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Water Logging and Salinization
A serious threat for our agriculture.

Asad Ali Khan,
Assistant Professor,
Department of Geography,
& Muhammad Shifque Chaudary
Cholistan Istitute of Desert Studies,
Islamia University, Bahawalpur.

ABSTRACT

Since independence our population has grown more than four fold and this is the story of just about 55 years. According to recent census it is still growing at an extremely high rate of2.61 percent per annum. Each year approximately 4 million individuals are added to it. Growing population demands more food on one hand while on the other hand our agriculture is facing many problems influencing productivity negatively. Total geographic area as well as agricultural area of the country is already limited. Current farmland too, is turning into unproductive non-farm area. One of the major reasons of this conversion is water logging and salinization. For our agriculture, which is already under a serious stress, this problem is an alarm of danger. This effort looks into some basic aspects of the problem and may prove fruitful for future planning and to overcome the problem.

INTRODUCTION

Pakistan is located on the arid western margin of the world,s one of the major climatic regions named as monsoon and its climate is subtropical continental. . Except a small northern portion its major part is dominated by dry climate (Map-1). About 72% of its lands receive below 250 mm annual precipitation (Ahmed, F.-1999-34). Such a low amount of precipitation is insufficient for agriculture and less useful because of its variable nature. Besides this, most of the rainfall occurs in late summer months when temperature remains high so its efficiency and effectiveness is further reduced due to high rate of evaporation. In these lands man has been fighting against aridity since a long time. The availability of water for farming has always been of prime importance for these areas. Except the Himalayan foothills, in almost all the leveled lands, precipitation is inadequate for agriculture. To meet this inadequacy nature has gifted Pakistan a splendid river system. Although, the use of underground water resources has also been increased over time yet the country is said to be dependent on its rivers for the supply of water. All its useful rivers are the components of Indus system (Map-2). Smaller rivers of Balochistan form inland drainage and have no major role in irrigation. The important tributaries of Indus system cover a long distance through the Himalayas and capture most of their flow before entering the fertile plains. The volume of water fluctuates highly with seasons. It becomes small in winter months and gradually increases in summer months. To

overcome the threat of aridity and to turn its arid lands into green agricultural fields, Pakistan has developed a well-knit canal irrigation system by utilizing the water of its flvers.

Our agriculture dates back to the Neolithic age. This activity provided the base for world's well-known civilization ofIndus valley. Currently it is playing the role of mainstay in the economy of the country. Starting with stone and wooden made tools, today tractors, combines and other modern equipments are important part ofthe rural scene. All this, is because of canal irrigation system which is also a gift of modern technology. History tells that irrigation is an old tradition in our country. Starting with simple type lift irrigation it has now developed into one of the most intricate irrigation system in the world. Our canal irrigation system is one of the largest irrigation system of the world and dominates the cultural landscape of the plain areas ofthe country. It consists on two large storage reservoirs at Tarbela & Mangla and a small storage reservoir at the Chashma Barrage, 19 barrages, 8 link canals and an extensive conveyance system consisting of main canals, branches, distributaries and minors measuring about 400,000 miles and 90,000 farm outlets. From the Indus system a unique network of 48 major perennial and non-perennial canal systems command about 34.5 MA (million acres) land. The perennial canals supply irrigation water to about 21.3 MA area throughout the year while the non-perennial canals supply irrigation water to about 13.2 MA land during the Kharif season only. It is now possible to divert about 75 % of the total surface water resource into the irrigation canals. About 104 MAF of irrigation water is withdrawn from the rivers by the canal systems each year out of which about 68 MAF is lost during transportation (IWASRI & UNDP-1989-Publication No.24).

After the introduction of perennial canal irrigation system in 1859, extensive areas have been brought under cultivation. At the time of independence, nearly 64 MAF irrigation water was diverted into the canals that had commanded an area of27 MA. Now our arable area is spanning over 51.4 MAincluding irrigated & rain fed area (Kureshy, K.U.-1995-78). Nearly 75 % of the total cropped area is canal fed (Khan,F.K -1996-113). About 80% of the food crops and almost whole of the cash crops come from this canal fed area (Kureshy,K.U.-1995-79). More than 90% of the total farm output comes from four main crops wheat, cotton, rice and sugarcane cultivated in these areas. No doubt, the prosperity of nearly 55 years old Pakistan is based on the development of agriculture and role of irrigation in the growth of agricultural economy of the country is vital. Canal irrigation has played the pivotal role for green revolution and contributed significantly to enhance agricultural produce several times but it has not been all blessings for us. It has created twin problems of water logging and salinization, which are seriously damaging our precious lands. Some experts jointly name these evils as the cancer of arable land. To meet the food needs of growing population, more arable land will be needed in future but on the other hand water logging and salinzation is reducing our farmlands. For this reason it needs to serious look into the problem and its scientific solution.

DEFINING THE PROBLEM

Many definitions of water logging and salinization have been formulated by different experts and researchers but all of them carry the same meaning.

Water logging simply means the saturation of the root zone of soil with water. It is infact a condition of soil in which due to the continuous percolation of water from upper surface the underground water table is raised to the soil surface and as a result ,soil is saturated with water. In more severe cases water comes out of the soil and accumulates on it . When soil remains saturated with water permanently or for the long period of time it is said to be waterlogged. This problem usually occurs in poorly drained soils mainly by excessive irrigation. Due to improper and over irrigation, water fills into the pores of soil and impede oxygen penetration into it, chokes the plants, stunt their growth and ultimately kills them.

A problem usually accompanying water logging is salinization which means accumulation of salts in soil that can eventually make the soil incapable of supporting plant life. Salinity originates due to adverse after effects of irrigating land that has poor drainage properties. In arid regions artificial irrigation results addition of more salts to the soil. Evaporation of salty water leaves a salt accumulation in the land which renders the soil unsuitable for crop production. Saline soils contain high concentration of soluble salts which raise their PH-value above 8.5 to 10. Water logging and soil salinization takes place by capillary rise from the water table and evaporation from the soil surface. The soluble salts present in the soil and ground water move upward through the soil profile where their concentration within the root zone and at the soil surface increases. The salinity problem is considered to be a by-product of water logging. These are the inborn problems of canal irrigated agriculture in arid zone of Pakistan and all over the world.

Salinization today threatens almost every arid land where irrigation is used. As irrigation water flows over and through the ground, it dissolves salts increasing the salinity of water. Most of the water in this saline solution is lost to the atmosphere by evaporation leaving behind high concentrations of salts in the topsoil.. The accumulation of salts such as sodium chloride, sulfate, magnesium, calcium, potassium etc. in the soil is called salinization .. In the intermediate or final stages of salinization problem the land falls into disuse. Without flushing or draining the salts from the soil their accumulation is promoted which impair plants growth, reduces yields, eventually kills the plants and convert the land into non arable.

