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Breeding species of Waterbirds in Nakhilo Island in 2006 to 2008

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Abstract

This study was conducted on Nakhiloo Island in the Persian Gulf, part of Bushehr Province, in south of Iran, from March 2006 to September 2008. The maximum number of breeding pairs (16124) of Lesser Crested Tern *Sterna bengalensis* in 2006 reduce to 15650 in 2008 and breeding population of Swift Tern *Sterna bergii* increased from 254 to 1294since 2006- 2008. However, Bridled Tern *Sterna anaethetus* breeding population reached 29,461 in 2008, its total population always being higher than the other tern species throughout the study period. Bridled and Lesser Crested Terns were the dominant breeding species in the island ,but White-checked Tern had small colony. The Nakhiloo Island is Sensitive and brittle habitat for breeding Terns species .It should more protect from human activity.

Keywords: Breeding species, *Waterbirds, Nakhilo Island,Persian Gulf.*

INTRODUCTION

The total number of bird species that breed or pass through Bushehr Province remains uncertain, but surveys of the birds of the Province's islands have shown that there are at least 44 species, including waterbirds, nine of which bred in the 2006-2008 study period: six tern species (Lesser Crested Tern *Sterna bengalensis*, Swift Tern *S. bergii*, White-cheeked Tern *S. repressa*, Caspian Tern *S. caspia*, Bridled Tern *S. anaethetus* and Saunders's Terns *S. saundersi*), one heron species (Western Reef Heron *Egretta gularis*), Crab Plover *Dromas ardeola* and Sand Plover *Charadrius leschenaultii* (Busher DOE 2002, 2006).Ticehurst *et al.* (1925) first established the status of seabirds of Persian Gulf islands (and islets), doing so individually for Great and Little Quoin, Henj(g)am, Tanb and Nabi-u-Tanb, Nabi-ul-Farur, Farsi; they did the same for Sir-Bu-Na' Air (part of the present-day UAE), for Halul (Qatar), for Arabi (Saudi Arabia) and for Um-Al-Maradim, Qaru, Kubbar, and Auhah (Kuwait). Tuck (1974) gave the general status of seabirds of the Persian Gulf and the Gulf of Oman for the 1958–1973 period. Finally, Gallagher *et al.* (1984) summarized the status of seabirds breeding on the coasts and islands of Iran and Arabia and Scott (2007) did so for breeding waterbirds in the 1970s in Iran . There was no new information for many years on the breeding tern populations, however, and consequently we recognised the need to follow up the first (1975) survey of Nakhiloo island (D.A. Scott, unpubl. data, Gallagher *et al.* 1984); we began study in 2006. We wanted to establish the degree of fluctuation in the breeding populations of Terns on the islands off the coast of Bushehr.

STUDY AREA

The four main offshore islands in the western Mond Protected Area are Um-al-Gorm, (27°00'N, 51°33'E, 140 km SE of Bushehr), Khan (27°29'N, 51°16'E, 108 km SE of Bushehr), Nakhiloo (27°49'N, 51°28'E, 133 km SE of Bushehr, Fig.2) and Tahmadon (27°51'N, 51°27'E, 130 km SE of Bushehr) (Fig. 1). The largest, Khan, covers an area of 800–1000 hectares and the smallest, Nakhilo, only about 35 ha, Tahmadon 700 hectares and Um-al-Gorm 75 hectares. These islands are warm in summer (45°C) and moderate in winter, and have very few man-made features worth nothing; their main inhabitants are the seabirds. On Nakhiloo and Um-al-Gorm, the most dominant plant species are *Cyperus*, *Halopyrum mucronatum*, *Lycium* and *Suaeda vermiculata*, which cover about 70%–90% of the islands' area. These islands have ample water; since natural and human predation is absent, they are an ideal environment in which birds may breed or stop over during migration. Marine turtles are present annually in

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spring and summer. This study concentrates on the breeding seabirds on Nakhiloo Island.

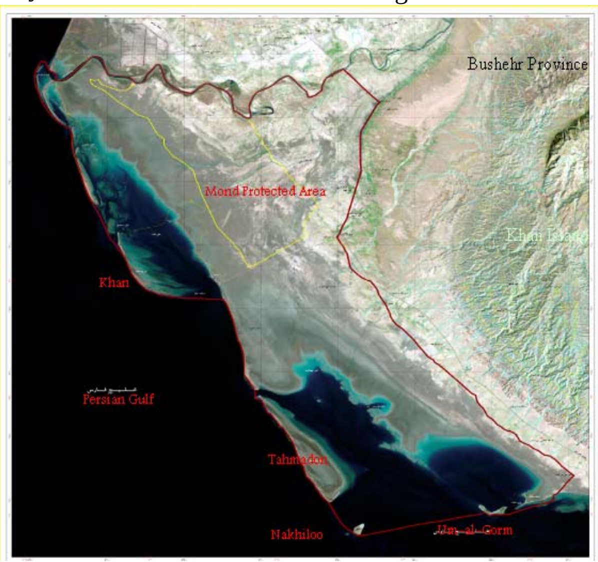

Figure 1. Map showing Nakhiloo Island and adjacent topography

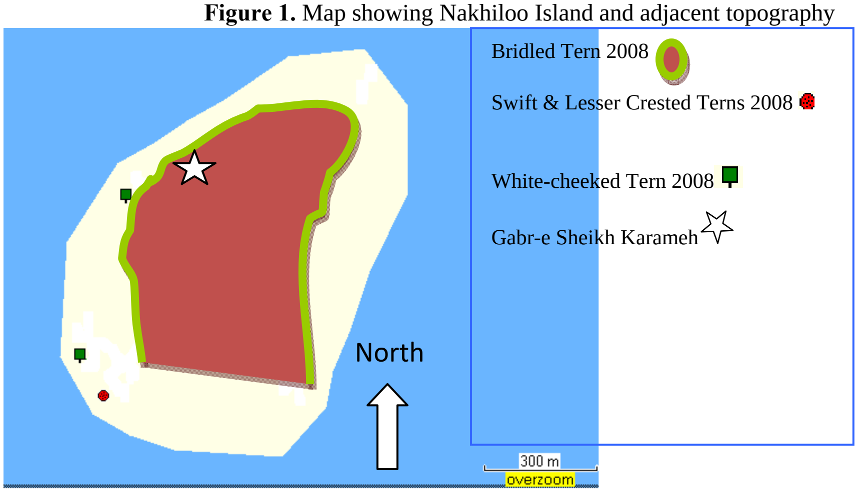

Figure2. Terns breeding colonies and sites on Nakhiloo in 2008.

MATERIAL AND METHODS

The study period on Nakhiloo Island ran from March 2006 to September 2008. We used the Quadrat Sampling method for the main colonies of three species: Bridled Tern, Lesser Crested Tern and Swift Tern. We determined the clutch sizes in smaller colonies by examining every nest, but in larger colonies, we had to determine clutch sizes by the Quadrat Sampling method. To determine nest densities in larger colonies, we calculated the nesting area from GPS readings and then counted all nests in sufficient randomly-selected quadrats to obtain a representative average number of nests per quadrat. This is a straightforward technique for Lesser Crested and Swift Tern colonies, which are in sandy terrain, but more difficult to apply to Bridled Tern colonies, which are in plant-rich areas. The typical breeding habitat of this species is plant–rich islands at Persian Gulf. The annual totals of nests included those counted in outlier colonies, which had been counted individually.

RESULTS

The annual nest totals for waterbirds were 37,018, 36,892, and 46,536 for the 2006–2008 period on Nakhiloo Island. Bridled and Lesser Crested Terns were the dominant breeding species with 20,620–29,461 and 16124–15650 nests respectively. The somewhat smaller

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Swift Tern colony, 254–1294 nests, was nevertheless still sizeable, whereas White-cheeked Tern had small colonies of only 44 nests respectively..The breeding population of Lesser Crested Tern on Nakhiloo Island reduced from 16124 to 15650 nests over the period of this study (Table 1). This species bred in large mixed colony with Swift Tern in the south of the island throughout the study period because they favour sandy places to nest, and this was the only such location. The occupied nesting area of the colony was about 1070 m^2. The clutch size was one egg for 98% of the pairs, the remainder being two eggs (Table 1).

The breeding population of Swift Tern increased from 254 to 1294 nests over the period of this study (Table 2) in the large mixed colony with Lesser Crested Tern. In 2006 the average nest density of the Swift Tern reached $1.37/m^2$. Clutch size was one egg (100%) (Table 2), only one nest being found with two. In 2007 the average nest density was $1.03/m^2$. Clutch size was one egg (100%) again.

In 2006, White-cheeked Tern nested in limited numbers in the northwest of Nakhiloo near Sheikh Karameh, as well as in the southwest. A total of 56 nests was counted at northwest and sothwest (10 nest at southwest and 46 nests at northwest, 35 nests had one egg and 17 nests had two,). In 2007, this species bred only in the northwest of the island. The total of 26 nests was counted. In 2008, of the 61 White-cheeked Tern nests in the west (Table 3), 40 nests were in a single colony near Gabr-e Sheikh Karameh and reminder nests were on southwest of the island.

The breeding population of Bridled Tern increased 20620 to 29461 pairs from 2006 to 2008. The nesting area covered about 23 ha, clutch size usually being one egg (98%) (Table 4). Less than 2 percent of nests had 2 egg.

Table 1. Number of nests of Lesser Crested Tern *Sterna bengalensis* on Nakhiloo Island.

Survey dates	Main nesting area (m^2)	No of Quadrats (1X1 m)	Average nest density per m^2	No of outlier nests counted	No of main colony nests	Total No of nests	Sampled clutch size		
							Clutch size 1	Clutch size 2	Total
18.06.05	1070	28	14.07	1070	10169	16124	374 (94%)	20 (6%)	394
10.06.06	923.5	35	12.34	923	11396	12343	377 (98%)	7(2%)	432
12.06.07	1252	50	11.5	1252	14407	15650	521 (97.4%)	14 (2.6%)	535

Table 2. Numbers of Swift Tern *Sterna bergii* nests in mixed colonies with Lesser Crested on Nakhiloo Island.

Survey dates	Main nesting area (m^2)	No.of quadrats (1x1 m)	Average nest density per m^2	Total No of nests	Total outlier nests	Total number of nests	Sampled clutch size		
							Clutch size 1	Clutch size 2	Total
18.06.06	1070	50	0.2	214	40	254	203	1	204
10.06.07	923.5	35	1.37	1265	35	1300	48	0	48
12.06.08	1252	50	1.03	1289	5	1294	40	0	40

Table 3. Numbers of White-cheeked Tern *Sterna repressa* nests on Nakhiloo Island.

Survey dates►	**08.06.2006**			**10.06.2007**	**12.06.2008**		
Nest locations ▼	**Clutch size 1**	**Clutch size 2**	**Egg totals**	**No of nests**	**Clutch size 1**	**Clutch size 2**	**Egg totals**
Southwest of Island	8 nest	2nest	12	0	4nest	2nest	8
Northwest of Island	27nest	15nest	57	26nest	40nest	21nest	82
Totals	35nest	17nest	69	26nest	44nest	23nest	90

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Table 4. Number of Bridled Tern *Sterna anaethetus* nests on Nakhiloo Island.

Survey dates	Total nesting area (ha)	Nos of quadrats (20x20 m)	Average No nests/ quadrat	Average No nests/ ha	Total No. of nests	No of outlier nests	Total No estimated nests	Sampled clutch size			
								Clutch Size 1	Clutch Size 2	Clutch Size 3	Total
19.06.06	22,80	14	38	893.2	20365	255	20620	509 (94.9%)	26 (5.1%)	1	536
10.06.07	23,21	15	39,6	990	22978	211	23189	594 (94.6%)	32 (5.4%)	0	562
12.06.08	23,00	14	50.8	1270	29210	251	29461	693 (97.3%)	19 (2.7%)	0	712

DISCUSSION

Fluctuation breeding population numbers of Terns on Nakhiloo Island

The breeding timescale of each study species is shown in Table 5and population trend of breeding birds is shown in Fig 3(data for 2005 is from Deprtment of Environment of Bushehr Province).The timing of the peak breeding period in the Nakhiloo shift from 5 to 15 days from one year to another. All form of relationships amongst colonial breeding species are determined by the motivation level and physiological condition of the birds, their composition, number, time and sequence of polyspecific colony formation. Monospecific and polyspecific colonies are characteristic of terns in the Persian Gulf islands and colony formation is dependent on the ecological situation The sequence of formation and occupancy of the colony is determined by the nest-building period(Table5). The Bridled Tern is the frist to form colony. This species commence nest building when vegetation is mature and density are about 70-90%. The so-called “protective”vegetation cover and its density are of great significance in the colonies In breeding habitat of Bridled Tern at Nakhiloo island, density of cover vegetation is about 70-90%. In this period colony is chiefly monospecific and inter-relation are displayed by changes in nesting sites. Polyspecific colonies evolve as soon as other species start breeding. There are no hostile inter-relation in nest site distribution within polyspecific colonies amongst Bridled Tern and Lesser Crested and Swift Terns. Bridled Tern occupy most part of Nakhiloo that coverd by vegetation, but the other tow species occupy the sandy part on southwest of Nakhiloo. The number of breedind species in Nakhiloo fluctuated, possibly with a slight decrease in the 2007, following by a recent increase.The reason for the increases in the breeding populations of, Bridled Tern, Swift Tern and Lesser Crested Tern, is probably that Nakhiloo offers greater security than adjacent islands in recent years. These fluctuations may, therefore, be due to local factors, because the weather and natural condition of island were stable during study period(2006-2008). in the 1970s the Nakhiloo breeding population of terns was greater than the other islands (Scott 2007), which suggests that even then it was the safest nesting site. During the study period was the same and the breeding birds occupied the Nakhiloo. However, when Nakhiloo suffers disturbance, then the birds may breed on other islands, which is very probably what happened when Golden Jackal managed to colonise Um-al-Gorm Island, and when fisherman with motor boats spent periods of time there in 2005. The islands of Khan and Tahmadon lack the good vegetation cover necessary for Bridled Tern and Western Reef Heron to nest. We did not find any breeding population of terns on Khark and Kharku islands in the 2006–2008 study period, but Table 6 shows that there once were breeding populations in the 1970s (Scott 2007). Among four islands in Mond Protected Area,The Nakhiloo is only island that the terns are breeding on it for meny years(1970s-2008), so it is sensitive breeding habitat for terns. For this reason it should more protect against human activity.

