

A SURVEY ON SOLAR SALTWORKS POTENTIALS IN SHADEGAN WETLAND, SOUTH WEST OF IRAN

MEHRAN AFKHAMI¹, and AREZOO KARIMIAN²

¹Ahvaz Islamic Azad University, FarhangShahr, Ahvaz, Iran,

²Khuzestan Water and Power Authority, Golestan, Ahvaz, Iran
info@mehranafkhami.com

EXTENDED ABSTRACT

International Shadegan Wetland is situated at the furthest point of downstream of Jarahi River Basin at 30,00 to 31,00 N and 48,20 to 49,20 E. This wetland covers the arid region of Khuzestan plain at the estuary of Jarahi River. In fact, it is a confluence of Jarahi River from north and Persian Gulf from south. Shadegan wetland with an area of 537700 ha, has been recognized as the largest wetland across the Iran, and 34th in the world, in Ramsar Convention.

Solar salt plants must be located in areas of low rainfall and high evaporation rates, and where suitable low-cost is available. In the Mediterranean, for example, salt works succeed because evaporation exceeds rainfall by a factor of 3:1; that advantage is even greater in Australia where it can reach 15:1. In Shadegan Wetland, that average annual rainfall is 201.2 mm and average annual evaporation is 3538.2 mm, this factor is 17.6:1 that shows that this area has a high potential for this purpose. In this study with using satellite images and field trips, the best places for solar salt works have distinguished and presented. The study area has a high rate of unemployment and this activity in the selected regions can help for mitigation of it. The main selected regions are in the southern part of the wetland which is tidal zone, between the brackish part of the wetland and Persian Gulf.

Keywords: Shadegan, Wetland, Khuzestan, Iran, Solar Salt Work

1. INTRODUCTION

International Shadegan Wetland is situated at the furthest point of downstream Jarahi River Basin at 30, 30 to 31, 31 N and 48, 48 to 49, 49 E. This wetland covers the arid region of Khuzestan plain at the estuary of Jarahi River [6]. In fact, it is a confluence of Jarahi River from north and Persian Gulf from south. Also, the wetland encircles the city of Shadegan from north, west and south. The cities of Ahvaz in north, Abadan in southwest, and Mahshahr in southeast are main residential centers surrounding the wetland [1]. Shadegan wetland with an area of 537700 ha has been recognized as the largest wetland across the country, and 34th in the world, in Ramsar Convention. Shadegan wetland is composed of three main separable areas: Freshwater Sub-wetland: This refers to the northern area of the wetland and feeds upon Jarahi River and has a dense vegetation cover, Tidal Sub-area: This is the southern area of the wetland downstream Abadan-Mahshahr road and is exposed to the flood flows from north and tidal events from Persian Gulf shores. The confluence of saline sea water flows and wetlands freshwater creates an area called Lab Shour (semi-saline) which is ecologically very sensitive and Coastal Sub-area: which extends from Persian Gulf shoreline at the

mouth of Bahmanshir River down to an area within the wetland where the water depth is, at minimum, 6 m during tidal events.