CAUSES OF WATER LOGGING & SALINIZATION

There may be a long list of the causes of these agricultural and environmental threats but only some significant are enlisted here. These are;

1. Uncontrolled seepage of water from rivers, dams, ponds, canals, channels and distributaries that rises underground water table.
2. Improper slope and poor drainage conditions of the land.

3. Poor physical conditions of the soil and presence of excessive amount of harmful salts in it.
4. Poor knowledge of farmers in treating their lands.
5. Over irrigation, inadequate and untimely supply of irrigation water to the fields.
6. Continuous capillary rise in arid areas and high rates of evaporation that brings salts above the land surface.
7. Intensive cultivation of rice in low water table areas.
8. Deep percolation from rainfall and flood waters.
9. Disturbance of natural drainage system by human activities and development efforts.
10. Sub-soil inflow from the upper to the lower reaches ofDoabs.
11. Addition of salts from irrigation sources, floods and hill torrents in the 'Salt Range'mountains.

Due to such reasons many of our canal fed areas are threatened by water logging and salinity. Main reason of the problem in our country is improper irrigation. In some plain areas, irrigation of croplands without sufficient drainage has caused excessive accumulation of water or salts. Farmers usually apply heavy amount of irrigation water to their fields and from artificial watercourses water percolates into the ground consequently giving birth to these threats. Main causes of the problems are also mentioned in Fig-I.

WORLD, S SITUATION

There is only about 11% arable area on the earth's land surface and about one-fifth of it is irrigated. Currently, water logging and salinization are threatening many areas of the world, particularly arid areas using artificial irrigation. In India, Pakistan, China, Australia etc. distribution of rainfall is irregular and uncertain. In all such countries irrigation for farming is needed. According to some estimates made in the year 1988 one- tenth of all irrigated land ofthe world was suffering from water logging and one-third of the world's irrigated land was affected by salinization (Miller,G.T.Jr.-1988-218,219). Besides Pakistan, this problem is very serious in Iraq, India, Argentina, Mexico, Mali, North Africa and western U.S.A.. It was reported in 1988 that in seventeen western states of U.S.A salinization reduced agricultural productivity on 25 percent to 35 percent of all irrigated land. Another estimate tells that 50 percent to 65 percent of irrigated land of the world was suffering reduced productivity in 2000 AD from excess soil salinity. In irrigated crop lands, every year this problem reduces the crop yields of one-quarter of the world's existing cropland (Leong,G.C.-1998-129).

In Canada, water logging is a main restriction to crop production in humid arable areas of eastern parts of the country and salinity occurs in the dry and irrigated farming areas located in the south of western provinces of Manitoba, Saskatchewan,

Alberta and British Columbia. About 2.5 million acres of the farm land of Alberta only is affected by this problem, whereas the data about other areas is not available (Broughton, R.S.& Paterson, B.-1989).

In Egypt, agricultural area is only 3 % of the total area (2.5 million hectares). This agricultural area is mainly located in the Valley and delta regions of the country. In these regions agricultural productivity has declined in the past because of soil salinity (Abdul Dayem,S.-1989).

In Australia, the agriculture of south eastern and western parts of the country has also been affected by these problems, particularly in Murray-Darling Basin, about 96,000 hectares ofland have been damaged by salinity and 500,000 hectares may be affected in the future (Jones, L.D.-1989).

In our neighboring country India, the estimated salt affected area is about 7 million hectares which is expected to increase in future. In Iraq, basins of the Tigris and Euphrates are ancient lands of irrigated agriculture. Due to poor soil drainage in these regions a considerable part of the basin lands have been turned into waterlogged or saline area. Almost similar conditions prevail all over the world's countries where irrigated agriculture is practiced and natural drainage has been largely disturbed by various human activities.

EXTENT AND NATURE OF PROBLEM IN PAKISTAN

Although in the world over, wherever irrigated agriculture is practiced, water logging and salinity problems are inherent but perhaps these are not so serious or involved in any part of the world as in our country. Irrigated agriculture is the base of our national economy and we cannot survive without it. We possess the largest single gravity flow irrigation network in the world, suitable climate and fine soils, but despite such favorable conditions, our average crop yields are very low than many other nations ofthe world. According to experts, one prime cause oflow agricultural productivity is the problem of water logging and salinity. Estimates of various research organizations indicate that due to these menaces we had been loosing arable land at an alarming rate of 50,000 to 100,000 acres per annum. These menaces arise mainly as a result of poor water management in irrigated agricultural areas. Unfortunately, the natural drainage in many irrigated areas of Pakistan is not enough to account for the excess irrigation water, which results in rise in water table.

History of the problem tells that rise in water table had started after the introduction of weir-controlled irrigation and it was geared up in 1940,s. Before the start of canal irrigation system, there was no physical occurrence of water logging problem to any harmful extent.. But, when the perennial canal irrigation system was put to work, the dynamic equilibrium between ground water recharge and discharge was highly disturbed. Due to high rate of recharge and low rate of aquifer discharge in canal fed areas, under ground water table started to rise at a rate of 1.5 feet to 2.0 feet or more per year in the Northern Zone (the upper Indus plains). Though, the rate of rise in water table of Southern Zone (the lower Indus plains) was slower than

Northern Zone but soon it took over most of the arable lands of both the zones and reached to within 10 to 15 feet from the surface (IWASRl & UNDP Publication No.24-1989-5). In these areas water logged conditions started to damage the drainage capacity and productivity of soils.

Now, it has been estimated that in the pre monsoon season, 3.7 MA canal fed area has a water table within the upper 0 to 5 feet and in the post monsoon season this area is increased to 11.8 MA.. The high level of water table in post monsoon season affects adversely the output of Rabbi crops. In addition to this, 10.5 MA area in the pre monsoon and 15.7 MA area in the post monsoon season have a water table between 5 to 10 feet.. Most ofthe researchers use pre monsoon water table as an index of the permanent water logged land, which is usually measured during the month of June because research studies reveal that lowest water table levels occur in this month and highest in December. An overall picture of water table is that 9% of the irrigation system controlled gross area of the Indus Basin have water table between 0 to 5 feet 38% between 5 to 10 feet and 53 % above 10 feet during pre monsoon period (Table-I), while during post monsoon period this proportion is changed into 29 %, 25% and 46 % respectively (IWASRl & UNDP Publication No.24-67).

Table 1: Depth of underground water table in pre and post monsoon seasons.