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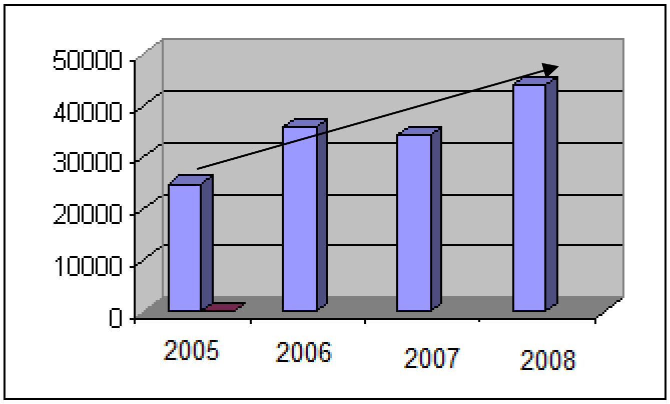

Fig 3:Trend of breeding population of Terns 2005-2008

Bridled Tern

The Bridled Tern like to breed in huge colonies. In 2006, Bridled Tern chicks hatched between 10 and 15 August, fledging one month later. That year the tern species bred on Nakhiloo, but delayed breeding for 15 days. They had begun to breed on Um-al Gorm, but probably because of disturbance by Golden Jackal *Canis aureus* and fishermen, they decamped to Nakhiloo Island to nest (Table 5). Back in 2005 (F.Tayefeh, pers. obs.), Bridled Tern had 24,873 pairs on Nakhiloo Island but later in that year, the area suitable for nesting Bridled Terns was reduced by 9% in the south of the island, because bushes were removed and plant cover was destroyed by fishermen. The overall effect was to reduce the breeding population of Bridled Tern by 17% in 2006. Nest density could not increase because nest separation distances were already at a minimum. A few pairs nested in unusual places or laid eggs in artificial nests or in the shadow of the study team's tents. However, since then, the breeding population has shown a slight but steady increase (Table 4). The breeding population of this species was 20620 in 2006 and increased to 29461 in 2008.(7% increased) This species was the dominant breeding species on Nakhiloo Island in the 2006–2008 period. The Brideled Tern breed under the short but wide bushes of *Suaeda* in most part of Nakhiloo island .(Fig 2). Under wide bushes of *Suaeda*, maximum nest were 4. The existence and density of wide bushes is main factor for Bridled Tern. The wide bushes have wide shadow and good security for eggs and chiks of this species. This species prefer the shadow place for breeding,because the study tem make artificial shadow by ston on the island and the Birdled Tern breed under the shadow of ston. The typical breeding environment of this species is plant cover(70-90%) bushes. In Persian Gulf the Nakhiloo,Shidvar and Tonbe Kochak islands coverd by *Suaeda* bushes, that Bridled Terns breed on these islands. In 2008 the breeding population of the Bridled Tern in Shidvar was 25000pairs and in Tonbe Kochak was 35000pairs(behrouzirad 2008 Per obs).

White-cheeked Tern

The number of colony and the number of nest per colony are variable between the southwest and northwest of Nakhiloo island, and are presumably determined by the local condition of island. The first egg-laying by White-cheeked Tern on in Nakhiloo was in 08,06 2006 laying continuing to the end of June. Genraly the laying period occurs in May(some early eggs can be laid at the end of April). The chicks are reared from end of may to early July and began to fly in under two months. White-cheeked Tern bred both in northwest and southwest of Nakhiloo Island in 2006 and 2008 (Table 3 and Fig 2), but in 2007, bred only in the southwest, nesting in the lowest numbers recorded in the study. The reason was unclear, but may be related to the presence of a few fishermen for a few days in 2007when nest-building was beginning. The siting of the colonies is presumably determined by the amount of human disturbance at the colony sites. The species needs a short grassy vegetation (halophytes and or/psammophiles) but open sandy grounds. low slope and soft sand on coast of this part of island are suitable place for fisherman for a few days staying. Haunt of the fisherman on this part of island effect on nest building or egg laying of White-cheeked Tern. It would be interesting to document shifts of colony sites in relation to changes in the foraging habitats or in the level of disturbance.

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Swift and Lesser Crested Terns

In 2008, very small numbers of Swift and Lesser Crested Terns laid their eggs later than usual in the breeding period (perhaps due to competition for nest place) along the colony margins, some 5–10 metres from the main colony. The four small sub-colonies each had 15–30 nests, some 75 nests in total, 40 for Lesser Crested Tern, 35 for Swift Tern. The first eggs were observed on 10 may 2007; egg-laying lasted until the end of July. Generaly the laing period occurs in mid-may(some early eggs can be laid at the frist of may) The chicks began to hatch in end of may, leaving the nest after a few days, but unable to fly until the end of August. In 2008, Lesser Crested Tern and Swift Tern bred in a large mixed colony near Ghabr-e Shiekh Kerame in the northwest of Nakhiloo Island. The selection of sites suitable for establishing colonies is subject to pressure by human disturbance and presence of soft sand ground. Consequently Lesser Crested and Swift Terns tend to confine their nests close to water in Nakhiloo on soft sand ground without any vegetation. The typical breeding habita of these two species is sandy open ground. At southwest of Nakhiloo island, there is about 2000 m^2 sandy open ground without vegetation that the Lesser and Swit Terns breed there. What are the basic requirement for successful breeding of these two terns. One major problem is obviously to find predator-free and human undisturbed islets in a island system. Morover, the nest site can be completely vegetationless or just coverd with a very short or sparse vegetation. There, the birds generally form very compact colonies with small inter-nest distances.(the distances of the nests in Nakhiloo island were 35-45 cm, (Behrouzirad 2006 unpublished data). Companian species in Nakhilooo are Bridled Tern (part of island that coverd by vegetation) and White-checked Tern.(Fig 2).

Table 5. Breeding species of waterbirds on Nakhiloo Island (Behrouzirad 2006, 2007, unpubl. data).

Species	Outward migration starts	Returning migrants arrive	Egg laying date	Hatching date	Date young leave nest
Lesser Crested Tern	01 Sep	01 May	Mid-May	End of May	Hatching + a few days
Swift Tern	01 Sep	01 May	Mid-May	End of May	Hatching + a few days
White-cheeked Tern	Late Aug	Late April	08 May	End of May	Hatching + a few days
Bridled Tern	01 sep	Mid-April	Mid May	Mid August	Hactching + a few days

Table 6. Numbers of breeding pairs of the four tern study species as given in references from the 1970s for the Bushehr islands (Gallagher *et al.* 1984, Scott 2007, F.H. Tayefeh, pers. obs.). (np = nesting pairs, ad = adults)

Island► Species▼	Kharku, May/Jun 74 (Scoot 2007)	Nakhiloo (Jun 75) (Scott 2007)	Morghu (Jun 75) (Scott 2007)	Umm al Karam (Gorm) (Jun 75)(Scott 2007)	Khark May 2007 Behrouzirad (2006-2008)	Khan May 2007(Behrouzirad 2006-2008)	Tahmadon May 2007(Behrouzirad2006-2008)	Bushehr Bay (1970s) (Scoot 2007)
Lesser Crested Tern	1500np	1000np	300ad	1000ad	0	1450np	0	0
Swift Tern	6ad	40np	40ad	100+ad	0	374np	0	0
White-cheeked Tern	1500np	170np	65np	300np	0	0	0	50np
Bridled Tern	250-300np	15000np	5500np	1000np	0	0	0	0

Other breeding birds on Nakhiloo and adjacent islands

The breeding population of Crab Plover *Dromas ardeola* on Nakhiloo Island were 2500, 3500, 4100 and 2266 pairs in 20066, 2007, 2008 and 2009 (Behrouzirad 2009 per obs) respectively. By 2008, when 481 pairs of Crab Plover *Dromas ardeola* bred successfully on Um-al-Gorm, Golden Jackal was extinct there and had not been superseded by other predators. In 2007, 2266 pairs of Carb Plover have bred in Nakhiloo. In 1970s four species of terns (Table 6) bred on Kharku Island (Scott 2007). On Nakhiloo Island on 23 May 2006 and 30 July 2007 two chicks of Sand Plover *Charadrius leschenaultii* were seen in the north, and three pairs of Saunders's Terns *Sterna saundersi* arrived in late April 2006, laying eggs in early May . Some 500pairs of Caspian Tern *Sterna caspia* bred in 2006 on Khan Island. 0n 30 May 2008, 5 nests of Gull-billed Tern, each with two eggs, were observed on Khan Island (53 11' 45"E 30 99' 53" N), the first recored breeding of this species in Khan island.

The Nakhiloo island is sensitive habitat for breeding species and the adjacent islands(Khan,Tahmadon and

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Um-al-Gorm) support this populations during resting or feeding period.

Threats and conservation

The Conservation condition and potential threats for Nakhiloo, is human activity like ,Fishermen, Researchers and Some time a few Ecotorisms. A lot of terns chiks captured by fish nets that leved on island during years. Some years and some time a few local torism specially Soprtman fishing) even from other cities of Busher province stay a few days at Nakhiloo. These pople cut the vegetation for coking. Localy, chiks are sometimes captured for food by fishermen,or by children. Sometimes children collect eggs of Terns, specialy Lesser Cressted and Swift Tern, because they are in colony and given much attention. It is belived that some small colonies have been deserted in the past due to continuous disturbance of breeding site by tourim and natural sport during breeding period.

Lesser Crested and Swift Terns had not bred on Nakhiloo Island up to 2003, but most probably they had to seek refuge to do so because of excessive disturbance on Um-al-Gorm. Since 2004, a large number of Bridled Tern fail to breed because the potential breeding population is too large, making competition very intense for suitable nesting places(peresence of wide bushes and shadow). This is probably due to fishermen having cut many bushes down that year, thus reducing the available bushes for nesting. Casualties from the intense competition are evident.

An other natural predator of tern's eggs was Ruddy Turnstone *Arenaria interpres* during its migration. It has often been recorded feeding on eggs, and in 2006, it fed on eggs of Bridled Tern. However, that year Crab Plover, Ruddy Turnstone and Rats were the Bridled Tern's predator, feeding on eggs on the margins of the colonies, despite vigorous defence mounted by the parent birds.(may be it is unormal but some eggs have been eaten by Crab Plover , Rat Only mammal species in Nakhilo and Ruddy Turnstone).

The data show that in the Bushehr islands, Nakhiloo, Um-al-Gorm and Khan Islands have the better quality and quantity of habitat to attract nesting seabirds. However, these habitats are vulnerable to destruction by man and the bird colonies are at risk from disturbance during the nesting season to both live for birds and maintain their marine or aqueous breeding birds. Our study happened to be the first since 1975. Much has changed in the 30-year gap, but these have been little documented. It is therefore important that the Bushehr island system be regularly surveyed to count the breeding birds, so that robust and current data are available to help devise the best way of managing this important but fragile island ecosystem. There is clear potential for making these islands a viable ecotourism attraction in ways that would not disturbing the colonial bird species.

Suggestion

- Arrest of human haunt to Nakhilo during breeding period of Seabirds.
- Investigation should be continued to collecting data on the fluctuation of the sea birds species population during breeding time as well as wintering time.
- Investigation affects Natural peridators(Rat, Ruddy Turnstone and Crab Polver) on breeding population

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Study of the impacts of common utilization on the management of countryside rangelands of Torbat-e-jam Abdul Abad

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Abstract- In utilization systems of the rangelands, studying the historical roots, paying attention to the convention, habits, traditions and using required legal leverages and tools for implementing and combining the scientific and technical viewpoints with the realities prevailing in the society in which we live is of special importance. The study area includes 5 conventional systems, which the number of its beneficiaries is over 109 individuals. In order to compare the average crown cover percentage, production utilization, capacity and the condition of vegetation in the ranges of audit and non-audit conventional systems of the one-way variance analysis test and LSD method, was used. According to the information obtained, it was specified that the ranges of all systems have surplus livestock of their range capacity and this is due to the conversion of downstream ranges of the region to the dry arable lands and also pastoral operation units being inadequate for livestock grazing in these fields.

Keywords: Conventional systems, livestock grazing, range capacity, Utilization systems

1. Introduction

In utilization systems of the ranges, studying the historical roots, paying attention to the convention, habits, traditions and using required legal leverages and tools for implementing and combining the scientific and technical viewpoints with the realities prevailing in the society in which we live is of special importance [3]. In Iran, utilization of the rural ranges and privacy is in the form of common [14]. Ranges are defined with common ownership, social units with certain members, specified boundary, interaction between members and the existence of common utilization culture between members [17].

Common utilization is mainly allocated to the countryside ranges. Since the countryside regions are mainly located in mountainous areas, according to the topography of the land in this regions and its minimal ability to change the land use and also the higher forage value and a density of pastoral vegetation cover and its diversity has led to have absolutely desirable pastoral limited area and this has led to the increase of the economic value [3]. In the United States ranges utilization is under two types of management, one is the private sector, which belongs to a rancher and usually includes the pasture, the ranger's installations and the rancher's residence in the range and the other one is the public ranges, which is based on the rangeland grazing permit for a group of ranchers that utilize the ranges commonly [21]. This kind of utilization has been highly criticized by many researchers including Nebel [20].