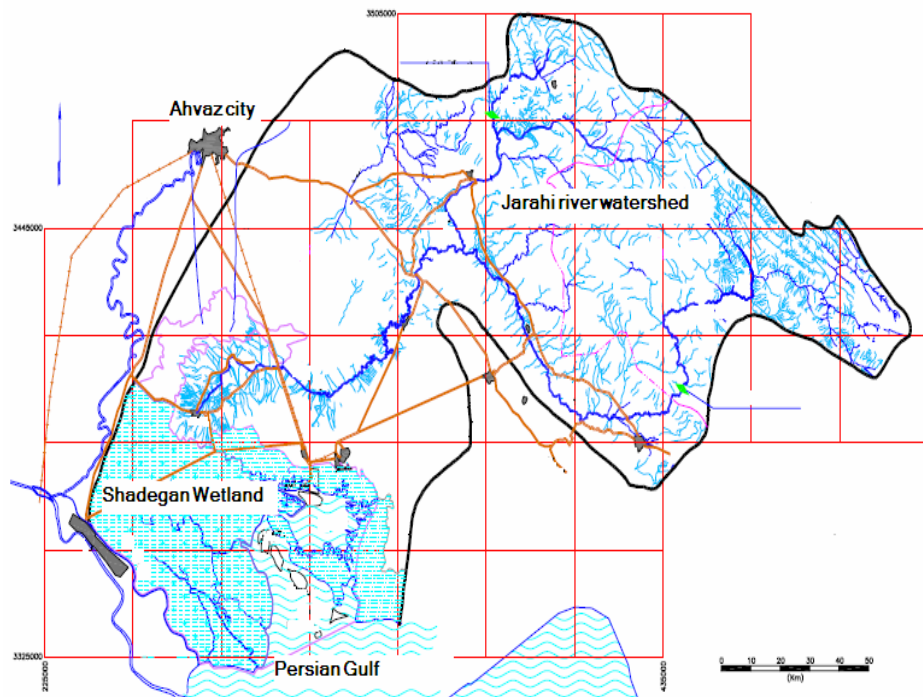


Figure 1 : Shadegan Wetland and Jarahi watershed

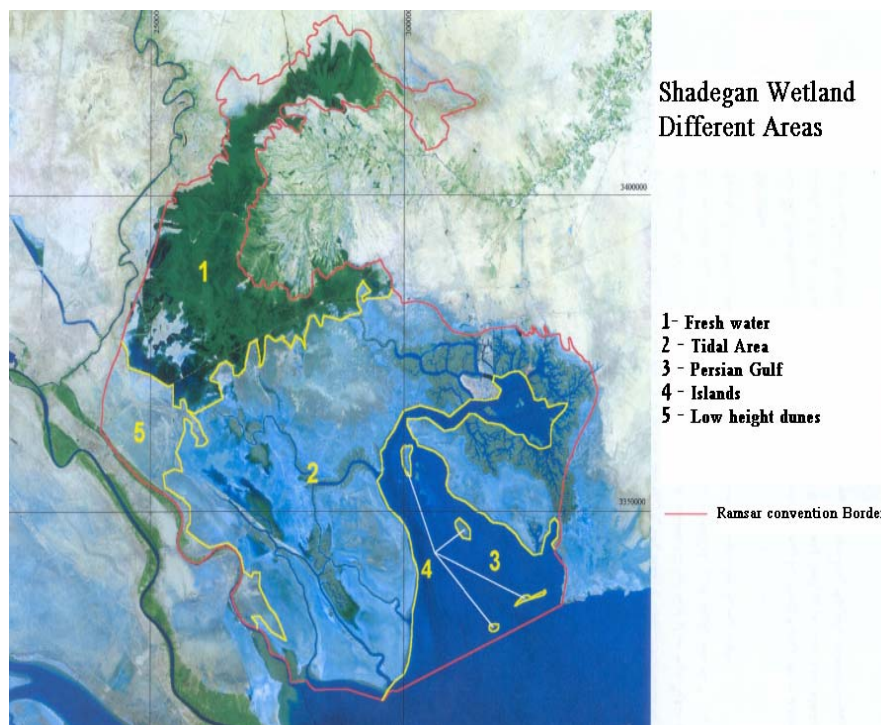


Figure 2: Shadegan wetland border and different areas

2. RESOURCES OF THE WETLAND

Jarahi River is the main resource to the international wetland of Shadegan. The average annual water level of this river, which flows into the wetland, is 2.3 b m³ [1]. This figure has been varying between 0.4 and 6.6 b m³ in recent years. Other resources to the wetlands include floods of Koopal stream and overflows of the Karun river floods. The drainage water from Sugarcane Development Units in the area also enters the wetland which due to its salinity will severely affect the wild life of the wetland in future. But the covered area is a very suitable place for solar salt works due to high salinity of the drainages, that is more that 25000 micromohs per centimeters and can be a very powerful source of salts, the approval evidence that shows the situation is lands that are covered with a layer of salts that is more that 20 cm in some places, but it is very important that some considerations is necessary in that case especially in the case of quality of the salts and probable treatments that is needed.

