

WAILING

over a

MURDERED LAKE
THE BADHA



Bhupinder Thakar Singh

2008

BANGLA GEET

सारे जहाँ से अच्छा है फाजिल्का हमारा,हम सभी हैं इस के वासी,यह बंगला हमारा,
इस शहर से हे सीखा, इंसानियत को प्यार करना ,मंदिर मस्जिद इस के, इस का हे गुरुद्वारा,

बाधा की झील प्यारी , और फूल बाघ इस के, आंखों में बस गया है, घंटा घर से नज़ारा,
दुनिया की आंखों में है, यह ऊन का व्यापारी,
पंजाब राजस्थान पकिस्तान हरियाणा का यह जंक्शन हमारा,

विद्या जी इस से सीखी, दुनिया के काम लाना , सारे जहाँ मे रोशन इस का है अब सितारा,
कुर्बानी अमर इस कि, इस की महिमान निवाजी , यह घर है प्यारा प्यारा,यह बंगला न्यारा।

सारे जहाँ से अच्छा फाजिल्का हमारा,हम सभी हैं इस के वासी,यह बंगला हमारा,
इस शहर से हे सीखा, इंसनिअत को प्यार करना ,मंदिर मस्जिद इस के, इस का हे गुरुद्वारा,

WAILING

over a

MURDERED LAKE

THE BADHA

the child of Sutlej River nourished for thousands of years
died at the hands of bad water managers of Indian subcontinent

a mother to the flora-fauna, fish, birds and habitation
at
the periphery of
THAR DESERT

Dr. Bhupinder Thakar Singh
Urja Purush Uttarakhand

2008

MURDERED LAKE

International Edition

Copy right © 2008 with the author

All rights reserved

"No part of the publication may be reproduced or translated in any language or distributed in any form or by any means or stored in a data base or retrieval system without prior written permission of the author"

This edition can be exported from India by the author only

Computer setting	by Amandeep
Offset matrices	by Raghupreet
Cover Collage	by Jaspal Singh

Library of Congress Cataloguing in Publication data

Singh Bhupinder Thakar

Murdered Lake; Bhupinder Thakar Singh

ISBN

Printed and Published by Er. Jasspreet Singh, USC, California, USA
Graduates Welfare Association Fazilka (GWAF)[®]
Publication Division,
1-Sardar Thakar Singh House,
Gowshalla Road, Fazilka-152123 Punjab, India

[The citizens of Fazilka should understand the implications of a dried up lake; it is a very bad omen. They should support GWAF[®] for claiming their right to Sutlej Waters from Bhakra Canal System]

FOREWORD

Badha Lake at the periphery of Fazilka town has dried up. The romance of quality living for citizens of Fazilka is now no more there. I spent my childhood in canal colony Fazilka, wherefrom visiting the Alamshah minor for a swim and watching the birds of distant lands playing on the Badha waters was a routine entertainment. Badha was discovered by Mr. Pat Vans Agnew during his mission to find a boating station down stream of Ferozepur where the forces of the East India Company had entrenched themselves. The refusal by Ranjit Singh to East India Company for permission to use Sutlej Stream at Ferozepur for boating activity motivated them to depute officers to find a suitable place down stream. That is how the Badha Lake was selected in 1844 for installation of a surveillance center as a Bungalow. The Bungalow later got a firm name of Fazilka to be developed as a township.

The Badha Lake, with its fresh water source and green surroundings was the attraction for establishing the boating station at this place. Now that it has dried up and is likely to be never charged with water from Sutlej. The river itself has dried up resulting in irreparable damage to the flora and fauna and human habitation in this region.

But hope sustains life.

This river has a cycle of getting flooded in 40 years and 1908 was the year when the floodwaters over ran the newly established settlement of Fazilka. The politicians try to control the fate of humans and the natural resources, but above them is the power of the Almighty. May be Badha a natural depression in the old course of River Sutlej gets recharged by natural upheavals if not by water managers. A flood is already surging on the Sutlej causing problems to encroachers in August 2008, who knows that it will influence the encroachers and politicians to refrain from causing damage to the environment through their nefarious schemes.

Prof. Dr. Bhupinder Singh, Urja Purash Uttarakhand, has produced a document on Badha Lake for the benefit of younger generation who never enjoyed its romance, but can get acquainted about the quality of living in this Bungalow town of Fazilka before acceptance of Indus Water Treaty of 1960.

Dr. Jagjit S Chopra MB, DCh (London) FRCPE, Phd, FAMS, FIAN
Professor Emeritus Neurology
PGIMER, Chandigarh
(Awarded Padam Bhushan by President of India, 2008)
September 1, 2008

DEDICATED

to the wise elders of Fazilka
who
were conscious about
education and ecology
long before other tribes
thought of these systems

The educational institutions established
at the turn of the Twentieth Century
by our elders include

Arya Putri Paathshalla Fazilka
Islamia Middle School Fazilka
Guru Nanak Kanya Pathshalla Fazilka, and
M. R. Degree College Fazilka
the centers of excellent education for
the people of Southern Punjab

CONTENTS

<u>TOPIC</u>	<u>Page No.</u>
Foreword	i
Dedication	iii
Contents	iv
Preface	1
Preamble	5
Introduction	7
Badha Lake-A Victim of Avaricious Water Managers	9
The wise, cunning and stupid rulers of Punjab	10
Wise Rulers	10
Cunning Rulers	11
Stupid Rulers	12
Horseshoe Lakes and Birth of Badha Lake	13
Meandering of Rivers resulting in horseshoe lakes	14
Natural Lakes	18
Limnology	19
The cause for disappearing of Lakes	20
Taming of Rivers of Punjab	20
Dried up Badha Lake	22
Horseshoe Lakes in Punjab	23
Badha Lake as a Reservoir of Raw Water	25
Appendix-A Well known Horseshoe Lakes	27
Appendix-B Important Lakes	29
Appendix-C Lakes which have disappeared	31
Appendix-D Pleasure Park at Badha Lake	32
References	35
Analysis of Water samples of Tube wells at Fazilka	36
Analysis of Water sample of Tube well at SDM Road	37
Typical Horseshoe Lake formation	38
Youngsters on a boating trip on Badha creek	39

PREFACE

As per anthropologists, the primitive human beings had all the elements for their evolution in the garden of the Almighty along with other living beings. The air and water essential for life were never in short supply. While he could gather the food and find natural shelters the present day descendants of the ancient man now needs to exert to keep his life ticking. The clothing was not needed, as the habitations were located in climatic and geographical regions where no apparel was required. The natural caves were available where they could take refuge for safety from inclement weather and predators. However, as of about 2 million years, the physical structure has not changed much with the limbs and body systems remaining the same, yet the brain activity increased as compared to other animals. Mankind became the ruler of the planet. All the living beings became subservient to him. Today the rulers have extreme machines and fatal weaponry to regulate their subjects and subdue other creatures. All other living beings have been rendered helpless by the doings of the man. The elephants are run over by our trains and poachers cannot be stopped. Several species have become extinct due to man's inferior tribal instincts and activities. A stage has been reached where water for drinking purposes is in short supply while the air, which was universally available, is getting heated to warn us of the coming events in terms of global warming. Man has over used the resources of the planet. Will the avaricious nature of man ever change?