Problems related to privacy ranges is related to two issue: first, how to audit and diagnosis of these ranges, which sometimes causes controversy among the villages, especially the villages, which are in the vicinity of the nomadic
areas, the other problem is the development of dry and irrigated agricultural lands and residential places that has led to the reduction of the ranges ' area
of the villages [11]. As Badinia [5], in the study of management challenges and problems in the ranges argues ranges being common, the small size of the range to the optimal economic size and also the conversion of pastoral fields (prone and low-slope) to agricultural lands, as the social and economic problems governing the ranges. On the other hand, Roodgarmi et al [7] in

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studying the social and economic factors affecting the degradation of natural resources in mountainous areas in Tehran consider that the issues related to the livestock and grazing management as the main factor of known destruction and in the Prairie areas the land-use change as the most important factor of destruction. This is while Adhikari et al. [15] and Maggs and colleagues [19] have introduced common ownership management as one of the ongoing performances to reduce poverty and a source of income of rural families and indicated that the assumption of the single-beneficiary model as the range manager causes harmful effects. On the other hand, Bon [16] in a study of comprehensive evaluation and management on rural lands in the East Africa stated that proper observance of the livestock size and livestock per capita share from the pastureland available for each household in the Eastern Africa region leads to creating sustainable capacity between food security and the protection of natural resources. Also Natham [19] in his studies related to considering the management quality of the conventional systems stated that

paying attention to human issues such as conventional systems and applications, determining the people who have the right, the existing convention and laws prior to implementing the plans and projects related to the natural resources have been considered important.

Now, the utilization method of range s under study is in the form of common, which according to the above contents seems that it cannot solve the problems of source of income and range s degradation in the systems. considering the role and the importance of the privacy and mountainous range s in providing the villagers' livestock grass in the area under study in Torbat-e-jam, in this research, the conventional systems in terms of the residents' utilization methods of the systems from the range , the number of livestock, the composition of herds, identifying the types of lands and the livestock exact grazing range in the conventional systems through various techniques, including GIS were identified, which can play an important role in the international distribution of livestock grazing in these areas . In this research, also the audit and non-audit systems have been identified and by measuring and comparing the Crown cover percentage parameters and production in the systems, estimation of the range capacity, the density of livestock and the proportion of livestock with the ranchers' range capacity they have found out the process of changes in the range and they can make decisions with more information to manage the livestock graze.

2. Materials and Methods

The study area is located in an area of 7712.4 hectares, geographical location of 28° 17′ 35° to 40° 23′ 35° North latitude and 58° 11′ 60° to 58° 17 ′ 60° eastern longitude and it is located in the altitudes between 1100 to 2600 meters above sea level have dry and semi-arid climate and they are located in a distance of 41 km from city of Torbat-e-jam in Khorasan Razavi province (figure 1).

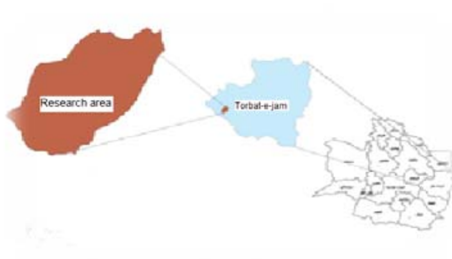

Figure 1- The position of the studied region in the province of Khorasan Razavi

The target area includes 5 conventional systems, which includes Zavader, upper Samsara, lower Samsara, Bidestan and Ghazqaveh villages (figure 3). It should be noted that the range audit operations have been done in ghzaqavah, Zavader and upper Samsara systems and in Bidestan and lower Samsara systems the auditing operations have not been done.

The area of pastoral lands, the arable lands and unusable lands in conventional systems is as percentage in accordance with Figure 2:

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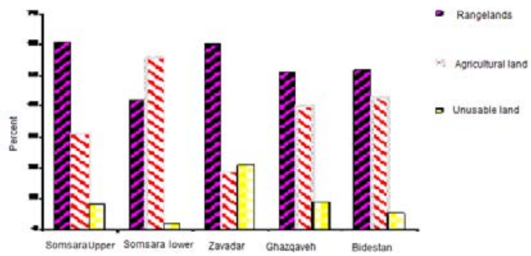

Figure 2 – Diagram of percentage of the pastoral lands, arable and non-usable conventional systems in the study area

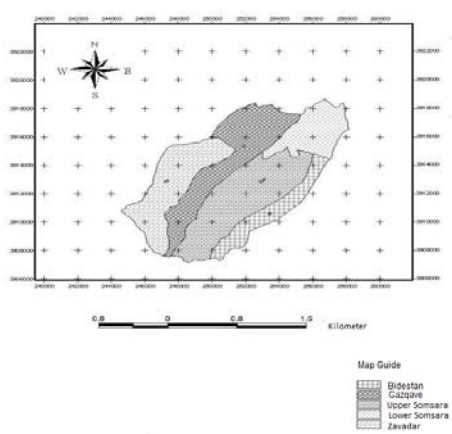

Figure 3- Map of conventional systems range in the study area

Also, in order to determine the percentage of Crown cover on range s of the area10, a 20- meter transect in the form of systematic and 10 one to two square meters plots are deployed randomly and in plots, the forage for grazing is cut and being dried, it was weighed. For estimation of forage production in the conventional systems also a modified double sampling technique was used [12]. In order to determine the condition, the four-factor method was used. Also the determination of the density of livestock per hectare was obtained on the basis of the ratio of livestock unit to the range s' area.

Measuring the capacity in different systems' range s was also obtained through using the calculated production in acre, the grazing course and the area of the tips during the grazing season. After collecting data, first the data normality test through using Anderson – Dar link test was carried out. For condition comparison, the Crown cover percentage, the production and the size of the herd in the convention systems the one-way variance analysis method (One-way ANOVA) was used. The dropped plots were as replicating and in the case of F-test being significant; to compare the above factors the least significant difference (LSD) was used. For the statistical analysis of the data, MINITAB (V. 16) software was applied [13].

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3. Discussion and conclusion

According to the figure (5), it was observed that the status of Lower Samasra system in comparison with other systems has lied at the lowest level and with a very poor status degree, it has a significant difference with Upper Samsara and Bidestan systems, although it has no significant difference with Ghazghaveh and Zavader systems, which the reason of this difference can be known due to the increase and the intensity of livestock graze , pastoral lands shortage, the accumulation of livestock in the downstream lands near the trough areas (watering place areas) and also the topographic conditions in Upper Samsara.

In their studies, Geelan et al. [18] and Shokri, et al. [9] have also reached the similar results in this field.

Based on the results observed between the crown cover percent, exploited production and the size of the herd in the conventional systems of the region, there is no significant difference at the level of 5 percent ($P > 0.05$), which the reason of it can be mentioned due to the existence of livestock surplus to the range capacity, exploited units being small and overgrazing. The results obtained conforms with most studies done in this field by Azarnivand and Mousavinejad[1], Sardari [8] and Arzani, et al. [2]. Sardari [8] knows the increase of the number of the livestock in the range in cases having plan and without plan and lack of proper and systematic management, the reason for the lack of this difference in the ranges having the plan (auditing) and states that through choosing appropriate methods of measuring the effective factors in the range capacity and also through increasing accuracy in choosing the grazing systems and corrective methods steps will be taken towards reforming the shortcomings and then he considers monitoring over their implementation essential.

It was also observed that the systems, which have the lowest levels of pastoral lands have the most rate of livestock density per hectare. In this regard Van Pollen et al. [23] in their studies concluded that the effect of livestock density in the arid and semi- arid rangelands is much more important than the type of grazing system. Achieving optimal grazing intensity is one of the major issues that must be considered in the grazing management, but the timing, abundance and selection of the forage by livestock also plays an important role in the gazing management.

In the past few years, population growth and the need for food has caused mankind to increase the number of their livestock to resolve their needs, particularly in the field of livestock products. Finally pressure of surplus livestock has become more on the capacity of the ranges and ranges have turned into agricultural lands [7]. Therefore, according to the information obtained, it was observed that all the systems have surplus livestock of the rangelands capacity and the reason is the conversion of the region downstream rangelands to rain- fed arable lands (Figure 4) and also pastoral utilization units for livestock grazing in these systems are inadequate , which according to researches done in the area and lands classification map, the application change from rangeland to rain-fed lands in the past have been observed in some parts of the study area and it conforms with the above results.

On the other hand, the area of rangelands for number of livestock units grazing that is necessary to supply to the costs of a household is not sufficient. The rangeland users with Per capita at least45 heads of small livestock with an average of 52.3 hectares per person, which its maximum belongs to Zavader system with 61.3 hectares and its minimum belongs to Lower Samsara with 16.01 hectares, use the conventional system rangelands commonly. These results are compared with some studies carried out in this area by Barani et al. [4], Arzanie et al. [2] has less average. Arzanie et al. [2] achieved similar results in their studies and they expressed that the least required area in order to run a flock of 100 heads in a period of 5 to 6 months is about 300 hectares, which in the summer- quarters rangelands this area has been estimated 200 hectares and in winter-quarters rangelands, it has been estimated 600 hectares. Appropriate size of the herd observance and the rancher's per capita share from the range land causes the creation of sustainable capacity between food security and resources conservation [16].

Considering the studies carried out in this field, we can realize this number of head of livestock and rangeland area is by no means a good income source for rural families in this system and if there is not a proper farming

among the region's households, they will face with a lot of economic problems. Therefore, if the lands management are defined as integrated based on conventional systems, which any agricultural, industrial, animal husbandry activities, etc. are managed within the framework of the conventional systems, the executive organizations can have a systematic and comprehensive planning in order to resolve the problems, in such regions.

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Governance of ecosystem services for sustainable development

H. Rezaei

Abstract**—** For sustainable use of ecosystem services (the benefits that nature provides to people) we need to identify services at different temporal and spatial scale. Then, good governance is required for personal and social behavior proportional to each service. The formation of the governance concept has been caused to many efforts have been made for implementing the governance of ecosystem services. Different modes include free market modes, private modes, public modes, and institutional environment is taken into consideration. Although each of them has the ability to carry part of the governance of ecosystem services but the integration of all the modes can govern the ecosystem services.

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Keywords**—:** ecosystem services, governance, sustainable development, welfare.

I. Introduction

THE term and concept of sustainable development was made for two reasons. First, people observed the biophysical degradation and damage of environment. This is occurred despite a better financial situation and the economic growth. The second reason was the un-successful efforts to "development" after World War II due to the continuation and worsening poverty. These concerns have been caused the UN and other agencies to investigate for decades before the establishment of "World Commission on Environment and Development". Finally, the commission working groups discussed and evaluated the issues. The working group found that social and ecological destruction have common causes and consequences. Thus, they need a common responses and actions. The final report "Our Common Future" [1] has attracted the interests of many around the concept of sustainable development which later stated in Agenda 21 and the Rio declaration [2].

The commission stated sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[2].

However progress towards sustainable development, need ecosystem to be managed in such a way to allow them to provide maintenance and sustainable use. However, the need for ecosystem services such as water and food are increasing and human activities simultaneously reduced the ability of many ecosystems in meeting the needs. Good governance [3] is required to achieve sustainability in our society. This paper has been paid the concept of ecosystem services, sustainable development and governance, to explain the governance of ecosystem services and its importance.

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II. Ecosystem Services

Direct or indirect use of the environment (nature) in different ways is not a new issue and it return to human history. The new concept of "Environmental Services" began from the 1970s" which was renamed "ecosystem services" in the mid 1980s, and expanded after 1997 [4]. Ecosystem services' is the term that has been used most frequently. Fisher et al. [5] indicated that the three following definitions are most commonly cited:

- the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life;
- the benefits human populations derive, directly or indirectly, from ecosystem functions;
- the benefits people obtain from ecosystems.

However, the most famous definition is the products of ecological functions or processes that directly or indirectly contribute to human well-being, or have the potential to do so in the future. In other words, ecosystem services are the benefits people obtain from ecosystems [6]. The "Millennium Ecosystem Assessment" distinguished four categories of ecosystem services including provisioning (food and fiber, fuel, fresh water, biochemical and genetic resources), regulating (climate regulation, disease regulation, water regulation, water purification, pollination), cultural (spiritual and religious, recreation and ecotourism, aesthetic, inspirational, sense of place, cultural heritage), and supporting services (soil formation, nutrient cycling). Ecosystem services affect human well-being and all its components, including basic material needs such as food and shelter, individual health, security, good social relations, and freedom of choice and action (Fig. 1). Changes in ecosystem services affect human well-being through impacts on security, basic material

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for good life, health, and good social relations and the freedoms of choice and action. Also the constituents of well-being are in turn have influence on ecosystem services [6]. In sustainable development, ecosystems services should be managed in such a way that it can be use services continuously and stable. Thus we should minimize the gap between needs and ecosystem services to obtain sustainable wellbeing.

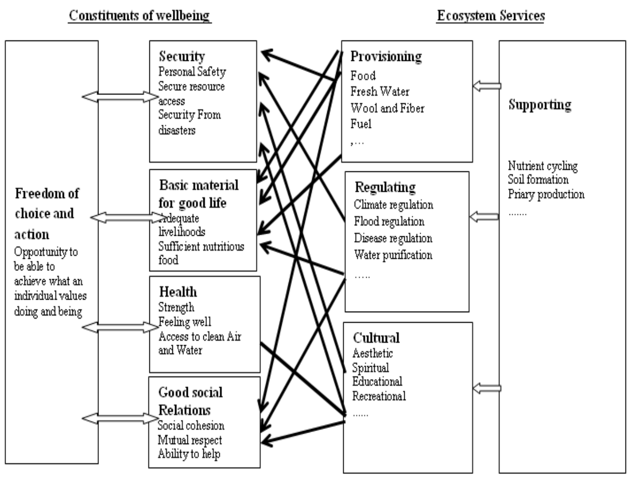

Fig 1- Ecosystem services and wellbeing constituents [6].

III. GOVERNANCE

The term of governance like "sustainable development" was widely considered in the 1980s. It is attractive because it contains various and important factors [2]. Various definitions have been proposed for governance. In the social politics and management science literature, governance is defined as ways that the community can organize themselves to achieve a goal [7].

