BI-ANNUAL RESEARCH JOURNAL "BALOCHISTAN REVIEW—ISSN: 1810-2174"
BALOCHISTAN STUDY CENTRE, UOB, QUETTA (PAK) Vol. XXV No. 2, 2011

DESERTIFICATION IN BALOCHISTAN UPLANDS & WATER RESOURCES MANAGEMENT: GOVT. PERSPECTIVE

Geography

Ahmad Saeed*
Dr. Abdul Ghaffar†

ABSTRACT:

Not just development, rather a sustainable development is what the modern prudent world is looking for. Agriculture is the main economy in Balochistan Uplands, which is feasible through groundwater irrigation only. Previously the resource was used through community based karez systems but now with the societal and technological changes it is being taped exclusively by private tubewells. This article has investigated the effects of tubewell irrigation on the ecology and landuse of Pishin Valley as a representative case for the whole of Balochistan Uplands. Three corroborative layers of data have been used –the farmers, line expertise and satellite- and analysed by simple descriptive statistics and computer aided cartographic techniques. It has come out that due to inadequate irrigation resource management, the once consistent agricultural growth has lulled; rather desertification has encroached in parts of the Valley; the public water management policies and interventions have also been inadequate and less effective in the aquifer's conservational agenda.

KEY WORDS: Balochistan Uplands, Desertification, Water Resources, Management

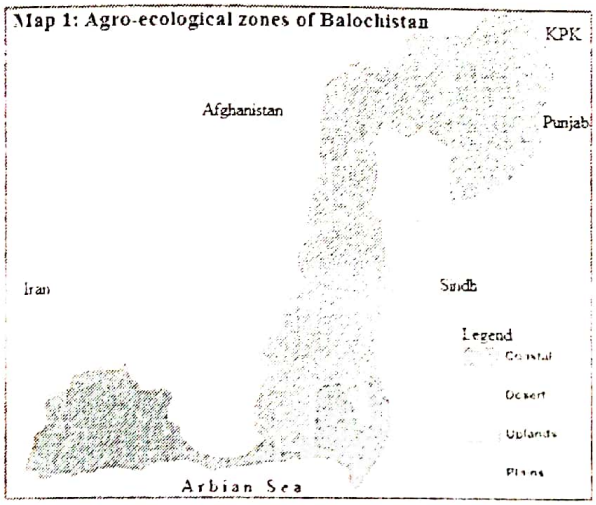
INTRODUCTION

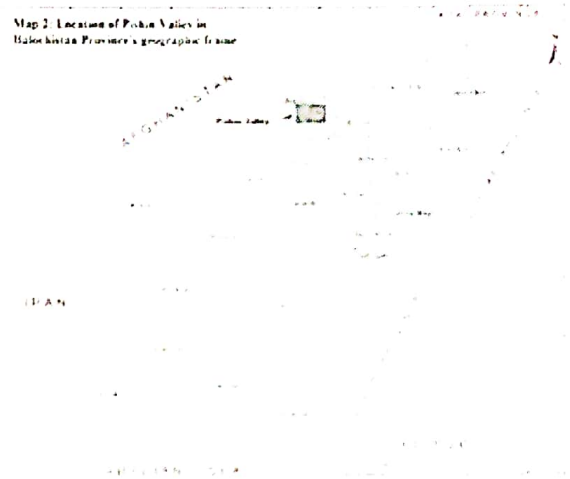
Sustainability of different human enterprises has different meanings and scopes, yet it has four general principals –ecological stability, social equity, economic viability, and institutional integrity (**Spangenberg, 2002**). Agricultural development, increasing number of human and livestock