		0- 5 Feet		5-10Feet		Above 10 Feet	
Province	Area Under Observation (MA)	Percentage of Area in Pre-Monsoon	Percentage of Area in Post-Monsoon	Percentage of Area in Pre-Monsoon	Percentage of Area in Post-Monsoon	Percentage of Area in Pre-Mon soon	Percentage of A rea in Post-Monsoon
Punjab	24.62	5	12	23	28	72	60
Sindh	14.17	15	60	66	22	19	18
NWFP	01.39	10	12	20	24	70	64
Balochistan	00.98	10	24	49	16	41	60
Total	41.16	9	29	38	25	53	46

Source: SCARPS Monitoring Organization, Planning Division WAPDA..

Salinization problem has also emerged with increasing water table and in many places of the country, it has reached to an intolerable level.. An estimated 10.5 MA salinity affected land is found in our canal fed areas of which 3.3 MA is strongly saline, 2.6 MA is moderately saline and 4.6 MA is slightly saline. The problem is found in every province of the country but Sindh is the worst affected province where almost 47% lands are saline, of which 18% are strongly saline (Table-2, Fig-2&3). Actually, the geological formation ofIndus Basin is of such a type that a considerable fraction of salts existed in it well before the start of canal irrigation system. Some

experts name this type of originally existed salinity as 'primary salinity'. Later on, due to various reasons salts accumulation increased in the upper strata of the soil which is termed as 'secondary salinity'. This type of salinity starts to develop when the rising water table approaches to the surface and considerable surface evaporation occurs. Salts start to move upward by capillary action and ultimately reach to the surface. The irrigation water played prime role to carry and accumulate salts in the root zone of plants. In the Indus Basin, particularly in the Punjab and the Sindh plains (Map-2), since the start of irrigation system soil salinization and underground water table are continuously increasing. This Phenomenon has turned the Indus Basin into a 'salt sink' of the country. In many areas a white crust of salts on the surface can clearly be observed.

Currently many national and international research organizations are involved in research on the problem. In 1998, a joint research was completed by IIMI--Pakistan & WAPDA, s planning and investigation unit on the impact of water logging and salinity on crop production. This research revealed that cropping intensity has a positive relationship with water table depth. Although water logging and salinity are both injurious for crop production but salinity has the most adverse effects on rapid soil degradation and crop yields.

Table2: Situation of Surface salinity in Pakistan.

Province	Surveyed Area (MA)	Percentage of salt Free Area	Percentage of Slightly Saline Area	Percentage of Moderately Saline Area	Percentage of Strong 1 y Saline Area	Percentage of Miscellaneous Type Area
Punjab	25.138	84	07	04	03	02
Sindh	13.396	50	19	10	18	03
Balochistan	08.750	74	17	05	04	---
NWFP	01.517	78	08	02	02	10
Total	48.801	72	11	06	08	03

Source: Soil Salinity Survey, Planning Division, (Data Reports).

All other researches and surveys conducted and data collected by different agencies and institutes indicate that the incidence of problem in canal irrigated areas is very severe. Some areas of NWFP and Balochistan are also affected but arable lands of the Punjab and Sindh are facing acute problems. As a consequence, soils are loosing productivity rapidly. Accumulation of water and salts in the surface have turned the soils oflarge areas unfit for cultivation. Although, the tube wells have been installed in many places to drain out the fields and flush out the salts, but now, the problem is where to dispose of the saline water and how to ensure that problem will not rebuild. One suggestion for the disposal of saline water is to throw it into the sea, but this needs other special arrangements. Installation, maintenance and operation of

tube wells is also expensive. In short, reclamation of affected lands by technological methods demands huge expenditures which is another big problem and burden on our economy.

ADVERSE EFFECTS OF WATER LOGGING AND SALINITY

The twin evils have very bad effects on environment, living organisms and economy of the country. Some of the major effects are summarized as follows. These;

1- Convert precious farmland into unusable non- farm land.
2- Restrict the growth of root system and damage the plant and animal life.
3- Cause marshy and poor physical conditions of soil by reducing its temperature nutrients, and oxygen penetration into it.
4- Cause death of microbes that decompose organic materials, thus interfear the supply of humus to the soil.
5- Cause the formation of hall om orphic and hydromorphic soils.
6- Damage the general hygienic conditions ofthe area.
7- Cause formation of toxic compounds such as methane, hydrogen sulphide, ferrous, butyric, lactic, formic and succinic acids.
8- Prevent boosting agricultural production and adversely affect our exports of agricultural commodities.
9- Cost extra expenditures putting burden on national budget and economy of the country.
10- Cause wear and tear oftransport routes and buildings etc.

The major adverse effects are also shown in Fig-4.

OVERCOMING THE PROBLEM

The continuous effects of water logging and salinity on the agricultural production attracted the attention of many researchers and concerned people and they started to frame out different strategies to overcome the problem. In this regard efforts have been made since 1912 but by the mid of 20th century, the problem became so serious that remedial measures were necessary to be intensified. Initially, in 1953-54 a comprehensive plan for detailed mapping of soils and land use ofIndus Plains was worked out under the supervision of Colombo Plan Administration. It revealed that 0.1 MA of fine irrigated arable land was turning into unproductive land each year, 16 MA land was severely affected and 11.6 MA land was water logged or poorly drained. Later, many agencies and institutions were involved in this conaction. Infact, to avoid water logging and salinity, a balanced type of water management is necessary. In this way land can be kept fertile and the crop yields high. In the all irrigated areas, it is important to provide drainage facilities so that the water can be kept moving and does not become stagnant.

To overcome the problem, our past strategies are mainly based on, firstly, preventing expansi on of the affected lands, by controlling canal seepage and

secondly, reclamation of already affected lands by vertical and horizontal drainage. In this regard various institutional and technical measures have been taken by the involvement of government & private sector and local & foreign consultants. Looking at the seriousness ofthe problem, our governments had given a high priority to control and reclamation efforts. Tube-wells were installed to discharge ground water and canals were lined to reduce ground water recharge. During the 3.5 decades from 1960 to 1995, WAPDA has completed 55-SCARPS and drainage projects covering an area of 15.78 MA whereas 14 projects covering an area of 6.521 MA are near to the completion (Table 3& 4,Fig 5&6).In future too, the problem can be solved by adopting both curative and preventive measures.

Water logging can be checked by;

1. Keeping the underground water table low by discharging the ground water.
2. Avoiding over irrigation and preferring seasonal and controlled irrigation system.
3. Lining the canals and distributaries and constructing pavements.
4. Planting hydrophytic plants like Eucalyptus in the affected areas.
5. Developing the efficient drainage system.
6. Increasing the capacity of canals and constructing flood drains.
7. Cleaning the canals to regulate the flow of water.
8. Avoiding the cultivation of crops that require high amount of water.