The World Bank defined governance as the manner in which power is exercised in the management of a country's economic and social resources for development [8]. Also, governance is defined by the United Nations as, '…the sum of the many ways individuals and institutions, public and private, plan and manage the common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and co-operative action can be taken. It includes formal institutions as well as informal arrangements and the social capital of citizens [9].

Two points should be considered in application of the term "governance". First, the government differs from the governance. Governance as a concept determined that power is inside and outside of official authority and institutions for three main groups of government actors, private sector, and civil society. Second, governance focuses on the process and makes clear that the decisions are taken regarding the complex relationship between the number of actors with different interests and priorities. Governance concept establishes compromise between competing interests, opposite interest and conflicting priorities. This is foundation of governance concept [10].

According to the previous section about ecosystem services to maintain and enhance ecosystem services we require "good governance. Therefore, ecosystem services governance is interactions of laws, norms, institutions and processes that will provide responsibility of decision-making and their implementing which affect ecosystem services [11].

To achieve sustainable development and effective provision of ecosystem services we require "good behavior" and coordinated actions at the local, regional, national, international and global scale. Management of ecosystems does not mean management of nature services but it is management of different actors with various activities to preserve the environment. Because there are different needs for governance according to the demands of actors (people are dependent on ecosystem services). Behaviors (actions or limit actions) are affected by governance mechanisms and different modes. People can manage their relationships with various modes, including free market, public modes, private modes, public modes and hybrid styles. In some cases, the choice of governance be imposing by "institutional environment" [12]. Institutions determines the rights and obligations of individuals and methods to forced them and they are including official rules, regulations, international agreements, as well as the cultural, religious, ideological, ethical norms and conscience (informal rules).

Market modes are decentralized actions that price competition has a key role. Purchase and sale, conventional contracts are examples of this modes. Environmental problems are controlled by price in this mode to individual preferences change into social preferences. The advantage of this mode is expression of ecosystem services in form of money. In this regard, concept of "payment for ecosystem services" is expanded [9]. Healthy and organic products are ways to use market modes properly benefiting from ecosystem services. Healthy and organic production methods are examples of free-market modes to make suitable use of the ecosystem services. However, taxes and duties has followed the same trend for exploitation of rangeland, forest etc. There are considerable concerns in these modes including supervision, accountability, and lack of affordable coverage for all values of ecosystems.

Private modes are including customs and cultural norms, practices and informal institutional arrangements such as voluntary measures, environmental agreements and environmental contributions.

Public modes: consists of various forms of government intervention in the market, the private sector and informal by ways such as laws, policies, guidance, government taxes, duties, public facilities, public investment,… [12].

This mode is often based on compliance with the rules and regulations and it is believed that the required changes can be performed by laws and regulations. Intervention and formulation of rules and regulations can play an important role when of other modes are not efficient. It should not be forgotten failures of public mode, because of improper

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interventions, too many rules. Finally, a hybrid modes is an integrations other modes. One mode can not provide good governance of ecosystem services exclusively, due to the preference and disadvantages of each mode. Thus a hybrid mode have higher integrity and is a good mode for implementing [12].

Ruokolainen et al. [13] have introduced six guiding principles for realizing service ecosystem governance:

1) identifying stakeholders and identifying management for ecosystem actors; 2) using collaboratively managed life cycles and choreographies;3) explicitly declaring and controlling dependable actor behavior; 4) addressing ecosystem knowledge management in all ecosystem operations;5) ensuring that ecosystem governance activities can be aligned with and analyzed with respect to governance principles and standards used in individual organizations; and 6) representing the ecosystem elements in a service.

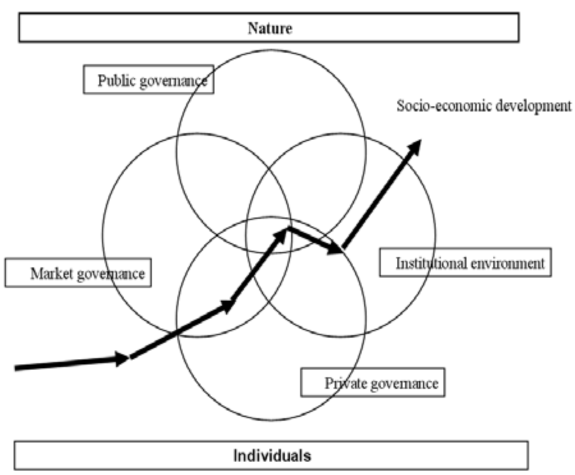

Fig. 2 - Governance modes and their relationship [11]

The steps to operationalize ecosystem services governance are including [12].

1-Specification of the various services and dependencies of ecosystems. Today, modern science has been presented, appropriate methods for grouping various ecosystems and services with desirable spatial and temporal scales [14] [15]. However, in many cases is not possible or at least can not be done easily. For example it is difficult to specify regulating and supporting services and functions in outside of administrative or the range of interest [1]. However, many efforts have been done to address the problems. For example to study ecosystem services in a region, consider wider area to allow trade-off between provided different ecosystem services [11].

2-Set the management requirements for each of the services ecosystem. In this stage, it is necessary to clear problems, issues and risks associated with each of the ecosystem services. Then management needs will be specified. The remarkable thing is that ecosystems services are not independent of one another, and the greater attention to one ecosystem services is caused to reducing of another service [16].

3- Practical options (the available and possible options) are determined for the specific conditions of ecosystems and their services and then evaluate various available options to the comprehensively [17].

4-Deficiencies (failures) will be determined in the private and market modes and government intervention will be identified.

5-The possibility of public mode intervention will be measured in the technological, economic, and political aspects. Different modes will be evaluated with performance criteria and to choose the best options.

IV.CONCULSION

To achieve sustainable development, we required environmental protection with respect to economic and social aspects. More comprehensive attitude to the environment and ecosystem was dominant after the formation of the concept of ecosystem services. This concept provided a platform for categorizing ecosystem services. Ecosystem constituents are classified as provisioning, supporting, regulating and cultural services.

Three debates that relate to ecosystem services and their governance in literature are often highlighted as conceptual framings, as drivers of methodological development and as points of operationalization of the concept. On the one hand, the necessity of conserving ecosystem functions for guaranteeing ecosystem services points to the need to identify and measure ecosystem services. On the other hand, the economic benefits and value of ecosystems and the services they provide for humans highlight the need to monetize ecosystem services. Third, falling between these two approaches are the spatially conceptualized and organized approaches. These approaches aim to provide a platform for merging the information on ecological characteristics and economic values as well as to solve cross scale coordination challenges [17]. These three approaches have to be integrated to obtain a basis for developing governance of ecosystem services.

Current solutions for governing complex socio-technical systems, such as agriculture section, are not feasible for managing service ecosystems in open and progressive business environments. Heterogeneity of the ecosystem and its members cannot be handled with approaches based on centralized decisions and control about the current and future state of the system [13].

Implementing the concept of ecosystem services is not possible with government alone and should be moving toward governance. There are many different modes of governance. But we can not rely only on market wisdom and/or public rules and regulations.

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A suitable approach for implementing governance of ecosystem services is based the steps as: specification of the various services and dependencies of ecosystems, Setting the management requirements for each of the services ecosystem, determination of the available and possible options for the specific conditions of ecosystems, determination of deficiencies (failures) in the private and market modes and identification of government intervention, and measure the possibility of public mode intervention in the technological, economic, and political aspects.

Also we cannot ignore capabilities and our accumulated knowledge of traditional societies that has taken shape in the form of customs and traditions. Thus, we should think beyond the power, the command, and the market. And ecosystem governance will be advanced through a hybrid mode that is an integration of other modes.

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Wintering place and Breeding Population of The Crab Plover *Dromas Ardeola* In Persian Gulf And Oman Sea in 2010

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Abstract

Crab Plover *Dromas ardeola* wintered in 25 sites and bred in 3 sites on Persian Gulf coasts and islands in 2010. It is fairly common on the coasts of Persian Gulf region, with up to 5551 pairs in breeding season and is known to hold more than 6038 individuals in winter but none of the other islands in Oman Sea are known to support large populations in 2010. In Persian Gulf region the sensitive habitats for breeding population are Khaber Nakhoda (2310 pairs), Nakhilo (1025 pairs) and Um-Al-Gorm (2216 pairs) islands in 2010. Important wintering sites were Khor Namaki (maximum 363 individuals), Khor Khaghoshi(maximum 356 individuals) Mangrove wetlands Hara Protected Area (Maximum 2242 individuals), Heleh protected Area (maximum 290) Busheher Bay (maximum 386 individuals) and coast of Gheshm island (Maximum 1337 individuals) in 2010.

Key words: Breeding, Wintering, Population, Persian Gulf, Sensitive Habitat

Introduction

The Crab Plover *Dromas ardeola* is Maritime coast of east Africa, Persian Gulf, and Arabian Peninsula(Ali & Ripley 1960-1974, Hockey & Aspinall,1996). It is resident of Persian Gulf and Oman sea coasts**(**Cramp & Simmons**,** 1983**).** The Crab Plover is known to breed only in the Persian Gulf, Gulf of Oman, Gulf of Aden and southern Red Sea, but, probably also breed in western India, the laccadives and Maldives(IUCN 2009). It is colonial breeder, and only about ten colonies are currently known, mostly in Iran, Oman, Saudi Arabia, and the United Arab Emirates. This species is known to have bred in Iraq and Kuwait in the early part of the twentieth century**(**Cramp & Simmons 1983**)** and may still do so. In Africa, it is known to breed only on islets off northern Somalia, and in Eritrea, but breeding is suspected in the Suakim Archipelago, Sudan**(**Urban& Keith 1986, Dodman, & Béibro et al 1999). Outside the breeding season, Crab Plovers disperse along coasts to Pakistan, India and Sri Lanka (less commonly to Bangladesh and south-east Asia), and south in Eastern Africa to Mozambique and Madagascar. Little is known of its distribution south of the Zambesi River, but it probably but it probably occurs regularly as far south as Maputo(Aspinall & Hockey 1996**,** Cramp & Simmons 1983**,** Hockey & Aspinall 1997). The winter range includes oceanic islands, and Crab Plovers are regular on most islands in the western Indian Ocean south to the Seychelles and Madagascar(Aspinall & Hockey 1996**,** Hockey & Aspinall 1997). Found on large flocks on tidal zone of islands and coasts. It had not seen in freshwater habitat in Iran. Breeds on suitable sand-barks, coastal dunes, mangrove wetlands in large colony. In the early part of this century, Archer and Goodman reported colonies from Somalia (British Somaliland'), on Saad al Din island; Meinertzhagen described Crab Plovers as being common in the Persian Gulf and placed colonies on the island of Umm al-Haradim, Kubbar and Auhah, adjacent to the coasts of Kuwait and northeastern Saudi Arabia. Other Gulf colonies from where there are no recent reports include Warba, Boonah (Boneh) and Dara and from the end of the last century, Montafis Island in Iran**(**BirdLife International**,** 2009).

Materials and Methods

Study Area

Study area are north coasts of Persian Gulf and islands in Iranian coasts, from Govater Bay at southeast of Iran to Khor Mosa at northwest in Persian Gulf in winter in 2010, (Fig 1). Three breeding islands were Khaber Nakhoda, Nakhiloo and Um-Al-Gorm in Persian Gulf in 2007, which surveyed on 20-26 July 2010. Khabre Nakhoda located on 30^{o} 20 26 N 48^{o} 55 53 E. It is flat, sandy and Shelly, 70-90% of area of the island covered by vegetation in Feb and March. All around of the island is mudflats. Area of the island is 3 hectare in high tide and more than 500 hectare in ebbs. There is a Grave in the middle of island, is named Ghabre

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Nakhoda (Ghabr mean is Grave and Nakhoda meaning is Captain). Main plant community of island is *Atriplex+Stipa+Suaeda+Halostachys*. The main plant species of this community are *Atriplex leucoclada, Stipa capensis, Suaeda fruticosa, Halostachys belangeriana, Calanderula persica, Malva sp, and Cistanche tubolusa. Suaeda fruticosa* is the distinguishing species of this community. Herons use the bushes of this species for nesting and breeding. There is another plant community in Khabre Nakhoda, Calendula+Cistanche. Sandy soil rich in oyster shell are covered with this community. *Cistanche tubolosa* is a vulnerable species in this community. *Calendula persica* is an endemic species. Terrestrial Birds feed on grains of *malva* and *stipa*. Homogenous communities of *Stipa capensis* can be found as in green cover in Gabre Nakhoda. One of the main roles of this plant community is conservation a surface soil against erosion. In the undulating part of the island, this community stabilizes the nests and provides a shelter over them. Four small, low-lying Persian Gulf islands located a few Kilometers offshore c.40 km south-east of the Mond river delta, (Fig 1). Nakhiloo (27°49'N, 51°28'E, 133 km SE of Bushehr) the westernmost island and furthest offshore, is c.35 ha, almost circular, and composed mainly of sand with some rocky shores in the south and west. There is a small brackish pool near the south end of this island. Main plant community of the island is *Arthrocnemum+Atriplex+Cyperus+ halopyrum.* The largest one is Khan, (27°29'N, 51°16'E, 108 km SE of Blusher), **(**Fig 1), covers an area of 800–1000 hectares, consisting of a broad expense of bare mudflats without any vegetation. Um-Al-Gorm(or Ummal Karam), (27°00'N, 51°33'E, 140 km SE of Bushehr), easternmost island, lies than 1 km off the main land and is c.1.5 km long and 500 m wide(c.75 ha),

With rocky shore in the south, sand beaches in the north, and extensive dunes particularly in the west. Central basin of the island completely covered by low scrub, main plant species are *Efedra foliate, Halocnemum strobilaceom, Arthrocnemum macrastachyum* and Tahmadon (27°51'N, 51°27'E, 130 km SE of Bushehr), 700 hectares with a chain of low vegetated(*Arthrocnemum macrastachyum,cyperus conglomerates,halopyrum mucronatum*) dunes along its south-west margin and round the southern end. All five islands are devoid of fresh water and uninhabited. These islands are warm in summer (45°C) and moderate in winter, their main inhabitants are the seabirds, but also Marine turtles are present annually in spring and summer.The seabirds are considered to be the most important inhabitant to live. Endowed with good texture of soil, overgrown plant covering and water enriched with food. These islands are safe and sound environment for nesting and breeding for migratory waterbirds as well as Crab Plover *Dromas ardeola* such that annually in spring and summer.