* Assistant Professor, Geography Dept., University of Balochistan, Quetta. asaeeduob@yahoo.com
† Professor & Chairman, Geography Dept. University of the Punjab, Lahore. ghaffarpu@yahoo.com

population, and drought have brought degradation of natural resources in the arid and semi-arid regions of the world **(Amissah-Arthur et al, 2000).** Particularly, access to freshwater is among the major challenges being faced today by humans and livestock, hence careful management of the water resources is very essential **(Tiwari & Dinar, 2002)**. Agriculture is the main consumer of land (1.9 mha), water (97.5%) and workforce (65%) in Balochistan **(World Bank et al, 2006)**. But this sector is currently questioned for its overall sustainability due to the so much and so fast depletion of major aquifers **(Ahmed & Ahmad, 2007).** The driver to this scenario is apparently the mushroom growth of private tubewells during the past couple of decades supported by government by various means **(Saeed, 2006; Nawaz 2004; GoB, 2004, 2006)**. The tubewells enhanced under-cultivation area and yield per area greatly but simultaneously pushed down the historically meager groundwater reserves because of over abstraction compared to its recharge potential. The government didn't respond to the crisis effectively and resultantly the high cost of irrigation reduced economic viability of irrigation farming **(Ahmed & Ahmad, 2007).** Being not sustained by the small farm income, the farming community quite largely transformed to non-agricultural occupations letting their previously lush farms deserted. Since non-farm employment opportunities in the region have also been insufficient, hence acute poverty is the ultimate outcome.

Balochistan Uplands is an agro-ecological division that extends from Lasbela Coastal Plain in the South to Toba Kakar Ranges in the North and trans-Sulaiman basins in the Northeast (Map 1). It constitutes nearly 53% of the Province (Nawaz, 2004) and is flanked from West by Chaghi-Kharan Desert and from the East by Kachhi-Sibi Plain. The sample area –Pishin Valley- is located in the foothills of Toba Kakar Ranges bounded by latitudes 30° 13' & 30° 47' N and longitudes 66° 27' & 67° 13' E. Its total expanse is 2416 km^2 (SoP toposheets) and is administratively shared by Pishin (35%) and Qilaa Abdullah (65%) Districts.





Objectives

The principal aim of this article is to describe in brief the major impacts of aquifer deterioration on agricultural landuse in a time frame between 1991 and 2008. Its specific objectives are to assess:

- Changes in depth to watertable, its annual fall rates, aquifer mining and water quality.
- Changes in irrigated area and expansion of desertification.
- Examine the government role in water resources management.
- Suggest a revised strategy for addressing the issue of aquifer degradation

Material & Methods

Both primary and secondary data are used, sources being two separate field surveys and Landsat. Survey A interviewed 178 farmers derived through the formula of "Proportional Allocation of Sample Size" in 17 grass root level administrative units –13 union councils (UCs) and 4 patwar circles (PCs) of Pishin and Qilaa Abdullah Districts respectively. Survey B interviewed official expertise in line departments. Three Landsat images with 15 meter spatial resolution are used –1991, 1996, and 2000.

Results & Discussion

1. Socio-Economic Features of the Respondents

Average household size is 32 indicating joint family system where married brothers share combined earnings. 32% of the farmers are illiterate, 18% are educated up to 5 year schooling, 41.5% up to 10 year schooling and only 8% are college/university graduates. For reasons, financial dependence on farms has been gradually reduced. During 1991–2000, there were 44.4% households depending completely on farm income, which dropped to 39% in 2001–04 and to 37% in 2005–08. This indicates the widening gap between farm income and population increase. To supplement the small farm income, the most of people undertake trade and govt. jobs.

2. Aquifer Depletion

Aquifers are underground saturated regions which can yield economically feasible quantity of water. The top of an aquifer is called watertable. Averagely it was 141 feet deep during 1991 – 2000 and declined to 252 feet in 2001 – 2004 with an annual rate of 27 feet (Table 1). The watertable further dropped to 308 feet in 2005 – 08 but here the fall rate was 14 feet per annum –quite less than the previous era; reasons may be:

- The dry spell of 1998 – 04 ended in 2005 and the precipitation expectedly contributed to aquifer (**Saeed, 2012**).
- From year 2000 onwards live tubewells decreased in number due to drying out of many under excessive aquifer drawdown (Saeed, 2012).

