the method for solution equation be exist. The most important advantages of mathematical models are lower cost than physical models, if the solution were exist, the results will obtain rapid and the simulation is possible. However, with these advantages mathematical models have some limitation. Sensibilities of results are dependent on the type of model and the numerical method of solution. In addition, for some phenomenon cannot determine mathematical describe. Some phenomenons are very complex, have complex mathematical relations, and in some cases are not the exact numerical solution (Water resources management, 2007).

Conceptual modeling in resent years have used in engineering. It is advancer than other models for problems solution. A conceptual model can be defined as a thermal; concept, relation and function (Andrade et al, 2004).

In conceptual modeling problem will represent from user's mind. In this model, different opinions will collect and from them one conceptual structure will form (Andrade et al, 2004).

A conceptual model is a visual method (diagram) of representing a set of causal relationships between factors that are believed to impact one or more biodiversity targets. A good model should explicitly link the biodiversity targets to the direct threats impacting them, the factors (indirect threats and opportunities) influencing the direct threats, and the strategic activities being taken to affect those factors. It will also usually indicate the points at which monitoring should take place, assumptions that have been made about causal relationships, and paths along which strategic activities can be used to change or positively influence these relationships. A conceptual model should be accompanied by a textual description that verbally explains the conceptual model. In summary, a conceptual model portrays graphically the situation at site and provides the basis for determining where can intervene with strategic activities. Note that conceptual models are designed primarily for projects, but can be applied to programmers, though complexity can be a concern with larger systems or complex project sites. A conceptual model has the advantage of being visual and, when kept simple, can be easily followed from indirect threats and opportunities to direct threats to biodiversity targets. Conceptual models are also powerful tools for workshops with partners and local stakeholders. In addition, while many people readily understand conceptual models, small but non-trivial fractions of people in the world have a strong dislike of this visual way of thinking. Conceptual models are used by numerous conservation organizations and therefore allow sharing of work, especially in the context of ecoregion conservation (Morgan, 2005).

Introduction Conceptual Model for Bamdezh Wetland

For introduction a conceptual model for determination of environmental water requirement should be obtained information about study geographical position, herbal and animal species of wetland. Because the environmental water requirement of wetlands can divided into two main methodologies; hydrology and ecology (Davis et al, 2001) variables of each part should be identified. For hydrological part, can be written budget equation. The hydrologic budget equation is based on the conservation of mass, namely that a change in surface-water volume for given time period is equal to difference between water inflows and out flows. Of equation, blow that represented by Kirk et al. (2004) can used:

$$\Delta S = (P_{gross} + GW_{in} + SW_{in}) - (I + ET + GW_{out} + SW_{out}) \quad (1)$$

Where ΔS is the change in storage, P_{gross} the gross precipitation, GW_{in} the groundwater flow into the system, SW_{in} the surface water flow into the system, I the interception, ET the evapotranspiration, GW_{out} the groundwater flow out of the system, SW_{out} the surface water flow out of. These variables schematic has been shown in figure 2.

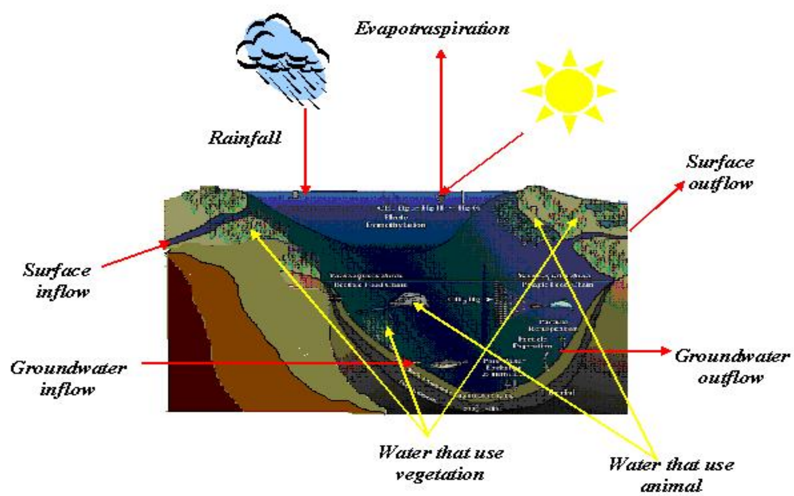

Figure 2. Schematic of budget equation in a wetland

The variables such as inflow, outflow, rainfall, evaporation and temperature for study area can be taken from climatology and hydrometers stations. For calculation evapotraspiration can be used the equation blow that represented by Mitsch and Gosselink (1993) or evaporation of pan class A:

$$ET_i = 1.6\left(\frac{10T_i}{I}\right)^a \quad (2)$$

Where ET_i is the potential evapotranspiration for month I (cm per month), T_i the mean monthly temperature (°C), I the local heat index ($=\Sigma_{i=1}^{12}(T_i/5)^{1.514}$), and

$$a = ((0.675 * I^3) - (77.1 * I^2) + (17920 * I) + 492390) * 10^{-6} \quad (3)$$

Surface inflow of this wetland is Shavoor River and outflow of this is Kharoor canal that can be measured rate of flow. The main characteristic of wetland is impermeable of it so, can be ignored groundwater flow or by measurement porosity or measurement difference between water level on input and output of wetland and using of seep hydraulic formulas can be determined that. Porosity is (Marino and Luthin, 1982):

$$porosity = \frac{V_W}{V_S} \tag{4}$$

Where V_W is volume of water storage and V_S is volume of sample.