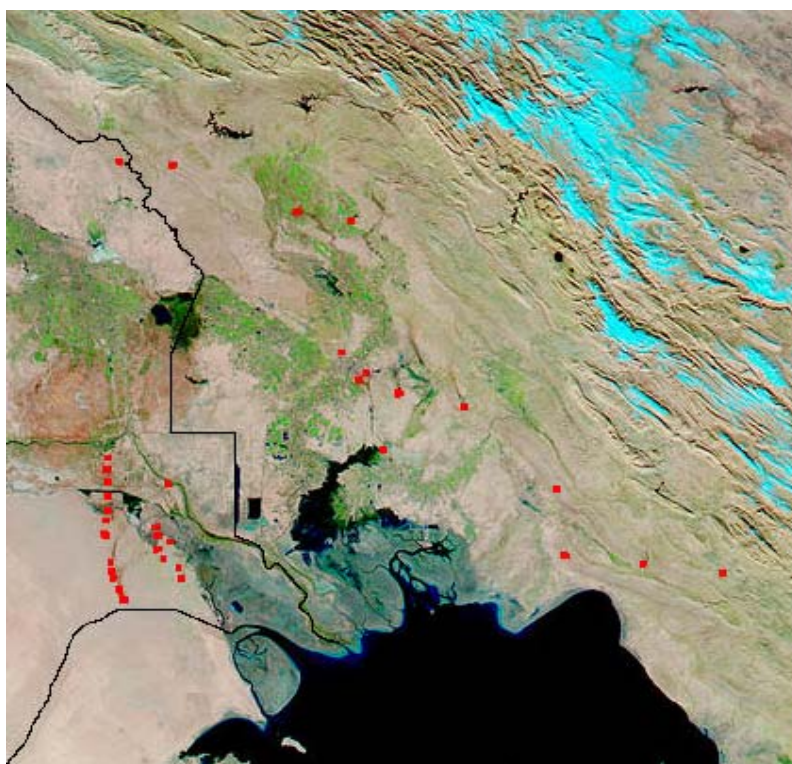


Figure 3: Satellite image of Shadegan wetland

3. VEGETATION AND BIRD LIFE

Since now, 110 plant species have been recognized in Shadegan wetland which is composed of 17 main plant communities in the area. Also, more than 174 varying bird species, both native and immigrating, have been found in the wetland including various species of podicitiformes, pelicans, herons, ciconiidae, flamingos, ducks, eagles, rails, sterculiaceae, and sea swallows [2].

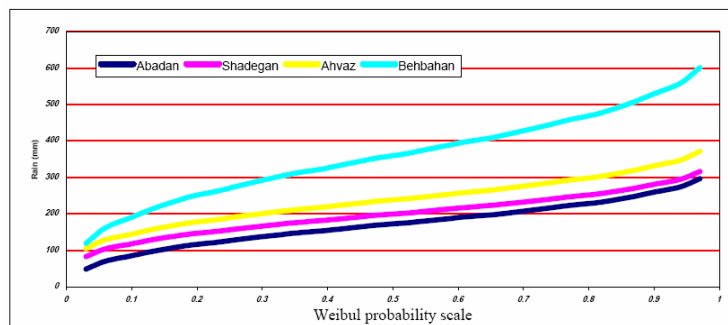


Figure 4: A village in Shadegan wetland

4. CHARACTERISTICS OF SHADEGAN WETLAND

Each wetland is composed of different physical, chemical and biological elements which in relation to each other form an integrated ecological system [4]. Shadegan wetland as an invaluable multi-functional ecosystem has the following characteristics: a) Ecological advantages, b) Containing various ecosystems i.e. saline, semi-saline and freshwater sub-areas, c) Rare living faunal and floral species, d) Bounteous nourishing resources (fodder, reeds, fish, birds, etc), e) Flood controller, f) Wind breaker, g) Sédiment trap, h) Spectaculaire natural perspective, i) Recreation place, j) Shadegan as a cultural heritage.