Individually, the UCs/PCs reveal disparity in depth to watertable demonstrating the role of relief as the watertable has been deeper in the surrounding piedmont flanks of the Valley than its low lying central part (Map 3). Likewise, the per annum fall of watertable has been faster in the areas of dense cultivation, which is reflective of the high significance of agriculture in aquifer deterioration (Map 4). For example, In the northern Manzari Union Council watertable dropped by 30 feet per year during 2005 – 08. The Table 5.5 shows that this area yielded almost double agriculture in 2005 than it was in the year 2000 (satellite data). Similary, watertable

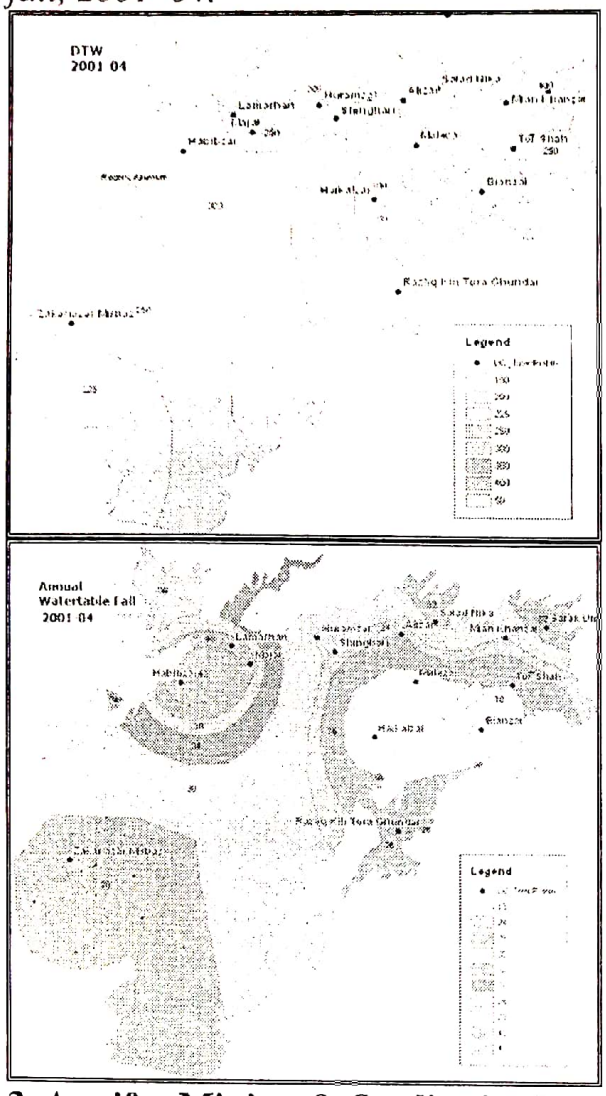
declined by 20 feet annually at Nale Malezai Union Council, where cultivated area grew nearly four times (from 4.66% to 17.25% of total area) in 2005 than it was in the year 2000 (satellite data).

Table 1: Average depth and per year fall of the watertable (ft).

Surveyed UCs/	Watertable depth 1991-	Watertable depth 2001 –	Annual fall 2001-	Watertable depth 2005 - 08	Annual fall 2005-
Yaro	158	237	19.7	269	8
Batezai	144	212	17	256	11
Manzar	75	296	55	332	9
Malaky ar	215	295	20	395	25
Torash	180	240	15	325	21.3
Sarana	77	96	5	111	4
Manza	217	410	48	420	2.5
D.	136	208	18	354	36.5
N.	130	185	14	210	6
Huram zai	146	211	16.3	261	12.5
Gangal zai	166	289	31	348	15
Simzai	162	287	31	294	24.3
Alizai	180	219	10	353	33.5
Gulista	82	302	55	350	12
Q. Abdula	111	289	44.5	335	11.5
Maizai	93	284	48	348	16
Segi	130	225	24	283	14.5
G. Averag	**141**	**252**	**27**	**308**	**14**

Source: Questionnaire

Map 3: *Average depth to watertable, 200–04.* ***Map 4:*** *Annual watertable fall, 2001–04.*



3. Aquifer Mining & Qualitative Degradation

Aquifer mining means exploitation of an aquifer beyond a non rechargeable depth; where the water is called fossil water and is non-renewable like petroleum –a fossil fuel. Chasing the fast fall of watertable, the farmers bored tubewells up to 1000 feet in some cases in 2008 but the valley average was 573 feet (Table 2). Moreover, the deep drilling ultimately punctures into sea-level water and thus the process of saline water intrusion starts. In the study area, this phenomenon has been evidenced by public reports and physico-chemical analyses (Table 2 & 3). Further, the satellite images also depict vast patches of white salt colour on soil (Classified imageries 1, 2, 3).