Saline soils can be reclaimed in the following ways;

1. By applying eradication method, that is the flushing out salts, but this practice demands much more water than is required for crops growth and increases pumping and crop production costs, and also wastes huge amount of precious water.
2. By converting toxic salts into nontoxic, soluble and leachable form. In this regard use of gypsum has proved very effective on sodic soils for changing the caustic alkali carbonates into sulphates.
3. By planting forage grass that promotes the substitution of calcium for sodium. Some experts recommend the cultivation of barley, rice, jantar, kallar grass and Sudan grass in the salt affected areas.
4. By using various other antisalinization materials and chemicals such as press- mud, fym, sulfuric acid etc.
5. By taking soil out of cultivation for two to five years.
6. By applying sprinkler system that pivots around the well because this system maintains downward drainage.

Table-3: Completed SCARPS & Drainage Projects by WAPDA up to 1995

Sr. No.	Province	No. of Projects	Project Area (in MA)	No. of Tube-Wells Installed	Length of Drains Constructed	Period
1	Punjab	27	9.599	20,585	2,800	1960-95
2	Sindh	18	5.486	4,788	7,352	1965-93
3	NWFP	08	0.518	491	946	1972-95
4	Balochistan	02	0.177	----	322	1974-89
	Total	55	15.780	25,864	11,420	1960-95

Table-4: On Going SCARPS & Drainage Projects

Sr.No.	Province	No.of Projects	Project Area (in MA)	No.ofTube -Wells to be Installed	Length Of Drains to be Constructed
1	Punjab	09	3.143	80	1713
2	Sindh	04	3.097	2,250	2,200
3	NWFP	01	0.281	---	---
	Total	14	6.521	2,330	3,913

Source: SCARPS Monitoring Organization WAPDA, Lahore.

RESEARCH ORGANIZATIONS WORKING ON WATER LOGGING AND SALINIZATION PROBLEM OF PAKISTAN

Different organizations involved in water logging and salinity research in the country are;

Pakistan Agriculture Research Council (PARC) Islamabad, SCARPS Monitoring Organization (SMO) Lahore, International Waterlogging and Salinity Research Institute (IWASRI) Lahore, Directorate of Land Reclamation Punjab Lahore, Drainage and Reclamation Institute of Pakistan (DRIP) Tandojam, Pakistan Council of Research in Water Resources (PCRWR) Islamabad, Punjab Irrigation Research Institute Lahore, Soil Salinity Research Institute (SSRI) Pindi Bhattian, Mona Reclamation and Experimental Project (MREP) WAPDA Bhalwal, Lower Indus Water Management and Reclamation Research (UM) WAPDA Hyderabad, Alluvial Channels Observation Project (ACOP) WAPDA Lahore, Soil Survey of Pakistan Lahore, Nuclear Institute of Agriculture and Biology (NIAB) Faisalabad, Ayub Agriculture Research Institute Faisalabad, Centre of Excellence in Water Resources Engineering (CEWRE) University of Engineering and Technology Lahore, Forest Research

Institute Guttwala Faisalabad, Forest Research Institute Peshawar, Agriculture Department Govt. of Sindh Karachi, Tarnab Agriculture Research Institute (TAR!) Peshawar, Watercourse Mointoring and Evaluation Project WAPDA Lahore, International Irrigation Management Institute (IIMI) Lahore, ISMRJUSAID Lahore, Various Universities of Pakistan etc.

CONCLUSION

In? the light of various facts considered in the foregoing discussion following concluding remarks are made. To satisfy ever-growing food and fiber needs of expanding population, raw material demands for the country's agro based industry and foreign exchange earnings from farming sector, the threats of water logging and salinity must be relieved at each and every cost.. These evils are doing serious harm to our agriculture in the form of farmland conversion, soil degradation and reduction in crop yields. If the problem is left unchecked or even treated leniently, it may engulf our existing farm land very soon. Because side by side to this problem, many other factors like expansion of human activities etc. are also working fastly to devour the already limited arable lands. So it must be stopped efficiently by sufficiently effective measures. In this regard training and involvement of farmers must also be ensured. Absence of adequate drainage is the basic cause that helps the disease to prosper, therefore, proper drains should be installed on large scale. Good results can be achieved not only by engineering measures but also by proper management of irrigation water and by taking ecological measures too. Proper understanding of the existing conditions, sufficient scientific knowledge, enough training and application of multidisciplinary approach is needed to kick out the problem permanently.

Least but not last;
'We must treat our agricultural land resources with great care and understanding. Only in this way we can save them as well as humans on this planet'.