By sampling of wetland soil in laboratory can be determined porosity and by approximate the volume of wetland by area and depth of it can be calculated volume of groundwater storage. Ecological part involves the determination of water regime requirement of existing or preferred biota and the provision of that regime (Davis et al, 2001). For this part should be determined relation between water regime and vegetation and frequency of animal species. In this part can be used of the relationship between water level and aggregation of vegetation and animal species. So, should be measured water level in west and northeast of Bamdezh wetland. Because of, vegetation and animal species in west and northeast are more than other part; determine mathematical equation of the relation between vegetation and animal species and water level. In addition, can use of trophic state index (TSI) and compare the results with standards or can select index vegetation and animal species and according that determine water requirement. For determination water requirement of aquatic organism should be measured organic load. For that reason Biochemical Oxygen Demand (BOD), Total Organic Carbon (TOC), Organic Nitrogen and Organic Phosphorus. After do above steps two parts of hydrological and ecological component and assessment. Figure 3 shows the diagram of conceptual of Bamdezh wetland by data that can measure.

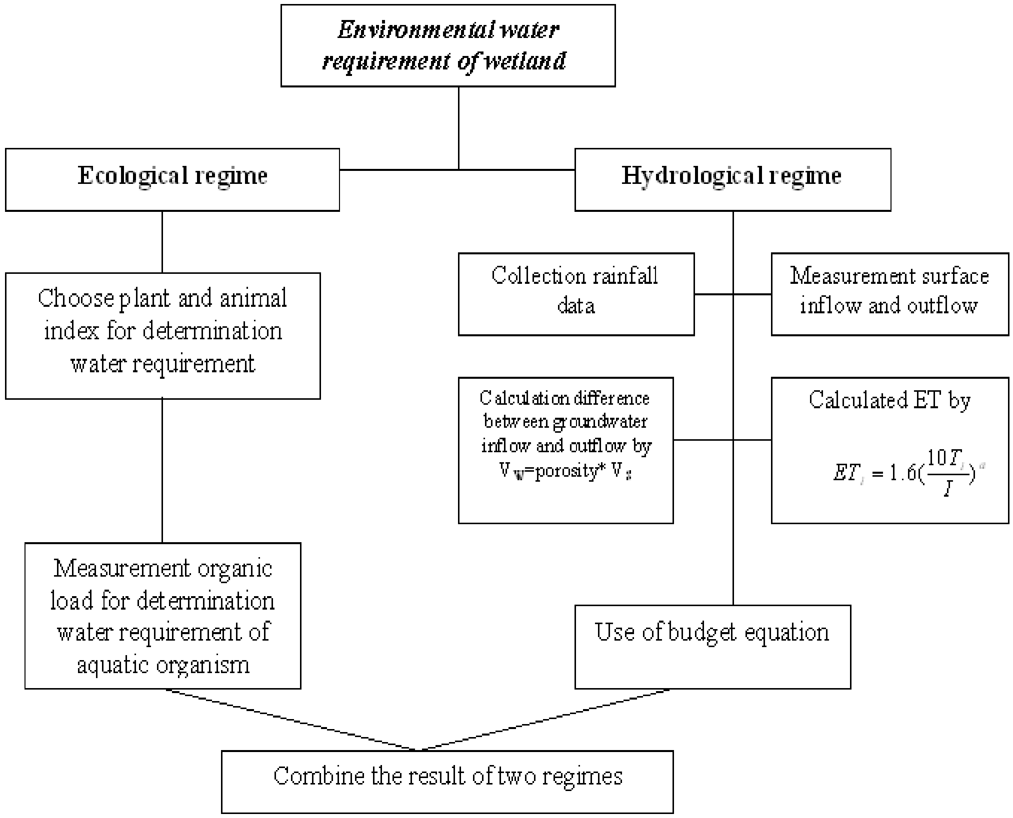

Figure 3. Diagram of conceptual model for Bamdezh wetland

Recommendation

By using this study will assess the water requirement of Bamdezh wetland to maintain the current ecological and hydrological process. This also gives idea on how much water could be released in the wetland to mitigate effect of anthropogenic impact and degradation due to situation. Based on these findings, an effective and comprehensive and wetland management plans could formulate by the concerned agencies. This will also sew as a model for management other wetland.

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