Table 2: Percent frequency of respondents expressing various water quality values.

Year	For drinking			For laundry			For irrigation		
	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
1981-90	72.3	12	15.7	85.6	13	1.3	85.5	13	1.3
1991-2000	90	9	1	88.7	10	1	88	11	1
2001-05	89	9.7	1	87.4	11.4	1	88	11	1
2006-08	89	9.7	1.3	87.4	11.3	1.3	88	11.4	1.3

Source: Questionnaire

Table 3: Physico-Chemical analysis of groundwater, February, 2007.

Union Council	Bate zai	Aliz ai	Gang alzai	Man zaki	Man zari	Sara nan	Yar o	Valley Average
pH (6.5 - 8.5, WHO)	8.75	8.53	8.5	8.5	8.33	8	8.5	8.44
TDS (mg/l) (1000, WHO)	516	245	221	330	658	702	598	467

Source: Pakistan Council of Research in Water Resources, Quetta (unpublished).

4. Desertification

In simple terms, the conversion of productive land into wasteland is called desertification. According to the survey data, average under-cultivation farm size was 67.6% of the total holding per household during 1991–2000. This decreased to 65.4% during 2001–04 and further 65% during 2005–08 indicating the process of desertification because the cultivable wasteland is growing accordingly. In the units of acres, the survey concluded that desertification appeared in 1996–2000 with a total toll of 167 acres of agricultural land among the sampled 178 responding farmers (Fig. 2). The process aggravated to extreme during 2001–04 by taking 431 acres but shows weakening in 2005 – 08; may be because of resumption of rainy years in 2005.

Fig. 1: Ratio of under-cultivation land in the total of a household

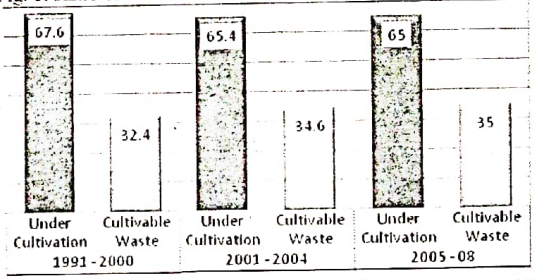
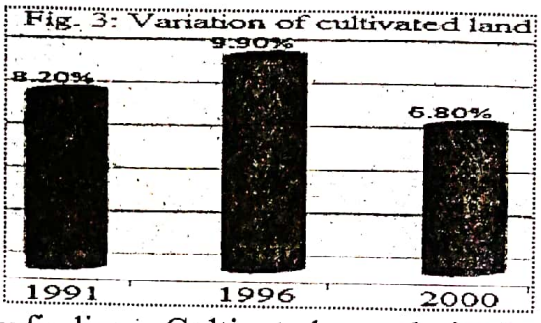


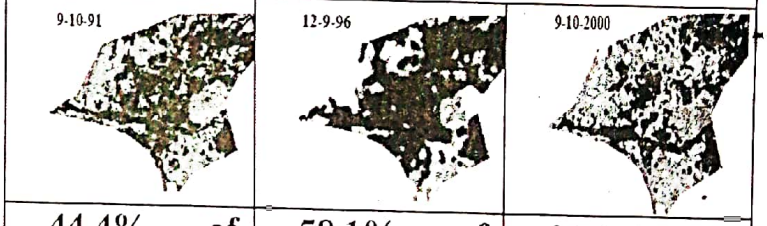
Fig. 2: Acreage of deserted land



The satellite images provided point data of the net-sown area in summer cropping season, which corroborate the survey findings. Cultivated area derived

from 1991 image is 48787 acres which is 8.2% of the total area of the Valley (fig. 3). In 1996 this ratio rose to 9.9% and in 2000 dropped to 6.8%. Since the main crop of the area are fruit orchards, which once die take years to rehabilitate, the 3.1% loss in agricultural area is obviously the land affected by permanent or temporary desertification.