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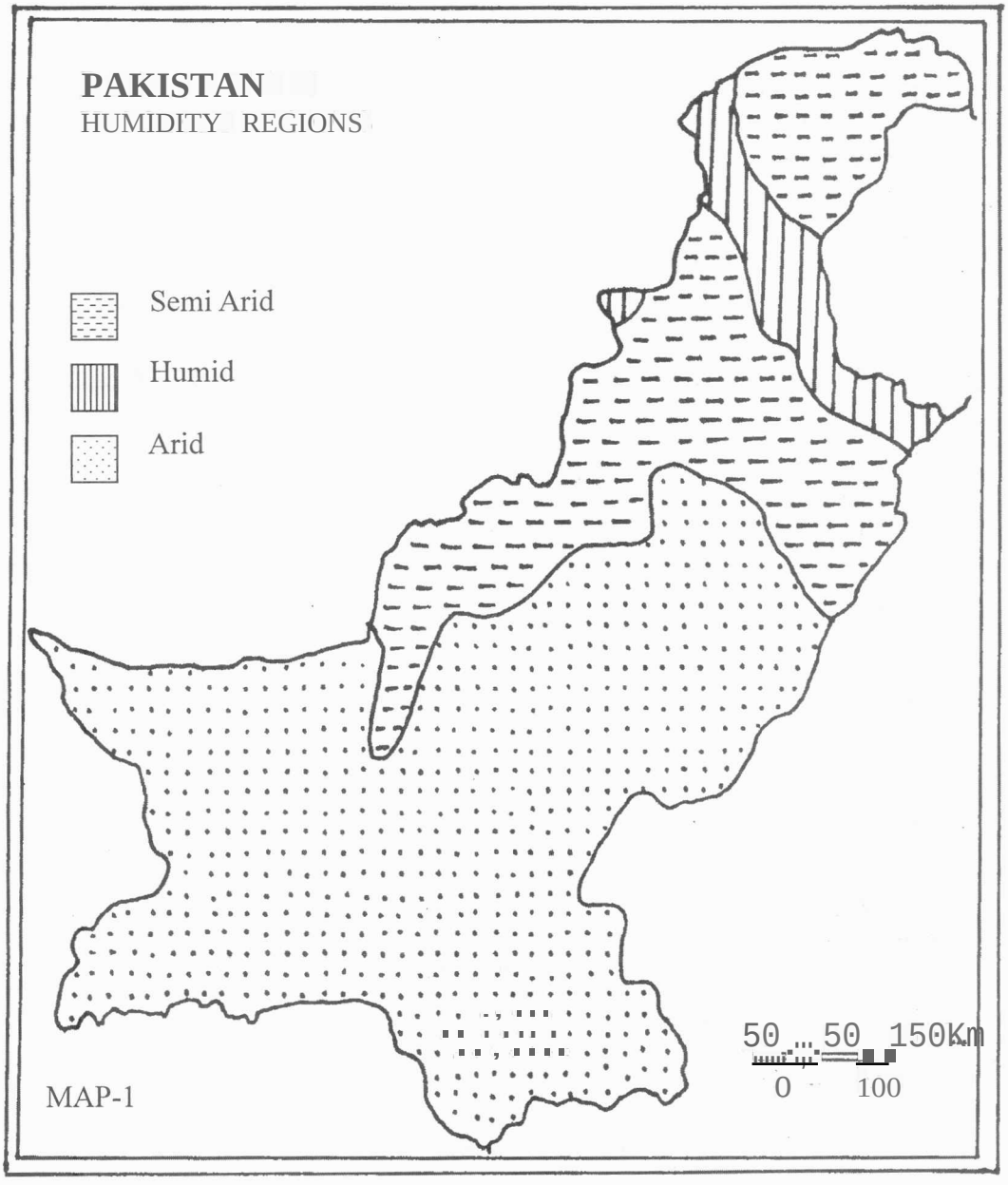
PAKISTAN
WATER LOGGED AND
SALINE AREAS
Affected
areas
~0 50 150Km
0 100
MAP-2


PAKISTAN
HUMIDITY REGIONS
Semi Arid
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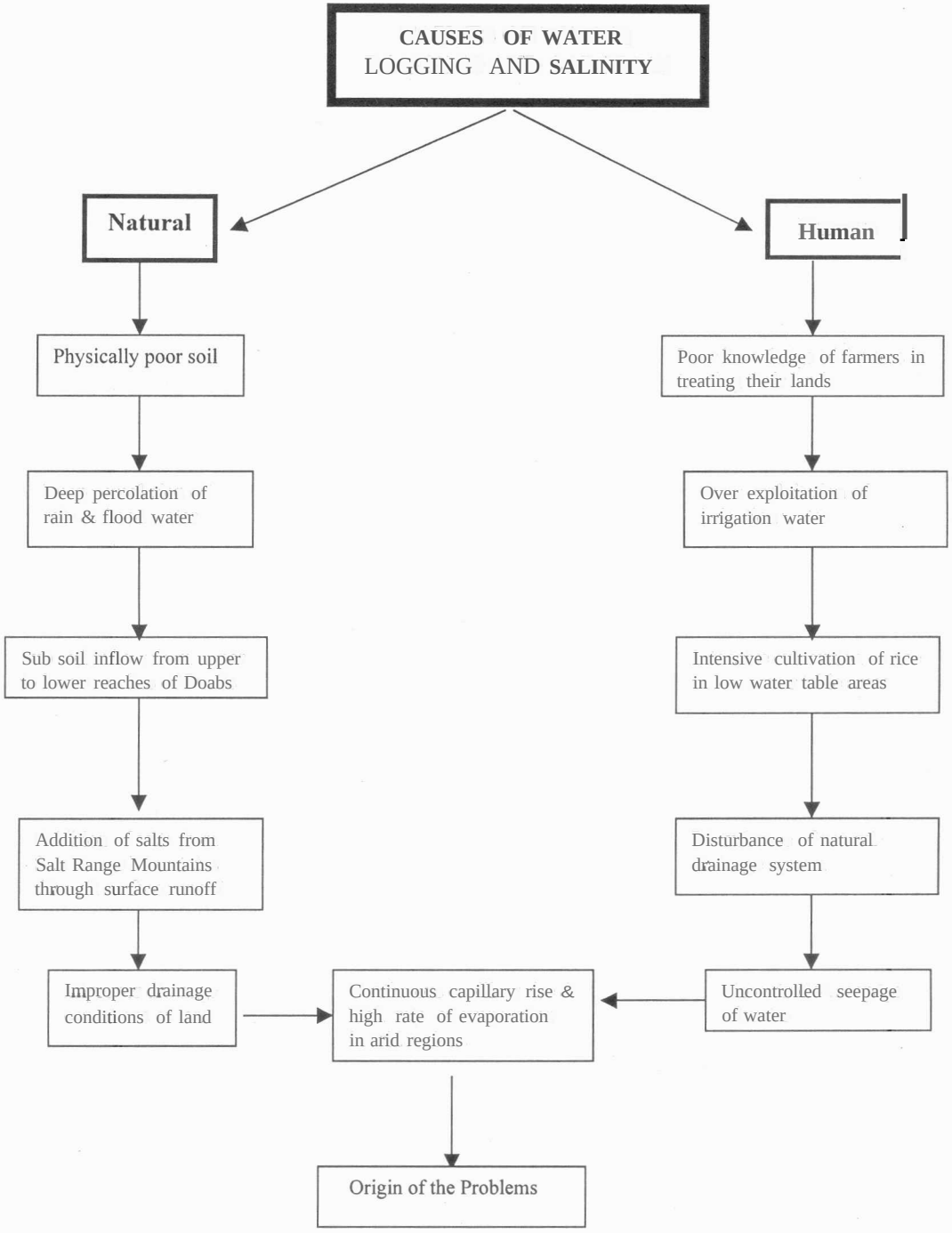
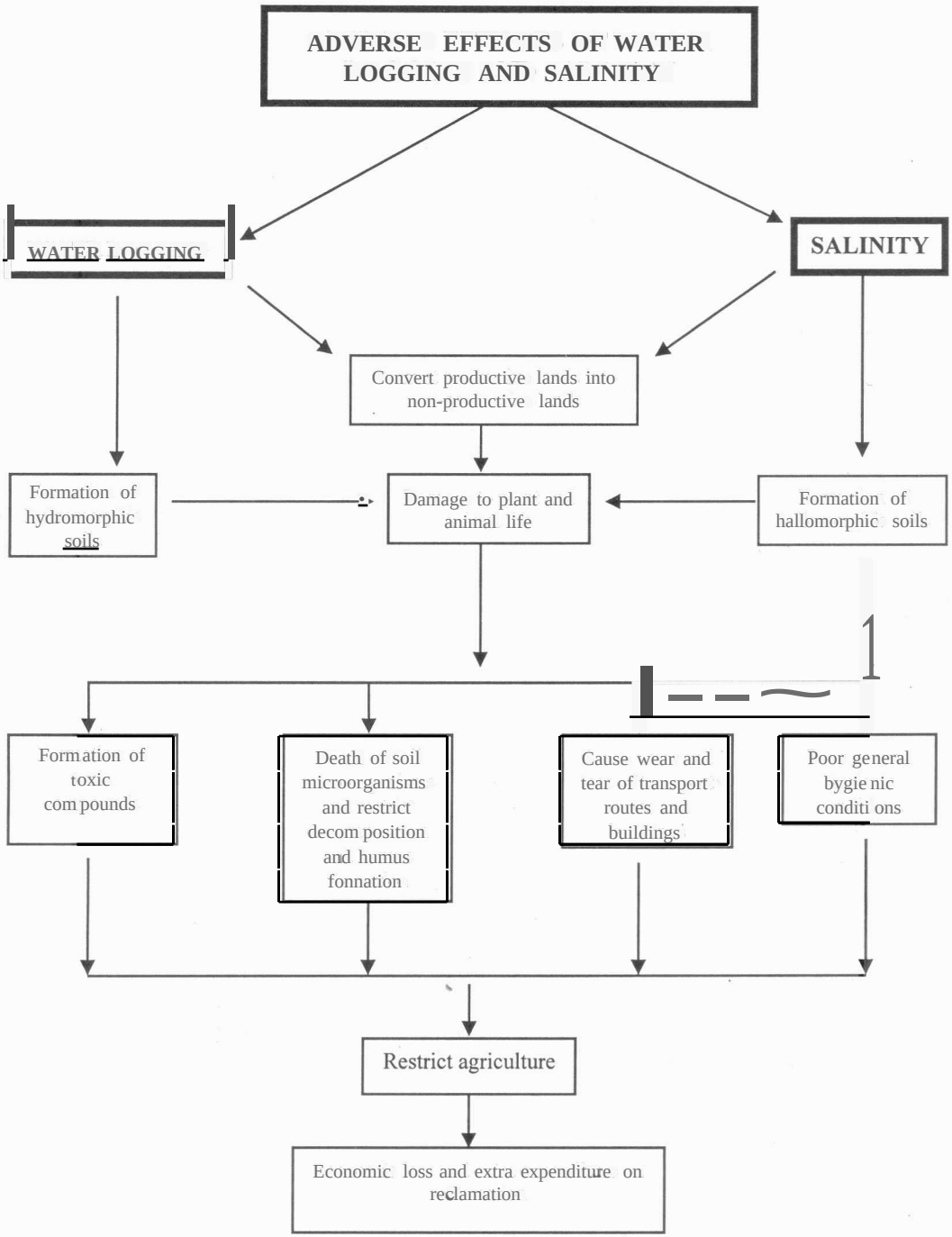
MAP-1