There are 8 established religions, still there are terrorists and other agents of Satan who are trying to subdue the civilized life. The increasing population needs to be fed with requirements to grow more food. The economic experts are responsible for depleting the quality of the air around the planet by over generation of synthetic energy.

Those persons living away from the metros can enjoy cool breeze of fresh air, while those in metros are serviced by medical clinics to make their systems operational.

Over exploitation of water is already showing mal results. The British Raj in their urge to convert the water for irrigation from Punjab Rivers into gold exploited the waters of Punjab Rivers to the hilt. Their European techniques became agents of intensive farming for dispatching the produce to international markets. They erected dozens of barrages on our virgin rivers. We had lost the Saraswati due to natural devastation, while now our rivers are gasping for breath as water has been transferred by our own rulers for irrigation to desert lands. The yield from the diversion of water was never investigated by pilot studies. The amount of water carried in Gung and Rajasthan canals don't give that much yield of farm products as compared to the Punjab farmers who fill the central ware houses to the brim even with the depleted water resources. The ground water level in the Punjab is going down while the water from Suttlej is wasted in Rajasthan. The industrial growth has already done irreversible damage to the ecology of the Northern India. Now the rivers carry the

sewer water to the sea rather than the pure snow melted water from Upper Himalayan glaciers, the AMRIT as outlined in our scriptures.

The poor water management has done huge damage to the eco systems on the banks of River Sutlej and its natural fresh water lake the BADHA near indo Pak border at Fazilka. A natural extension of the longest river of Punjab the Sutlej has already been killed along with the ecological system it sustained. Incorrect data about survey of precipitation from watersheds and then bad management of Punjab rivers has damaged the ecological system under ill conceived Indus Water Treaty 1960. The fish, birds, flora and fauna have been exterminated. Due to neglect of the directives of Riparian laws the whole region has been ecologically damaged with limited agriculture produce with drying up of ground water aquifers. The elimination of the fresh water Badha Lake is an obvious indicator of future debacles. The present inhabitants living on its banks purchase water at the rate of Rs0.60 per litre for drinking purposes in 2008. All this happened due to imprudent decisions of our new democracies. After the Indus Water Treaty huge chunk of water was fed to Thar Desert without much favourable farm production as the intensive labour and expertise required for farming was missing among the non-farming communities living there. The Rajasthan canal water drained itself into the sandy tracts of Thar Desert to join the underground stream of Sarswati, which reaches the Arabian Sea. The Riparian laws guarantee that the benefits of the inhabitants on the riverbanks from the river stream are maintained.

Farraka Barrage on the great Ganges has never got filled up due to protests of the Bangladesh government. They use the stream downstream of this Barrage for boat navigation, which would fail if the water were stored at Farraka. We, at Fazilka are apprised that the Pakistan Government transferred water through link canals from Ravi River to feed their canals (Pakpattan, Sadqi, etc) emanating from Suleimanke Headworks. This helps them manage the floodwaters of Ravi River. Our region on the left bank of Sutlej River has suffered due to division of the waters of Punjab Rivers and their mismanagement. The Indian government in their motivation to stop water to Pakistan in 1947 killed the interest of the habitations on the left bank of Sutlej. The stretch of stream from Ferozepur to Fazilka, hardly gets any water from Sutlej in this 105 km stretch along the border carries the sewer from leather industry of Kasur Pakistan.

No doubt the tribes inhabiting the region from Khyber to Sutlej have been fighting with each other for the last 15000 years and the ray of hope came on freedom for the sub continent. Yet what have we done to deserve such a fate at the hands of our own rulers. Even Alexander was challenged not to touch or water and food baskets by Taxila's ruler. The Rhine River of Europe takes its source in Switzerland and passes through, Germany, France, and Netherlands; it still maintains its graceful movement from its source in Alps to the Northern Sea.

As tribesmen, we are lesser mortals and have already caused extreme damage to the flora and fauna of our region by not following the Riparian laws accepted internationally.

This small booklet is written to apprise the intelligentsia that they can still save our future generations if we claim water from Bhakra Canal system for recharging our Badha Lake. Our Badha Lake was a sacrificial goat at the hands of planners of this great dam. Another alternative could be to erect a buffer barrage upstream of Suleimanke Head works. It will make this 105 km stretch of Sutlej get enlivened with life. The government should shed its apathy for the region which has added to the revenue of the state since 1844. The water by a perennial canal from this buffer dam shall ameliorate the present damaged state of this region.

PREAMBLE

The five rivers of Punjab were a part of the seven streams of Indus basin. Saraswati River (still worshipped by Indians) became extinct due to natural and climatic upheavals and happenings. But the avaricious managers who came in the form of aggressive traders tamed the remaining rivers to cause damage to the plains of the Punjab. Our own rulers have been compelled to play with the rivers for feeding the increasing populace. These ancient water streams fed by Himalayan snow have changed course during monsoon resulting in Budha Darya near Ludhiana, Boorhi Ravi near Lahore and Khushak Bias near Sahiwal and

landmarks of changing courses of water streams. But the inconsiderate and incompetent water managers have caused damage to the prosperous habitation for the last 160 years.

Sutlej River along with its horseshoe lakes has been blessing for the inhabitants of the Punjab since time immemorial. The longest river of Punjab collects water from Beas, Ravi, Chenab, and Jhelum and becomes Punjab to join the great Indus River to drain into Arabian Sea. During its sojourn from the lake in Tibet and through hilly tracts of Himachal Pradesh and then through the plains of Punjab, it scatters its benedictions. While interacting with the banks it creates horseshoe or oxbow lakes out of which Badha Lake has been providing solace to the tribes living on its banks. There was no consideration for Riparian laws which outline the right of way for the settlements on the riverbanks. The people knew the art of conserving, using and managing the waters of perennial rivers of the Punjab. The flora and fauna prospered on riverbanks. In records, the Harrapa and Mohenjodaro had used the waters of snow fed rivers.

Badha Lake the child of this great River is now a dried up patch and all the aquatic life has become extinct. All this has happened at the hands of our own rulers who have to be held in the court of Almighty for damaging this eco-balancing agency of riverine systems. We have tried to convey to the people of this region to understand the fate of their progeny due to this stupidity of water managers of our land. A dried wet body indicates

a tragedy which is going to strike in this region. With very small amount of annual rainfall, the region will become a part of the Thar Desert with Sutlej River having receded.

INTRODUCTION

A lake is a large body of fresh water. Some huge brackish water lakes are also there. Lakes can range in size from small ponds to huge bodies of water such as the Great Lakes in the American continent located on US Canada borders. Lakes and rivers are closely tied. The lakes in Himalayas are the source of high quality water for the Indian rivers. The Sutlej River takes off from Mansrovar in Tibet region and also gets water from its tributaries. The monsoon rains add to the discharge of this river during June to August.