Mosaic 1: Land cover changes in Dab Khanzai union council, District Pishin



44.4% of total area	58.1% of total area	31.1% of total area

. The landcover of the individual UCs/ PCs was also assessed from the imageries. Dab Khazai UC is presented as an example. It magnificently shows enormous encroachment of desertification in 2000.

5. Government Role in Water Management

i. On-Farm Water Management

It means field level irrigation management. This aspect was assessed by the parameter of lining/ piping of irrigation infrastructure including tanks and courses. It was found that only 20% of the irrigation tanks are concrete lined. These tanks are filled with water during night time through tubewells and the water is applied at daytime to crops by flood method. Likewise, lining and piping ratio of irrigation courses was also nominal (Table 4).

Table 4: %age ratio of lined/ piped irrigation tanks and courses, 2008.

Total irrigators 159 (89.3% of the sample)	Lined irrigation tanks (%)	%age of farmers per a %age of lined watercourses						%age of farmers per a %age of piped irrigation courses						
		Group farmers	%age of lined water courses					Group farmers	%age of piped water courses					
			≤10	21-30	31-40	41-50	61-70		≤10	11-20	21-30	51-60	71-80	81-90
	20	11.3	11	33.3	5.6	44.4	5.6	5	25	12.5	12.5	12.5	12.5	25

Source: Questionnaire

Out of the total tubewell irrigators in 2008, 11.3% had around 41–50% of the watercourses lined, while 5% had some piped. Lining & piping of irrigation infrastructure serve water conservation several ways. The low ratio in this regard indicates wastage and small water productivity per unit of use. Except 1, who had met full cost himself, the rest of tanks/courses liners/pipers were funded by government by various ratios of their actual expenditure; in majority cases by 60 to 70% of the total cost. It is commendable to see govt. support in water conservation, however, given the general poverty in the area funding level may be raised indiscriminately for all farmers.

ii. Introduction of Micro-Irrigation Technology

In arid climates, to conserve water and give it best efficiency, micro irrigation technology is the modern most recommended option. This technology has several forms but drip/trickle and bubbler systems are much apt for the local horticulture. The drip technology was installed first at Quetta during early 1980s on a limited scale, which subsequently disseminated to some other parts of the province under projects funded by international and national donors. However, these systems could not gain much popularity with the farmers for reasons like high capital cost, lack of awareness, cultural inertia, etc. The survey found none of the farmers using the High Efficiency Irrigation System. The more sad aspect is that most of the farmers (29%) reported not having heard about any such technology. The next severe hurdle was power loadshedding.

The fact that efficient micro irrigation technology has no presence in the area is a failure role of the government, especially when the respondents claim no awareness and training to these systems. The officials in line departments consider subsidized provision of HEIS to framers as one of the best choices for a sustainable progress of irrigation farming in the region.

v. Rainwater Harvesting

Rainwater harvesting includes runoff storage and its direct use through diversion structures. In the area under study the storage structures are called "Delay Action Dames (DADs)", which are constructed on flood torrents within the hilly terrain close to plain agricultural areas. The concept of DADs was picked up in Balochistan Uplands in 1960s. During 1980s and 90s the DADs were considered as an urgent remedy for the rapid aquifer depletion. However, in the later years their usefulness was questioned by expertise.