CAUSES OF WATER LOGGING AND SALINITY
Natural
Human
Physically poor soil
Deep percolation of rain & flood water
Sub soil inflow from upper to lower reaches of Doabs
Addition of salts from Salt Range Mountains through surface runoff
Improper drainage conditions of land
Poor knowledge of farmers in treating their lands
Over exploitation of irrigation water
Intensive cultivation of rice in low water table areas
Disturbance of natural drainage system
Uncontrolled seepage of water
Continuous capillary rise & high rate of evaporation in arid regions
Origin of the Problems


ADVERSE EFFECTS OF WATER LOGGING AND SALINITY
WATER LOGGING
SALINITY
Convert productive lands into non-productive lands
Formation of hydromorphic soils
Damage to plant and animal life
Formation of hallomorphic soils
Formation of toxic compounds
Death of soil microorganisms and restrict decomposition and humus fonnation
Cause wear and tear of transport routes and buildings
Poor general bygienic conditions
Restrict agriculture
Economic loss and extra expenditure on reclamation

LAND AND AGRICULTURE RESOURCES: A CASE OF NWFP

Atta-ur-Rahman
Lecturer, Department of Geography,
Urban & Regional Planning,
University of Peshawar

ABSTRACT:

The Agriculture sector of NWFP has attained an impressive growth rate during the past few decades. The same trend would likely to continue, if government remains committed to develop the rural economy.. In this paper an attempt has been made to examine the land and agriculture resources of NWFP with particular emphasis on the trends and prospects of potentials. The climate is arid to semi-arid and agriculture is the dominant economic activity. The former faces numerous constraints in the agriculture sector. Parallel to this, Government has initiated various developmental programmes, in order to enhance the incame of the farming community. Moreover,, due to the application of new technology,, a large chunk of land has been brought under cultivation.. The yield per hectare is continuously increasing.. Nevertheless, self-sufficiency is a challenge for the agricultural sector to compete with the booming population of the province. Consequently, increase use of high yielding seed varieties and inputs of green revolution technologies countered the age-old stagnation in agriculture.

The paper is divided into ten sections. Section one deals with the detail introduction of the study.. Section two explains methodology adopted for the study.. Section three describes the relationship between agriculture and its environment. Sectionfour evaluates the agriculture development planning in NWFP Section jive and six discusses land use and cropping pattern respectively.. Section seven analyses horticulture in NWFP Section eight focuses on livestock.. Where as section nine explains thefinding and conclusion.. Recommendations are given in thefinal section..

1. INTRODUCTION:

Agricultural development is a complex process, which involves a transformation of production from a traditional and subsistence stage to modern and more technologically advanced stage (Ladele and Omotesho, 1997). However, the existing farmer community, apart from providing for the family, also aims at producing for market.. To improve the productivity, they will require utilization the modern technological inputs. Government has formulated various systems for agricultural development and realised that it is essential for rural sector and attaining national development (GoNWFP, 1996a). Hence, this study would help planners and decision-makers a firm foundation for formulating comprehensive policies and plans for agriculture development in the province.

Agriculture has played a pivotal role in the socio-economic up-lift ofNWFP. In this slice of earth agricultural activity started from time immemorial.. Primarily, the agriculture was totally dependent on rain. Likewise, agriculture was dominant economic activity and the whole family including male and female were engaged in

growing crops and rearing animals. Due to lack of agriculture advancement and use of primitive means of farming, the province is not self sufficient in the food production. Currently, in NWFP about 80 percent people are directly or indirectly involved in agriculture economic activity.