Since both rivers and lakes are fresh water and flow in and out of each other, they share similar characteristics and many species reside in both habitats.

The tools of Kalayuga (the age of contraptions) came into the hands of mankind for their betterment, yet we find that not only the various groups fought wars, they also played havoc with the natural resources and the gifts of the Almighty.

The tribes of Punjab were happy with their herds grazing on Jungle-Belas (grazing grounds) and enjoyed the Bhangara and Jhummar with Sammi dance on the drumbeat.

The poets sang of the pleasures of riding on the cabin behind the pair of bullocks moving on the rotary track of a Persian wheel bringing water from the broad brick wells. And then came on the scene the agents of the British Raj. Their cunning and aggressive officers understood the psyche of the tribes on the banks of the five rivers. They had single point objective of generating wealth for the British Isles. They used the tools and techniques invented during Industrial revolution, which had taken place in Europe to colonise this land with intensive irrigation channels taken from barrages. The tribes, who had the expertise of farming and cultivation for thousands of years, got trapped in the British Raj's web. And we find that when the Raj withdrew and left the land of Hindustan, there were about 45 irrigation channels, which went to Pakistan. They converted the waters of five rivers into transformers of tribal labour, new tools, transportation technique into cash crops of cotton, sugar cane, wheat and rice. In a way they converted by their technology our river waters into gold to be dispatched to the England. The land was divided in 1947 and the waters were also staked. Our own democratic rulers never respected the waters of these rivers and further generated electric energy to operate their comfort machines. Our Vote-Naresha rulers under the garb of more energy, and more irrigation water showed green pastures to the innocent Hindustanis. They did not leave even the great sacred Ganges, resulting in damage to the ecology of the Himalayas.

An engineer turned philosopher is on hunger strike at Uttarkashi to stop the further damage to the Gangotri glaciers and the tributaries of the Ganges by the construction of series of dams on this sacred river. The government of Uttarakhand should learn from the damage done to the five rivers of Punjab. Most of the benefits go to the non-worker groups. While the real wealth generators are left hungry and dry. The so called managers are having hey day from resources of our land. The Hindustanis, who have standard patented practices for saving the ecology and natural resources, should not copy the western concepts of living, as these are not stable systems. Any day these will crumble. Our elders identified conscious humans as Devtas to save the ecology. The Ganesha, Hanuman, Garuda, Neel Kantha, Peacock, Kag Bhasund , Nandi Bull, Lion, Varuna, Indra and so many are all described as sacred in our scriptures enunciated thousands of years ago to inculcate the respect for the animal kingdom.

BADHA LAKE A VICTIM OF AVARICIOUS WATER MANAGERS

Punjabis greet any happening of happiness with Badhai or Wadhai. When the horse shoe lake was added to the left bank of the river Sutlej due to natural interaction of the stream with the banks, it was named Badha or It must have been a part of Wadhai to their eco systems. Badha Lake has been there for thousand of years at the periphery of the Thar Desert. So people must have been excited and named the new water body as Wadha or Badha.

A village of the same name is still active on the banks of this Lake. The sister river of Sutlej the Saraswati is no more as it vanished due to natural happenings about 5000 years back. Yet the Badha Lake has dried up due to carelessness of water manager who cultivated the Indus Water Treaty of 1960 for sharing the natural gift of the Almighty.

THE WISE, CUNNING, AND THE STUPID RULERS OF PUNJAB

THE WISE RULERS

No written history was available for the people of the land of five rivers till 2330 years ago when Alexander of Macedonia, came to this part of our country. His letters written to his mother were edited by Plutarch (46 AD) an academician residing in Rome. These were published in Greek language under the title "Lives". This book carries wisdom of that era through recordings and anecdotes about reputed personalities of those times. While Taxila Naresh the ruler on the right bank of Jhelum impressed Alexander by his wise counseling during the parleys conducted at the battlefield. He was also impressed by the tall and handsome personality of valourous Porus, the king of tract on left bank of Jhelum. He was influenced by the philosophies of the Eastern thinkers. Taxila Naresh opined: "-- ***to what purpose should we make war upon one another, if the design of your coming to these parts be not to rob us of our WATER or our necessary food, which are the only things that wise men are indispensably obliged to fight for***"

Alexander presented to the Taxila Ruler a bagful of TALENTS (Greek gold coins) for his valuable counselling. Incidentally, Alexander himself identified this region of the Indus based on phonetics of the Sindhu River. He coined the name INDIA for this sub continent. The Persians identified this region as Hindustan with Sindhu.

THE CUNNING RULERS

When Raja Ranjit Singh was consolidating his dominions around 1802 in Punjab, the East India Company officers were watching him critically. After Mr. Charles Metcalf a 23 years old Company officer worked out the Amritsar Treaty in 1809, the agents of Company would often visit the court of Sikh ruler by going across the Sutlej. One of these officers was Capt. W. G. Osborne.

A look at the scribbles of May 25, 1838, on the diary of Captain W. G. Osborne, Military Secretary to the Governor General who was on his way to meet the Maharaja at Adina Nagar is instructive in this regard.

“ The soil appears to be rich and prolific, as far as it is possible to judge from the small quantity of ground under cultivation, and with a more enlightened government, there can be little doubt of the Punjab becoming one of the richest provinces of India”

Prophetic, these words!

And he also prophesied the fate of the Punjab, which was still under rule

of Ranjit Singh right in May 1838:

“It is a melancholy thing to contemplate the future probable state of this beautiful country. On the death of Ranjit Singh which in the common course of nature must take place in a very few years (Incidentally Ranjit Singh expired in June, 1839) the whole country between the Indus and Sutlej must become a scene of protracted fratricidal war, only to be terminated by the interference of a third and stronger power, with an army sufficiently strong to bid defiance to all hope of resistance, and that army must be the British Army, and that power the British Government, there can be little doubt”

THE STUPID RULERS

The over aggressive water managers planned to stop even a drop of water to Suleimanke Barrage across the Radcliffe line. And in this pursuit, the stretch of river 105 km in length from Ferozepur to Fazilka became drain for leather industry located in Kasur in Pakistan. No consideration for Riparian laws stopped the waters in this part of the river. And Badha Lake dried up due to no recharge from gasping stream of Sutlej due to water considered as commodity and not a gift from nature.

Principles of Humanism were forsaken when the two new republics divided the waters of the five rivers. The control of waters landed several Riparian habitations into trouble in both the new republics. But the nature takes its toll on the governments for the damage done to the flora and fauna. Several perennial water bodies like Badha dried up due to this division. If the River Rhine of Europe could serve the 4 countries of Switzerland, France, Germany and Netherlands, why the managers of Punjab waters failed to understand the damage their planning and proposals will bring for the habitation on the riverbanks.