Graph 1: Annual precipitation incidence distribution



5. MATERIALS AND METHODS

For surveying the wetland area for solar salt works potential, the whole surface of the wetland has divided in to 10 different parcels and by using satellite images of Landsat satellite and combining it with existing quality data like EC and TSS, the best places for solar salt works have been distinguished. Ten sampling stations among the wetland have been used as data centers and by using Taisson method in ArcView and some other GIS software's that parcels have been made, After it by using the data and comparison of the data with the meteorological conditions of each parcel with emphasis on evaporation and rainfall. The satellite images combined with field trips to increase the accuracy of the research and the results.

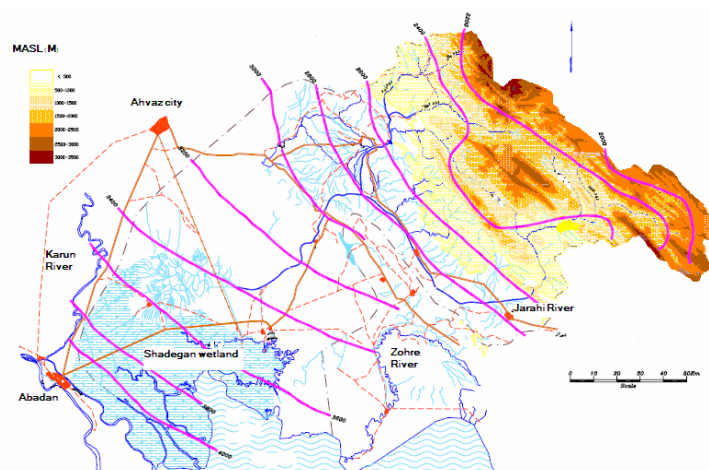


Figure 5: Isopluvial map of Shadegan wetland and Jarahi watershed

6. CLIMATOLOGY

The climate of southern parts of Maroon-Jarahi basin in Khuzestan province that covers shadegan wetland is arid, semi arid and desert. In this climate, summers (June-October) are very hot and dry and winters (November-May) are medium in temperature with a little rainfall. Season change reason is movement of inter-tropical front that separates hot and humid Indian Ocean masse from colder system of north and west. Due to wind way and topographic situation, the precipitation is less that 150 mm per year at Persian Gulf coasts till more that 900 mm per year at mountainous areas [3].

In spite of existing data and for data classification and categorization, a 30 years data period from 1974 till 2004 has been selected. The climate of Jarahi river basin and shadegan wetland is affected by a special situation that is low altitude and Persian Gulf existence at the southern part of it. The study area rainfall regime is a Mediterranean one that the main rainfalls are in winter, the other months of the year are dry and without any considerable rainfall. Summers are very hot and dry and long. An Isopluvial map has drawn and shows the rainfall rate in different paces. Existing data analysis shows that the relation between average annual precipitation (P) and the height fluctuation (Z) is as below:

$$P \text{ (mm)} = 207 + 0.570 Z \text{ (m,amsl)} \quad R=(0.97)$$

Table 1: Shadegan station average minimum temperature (C)

Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1975	7.7	9.3	13.3	18.4	21.3	25.7	26.8	26	23.8	14.8	12.6	7.1
1988	8	11.3	14.3	17	14.9	18.9	21.5	21.9	18.1	14.5	8.6	8
1990	7.4	8.8	12.8	17.9	23.3	25.2	27.4	25.2	19.7	18.8	13.3	8.7

Table 2: Shadegan station average maximum temperature (C)

Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1975	16.5	19.4	24.7	31.3	38.2	42.3	43.8	43.8	42.8	35.2	27.3	16.4
1988	18.3	22.9	25.8	31.6	38	41.2	44	43.8	42.7	37.2	28	20.6
1990	17.4	21.6	27.7	32	40.1	42	44.2	43.7	43	37.1	29.6	23.1

Table 3: Shadegan station month rainfall (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1975	73	17	2.5	18	0	0	0	0	0	0	0	96
1988	36	29	38	53	0	0	0	0	0	0	0	5
1990	5	17.5	10	7	0	0	0	0	0	0	17	0