The province ofNWFP came into being as an administrative entity in 1901 (Quddus, 1990). It comprises administrative units called divisions and Federally Administered Tribal Areas (FATA). NWFP occupies approximately 8,345,171 hectares, of which 5,623,129 hectares are under provincial Govermnent. . The rest is FATA (2,722,042 hectares), which is under the control of the Federal Government through the Governor of NWFP. The tribal territory bordering Afghanistan are federally administered, but geographically and culturally these are the part ofNWFP. Therefore, in this paper data regarding FATA is incorporated in NWFP figure.

2. METHODOLOGY:

This paper attempts to find out the trends and potentials of land and agricultural resources ofNWFP. To achieve the mandated task, the study focused on the following objectives,. Primarily, to find out the existing land and agriculture resources ofNWFP. Secondly, to analyse the landuse and cropping pattern. Finally, the paper attempts to suggest policy recommendations.

To achieve the objectives of the study, both primary and secondary data were collected. Surprisingly, review of available literature was undertaken, which were based on both published and unpublished documents including govermnent reports, articles and research papers as a source of information for the study. An empirical and systematic review of the electronic database searches was also under taken.

Data from various surveys were used, particularly the data set generated by the agriculture statistics wing, agriculture department, Peshawar. Likewise, an interviewing schedule was designed, to collect the relevant data from the officials of the implementing agencies. Other tapped sources were the Bureau of Statistics, Forest Department, Manpower and Labour Department, PE&D Department. .

Finally, the collected data and information were classified, analysed and presented in the form of tables, and descriptions. On the bases of this data conclusion were drawn and recommendations were made keeping in view the socio-economic and physical enviromnent ofthe study area.

3. AGRICULTURAL ENVIRONMENT:

Agriculture is the dominant economic activity in NWFP. Its contribution to the provincial income, products for export, or the size of the rural population are of immense importance (GoNWFP, 96a). The rural population constitutes about 83 percent of the total, but a major part of the urban population is also affected by agriculture. In spite of its dominance, NWFP agriculture has all the attendant problems. Productivity is among the lowest, and plough is done by wooden plough of ancient design pulled by a pair of oxen. Many farmers are tenants and have little incentives to increase production.

Another serious problem is the water logging and salt accumulation in the

soil, caused by poor drainage in the vast, nearly flat plain, that are slowly destroying the fertility of much of the irrigated fields. Of the canal-irrigated land, water logging and salinity have, seriously damaged more than 20 percent of the sown area (GoNWFP, 2000c). Increased use of high yielding seeds and other inputs of the green revolution technology countered the age-old stagnation in agriculture. The green revolution and mechanization have significantly changed the structure of NWFP agriculture.

Demographic situation is also important in the agriculture. The rate of population increase (2.8%) continues to be too high for limited agricultural resources (GoP, 2000). The agricultural lands are increasingly unable to absorb the exploding growth. The variation in soil and water availability results in wide spread differences in carrying capacity ofland. **In** Chitrallittle arable land could support only 10 per sq. km. Likewise, the devoid hills of Swat, Kohistan and Dir with negligible arable land, have almost no capacity to sustain livelihood. But still people are living in that area and population density is many times higher than the supporting capacity (GoNWFP, 1996a). The Government of Pakistan constituted a National Commission on Agriculture (NCR) in 1987 to review the agricultural situation in the country. The Commission made a thorough review and recommended that essential and high value crops be accelerated. **In** addition, the Commission recommended strengthening and improvement of infrastructure, improvement of the livestock sector, adequate maintenance of land and water resources, development of irrigation areas, environmental protection of land, and development of forests. Another important feature of the land holding system was the fragmentation of holding. The result of successive generations from a common ancestor is the division of land into smaller and smaller fields. The work of the individual farmers becomes more and more difficult as irrigation, drainage, disease control as well as applications of new tools and techniques.

Agriculture implements are generally traditional and primitive. Hand labour and draft animals are common on small farms. On large falms, tractors are becoming more popular, since the early 1960s. **In** the 1990s use of fertilizers, high yielding seeds and irrigation became widespread. The assemblage of traditional agricultural implements consists of plough, clod crushers, hoes, and sickles.

To mechanize agriculture and support the green revolution technology was introduced in 1958. Latter, tractors substituted for the disc plough are still pushed by the government through subsides and price supports. Since 1970, NWFP has seen a rapid increase in the use of tractors. The government has a liberal policy of importing large numbers of tractors and selling them to the landowners on easy instalments (Table No.1). The number of farm animals is decreasing, as a result of the increasing number of tractors. Such a trend is also noticeable in other provinces of Pakistan. The decreasing livestock and exponential population growth have forced the country to import powdered milk and butter from Europe and Australia.

The survey of Agriculture Development Bank of Pakistan, revealed that the

introduction of each tractor, destroys about ten permanent jobs, but this is compensated by the creation of jobs for casual workers equivalent to five permanent jobs. In the fiscal year 2000-2001, the number of tractors in use were 19,197, means that tractors are causing a total displacement of95,985 jobsby using the figure offive displaced workers per tractor. Consequently, the rural unemployment and under employment reached to an alarming stage and threatened the very survIval of the rural areas.

TABLE NO.1
MODERN AGRICULTURE IMPLEMENTS, 19802000.

Govt./Private	Type	1980	1985	1990	1995	2000
Government	Tractor	113	176	185	306	235
	Bulldozers	265	320	317	307	267
Private	Tractor	4877	8630	11649	15173	18962
	Bulldozers	3	3	4	5	21
Government	Wheat thresher	31	34	31	83	115
Private	Wheat thresher	1703	2608	3215	4805	4927
Govt..	Maize shellers	0	5	5	21	27
Private	Maize shellers	0	324	455	697	973
Govt..	Wheat harvester	0	0	1	25	28
Private	Wheat harvester	31	86	388		

Source: GoN1Wpp, 20008.

4. STATUS OF AGRICULTURE AND DEVELOPMENT STRARTIGIES

Pakistan has developed a reasonably good infrastructure for effective agricultural education and research. Nevertheless, these facilities are mainly related to production technologies of major crops and livestock in the country (Mustafa, et aI, 1997). Moreover, to improve the living condition of farming community, Government has initiated programmes including agriculture extension, agriculture research and agriculture engineering. In order to achieve the objective of self-sufficiency in food and production of surplus for export (GoNWF, 96b).