“On the exchange of enclaves between India and Pakistan on 17 January 1961, following an agreement between the Government of India and the Government of Pakistan on 11 January 1960, certain areas in the vicinity of the Suleimanke Head works in the Fazilka Tehsil were transferred to Pakistan in exchange of the areas near the Ganda Singh Wala Barrage. These areas were added to the Ferozpur Tehsil.”

But what happened to the children of Sutlej none of these water managers cared.

HORSE SHOE LAKES AND BIRTH OF BADHA LAKE

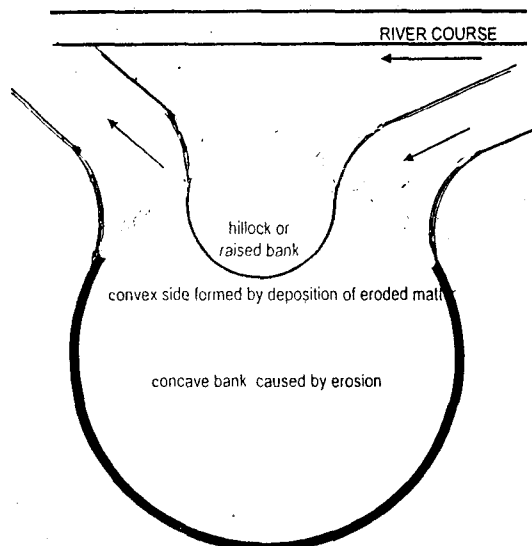
The horseshoe lakes develop when a river enters the plains and seeks its path of least resistance.

Such a lake is a gift of the river in the form of high quality water stored on its periphery. All over the world such lakes developed on untamed rivers. The river streams meander and move around the higher contours in its path. And with time these create water bodies as per the principles of hydromechanics. Fig-1 describes the meandering of a river stream to generate a horseshoe or oxbow lake. The great Ganges also has a group of such lakes. The reputed horseshoe lakes are listed in Appendix- A.

MEANDERING OF RIVER RESULTING IN HORSESHOE LAKE

Action of Stream

1. Continuous deposition of sand and gravel eroded from outer bank
2. After several decades the stream goes back to straight course leaving a horseshoe lake in the original course.
3. The nature of the contour and soil causes the concave bend to emerge due to hydrodynamic forces moving the stream to broaden the wetland.



HYDRO-MECHANICS OF FORMATION OF A HORSESHOE LAKE

Badha Lake is a horse shoe lake which emerged from the Sutlej River. Such horse shoe lakes are also known as Oxbow Lakes in general usage. In Australia such water bodies are called Billabong.

This natural phenomenon of formation can be explained on the basis of principles of Fluid Mechanics. When a river reaches a low-lying plain, often in its final course to the sea or a lake, it meanders widely. In the vicinity of a river bend, deposition occurs on the convex bank (the bank with the smaller radius). In contrast, both lateral erosion and undercutting occur on the cut bank or concave bank (the bank with the greater radius.) Continuous deposition on the convex bank and erosion of the concave bank of a meandering river cause the formation of a very pronounced meander with two concave banks getting closer. The narrow neck of land between the two neighbouring concave banks is finally cut through, either by lateral erosion of the two concave banks or by the strong currents of a flood. When this happens, a new straighter river channel is created and an abandoned meander loop, called a cut-off, is formed. When deposition finally seals off the cut-off from the river channel, horse shoe lake is formed. This process can occur over a time scale from a few years to several decades and may sometimes become essentially static.

Watching the Sutlej stream near Fazilka by satellite imaging one can observe the meandering of this stream and the likely hood of formation of another horse shoe lake. The sketch based on this satellite image (2008) shows the serpentine course of the river near Fazilka. But as the river

hardly carries any water except drains from Kasur (Pakistan), there is no possibility of any addition of similar water bodies in future. A tamed river is not likely to have any natural formation unless there is some natural episode which may again enliven the dead stream from Firozpur to Fazilka.

Gathering of erosion products near the concave bank and transporting them to the convex bank is the work of the secondary flow across the floor of the river in the vicinity of a river bend. The process of deposition of silt, sand and gravel on the convex bank is clearly illustrated in point bars.

The formation of the wet body can be explained by watching the interaction between the following agencies:

- a. Velocity of stream under vortex flow
- b. Contour history on river domain
- c. Nature of the soil on the meandering river banks
- d. Eroded material sand, gravel and soil deposited on the inner side

When a water follows a curved path, such as around a circular bowl, around a bend in a river or in a tropical cyclone, the flow is described as vortex flow. The fastest angular speed occurs where the radius is smallest, and the slowest angular speed occurs where the radius is largest. The higher water pressure and slower speed where the radius is greater as on the concave region, and the lower pressure and faster speed where the radius is smaller as on the convex side.

The stream velocity in the left side of Sutlej causes erosion on the soil and the eroded material is transferred to the right convex bank by secondary stream near the flow. Now when the Badha Lake is dried up, the high quality sand mining is carried on the inner wing where the deposition of the sand and gravel etc took place during the period when Badha was formed. (The local mafia is mining this sand for construction work at a brisk rate causing further damage to the natural gift of nature)

It is educative to demonstrate the principle by watching the water agitated by a spoon in a circular bowl. The secondary flow can be demonstrated by a simple experiment. Partly fill the bowl with water and sprinkle some grains into it. If a spoon is used as a stirrer to set the water into circular motion the grain particles will quickly be swept into a neat pile in the center of the bowl. This is the mechanism that leads to the formation of point bars and contributes to the formation of horse shoe lakes. The primary flow of water in the bowl is circular and the streamlines are concentric with the side of the bowl. However, the secondary flow of the boundary layer across the floor of the bowl is inward toward the center. The primary flow might be expected to fling the grain particles to the perimeter of the bowl, but instead the secondary flow sweeps the grains toward the center. This is how the material eroded from outer rim gets transferred to the inner bank. The flood causes the stream to straighten up and the earlier bend now is added to the river region in the form of a horse shoe lake. Sutlej has a frequency of getting flooded after 40 years.

The flood in Sutlej of 1908 inundated the present location of Fazilka. During the monsoon of 2008 when the heavy down pour in the Punjab caused flooding of the river upstream of Suleimanke Barrage. The stream if it were untamed would create a new course. Image shows it.

The curved path of a river around a bend causes the surface of the water to be slightly higher on the outside of the river bend than on the inside. As a result, at any elevation within the river the water pressure is slightly greater near the outside of the river bend than on the inside. There is a pressure gradient toward the convex bank which provides the centripetal force necessary for each parcel of water to follow its curved path. The boundary layer flowing along the floor of the river is not moving fast enough to balance the pressure gradient laterally across the river. It responds to this pressure gradient and its velocity is partly downstream and partly across the river toward the convex bank. As it flows along the floor of the river it sweeps loose eroded material toward the convex bank. This flow of the boundary layer is significantly different from the speed and direction of the primary flow of the river, and is part of the river's secondary flow.