To recharge Pishin Sub-Basin's aquifer 14 DADs were completed till 2008. But 98.5% of the respondents reported that these DADs have not contributed in watertable rise. The experts also claimed only marginal effectiveness of DADs in aquifer recharge. It means, the government should revisit its policy in this regard.

vi. Cropping Pattern Adjustment & Extension Training

Our survey asked farmers whether or not the government checks their crops selection, all said "No". Similarly, 100% of the farmers put it that they neither have been invited on any extension training workshop from public sector nor have they attended any from any source else. Yet the farmers on their own perceptions and knowledge have made some modifications in the selection of crops. For example, horticulture, which has been the dominant cropping in the area, is giving place to annual vegetation. Though horticulture gives higher return but one lost it requires several consecutive good years to rehabilitate. In contrast, field crops like wheat, vegetables, etc are a season to season gain/ loss business.

CONCLUSION

The study concluded that the aquifer of Pishin Valley has greatly deteriorated both quantitatively and qualitatively. Depth to watertable varied with relief of the land and its fall rate was proportional to the growth rate of irrigated agriculture. This means, agriculture is the main consumer of local water and that conservational strategies in water use are neglected both privately and institutionally. Government role in various aspects of water

management is not yielding ambitious results hence review of the policies is direly needed.

SUGGESTIONS

- ✓ An integrated watershed rehabilitation and management pilot project should be initiated in the Pishin Lora basin in order to check groundwater depletion and mining process.
- ✓ Micro irrigation systems –drip, bubbler- be introduced for all the tubewell irrigated farms to have complete conversion from flood irrigation to them with financial and technical support of the government.
- ✓ Farmers are complaining prolonged loadshedding and huge fluctuations in voltage affecting performance of electric motors and irrigation schedules. The QESCO must initiate schemes to improve the infrastructure and management to ensure quality and reliable power supply to the rural consumers.
- ✓ Pishin Lora is one of the overdrawn river basins of Balochistan. This has come about due to increased number of tubewells. Therefore, installation of more tubewells should be banned.
- ✓ Balochistan's water resources should be undertaken in a holistic and sustainable manner. In this regard, integrated water resources management framework is an aspect that needs to be included while addressing the issue of water management.
- ✓ There is a need to introduce subjects of water management at school, college and university levels covering the resource picture of the province including water, existing developments and the innovative technologies available for efficient use of water and precision farming in the world.

REFERENCES

Ahmad, I. and S. Ahmad. (2007). Water Productivity and Economic Efficiency of Tubewell Irrigated Farms in Balochistan – Issues and Policy Reforms. Vol. (3), No. (11), TA-4560 (PAK), Quetta, Pakistan.

Amissah-arthur, A. Mougenot, B. and Loireau, M. (2000). Assessing Farmland Dynamics and Land Degradation on a Sahelian Landscape Using Remotely Sensed and Socio-Economic Data, International Journal of Geographical Information Science. Vol. 14, No. 6, pp. 583 – 599.

GoB (2004). Integrated Water Resources Management Policy, Balochistan, Pakistan: Final Draft Report, Component # 3, Balochistan Resource Management Programme.

GoB. (2006a). Integrated Water Resources Management Policy of Balochistan. Government of Balochistan, Pakistan, Department of Irrigation and Power

GoB. (2006b). Agriculture Statistics of Balochistan. Directorate of Crop Reporting Services, Department of Agriculture, Balochistan, Pakistan.

Nawaz, Karim (2004). Community Participation and Water Management in Balochistan, Pakistan. Available at: http://www.unu.edu/env/workshops /Aleppo/06%20-%20Nawaz.doc. (16/5/2008).

Saeed, Ahmad (2012). Inter-Effects of Tubewell Irrigated Agriculture and the Aquifer Potential in Balochistan: Case Study of Pishin Valley, Ph.D. thesis submitted to University of the Punjab, unpublished.

Saeed, Muhammad (Dr.) (2006). Promising Crops and Water Efficient Cropping Patterns for Irrigated Farming Systems of Balochistan, Pakistan, Summary Report, TA-4560 (PAK) Project for Supporting Implementation of IWRM Policy in Balochistan – Government of Balochistan – ADB and Royal Government of Netherlands

Tiwari, D. and Dinar, A. (2002). Balancing Future Food Demand and Water Supply: The Role of Economic Incentives in Irrigated Agriculture. Quarterly Journal of International Agriculture, 41(1/2), 77– 97pp.