Nest count method

Counts are done in 20-26 in all islands, after Crab Plovers made nests and laid egg. Total count method used to take census the nests (burrows) and breeding population of Crab Plover *Dromas ardeola.* Wintering population counted on January 2010 at all coasts on Persian Gulf and Oman Sea.

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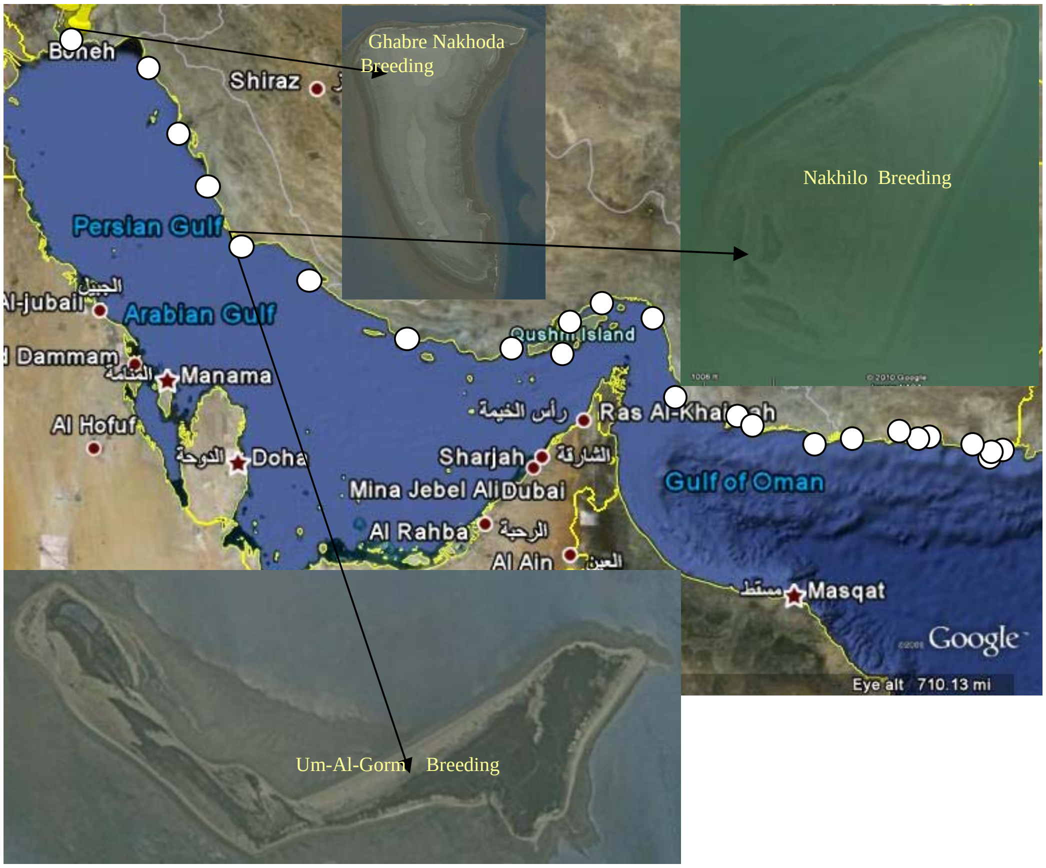

Fig. 1: Breeding and wintering places of Crab Plover at Persian Gulf and Oman Sea coasts in 2010

Species characteristic

Crab Plover *Dromas ardeola* is classified as Charadriiformes(Sibley& Monroe 1996). The species was named by Paykull in India, in 1805(Sibley& Monroe 1996). However, these birds are distinct enough that most taxonomists consider them to be a monotypic family with uncertain affinities to other groups(Sibley& Monroe 1996). For instance, the tarsal scutellation and UN patterned down of chicks indicate a grouping with the gulls (family Laridae), whereas their burrow-nesting habits suggest a close relationship with the auks (family Alcidae). In general, the most widely accepted classification is to group Crab Plovers within the shorebirds or waders of the suborder Charadri(Burton & Burton 2002, Cramp, & Simmons 1983, Hayman&. Marchant 1986**,** Peterson & Mountfort 1993). The Charadrii comprise a large and diverse group. Based on plumage and initial appearance, Crab Plovers closely resemble avocets (family Recurvirostridae), yet there are greater similarities in skeletal characteristics and external morphology with thick-knees (family *Burhinidae*) and coursers and pratincoles (family Glareolidae). DNA-DNA hybridization work of Sibley and Ahlquist (1990) support grouping Crab Plovers within the *Glareolidae* and divergence of Crab Plovers from other shorebirds during the Oligocene, approximately 35 million years ago(Sibley & Monroe 1996). However, the methodology of this work has received sufficient criticism to cast doubt on results. A more detailed examination of the origin of Crab Plovers and its taxonomic affinities must await results from detailed comparisons of mitochondrial and nuclear DNA(Sibley & Monroe 1996). Crab Plovers are gregarious birds that congregate throughout the year at breeding colonies, foraging areas, and roost sites(Burton & Burton 2002**,** Hayman & Marchant 1986**,** Kazmierczak. & Perlo 2000). Flock sizes at foraging sites are as large as hundreds of birds. At Persian Gulf coast on Gheshm island a flock were 1337 individuals. Most of the flock sizes are more than 200 individuals. They levee the breeding habitat in winter completely. As table 1 show there was not Crab Plover on Thee breeding sites (Ghabre Nakhoda, Um-Al-Gorm and Nakhilo islands) in 2010. At traditional roost sites birds may travel as far as 15.5 mi (25 km) to join flocks of up to a thousand individuals. In these groups, birds are noisy and emit

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a constant chatter of barking "ha-how" or "crow-ow-ow" calls(Urban & Keith 1986). There are reports of flocks being audible from distances of 1 mi (1.5 km. Birds are most active at dawn and dusk in addition to nocturnal periods. This activity pattern is attributed to avoidance of the intense mid-day temperatures of regions they inhabit. Both migratory and sedentary populations. The Crab Plover is noisy, gregarious and commonly encountered in small groups foraging on the shore for its preferred prey of crabs(Fasola & Biddau 1996). These foraging groups usually comprise around twenty to thirty birds, but may number as many as 400 outside of the breeding season.(Fasola & Biddau 1996) The Crab Plover is active during the day and night taking advantage of crabs, marine worms and mudskippers exposed by the receding tide**(**Fasola & Biddau 1996**)** This species' large, powerful beak allows it to tackle crabs without suffering injury, swallowing smaller individuals whole, and smashing larger specimens against the ground, to be consumed specimen. It feeds in the intertidal zones of mudflats.

Wintering population

The principal wintering concentrations are found along the Persian Gulf coast. In the eastern parts of the non-breeding range in Persian Gulf, the greatest numbers appear to be in Mangrove wetlands at Bandar Khamir 1337 individuals. The counted population in winter was 6038 birds, table 1. In 1990, 856 Crab Plover counted at northern coast of Hara protected Area(Behrouzi-Rad 1990). Hara Protected Area located between Gheshm Island and Bandar Khamir port (North of Gheshm and south of Bandar Khamir Port). Area of the Hara Protected Area is about 100000 hectare and 10000 hectare of it is Mangrove wetlands. There are more than 60 small islands in the Hara Protected Area that surrounded by mudflats and creeks. These islands are very suitable habitats for many wintering waders also Crab Plover. Some estimates of wintering populations include 1,250,1,750 in Iran in the 1970s(Scott 1995). A wintering population of 2,500-5,000 birds was located in the Gulf of Kutch Marine National Park in Gujarat, India, in 1984, and this population has since been estimated at a minimum of 6,000 birds(Wetlands International 2002). The species is abundant on the coast of Tanzania between September and Apri(Urban & Keith 1986). 6,059 were counted by the African Waterbird Census in January 1998, including over 4,200 on Zanziba(Dodman et al 1999). 1990s population size estimate 60,000-80,000 individuals in the world. 1% threshold 1990s were700, 1990s population trend was possibly stable(Cramp & Simmons 1983) minimum estimate based on maximum counts of wintering birds in combination with estimates of 1,500 in Iran, 6,000 in the Gulf of Kutch, 500 in the rest of India, 2,000 in Kenya and 1,000 in Aldabra produces a figure of about 40,000 birds. Given the lack of mid-winter counts from Somalia (where the species is a regular visitor to much of the coastline and could be abundant, Sudan and most of the Indian Ocean islands, and the poor coverage of many other parts of the wintering range, especially the south and west coasts of the Arabian Peninsula, it is possible that the total population could be double this figure. The Perennou *et al*. (1994) estimate of 43,000 would thus seem too low, and is here revised to 60,000-80,000 (comprising 40,000-50,000 in Africa and 20,000-30,000 in Asia). The overall status of the population is uncertain. The decreasing trend given by Perennou *et al.* 1994 was based on reports of a decrease in the numbers of birds wintering in some areas in Southern Asia, and may not be applicable to the bulk of the population further west concluded that there was no evidence of any change in numbers in recent years.

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Table 1 : Wintering place of Crab Plover at Persian Gulf and Oman Sea coasts in 2010

Sites	Number	Located
Korea sayeh Khosh	65	Persian Gulf Coast
Hara p.A.	2242	Persian Gulf Coast
Qeshm island Northern coast	1337	Persian Gulf coast
Chore Bande zarak	42	Persian Gulf Coast
Khor Karakan	85	Persian Gulf Coast
Khor Kolahi	2	Persian Gulf Coast
Khor Namaki	363	Persian Gulf Coast
Khor Kharagi	20	Persian Gulf Coast
Koore Tiab	180	Persian Gulf Coast
Mouth of Rude Shour	225	Persian Gulf Coast
Khor Berzik	263	Persian Gulf Coast
Khor Kargoshi	356	Persian Gulf Coast
Khor Gavbandi	310	Persian Gulf Coast
KhorTafarkan	6	Persian Gulf Coast
KhorJask Gharbi	14	Oman Sea Coast
Koore Kontaki	23	Oman Sea Coast
KhorNehor	34	Oman Sea Coast
Khor Noktarash	1	Oman Sea Coast
Khor Had	1	Oman Sea Coast
Khor Meydani	2	Oman Sea Coast
Helleh P.A.	290	Persian Gulf Coast
Bushehr Bay	386	Persian Gulf Coast
Mond P.A.	43	Persian Gulf Coast
Govater Bay	38	Oman Sea Coast
Hore Baho	10	Oman Sea Coast
Total	6038	25 sites

Breeding population

The breeding season occurs between April and August, at which time dense colonies form around areas that have an abundance of Crabs on which the young can be fed.

Compared with the majority of the worlds' coastal breeding waders, Crab Plovers have a very restricted breeding range, stretching from Somalia in the west via the coast of Arabia to Iran in the east(de Marchi, Chiozzi, & Fasola 2008**,** de Marchi, Chiozzi, Semere & Galeotti 2006). Most waders with such a characteristic are confined to one, or a few, islands and several have become very rare while others are now extinct(Rands 1996). Colonial nesting, an aspect in the nesting behavior of Crab Plover which has a strong bearing on their conservation, is much more characteristic of seabirds, be they on cliffs or on islands, than of waders. Only a dozen or so Crab Plover breeding colonies are known and several of those that have been pinpointed have not been visited in recent years(Aspinall & Hockey 1996**,** Hockey & Aspinall 1997). All are on islands and conservation is effectively an 'all or nothing' act: an entire population can be saved, or just as easily lost, in one fell swoop. The same applies in the winter quarters, albeit to a lesser degree, because they remain sociable year-round, feeding in a limited number of particularly favored areas.Breeding colonies of the Crab plover have been reported on various islands in the northern Persian Gulf. In Kuwait, on Auhah and Warba, In Iran, on Dara and Booneh(Boneh) in Khor Mosa and on islands near Bushehr(Ticehurest, Buxton, & Cheesman 1922, Ticehurest, & Cheesman 1926). It probably has also bred on Kubbar Island, Kuwait(Ticehurest & Cheesman 1925). Breeding occurred on Aulah 1n 1942(14). Since 1970, only two active colonies have been reported(Scott 1995). The breeding population of Crab Plover *Dromas ardeola* on Nakhilo island were, 1025, 2266 and 2110,in 2007, 2008 and 2009(Behrouzi-Rad 2008). This population was breeding on Um-Al-Gorm until 2009. Table.2 Scott reported 10 breeding pairs from Nakhoda Island(Scott 1995). In 2001, 470 pairs had been bred on Ghabre Nakhoda. Since 2003 this species breed on Ghabre Nakhoda regularly, Table 2**.** 500 pairs had been bred on Govater Bay in 2008 and 2600 pairs on Mangrove wetlands, table 2. The Crab Plover differs from the other wader species, however, in that it breeds underground - the only wader in the world to do so. Crab Plovers excavate their own nest burrows, more than two meters long and half a meter deep, in raised areas of sand close to the sea(Hockey&. Aspinall**,** 1996, 1997). Crab Plovers breed later in the year than other waders in the Middle East(Cramp & Simmons 1983). Coast species such as Kentish plover (Charadrius alexandrinus) start to breed in March (the end of northern winter), whereas Crab Plover do not lay eggs until well into May. The first Crab Plover chicks to fledge each year do so at the very end of July or beginning of August when the temperatures and humidity are at their highest. Although some Crab Plovers remain in their breeding range during the non-breeding season, they do not remain at their breeding sites(Cramp & Simmons 1983). The Crab Plover is unique amongst the waders for its habit of constructing its nest in an underground burrow. The entrances of the burrows are initially angled downwards, before curving upwards and terminating in a nest chamber situated a short distance from the surface(Aspinall & Hockey 1996**,** Cramp & Simmons 1983). Crabs are most

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abundant in intertidal areas in hot climes, particularly where mangroves occur, and spend much of their time on the surface outside of their own burrows. Breeding occurs from Somalia and Madagascar east to areas of western India(Cramp & Simmons 1983). The limited breeding distribution is partly a result of the need for areas with sandy substrate suitable for burrow construction in conjunction with sufficient foraging sites.