Once a habitat for fresh water fish, flora and fauna cared by inhabitants of the region it is now reduced to the dry state. It is not likely to be wet again as the river itself is itself is now a sewer.

NATURAL LAKES

The natural lakes usually recharged by rains or streams are precious asset of humanity and provide comfort life to all living beings.

LIMNOLOGY

Limnology is the study of inland bodies of water and related ecosystems.

The natural lakes abound all over the planet and are listed in Appendix-B.

Limnology divides lakes into three zones:

- A. the *littoral zone*, a sloped area close to land;
- B. the *photic* or *open-water zone*, where sunlight is abundant; and
- C. the deep-water *profundal* or *benthic zone*, where little sunlight can reach.

The depth to which light can reach in lakes depends on turbidity, determined by the density and size of suspended particles. A particle is in suspension if its weight is less than the random turbidity forces acting upon it. These particles can be sedimentary or biological in origin and are responsible for the color of the water. Decaying plant matter, for instance, may be responsible for a yellow or brown color, while algae may cause greenish water. In very shallow water bodies, iron oxides make water reddish brown. Biological particles include algae and detritus. Bottom-dwelling detritivorous fish can be responsible for turbid waters, because they stir the mud in search of food. Piscivorous fish contribute to turbidity by eating plant-eating (planktonivorous) fish, thus increasing the amount of algae (see aquatic trophic cascade). The light depth or transparency is measured by using a *Secchi disk*, a 20-centimeter diameter disk with alternating white and black quadrants. The depth at which the disk is no longer visible is the *Secchi depth*, a measure of transparency.

The Secchi disk is commonly used to test for eutrophication. A lake moderates the temperature of surrounding region and climate because water has a very high specific heat capacity (4186 J/kg-K). In the daytime, a lake can cool the land beside it with local winds, resulting in a sea breeze in the night, it can warm it with a land breeze.

THE CAUSE FOR DISAPPEARANCE OF LAKES

Most of the drying up of lakes and ponds all over the planet is due to encroachers and political interference with the urge for irrigation, flood control and power generation schemes. The increasing population is pressurizing the vote rulers to exploit the natural resources to the hilt. But with rational decisions the damage to environment is likely to be curbed. Most of the ponds near villages which collected rainwater in depressions have been occupied by encroachers resulting in total collapse of ecology. The flora and fauna have been eliminated. Appendix-C gives information about the lakes which have disappeared.

TAMING OF THE RIVERS OF PUNJAB

The British Raj in their urge to collect revenue from this fertile province made huge investments to harness the waters for the arable land. Herdsmen grazed their cattle in the forests of the Punjab without any political interference. The British Raj usurped the arable pastures. They allotted the lands to their followers for intensive farming. The rivers were tamed by a large number of barrages for feeding water to these farms.

The canal colonies emerged as new 'forts' for maintenance of the huge network of irrigation channels. The earlier British water managers had some ethics in obtaining water from the rivers. Col Sir Proby Cautley supervised the construction of the Ganges Canal taking off from Haridwar and arranged to deposit the tail waters back into the Ganges River at Kanpur. However, in the Punjab no such ethics were observed. The international Riparian laws for guidelines of river valley exploitation were ignored. After the British Raj was wound up in 1947, our own managers of river waters have been more ruthless in disturbing the national assets of water. Their activities eliminated even the fresh water lakes like Badha at Fazilka.

Badha Lake was the pride of Fazilka. Mr. Pat Vans Agnew installed the surveillance station approved by the East India Company in the form of a Bungalow on its banks in 1844. The landscape and availability of high quality water enamoured him. The region flourished to attract intelligent tribes to migrate to this area of growing opportunities and employment.

The deterioration in this natural resource was initiated when the Indus Water Treaty of 1960 was agreed upon. Our own government did not realize the damage to the stretch of 105 km from Ferozepur to Fazilka which would occur due to stopping the stream at Ganda Singh Wala Head works. To these rulers the urge to collect votes is supreme rather than optimized use of natural resources.

The region's whole ecology has changed in last 60 years. Instead of Riparian principles, the Satluj waters have been diverted to other regions. It has been typical case of robbing peter to pay Paul. The over use of the resources of the sub continent and its dilution serves their purpose of cultivating vote banks. The ways of Nature are stranger than fiction and the grand designs and aggressive schemes of man crumble before the nature. The floods in Punjab and Bihar show the limitations of our water managers. The Katrina and Rita have already brought some sense to Mr. Bush to adopt new policies of conservation. The same may happen with our masters of economics who enamour the people with Economic Indices. None of the schemes of resource management will prosper as long as these are not related to humanism.

DRIED UP BADHA LAKE

Badha Horseshoe Lake can also be identified as Oxbow Lake. During its prime days charged from floodwaters due to its location on a low flood plain at the periphery of Thar Desert. Rivers never follow the same path over extended periods of time. Some isolated sections are created when the stream changes its direction and cuts new channels in the form of Oxbow. Badha Lake was formed in this manner centuries ago and is one of two large horseshoe lakes near Fazilka. The inconsiderate water managers of the sub continent never cared for its reduction. The policy of taming the Punjab Rivers by the British Raj was further supported.

The nature takes its toll in the form of climatic damage and Psunamis. Human habitation in this area dates back to 8,000 years and got support from horseshoe lakes. The lake was a source of fish, game, waterfowl, and wild vegetables besides quality water for drinking and irrigation. Herdsmen from Thar Desert visited this region from Rajasthan with their cattle during periods when monsoon failed Chawras a Gujrati tribe visited this region regularly and their settlement at Chawaraianwali village is quite old. (Chawari Bazar in the Delhi is also having some connection with this tribe) Invaders passed through this region to reach Delhi and devastated settlements like Multan, Ajudhan (Pakpattan) and Abuhar but that damage was transient. But irreparable damage to the region has been done. Our own water managers have done it.

HORSESHOE LAKES IN PUNJAB

The five rivers of Punjab have been a boon to the inhabitants residing on the banks since ancient times. The floods cause meandering of the rivers resulting in the formation of horseshoe lakes. Several old regimes of rivers exist to this day along the main stream as these are very ancient watercourses. These horseshoe lakes provide fresh water even during lean periods of river flow. Each year the monsoon brings a harvest of water for these lakes filling these depressions to the brim. As a matter of fact the horseshoe lakes are forsaken courses of the main river.

The great Ganges also has several horseshoe lakes on its banks in the plains of Uttar Pradesh. Such lakes are useful not only to the human habitations but also to the flora and fauna. Lakes act as natural storage of high quality water derived from streams carrying melted snow and rainfall. These act as a capacitance element for damping the surge of flooded rivers. A natural recharge from rivers to ground water eliminates the yearly fluctuation of groundwater level. The lake water dilutes the salts of ground water. The tourists are attracted to these lakes due to opportunities for swimming, boating, fishing and hunting. The feathered visitors from Siberia find a resting place during their long distance flights. The water body influences the climate near the region during summer season.