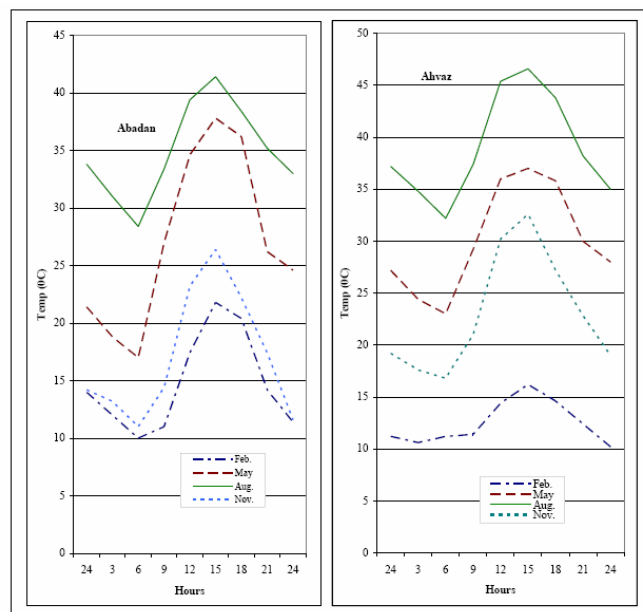


Figure 6 : Daily temperature fluctuation rhythm

7. DISCUSSION AND RESULTS

The research that has been done shows that the special situation of the wetland and social characteristics of the area let that the wetland can be a very suitable area for solar salt works and by creating a good management plan and implementation of it can become a good source of income for the people of the surrounding area those are very poor and need a system to help them to overcome their poverty. In fact the surveys on the area meteorological situation and evaporation, rainfall ration from one hand and soil conditions and natural dry land salinity from the other hand, with composition of it with satellite images review shows that some parts of the Shadegan wetland have more suitability for solar salt works. It is clear that improvement of this site selection a period of operation is needed and can change some sites [5].

It is clear that due to special characteristics of wetland areas the coastal areas that become dry in some seasons are the best natural condition for solar salt works. It is very important that we consider the three different parts of the Shadegan wetland (Fresh, Brackish and tidal part – that naturally should have three different points of view. In the northern fresh water part of the wetland that is from north of Ahvaz city till the brackish part at the south, the best parts are western coasts that covers eastern banks of Karun river and due to drainage of sugar cane farms can be a very powerful source of salt, It is noticeable that the average electrical conductivity of these drainages is more than 20000 micromhos/cm and therefore can be considered as a good site for solar salt works. At the brackish part of the wetland the eastern and western borders are the best sites that can be considered, but it is clear that the potential of these parts is very weaker than the two other parts and in the time planning can be list at the end time of the procedure. The last part of the wetland is saline water part that contains coastal areas and four islands, in fact the best region that has the most potential for salt works is this part, in the land area the coastal line has a very good potential but it seems that some construction for delivering sea water in to some evaporation ponds and extraction of salts after the full evaporation is needed, a similar situation can be seen in the islands that can be used for this purpose. Existence a variety of large industries that consume salt in the production process is a very reasonable factor in economical issue of solar salt works activation in the region, some of these industries that have a key role in the Persian Gulf region and all of Iran economy are Bandar Imam Petrochemical Company, Mahshahr petrochemical complex

and Abadan Refinery. It is noticeable that these factories buy their needs from other sources at the moment and a lot of expenses should be paid for this purpose. From the other hand environmental pollutions due to transport of these salts from far distances is another important issue that makes a lot of air and soil pollution in the area. It is clear that activation of solar salt works projects in this region by consideration local and international regulations can play a key role in the country.

REFERENCES

1. Afkhami M. (2004) *Determination of minimum water requirement of Shadegan Wetland*, Iranian Department of Environment.
2. Firouz E. (2000) 'A guide to the fauna of Iran' ,Iran university press, Tehran, Iran.
3. Khuzestan province annual meteorological report. (2005), Iranian Meteorological organization.
4. Partow H. (2001) 'The Mesopotamian marshlands: Demise of an ecosystem', UNEP, Switzerland.
5. Pirot J. Y. et al. (2000) 'Ecosystem management, lessons from around the world, *A guide for development and conservation practitioners*' ,IUCN, Gland, Switzerland and Cambridge, England.
6. Scott D. A. (1995) *A directory of the wetlands in the middle east*, IUCN, Gland, Switzerland and IWRB, Slimbridge, England.