Table 2: Breeding pairs of Carab Plover in Islands of Persian Gulf 2003-2007

	2006	**2007**	**2008**	**2009**	**2010**	**Coordinate**
Khabre Nakhoda	750	0	0	0	2310	30^{o} 20 26 N 48^{o} 55 53 E
Um-Al-Gurm	700	2168	2825	2624	2216	27°00' 54"N, 51°33' 37"E
Nakhilo	-	-	-	-	1025	27°49' 16 N, 51°28' 27"E,
Khan	5	-	-	-	-	27°29'37"N, 51°16' 52"E
Mangrove wetland, Bandar khmir	-	-	2600	-	-	26^{o} 53' 35" N 55^{o} 40' 42" E
Govater Bay	-	-	500	-	-	25^{o} 11' 49"N61^{o} 33' 15" E
Total	1455	2168	5925	2624	5551	

Within the breeding range, but during the non-breeding season, a maximum of 600 has been counted at Khor-Al-Beidah when just over 500 were present on Merawah Island, both sites being in the United Arab Emirates. The Abu al Abyadh colony, of c300 pairs, is vacated at this time and it is thought that these birds travel the short distance to Merawah, whereas it is possible that birds at Khor al Beidah have come from one or more Iranian colonies. Their occurrence at this locality has been erratic and unpredictable in recent years. Elsewhere in the Persian Gulf, Kuwait and Saudi Arabia have more than 200 birds each, and between 1250 and 1750 spend the nonbreeding season on the (Mekran and Baluchistan) coast of Iran**(**Evans 1994). In Oman, there are records of 2000 at Masirah Island (also a breeding station) and 3000 at Barr al Hikman, although these may refer to the same wintering group. East of these western and northwest Indian Ocean resorts, the only major concentration found to date, and a very important one at that, are some 5000 birds in the southern Gulf (Rann) of Kutch. These come from an unknown source.

Conservation

Within the United Arab Emirates the Crab Plover's breeding colonies, located on two islands in the Abu Dhabi Emirate, receive formal protection, as does the colony on the Farinas Islands, Saudi Arabia(Aspinall & Hockey 1996). In order to safeguard this species against potential threats, the other known breeding colonies, in particularly the large Eritrean colonies, would also benefit from the implementation of protective legislation(11). Crab Plovers are not listed as threatened or endangered. Based on extrapolations from large-scale winter surveys, the global population is estimated at 43,000–50,000 individuals with the greatest numbers found in Tanzania (20,000–26,000 birds). Counts at nine known colonies sum to 4,000–5,000 pairs**(**Wetlands International 2002). Includes Iran: 5551 pairs; United Arab Emirates: 300 pairs; Oman: 85 pairs; Saudi Arabia: 110 pairs**(**Cramp & Simmons 1983**).** However, with only nine identified breeding colonies worldwide, the locations of most breeding sites remain unknown.One cause for concern is that large concentrations of Crab Plovers occur near to oil production sites. Due to their small population size, low reproductive rate, and narrow habitat requirements, the species would take a long time to recover from a catastrophic event. Other potential threats are the destruction and degradation of mangrove and other coastal habitats from pollution and development(de Marchi et al 2006). This fascinating species warrants further studies, as well as increased survey and monitoring efforts to ensure its continued persistence. Nesting on islands is one way of avoiding predators; in general, the further from the mainland the less the likelihood of ground predators being present. Burrow nesting avoids the excessive heat experienced at the surface and this is likely to be the real reason for Crab Plovers digging their burrows, since the predator-free island they occupy would not necessitate disappearing underground(de Marchi et al 2006). A single white egg is laid, which is very large and provides the developing chick with sufficient energy that after the 32 to 33 day incubation period it hatches very well-developed and is quickly able to walk. With a large overall population, the Crab Plover is not considered to be globally

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threatened(IUCN 2000). Crab Plover is not protected species in Iran.

Discussion

The Crab Plover *Dromas ardeola* is an aberrant maritime wader, endemic to coastlines of the Indian Ocean Region**(**Cowan 1990**).** At the end of the breeding season, most Crab Plovers head away from their colonies. Outside the breeding season, the Crab Plover occurs over a large range, extending throughout much of the Indian Ocean, from Natal, South Africa, east to the Andaman Islands(Aspinall 1996). After breeding season, Crab Plover spread in Persian Gulf and Oman Sea coasts from Govater Bay at south east of Oman Sae to Khor Mosa northwest of Persian Gulf, table 1, (More the 2200 km). During the breeding season, however, the known breeding colonies are found within a much more restricted range at a small number of sites around the southern Red Sea, the Gulf of Aden, the Gulf of Oman and the Persian Gulf(Aspinall, & Hockey 1996, Burton & Burton 2002, Hockey & Aspinall). Breeding colonies were in three sites, Ghaber Nakhoda, Nakhilo and Um-Al-Gorm (2310, 1025 and 2216 pair's respectivly in2006-2010) table 2. There have been no recent counts from Somalia but Crab Plovers certainly still occur and presumably breed there. The present most westerly colony lies in the Farasan Islands (belonging to the Kingdom of Saudi Arabia) in the southern Red Sea. Four other colonies are known around the Arabian peninsula, two in the United Arab Emirates (UAE) in Abu Dhabi; one on an islet off Umm al Karam(Um-Al-Gorm,)(Scot 1995). This colony, the largest known, held 1500 pairs in the early 1970s and may well still survive at the present time(15,30). This colony is active and breeding population of this colony increased from 700 in 2006 to 2216 pairs in 2010(Behrouzi-Rad 2008). In the early 1970s, the colony at Auhah was still active, but it was reported in 1990 that there was 'no longer any evidence of breeding' on the coast of Kuwait(Cramp & Simmons 1983). On the basis of numbers of birds counted during the non-breeding season (6038 individuals), there must be some undiscovered, perhaps substantial, colonies still to be found because it is impossible to cover all wintering place of the Crab Plover at Persian Gulf and Oman Sea coasts. Other colonies, unvisited since the early 1970s, may of course still be occupied. Nonetheless, it seems possible perhaps probable, that the entire world population breeds at less than 15, or even less than ten, sites. Crab Plovers are a coastal marine species that occurs in desert and semi-desert regions. Population is estimate 60000-80000 individuals(BirdLife International 2009**,** IUCN 2000). It seems likely that birds moving east or remaining within the breeding range in the Persian Gulf. The three colonies in the west of here, in the Red Sea and Gulf of Aden, would have to be the source for the African /Madagascan populations(Fasola & Biddau 2002). These alone are much too small for this to be possible. This can only point to one conclusion: somewhere along the coast of Somalia (and probably including Saad el Din Island) are major breeding grounds of Crab Plovers- to the point that they may contain half or more of the world population(Wetlands International 2002). It seems likely that these 'armchair-theory' colonies are the principal source of birds migrating to East Africa, Madagascar and associated islands. The challenge now is to find them! The Bajun Islands off southern Somalia seem a likely place to look. Various aspects of Crab Plover reproduction are fascinating and in some cases unique(Fasola & Biddau 1996**,** Wetlands International 2002). These birds nest during the hottest and driest times of the year (May to July) when temperatures in the shade can exceed (40°-45C). Presumably, the timing of nesting coincides with the period when Crabs are plentiful enough to sustain young growing chicks. As a response to these extreme temperatures, Crab Plovers nest underground and are the only shorebird or wader (Charadrii) to construct burrows(Aspinall & Hockey 1996, Fasola,Canova &Biddau 2002**,** Hockey & Aspinall 1996). These birds use their bills and feet to construct burrows in sandy substrates. Despite this fact, the chick remains in the nest chamber until fledged, where it is fed live crabs by both parent birds. Recently described 30 new nesting sites of the Crab Plover *Dromas ardeola*, the main breeding grounds of which were largely unknown, and for which fewer than 30 colonies had been confirmed since 1970. Survey included 90 islands, 53% of those existing, in the Dahlak and Howakil archipelagoes, and off the coast of central Eritrea(Rands 1996, Wetlands International 2002). Colony size varied between 20 and 400 nests. The numbers of Crab Plovers breeding in central Eritrea estimated 5000–6000 pairs, i.e. about 50% of the known world breeding population(de Marchi et al 2006). Breeding colony size varied between 700 and 2216 pairs in Um-Al-Gorm and 750 to 2310 pairs in Khabre Nakhoda Island in 2007. Breeding colony in Nakhilo were 1025 pairs in 2007. It seems the number of birds in breeding colonies in Persian Gulf is more than other places. Wintering population of Crap Plover is estimated 60 000–80 000 birds(36). Most recently, in a survey conducted between 2002 and 2004, the largest colony yet discovered was found in the Dahlak and Howakil archipelagos, off the coast of central Eritrea. However, while this comprised an estimated 4,800 to 6,500 individuals—half of the known breeding population—it still does not account for

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the large numbers of birds observed at the wintering grounds after the breeding season, some Crab Plovers remain in the vicinity of the breeding colonies, while the majority fly southwards or eastwards to wintering sites around the Indian Ocean**(**de Marchi et al 2006). Interestingly, while surveys of birds at the wintering sites appears to indicate that this species could have a global population of between 60,000 and 80,000 birds, the total population at the known breeding grounds represents only a fraction of this figure. Hence, there must be some large breeding colonies of Crab Plover that have yet to be discovered**(**Aspinall & Hockey 1996**,** de Marchi et al 2006**).** The authors of the study therefore speculate that the missing colonies probably lie in Persian Gulf. Certainly there is not breeding place in Persian Gulf and Oman sea coasts, did not discovered. From 2003 - 2007, all islands of Persian Gulf and Oman Sea Iranian border visited and only in 2005 I found tow new colony, one at Govater Bay (25^{o} 11' 49"N61^{o} 33' 15" E) with 500 nests (500 breeding pairs) in 6^{th} July 2005 and other colony in Mangrove wetland on small island near Bandar Khamir, (Between Qeshm island and Bandar Khamir (26^{o} 53' 35" N 55^{o} 40' 42" E) with 2600 nest in 12th July 2005. The diet of the Crab plovers consist mainly of Crabs, thought other invertebrates and mudskipper fish have been recorded**(**Cramp & Simmons 1983**).** Crabs and mudskippers are extremely numerous inhabitants of Persian Gulf mudflats. All around of the breeding Habitats of Crab Plover (Nakhilo, Um-Al-Gorm and Khaber Nakhoda), are mudflats, and full of Carbs and Mudskippers. The population is not monitored comprehensively in most of its range in either summer or winter, and accordingly trends are not known with any precision.

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The Effects of Planting Density and Nitrogen Fertilizer on Yield and Yield Component of Rice '7-Line' Cultivar

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Abstract— In the study was effect of nitrogen fertilizer levels and plant spacing on the grain yield and yield component of Rice '7-Line' Cultivar, A factorial experiment was laid out to determine an effective planting density and nitrogen rate for rice cultivar, '7-Line' in a randomized complete block design (RCBD) with three replications at the Rice Research Institute of Iran (RRII), Rasht. The two factors that were considered for this factorial experiment were nitrogen fertilizer with four levels and three planting densities. Three levels of nitrogen (200, 250 kg.N/ha) and three spacing's (15cm×30cm, 20cm×20cm, 25cm×25cm) were included as treatment variables. Results showed that nitrogen fertilizer management on grain yield was not significant. Planting spacing on grain yield was significant at the one percent level. Interaction of nitrogen fertilizer and planting spacing on yield was significant at the 5% probability level. Grain yield with 6300.1 kg/ha were observed in planting density for 25cm×25cm and nitrogen fertilizer levels 250 kg/ha. Maximum of nitrogen fertilizer on panicle length was in nitrogen fertilizer levels 200 kg/ha with 24.7cm.

Keywords—Planting Density, Nitrogen, 7-Line Rice, Yield

INTRODUCTION

Rice is one of the most important staple foods after wheat as second cereal in the world [2]. Rice is among most valuable crops with long plantation history and now it it's considered as important food products. Rice seed and products resulting from it form approximately 40% of food required by half the people worldwide. It can be comparable to wheat in respect of world's production. Rice plantation is oldest agriculture in Asia and supplies more than 80% of calorie and 75% of protein consumed by people of these continents [16], [13]. This crop is main food for people of southeast Asia and more than half of world people are dependent to this crop [2], [11] with attention to trend of world population growth and rice demands present production rate is not enough for consumption of consumers very most efforts has been done for new high yielding varieties but yet, the most rice fields have been allocated to local varieties, with low potential yield but with high quality [2]. With choice of adapted and high yield varieties in natural environment of rice land and extension of these varieties for farming in paddy fields to, self-sufficiency would be available [2], [9]. Nitrogen is involved in enzymatic reactions, protein synthesis and is a major component of amino acids and nucleic acids [4]. On one hand the nitrogen can be used at higher rates to increase the tillering in order to compensate the insect injured plant while on the other hand, this excess nitrogen can build huge insect population through enhanced vegetative growth [4],[15],[6]. Use of nitrogen fertilizer is inevitable to harvest higher yields but the information regarding the optimum dosage of nitrogen reported in the previous literature is contradictory. Many of the studies indicate that already used nitrogen rates are lower as the increasing applications of nitrogen increased the yield and yield contributing parameters of the rice crop [4], [3], [7], [5]. Even under optimal nitrogen supply, the importance of increasing its use efficiency cannot be underestimated. Therefore nitrogen application either in excess or less than optimum rate affects both yield and quality of rice to remarkable extent, hence proper management of crop nutrition is of immense importance [4], [11] Therefore nitrogen application either in excess or less than optimum rate affects both yield and quality of rice to remarkable extent, hence proper management of crop nutrition is of immense importance [4], [11]. Plant spacing is an important factor, which plays a significant role on growth, development, and yield of rice at its optimum level beside it, which provides scope to the plants for efficient utilization of solar radiation and nutrients [17], [12]. Closer spacing hampers intercultural operations and as such more competition arises among the plants for nutrients, air, and light. As a result, plant becomes weaker, thinner and consequently reduces yield. Under closer plant spacing, farmers cannot get desired hills/unit area which also ultimately reduces yield. Plant density exerts a strong influence on rice growth and grain yield because of its competitive effects both on the vegetative and reproductive development [4], [1]. [8], [4] observed that grain yield increases linearly with plant density until some competitive effects become apparent. The present investigation was carried out to investigate the yield response of 7-line rice in relation to nitrogen levels and plant spacing.