The town of Fazilka got the high quality water from Badha Lake with its under ground aquifers. The Lake has dried, and the ground water level has gone deeper. The pumping costs are increasing. The inferior water quality from the ground has made the population suffer from damaged bones due to too much fluoride in the pumped up water. The citizens are migrating to other places. Those presently at Fazilka are compelled to purchase drinking water at a huge cost (Rs0.60/Litre). The water works planned by the municipality did not have wise consultants, who opined for excavation of a huge open air tank for storage of canal water collected from a seasonal irrigation channels of British times. The experts should have weighed the possibility of using the Badha depression for storage of water.

The water can be collected via the Alamshah minor from escape gates of Bhakra canal system near Malout. The present water supply scheme is a failure. The deprived sections have to drink the Fluoride ridden ground water, while rich people purchase cans of water from Jheevers at the rate of Rs0.60 per litre.

If they shift their filtering system to Badha axis even now, the high quality water will be available all through the year not only from the feed from Bhakra but also from the aquifers. The Badha Lake will get back its glory and make Fazilka a pleasant place for visitors and tourists. Appendix-D describes the pleasure park that was on the banks of Badha Lake before it was dried up.

BADHA LAKE AS A RESERVOIR FOR RAW WATER

This lake has been a precious source of high quality drinking water for the people of Fazilka for about 100 years. The yearly recharge from Sutlej kept the ground water level at a stable depth. The dried up depression of the left bank Sutlej still is having its aquifers connected to the river. Even in 2008, the tube wells near its bank are still having high quality water.

The householders of this region in 1950s used a low-cost hand pump to get water from 4 m deep aquifer for their water needs. When the scheming continental water managers arrived on the scene, the natural recharge of the ground water aquifers deteriorated. There was no water feed from the Badha to the aquifer. The hand pumps failed due to lowering of ground water level.

The householders installed submersible pumps to lift water from aquifer at 30 m depth. The municipality tried deep bore wells for tapped water for householders but was discovered to be of inferior quality.

This motivated the installation of water supply for the town. The supply of raw water from seasonal irrigation channels required storage system. The dried up depression of Badha Lake, could be utilised for storage of raw water but they opted for an excavated tank as a site on southern periphery of the town. The water works was installed at huge cost. Erring on estimates of raw water requirements for the town made²⁷ the system insufficient. The water works supply scheme was not very successful due to season availability of raw water. If wisdom had prevailed they should have used the Badha depression for storage of raw water from perennial Bhakra canal system. Even now a retrofitted water-works on Badha depression will be better.

Appendix-A

SOME WELL KNOWN HORSESHOE LAKES

ALASKA



An horseshoe lake in the making:

It is formed by meandering stream and sandbank deposition on the Nowitna River, Alaska

ARKANSAS, USA



A Horseshoe lake near Hughes, Arkansas, USA.

The bulges in the border reflect changes in the course of the river; when the river shifted its course and cut off the former channel, the border did not change.

The town of Horseshoe Lake, Arkansas is named after the horseshoe shaped lake at the eastern tip of which the town is located.

The Reelfoot Lake in west Tennessee is horse shoe lake formed when the Mississippi River changed course following the New Madrid Earthquake of 1811–1812. There are many horse shoe lakes alongside the Mississippi River and its tributaries. The largest horse shoe lake in North America, Lake Chicot (located near Lake Village, Arkansas), was originally part of the Mississippi River.

SOUTHWEST WALES



Gower Peninsula, Southwest Wales

Early stages of formation of coastal plain horse shoe lake. Cuckmere Haven in Sussex, England contains a widely meandering river with many horse shoe lakes, often referred to in physical geography textbooks.

IMPORTANT LAKES

- The **largest** lake in the world by surface area is the Caspian Sea. With a surface area of 394,299 km² (152,240 mi²), it has a surface area greater than the next six largest lakes combined.
- The **deepest** lake is Lake Baikal in Siberia, with a bottom at 1,637 m (5,371 ft). Its **mean depth** is also the highest in the world (749 m)
- It is the world's **largest freshwater lake by volume** (23,000 km³), and the second longest (about 630 km from tip to tip).
- The **longest** freshwater lake is Lake Tanganyika, with a length of about 660 km (measured along the lake's center line). It is also the second deepest in the world (1,470 m) after lake Baikal.
- The world's **oldest** lake is Lake Baikal, followed by Lake Tanganyika (Tanzania).
- The world's **highest** lake is an unnamed pool on Ojos del Salado at 6,390 m (20,965 ft). The Lhagba Pool in Tibet at 6,368 m (20,892 ft) comes second.
- The world's **highest** commercially navigable lake is Lake Titicaca in Peru and Bolivia at 3,812 m (12,507 ft). It is also the largest freshwater (and second largest overall) lake in South America.

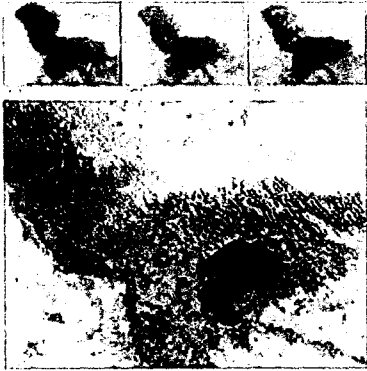
- The world's **lowest** lake is the Dead Sea, bordering Israel, Jordan at 418 m (1,371 ft) below sea level. It is also one of the lakes with highest salt concentration.
- Lake Superior is the **largest freshwater lake by surface area** (82,414 km²). It is also the third largest by water volume. However, Lake Huron and Lake Michigan form a single hydrological system with surface area 117,350 km², sometimes designated Lake Huron Michigan. All these are part of the Great Lakes of North America.
- Lake Huron has the **longest lake coastline** in the world: about 2980 km, excluding the coastline of its many inner islands.
- The **largest** island in a freshwater lake is Manitoulin Island in Lake Huron, with a surface area of 2,766 km². Lake, located on Manitoulin Island, is the largest Lake on an island in a freshwater Lake.
- The **largest lake** located on an island is Nettilling Lake on Baffin Island.
- The **largest Lake** in the world that drains naturally in two directions is Wollaston Lake
- Lake Toba on the island of Sumatra is located in what is probably the **largest resurgent** caldera on Earth.
- The **largest** lake located completely within the boundaries of a single city is Lake Wanapieter in the city of Sudbury, Ontario, Canada.

Before the current city boundaries came into effect in 2001, this status was held by Lake Ramsey, also in Sudbury.

- Lake Enriquillo in Dominican Republic is the only **salt water** lake in the world inhabited by crocodiles.
- Lake of the Ozarks is one of the United States **largest** man made lakes, created by the Bagnell Dam

Appendix-C

LAKES WHICH HAVE DISAPPEARED



LAKE CHAD IN A 2001 SATELLITE IMAGE,

With the actual lake in blue, and vegetation on top of the old lake bed in green. Above that, the changes from 1973 to 1997 are shown.

A lake may be filled with deposited sediment and gradually become a wetland such as a swamp or marsh. Large water plants, typically reeds, accelerate this closing process significantly because they partially decompose to form peat soils that fill the shallows.

Conversely, peat soils in a marsh can naturally burn and reverse this process to recreate a shallow lake. Turbid lakes and lakes with many plant-eating fish tend to disappear more slowly. A "disappearing" lake (barely noticeable on a human timescale) typically has extensive plant mats at the water's edge. These become a new habitat for other plants, like peat moss when conditions are right, and animals, many of which are very rare. 33 Gradually the lake closes, and young peat may form, forming a fen. In lowland river valleys, where a river can meander, the presence of peat is explained by the infilling of historical oxbow lakes. In the very last stages of succession, trees can grow in, eventually turning the wetland into a forest.

The Badha Lake disappeared due to non-availability of recharge from the dried up river Sutlej. The stretch of this stream from Firozpur to Fazilka having a length only carries sewer water. The only way to revive this water body is to feed it with water from Bhakra canal system artificially. This has been a lifeline for the people living on the periphery of Thar Desert.

Appendix-D

PLEASURE PARK ON THE BANKS OF BADHA LAKE

Only about 10 minutes away from Clock Tower of Fazilka, on the Northeastern side the lake offered a wide variety of recreational opportunities on 250 acres of water body. Festivals with colourful activities were held on its banks.

The vendors made the people happy with their stalls of eats (Golgappas, Dahi-bhallas, Papri and of course Jalebis)

Mr. J. H. Oliver (1847) planted a set of exotic trees establishing Oliver garden on the Southern bank of Badha Lake. The main feature of the park, around the Badha Lake has been the benefits of a water body which supports flora and fauna. The western portion of the lake is considered to be the best area to find fish. Mr. Samuel, the engine operator at local Ice factory would engage himself in angling to collect fish for his lunch. He taught the young anglers how to collect worm (Kainchwa) for placing on the fishing line. He would demonstrate how to throw the bait line with one swing of the fishing rod into the lake waters. The fishing season was controlled by the SDM. A fishing license was needed to fish at this lake. The depth of one meter near the banks made it ideal for bluegill and channel catfish. Boating was allowed on this lake. However, an episode when a person lost his life in a boating accident this sport was officially banned.

Bird Watching

Old timers know how easy it was to go for fowl hunting on the waters of this lake. Also Badha' Oliver garden was an excellent place for bird watching. Virtually all species of birds that have been spotted in North India have been seen at one time or another at Badha.

The crying of peacocks at the evening time was a typical feature of the region. It was pleasant site to watch the beautiful bird dance with spread tails. The Kamal (Kaul Doda and Bhain and Singhara) provided livelihood to quite a few tribes who would float on a pair of inverted pitchers to harvest the produce from Badha waters. The greenery attracted many snowy egrets and blue herons in search of clams and snails.No birds now visit this dried up patch for stop over from their flight from Siberian regions.

The people tell crisp anecdotes about Badha's flora and fauna as it was is one of the most well known places on the periphery of Thar Desert. People from the Desert would be amazed to watch this beautiful tract of water. They could watch a diversity of herons and egrets. Snowy Egrets and Little Blue Herons swam around in large numbers. Owl the wise bird can still be seen on the dry bed of the Lake at night. This was an excellent spot to see Harials (green birds) and sparrows as well.

Hunting and Fishing

There was a time when every Punjabi boasted of DBL gun with Eley cartridge belts on his waist. The young ones would go to the Lake to have a feel of the first shot. The times have changed the attitude. People now watch the birds rather than shooting them. Fishing was a normal activity in the riverine region.

Now it has emerged as Fish Farms on excavated artificial tanks.

Swimming

The water was quite deep in the center of the lake. Once a young swimmer got his legs entangled in under water growth of lake, he cried for help thinking it was an alligator. He was rescued, yet a bystander opined that bushe got entangled in his legs. Now with dried up patch, which was once the Badha Lake, all these narrations seem fiction.

REFERENCES

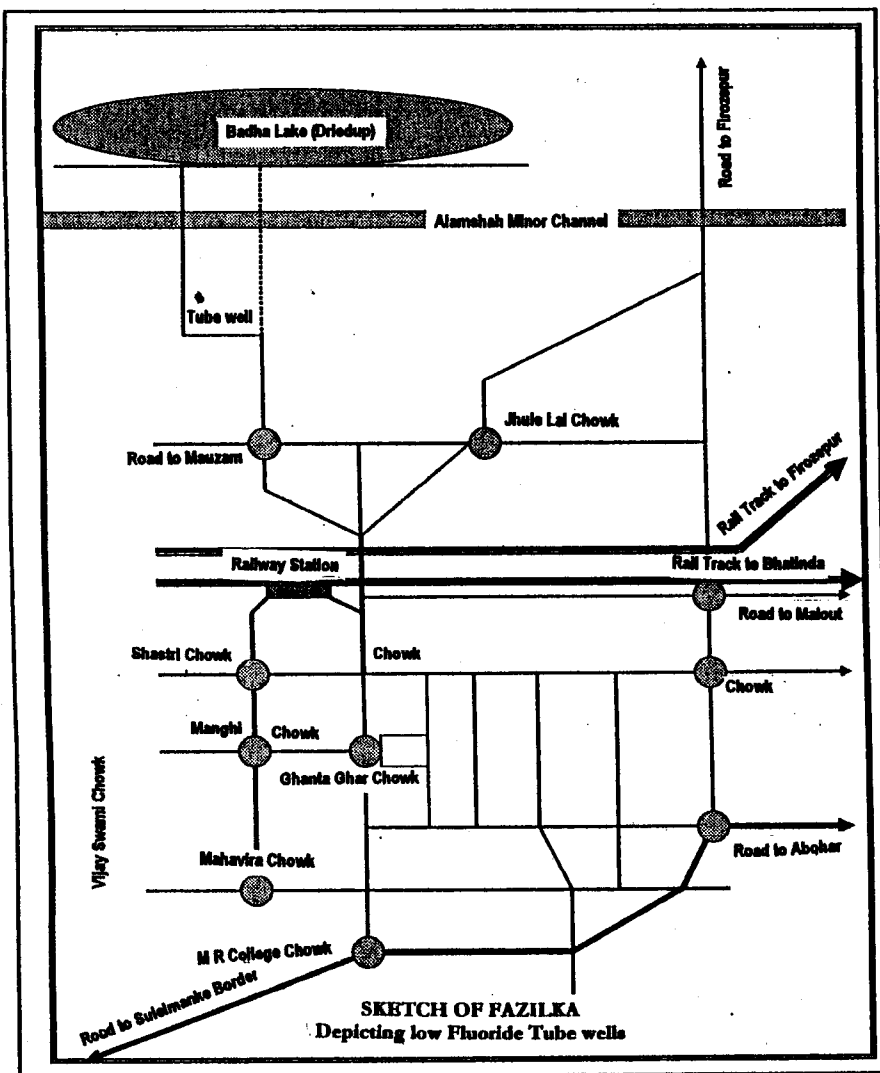
1. Clough A.H., "Plutarch Lives" J.M. Dent & Sons Ltd London, 1957
2. Gazette of Ferozpur District, 1890
3. Interaction with senior citizens, Er. Hans Raj Madaan, Mr. Girdhari Lal Nagpal, 2008
4. Osborne, W. G. "Diary Notes while visiting Punjab ", May 1838
5. Records on Wikipedia web, 2008
6. Singh Bhupinder, "Badha- a sad story", Down To Earth, 2005
7. Thorburn, S. S., "The Punjab in Peace and War", 1883, Reprint by Languages Department Punjab, Patiala, 1970