MATERIALS AND METHODS

Present study was effect of nitrogen fertilizer levels and plant spacing on the grain yield and yield Component of Rice '7-Line' Cultivar. A factorial experiment was laid out to determine an effective planting density and nitrogen rate for rice cultivar, '7-Line' in a randomized complete block design (RCBD) with three replications at the Rice Research Institute of Iran, Rasht. The two factors that were considered for this factorial experiment were nitrogen fertilizer with four levels and three planting densities. Three levels of nitrogen (200, 250 kg N/ha) and three spacing's (15cm×30cm, 20cm×20cm, 25cm×25cm) were included as treatment variables. At first prepare the nursery ground leveling, trowel and fertilizer application were performed. Grains were disinfected by a solution of 5 thousand vitawax thiram and the environment (in the dark and closed container with wet 60 to 70 percent) was gemmated. The seed was then sprayed in the treasury. Land equal to three repeats, each repeat was divided of 27 plots with length and width 4×3 meter. Prevent the escape of water, fertilizer and herbicide plots were drawn to a depth of half meter nylon cover. When transplanting to 25cm in height was transferred to the main floor and 2 days after transplanting the desired plots were irrigated. In each plot 50 kg/ha urea at each step was used. Fight weeds with herbicides poison tereflan 2.5 liters per hectare was performed 4 days after transplantation and three times with hand 20, 38, 50 days after transplantation. Length of clusters per unit area was by the measurement of plants in a square meter. The meteorological data and soil characteristics of experimental site are presented in Tables 1 and 2, respectively. Data were subjected to analysis of variance using Fisher's analysis of variance technique and treatment means were compared with standard (control) by least significant difference (LSD) test. The differences were only considered when significant at $p \leq 0.05$. Drawing diagrams and charts with Excel software was performed.

Table 1. Characteristics of soil in the study area

Particle size distribution (%)							
Soil depths (Cm)	Sand	Silt	Clay	Total nitrogen	Soil Texture	Potassium Absorbent (ppm)	Electrical Conductivity (ds/m)
0-20	35.5	39	25.5	0.163	Clay Loamy	306	1.45

Table 2. Information on meteorological data

Month	Max Temp (°C)	Min Temp (°C)	Rain fall (mm)	Max Humidity (%)	Min Humidity (%)
May	27.3	17.3	39.5	92	58.9
Jun	41.9	20	0	85.9	49
Jul	29.5	18.8	149.5	93.4	66.9
Aug	28.4	18.5	11	91.3	63.8
Sep	32.3	21.0	16.1	94.0	54.3

RESULTS AND DISCUSSION

Grain yield

Analysis of variance showed that nitrogen fertilizer management on grain yield was not significant (Table 3). Planting spacing on grain yield was significant at the one percent level (Table 3). Interaction of nitrogen fertilizer and planting Spacing on yield was significant at the 5% level (Table 3). Grain yield were observed in planting density for 15cm×30cm and 25cm×25cm respectively with 6394.9 kg/ha and 6300.1 kg/ha (Figure 1). Maximum of interaction of nitrogen fertilizer and planting spacing on grain yield was in nitrogen fertilizer levels 250 kg/ha and 15cm×30cm with 6970.3 kg/ha and Also was nitrogen fertilizer levels 250 kg/ha and 25cm×25cm with 7272 kg/ha (Figure 2). Earlier, [1], [4] concluded that higher nitrogen rates with higher seedling density enhanced the number of tillers that directly contribute to the rice grain yield. Nitrogen being the major component of chlorophyll and hence possessing the important role in photosynthesis plays its role in yield maximization due to more accumulation of assimilates that resulted in heavier grains [18]. There are many reports available that highlight the role of nitrogen in enhancing the rice grain yield due to its involvement in enhancing kernel weight [4], [1], [11], [14], [10].

Table 3. Variance analysis for effects of Planting density and nitrogen fertilizers on 7-line rice

		Mean squares			
Source of variation	df	Grain yield	Panicle length	Paddy length	Paddy width
Blocks	2	418943.81^{ns}	5.02**	0.26*	0.004^{ns}
Nitrogen	2	1053529.59^{ns}	2.78*	0.52**	0.004^{ns}
Planting density	2	4490699.59**	0.16^{ns}	0.17*	0.004^{ns}
Interaction	4	1276543.7*	1.1^{ns}	0.11^{ns}	0.008*
Error	16	325799.11	0.78	0.04	0.002
CV (%)		9.61	3.67	1.89	2.33

**,*: Significant at 1%, 5% level and ns: Not significant

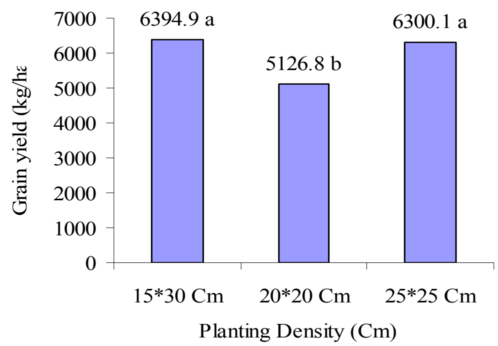

Figure 1. The Effects of plant spacing on grain yield of 7-line rice

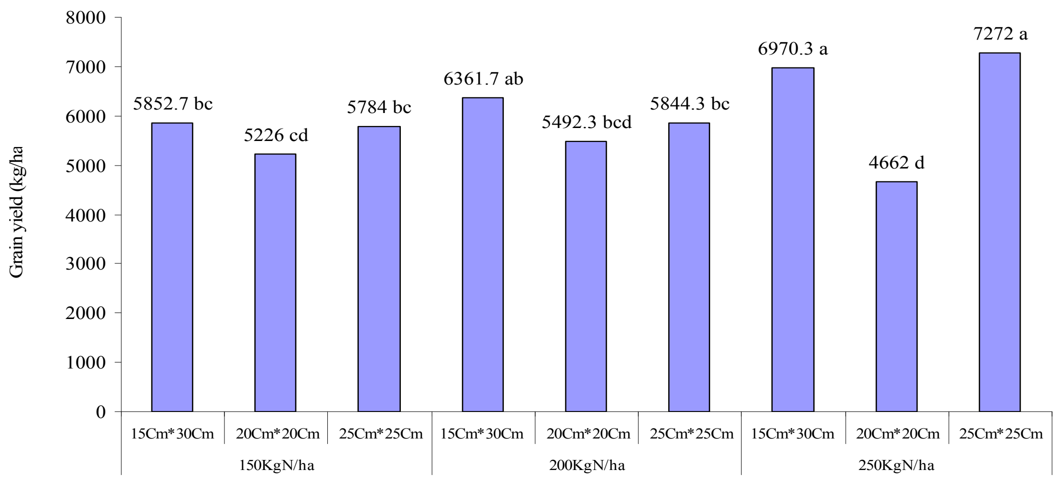

Figure 2. Interaction of nitrogen fertilizer and planting Spacing on grain yield of 7-line rice

Panicle Length

Planting spacing and interaction of nitrogen fertilizer and planting spacing on panicle length was not significant (Table 3). Nitrogen fertilizer management was in probability level the 5 percent significant (Table 3). Maximum of nitrogen fertilizer on panicle length was in nitrogen fertilizer levels 200 kg/ha with 24.7 cm (Figure 3). With the increase in nitrogen levels up to 250 kg/ha and declined thereafter. Panicle length in nitrogen fertilizer levels 250 kg/ha was 23.6 cm. Nitrogen in combination with proper seeding densities may play its role for optimizing rice yields per unit area [4] ,[10]. It is evident from the data that genetically controlled yield contributing parameters like panicle length was not affected more than 15% by the management practices or managed environment like the application of nitrogen [4].

Paddy Length

Analysis of variance showed that nitrogen fertilizer management on paddy length was significant at the one percent probability level (Table 3). Planting spacing on paddy length was significant at the 5 percent probability level (Table 3). Interaction of nitrogen fertilizer and planting spacing on paddy length was not significant (Table 3). Maximum of nitrogen fertilizer on paddy length was in nitrogen fertilizer levels 250 kg/ha with 11.6cm (Figure 4). Planting Spacing on paddy length was in 25cm×25cm with 11.5 cm (Figure 5).

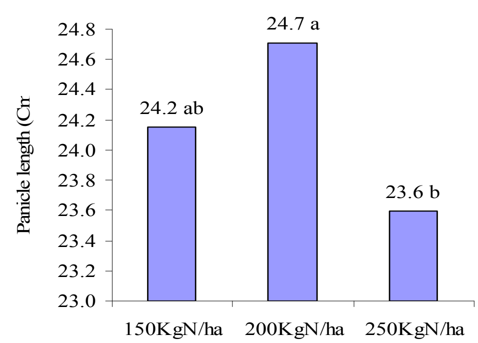

Figure 3. The effects nitrogen fertilizer on panicle length of 7-line rice

Paddy Width

Analysis of variance showed that nitrogen fertilizer management and planting spacing on Paddy Width was not significant (Table 3). But Interaction of nitrogen fertilizer and planting spacing on paddy width was significant at the 5% level (Table 3). The higher of interaction in nitrogen fertilizer and planting spacing on paddy width was in nitrogen fertilizer level 200 kg/ha and 25cm×25 cm with 2.33 cm (Figure 6).

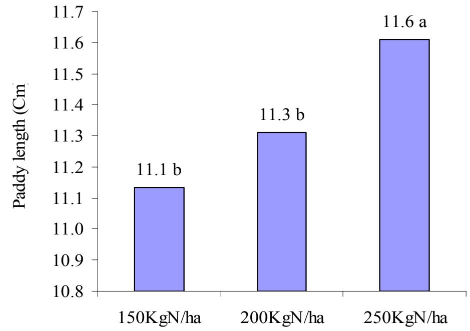

Figure 4. The effects nitrogen fertilizer on paddy length of 7-line rice

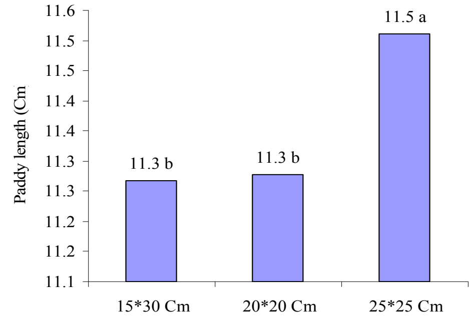

Figure 5. The effects planting spacing on paddy length of 7-line rice

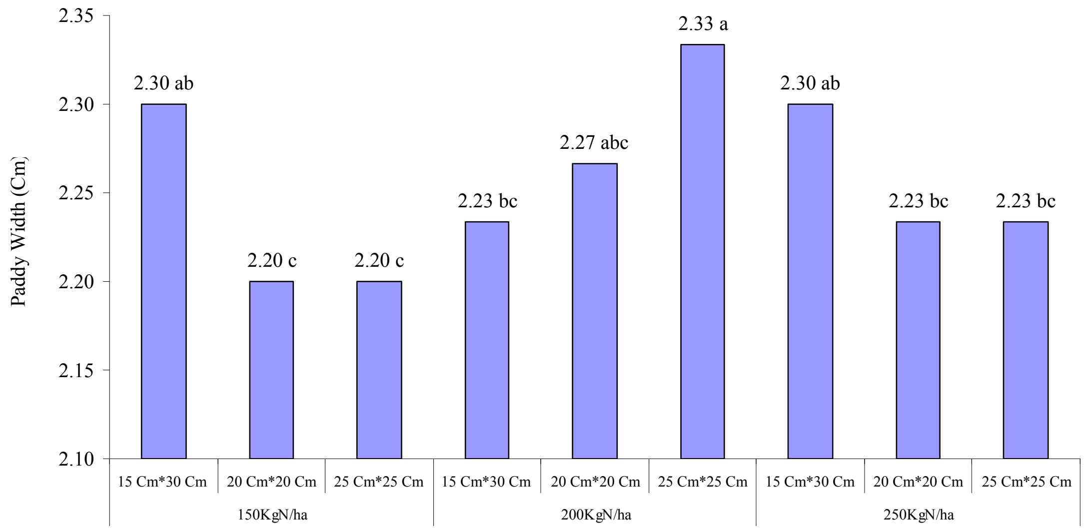

Figure 6. interaction in nitrogen fertilizer and planting spacing on paddy width of 7-line rice

CONCLUSION

The objective of this research was to determine the relationship between rice seeding rate, nitrogen fertilizer levels and plant spacing on '7-Line' rice cultivar. Results showed that nitrogen fertilizer management on grain yield was not significant. Planting spacing on grain yield was significant at the one percent level. Interaction of nitrogen fertilizer and planting spacing on yield was significant at the 5% level. Maximum of nitrogen fertilizer on panicle length was in nitrogen fertilizer levels 200 kg/ha with 24.7cm. Grain yield with 6300.1 kg/ha were observed in planting density for 25cm×25cm and nitrogen fertilizer levels 250 kg/ha. So, the most appropriate of treatment in the study was in nitrogen fertilizer levels 250 kg/ha and planting density for 25cm×25cm treatments.