WATER QUALITY AT THE TUBE WELLS IN VARIOUS SECTORS OF FAZILKA TOWN

Serial No.	Location	TDS-mg/L	Fluorides-mg/L	Remarks
1.	Fazilka Distributory	183	0.3	Superb Quality
2.	Tube well SDM Road	450	0.15	Superb Quality
3.	Near BADHA Axis	638	0.5	Superb Quality
4.	Ghas Mandi, 30m deep	1870	0.3	Average Quality
5.	Shallow Hand Pumps	1700	0.35	Average Quality
6.	Partap Bagh 2	1233	0.8	Can be used
7.	Ghas Mandi 1	1259	0.9	Can be used
8.	Ghas Mandi 2	1218	0.9	Can be used
9.	Adarsh Nagar	1385	1.2	Unsuitable
10.	Badal Colony	1417	1.2	Unsuitable
11.	M. C. Colony	1442	1.4	Unsuitable
12.	Partap Bagh I	1364	1.4	Unsuitable
13.	Sanjeev Cinema	1577	1.5	Unsuitable

WATER ANALYSIS TUBE WELL NEAR SDM ROAD

TESTS	TESTS RESULT	ACCEPTABLE	REJECTION LEVEL
1. Turbidity (Ntu)	Nil	2.5	10
2. Colour (Unit Colour Scale)	-	-	-
3. Taste & Odour <i>Qualitative</i>	Ordinary	-	-
4. Ph	8.1	7 To 8.5	6.5 To 9.2
5. Conductivity	-	-	-
6. Total Dissolved Salts (Mg/L)	450	500	1500
7. Alkalinity (As CaCO_3) Mg/L	192	-	-
8. Total Hardness (As CaCO_3) Mg/L	128	200	600
9. Calcium (As Ca) Mg/L	40	75	200
10. Magnesium (As Mg) Mg/L	21	30	150
11. Chlorides (As Cl) Mg/L	24	200	100
12. Sulphates (As SO_4) Mg/L	-	200	400
13. Fluorides (As F) Mg/L	0.15	1.0	1.5
14. Nitrates (NO_3)	-	4.5	4.5
15. Iron (As Fe) Mg/L	-	0.1	1.0



BASED ON SATELLITE IMAGES OBSERVED FROM 2003 TO 2008

STREAM TO SULEIMANKE HEADWORKS

FORMATION OF HORSESHOE LAKES ON SUTLEJ RIVER
UPSTREAM OF SULEIMANKE HEADWORKS

FAZILKA TOWN

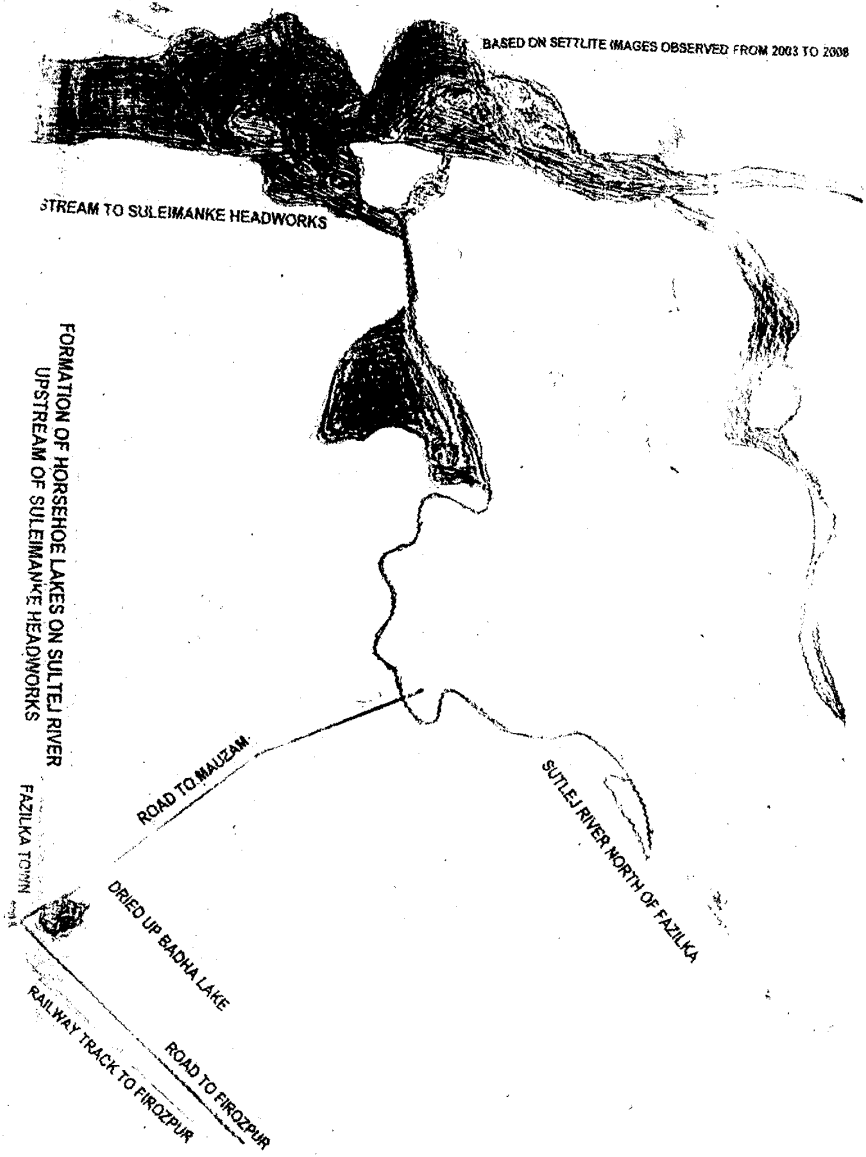
ROAD TO MALUZAM

SUTLEJ RIVER NORTH OF FAZILKA

DRIED UP BADHA LAKE

ROAD TO FIROZPUR

RAILWAY TRACK TO FIROZPUR



Youngsters having a boating trip when Sutlej was really a river