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Underground Dam, an Approach to Harvest Rainwater in Arid and Semiarid Areas

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Abstract- According to the recent researches, in forthcoming years, earth will be encountered to available water supply issues, hence, increasingly, greater attention is being placed on how to manage water resources and adopt new harvesting procedures. To harvest rainwater, serves as an action in case of succeeding, improves water storage, meets increasing trend of water demand, alleviating drought impacts. The present study aims to deal with and introduce underground dam as new construction technique to exploit groundwater.

Keywords- water harvesting, drought catastrophe, underground dam, water resources, arid and semiarid areas

I. INTRODUCTION

Although it is known to be at early infancy stages for water harvesting, underground dam has been satisfying in various parts of the world. Since Iran is spanned over in arid and semiarid climate and its people and policy makers are tackling with water scarcity, to position and construct underground dams in suitable areas seems to be crucial. though application of underground dam in Iran and world dates back to ancient periods(e.g. underground dam in Sardinia island in Roman times and Meimeh in Safavid), however, as a scientific project calls for accurate reconnaissance and taking different perspectives into account, hence, the present research deals with shed lights on advantages and disadvantages of underground dam application. To the best of our knowledge, there have been some reports in literature on underground dam. Behrangi (2001), while studying of various aspects of underground dams, demonstrated that varies to local conditions, underground dams increased water resources exploitation up to 30 percent. Ishida et al., (2011), in a research as title "the sustainable use of water through construction of underground dams", addressed basics of underground dams, its construction issues around the world. They concluded that to develop underground dams and cope with the arisen problems in this area, different countries should exchange their information and experiences. Hosseini Morandi et al., (2011) evaluated determinant factors in underground dam site selection in the Fars province and concluded that due to its novelty there is no certain procedures and instructions in Iran. Chezgy et al., (2010), in a study on underground dam site selection, found that ephemeral streams bed in scores 3, and 4 are among the most suitable place to construct underground dams.

II. MATERIALS and METHODS

Underground dam is a wall made of impermeable materials in the course of a seasonal stream and impedes underground flow within the alluvium. This is done so that the water permeability from the body wall and surrounding (Between the wall and impervious bedrock) is stopped such that water level rises behind the wall and overflow it.

This overflowed can be directed to the place of consumption through water pipe or channel in gravitational manner [15]. Such structures are used in areas where there is remarkable groundwater flows fluctuations during the year. The logic behind underground dam is to store water under the ground rather than the surface [9].

III. HISTORY OF UNDERGROUND DAM IN IRAN

The first application of subsurface dam in Iran dates back to Safavid era where to increase water level in Vezvan aqueducts main wells in Meymeh Isfahan, another subterranean water were deviated to them [11]. This is continued such that valves are closed in the winter when the water is exceeded and they reopen from top to bottom to reach aqueducts gallery in the dry season water water decreases. This dam is one of the oldest underground dams in world. The first project to construction of an embankment underground dam area was launched in Kahnooj Kondur to supply water for a residential estate by the Ministry of Construction in 1991 [1]. Another main underground dams built in Iran are Kharaneq Yazd, Kuhhroz Damghan, Maku in west Azerbaijan, Sefid Dasht Shahrekord and Chandab Garmasar, Chelkrood Ramsar among many others.

IV. HISTORY OF UNDERGROUND DAM IN IN THE WORLD

History of underground dam in world backs to the ancient civilizations including the Sardinia Island built in Roman times. The world's first large underground dam as basis for technology of today's underground dams was to be built in pakoyama, California between the years 1887 [18]. In northwestern Africa, very big underground dams have been designed, mainly to increase access to water for irrigation purposes [12]. The similar structures have been used in different regions of the world specifically in India, Africa, China, Brazil and Japan [18]. Miyako Island in southwest Japan receives 2000 to 2200 mm annual precipitation. Hydraulic conductivity of the surface layer which is

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consisted mostly of sand is considerably high and surface runoff is generated rarely under normal precipitation. So water needed for domestic use and irrigation and other purposes, is supplied only by rainwater harvested in roofs and pits. Construction of underground dam in height 16.5 m and a crest length of 500 meters, the water scarcity issues in area were obviated.

VI. TYPES OF UNDERGROUND DAMS

Underground dams are divided into two general types:

1) **Subsurface dams** The principle of a sub-surface dam is relatively simple. A trench is dug across the valley, reaching down to bedrock or their impervious, solid, impervious layer at a suitable location. In the trench an impermeable wall or barrier is constructed and the trench is refilled with excavated material. A subsurface reservoir created this way retains water during wet reason and may be used as water resource throughout the dry season. This type of dams are widely common the north east of Brazil to increase the supply of agricultural water resources. These dams usually built perpendicular on river, prevents subsurface flow permeation to downstream, accumulated it the rivers sand-bed. In this way, groundwater fluctuations is lessen through water storage. The surface dam play the same role to control the river flow variations [9]. The presence of thick alluvial stream bed, makes subsurface dams appropriate for the intended purposes.

2) **Sand-Storage dams** The general principle of a sand-storage dam is as follow: a suitable size weir is constructed across the stream bed, sand carried by heavy flows during the rains is deposited and the reservoir is filled up with sand. Such artificial aquifer is replenished each year during the rain storms and the water stored is used during the dry season. They serves as sand dams that are impermeable barrier wall located on an impermeable bedrock extended to above alluvium in river bed (figure 1). Such dams are built on rivers low in alluvial thickness (3-2 m) [5]. They are constructed in layered manner such a way to allow sand and gravel sediment behind the dam and the finer particles to be washed downstream.

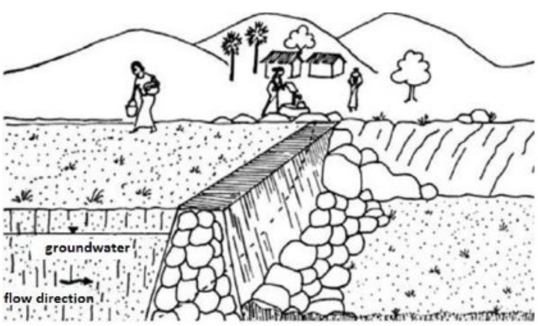

Figure 1: Typical sand-storage dam

VII. UNDERGROUND DAMS COMPONENTS

Overall, an underground reservoir dam is inspected structurally including body, operation of utilities, drainage and discharge facilities.

1) Body of the Dam Vertical and an impenetrable wall and serves as the most important and most expensive part in which materials such as brick, compacted clay, concrete, aggregates are applied [6]. The structural stability of the wall against the forces encountered during construction and during operation must be guaranteed and seepage into the body and the junction of the body and bedrock (Anchorage) should be minimal [15].

2) Utility facilitates A set of facilities that collect groundwater extraction from the dam like a series of horizontal collector pipes directs water to storage reservoir as an underground drainage. Water stored in reservoir is brought to the surface by pumping [6].

3) Drainage and Discharge facilities As in surface dams, one of the most important parts of an underground dam is weir to drain and discharge excess water. So to avoid washing the dam crest and stabilizing it, it is necessary to cut dam wall at a depth of 1 meter and then filled with coarse aggregates and stones.

4) Inspection facilities Devices and boreholes are used to control the water level in the reservoir and it fluctuations. Based on data from the facility, the decisions on amount of harvested and stored water can be made.

VIII. UNDERGROUND DAMS APPLICATION

Underground dams have wide varieties of applications depending on specific purposes and site location some of which are as follow:

1) To be served as a reservoir to storage water for drinking, agricultural or industrial purposes
2) To artificial recharge of groundwater aquifers and raise the water table
3) To avoid interference of brackish and freshwater especially in beaches and desert regions
4) To harvest rain water and water management

IX. ADVANTAGES OF UNDERGROUND DAMS

1) high flexibility to find a place suitable for the construction of underground dams that they may be built adjacent areas of agriculture, the rural and industrial lands [9].
2) Less evaporation from the reservoir than the surface dams, especially in arid areas
3) To construct, exploitation, maintains and repair such dams are most cost-effective.
4) Lifespan for underground dams is longer than those surface ones
5) Undergrounds reservoirs water experiences no temperature fluctuations
6) They are more stable and stronger than the surface ones, for this they are less subjected to collapse (5).
7) Due to less contamination, there is no additional water filtration costs.

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X. DISADVANTAGES OF UNDERGROUND DAMS

1) Invisible operation leads to lack sufficient control of border permeability, hence it entails for detailed and carefully study [8].
2) It accommodates less water volume compared to those aboveground, as their reservoirs is formed behind the dams' alluviums.
3) The deeper alluvium, the more constriction cost would be.
4) Groundwater table rises to surface, increases chance of water evaporation from reservoir, in turn, accumulates salts in soil, results in salinity.

XI. SUITABLE SITES TO CONSTRUCT UNDERGROUND DAMS

The main issue in the development and construction of underground dams is to select suitable sites. This problem arises because wide varieties of technical, environmental and socio – economic factors are involved in making decision on site selection [9]. To evaluate and determine such factors field is not cost effective using traditional methods, requires a lot of time [7]. The best way to find the perfect place for underground dams is to integrate aerial photographs and satellite images as well as reconnaissance [14].

To select a suitable site for underground dam, following notes should be considered:

A. **Climate** Irregular rainfall across the year, necessitates the water storage, however in humid climates the water abundance and less evaporation to construct aboveground dams is useful. Arid area experience a few month rainfall in variable and unpredictable manner, hence underground dam may be a promising option to water harvest.

B. **Topography** Topography data are essential on feasibility of underground dam construction as well as selecting big reservoirs under good recharge condition and less leakage. It is recommended to construct such dams in valleys or narrow rivers with considerable alluvium located at upstream. This leads to projects cost and time-effectiveness. In addition, slope is a determinant factor and should not be more than 5%. Also, in flat area, as water velocity decreases, it infiltrate more into subsurface.

C. **Geology** Due to the formation of underground storage reservoir and water stored in formations surrounding the dams, to create a repository with the proper discharge, presence of geological porous formations is seems to be essential. Streams with gravel coarse texture and coarse sand particles larger than 5 mm are in higher priority due to good porosity and specific discharge [9]. Crystallized formations such as granite, and gneiss are among the best, whereas basalt and rhyolite the worst formations in forming aquifer. Reservoir bedrock and its walls must be low in permeability and porosity and fractures to prevent water leakage and wasting. Faults and fractures in construction sites are found to be main causes of water leaks in underground dams. On the other hand, often valleys in the mountainous areas are formed due to faults and tectonic phenomena so to identify faults and fractures as inappropriate sites is necessary [10].

D. **Hydrology** Hydrological factors such as subsurface flow, runoff, drainage density, water quantity and quality are of the main factors in selecting suitable sites for an underground dam. If subsurface water present in the substrate is stationary and motionless, it cannot be expected to increase the volume of the dam. In the absence or scarcity of subsurface flows, underground reservoir is not completely water filled and water supply problems, including water rights are arisen. in quality perspective, in case water contaminants sources such as salt domes, evaporative deposits and industrial plants are existed, it is impossible to construct underground dam, as it causes water pollution and sedimentation and less storage coefficient, limiting water for drinking and agriculture purposes.

E. Socio-economic Issues Socio-economic issues on underground dam are addressed through define and estimate water demands of the region, the availability of dam, dam's impact on water resources, the availability of materials, land use and etc. Underground reservoir, not only should not affect local water resources negatively, but it should be easily accessible as much as possible in order to meet drinking water, agriculture and industry demands.

XII. TWO EXAMPLES OF UNDERGROUND DAMS IN IRAN

An underground dam in the area of Mil Sefid Ardakan, has been constructed to supply water for agriculture and domestic uses demands of village Kharaneq. Mil Sefid basin is one of the sub-basin of Khranq catchment covered in area by 33.178 square kilometers. Main channel length, maximum and minimum elevation above sea level are 11.4 km, 2945 m and 1690 m respectively. According to climatological gauges data, its annual mean rainfall and temperature is 171.3 mm and 13.3 C respectively. As per Koppen climate classification, study area is fall into dry and cold. Geologically, the major formations, include shale, sandstone and limestone belonged to Jurassic and Cretaceous. The underground dam project was launched at outlet of hydrological units in course of the main channel in downstream of Mil Sefid village in coordinates 32° 22 ′56″, 42 N and 54° 37′ 48″ 36 E. its dimension is designed as 11 m height, 42 m width made of stone and concrete. Assuming the reservoir bed slope equal to stream slope and considering alluvial depth at the dam is dam volume was calculated about 4,200 m^3. Discharge measured during implementation and after completion is 42 m^3 per day, which is equivalent to the annual discharge 15,330 m^3. Underground dam is constructed Sanganeh Kelat, Razavi Khorasan province in Sanganeh with an average rainfall of 200 mm and annual evaporation about 2200 mm in semi-arid climate. Bedrock and anchorages of underground dams is consisted of shale and marl units by coefficient of storage 7 percent. Dam alluvium thickness is 10 m, wall length 50 m, bed slope 2.5 percent and the dam volume is 8000 m^3.

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XIII. CONCLUSION

Water scarcity (deficiency) is becoming a serious catastrophe particularly in arid and semiarid areas. Since precipitations are the main source of water in these areas, so to offer an approach to store the highest water in cost effective manner in the wet season as well as dry season storage technology will be effectively promising step in the management of water resources and cope with water scarcity. Based on experiences, underground dam is known to be technically acceptable and effective in water harvesting. The main idea behind it is to stop the natural water flow to save water. In case of appropriate site selection, such structures can meet water demands. In addition, they can be taken into account in absence of others water supply resources like aqueduct and wells.

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