The mandated task of the agriculture extension is, to transfer the modem technology to the farmers and motivate them about the benefit of new trends and development in agriculture sector. For the production of high yielding quality seeds, the department has already established ten agriculture farms, in D.I.Khan, Bannu, Kohat, Karak, Mardan, Charsadda, and Haripur districts of NWFP (GoP, 2000). Whereas, they produce and distribute seeds of wheat, gram, maize, rice, sugar cane, pulses and oil seeds etc. During 1997-98, about 3146 tones of high yielding seed varieties were distributed among the farmers.

Parallel to this, the Government has started, the Agriculture Research Programme, to develop modem technologies that are better suited to the local environment.. To achieve its objectives, agriculture research is continues particularly in the agriculture institutions namely: Tamab, Pir Sabaq, Surizai (Peshawar) D.I.Khan, Kohat, Serai Naurang (Lakki Marwat), Karak, and Chitral.. Wheat being

the staple food suffers from low productivity and non-availability of improved seed varieties. Moreover, these institutes produced nine varieties of wheat and also ensured the availability of quality seeds.

The agriculture-engineering branch is mainly responsible for reclamation and development of agriculture land as well as improving its productivity, exploiting groundwater resources for irrigation and protection of land from erosion. At present, the department has about 235 tractors, 267 bulldozers, 115 wheat threshers, 27 maize shellers and 28 wheat harvesters spread over the province.

5. LAND USE:

Land utilization means the classification of the geographical area in accordance with its use (Khan, 96) Seventy eight percent ofNWFP is uncultivated, which consist of forests, culturable waste and uncultivated area (GoNWFP, 2000c). Of the total 8.345 million hectares in NWFP, 1.847 million hectares were cultivated in 1999-2000. Out of total cultivated area, 5,70,797 hectares were cultivated more than one time, bulk of, which are located in eastern and central sections of the province (GoP, 2000). Since independence, the cultivated land has increased significantly, as a result of institutional changes, reclamation, intensification of irrigation and introduction of new technologies. The development was so intense that by the year 2000, NWFP had little land left that could be brought under cultivation. A large proportion was lost to built-up area as well as to the twin problem of water logging and salinity (GoNWFP, 96c).

The scant rainfall has made cropping largely dependent on irrigation over much ofNWFP. The only area cultivated without irrigation in 1999-2000, amounted to 9,23,948 hectares. This land is cultivated after the rains. According to agriculture statistics, a small percentage (22%) was cultivated in 1999-2000. Aridity and rugged topography are the major constraints in the rapid extension of cultivated area. Still the cultivated area (net area sown plus current fallow) has increased from 1947-48 (11,50,000 hectares) to 2000-2001 (447,18,914 hectare).

TABLE NO.2
LAND USE CLASSIFICATION, 1999-2000.

SNo.	*Land use*	*Area (Hectares)*	*%a~e*
1.	Total area (2+3)	83,45,171	100
2.	Cultivated area (1 + ii) or (iii + iv)	18,47,914	22
	i. Net Sown	14,34,171	17
	ii. Current fallow	413743	5
	iii. Irrigated area	9,23,966	50
	iv. Un-irrigated area	9,23,948	50
	v. Area Sown more than once	5,70,797	-
3.	Un-cultivated area (4+5+6)	64,97,257	78
4	Culturable waste	12,11,949	15
5	Forest	13,60,774	16
6.	Not-available *fQtlRNl~:V(\Ji;mlWFp, 2000c*	*'rmd Gob,91lJ(Y(j34*	47

6. CROPPING PATTERN:

In NWFP agriculture is largely a two-season activity. Rabi or winter cropping season, these are cultivated in the beginning of winter season and harvested in early summer (Quddus, 90). They include the cereal crops of wheat and barley. While the oil seeds include mustard and sunflower. The pulses are gram and *masoor*. Whereas cash crops are tobacco and sugar beet. Besides this, *Rabi* vegetables and fruits are also cultivated on large scale. Oil seeds are raised in both *Kharif* and *Rabi* seasons. *Kharif* or summer cropping season, the crops that are sown in the beginning of summer and harvesting takes place in early winter. Kharif cereal crops include maize, rice, *bajra, andjowar,* while cotton, groundnut, sesamum and soybean are oil seed crops. The pulses are *mung, mash,* etc, and the major cash crop is sugar cane. Beside this, Kharif vegetables and fruits are also cultivated (GoNWFP, 2000a). In some places a single crop dominates the system, whereas in other complex combinations of many crops is found.

i. WHEAT

Wheat is the most important Rabi crop ofNWFP, both in value and acreage. It is grown all over the province except the rugged and derelict high terrain, whose soil discourages its cultivation. Its distribution and acreage reflect a close association with the canal irrigation (GoNWFP, 96a). Wheat grows well on irrigated lands, but it is also cultivated on baraui leuid. In NWFP, wheat is sown in October and November. Traditionally, farmers using their best yielding seed. Likewise, agriculture department also supplying high yielding seeds to the farmers.

Wheat is grown in all the districts and frontier agencies. The canal irrigated area of Peshawar vale rank first both in production and yield per hectare. The plain areas of Peshawar, Nowshera, Charsadda, Mardan and Swabi districts have alluvial soil brought by river Kabul and its tributaries. The canal irrigation system further improved the fertility of soil, by adding number of organic and inorganic nutrients, brought from the catchment area. The table no.3 shows that there is increase both in acreage and production. Application of new technology has enhanced the per hectare yield. In FATA, Khyber, Bajaur, and Kurram agencies are the leading producing areas in terms of acreage and yield per hectare. Besides this, wheat is also grown in hilly and un-irrigated areas, where wheat cultivation is totally depend upon the rainfall.

TABLE 1\0. 3

AREA, PRODUCTION AND YIELD OF WHEAT CROP, 1975-2000

Year	Area in Hectare		Production in tonnes		Yield in Kg./hectare	
	Irrigated	Unirrigated	Irrigated	Unirrigated	Irrigated	Unirrigated
1975-76	284617	422355	398588	261811	1400	620
1980-81	304082	486346	525637	415171	1729	854
1985-86	305048	476886	536148	370378	1758	777
1990-91	334390	505739	633217	515210	1894	1019
1995-96	352190	513956	679370	523148	1929	1918
1999-2000	326103	480378	635446	432398	1949	900

Source: Agriculture Statistics H'ing. Agriculture Department. Peshml'G/:

Ii. TOBACCO

Tobacco is an important cash crop of NWFP and dominant item of export. But during recent years, its acreage, production and yield have registered an incline. Tobacco is a Rabi crop. It occupied an area of 28,538 hectares in 1975-76. That decreased gradually to 26,055 hectares in 1995-96. But than the acreage under tobacco crop has registered an increase and marked the figure of 35,682 hectares in 1999-2000 (Table No.4). As far as the production is concerned, it was 36,243 tonnes in 1975-76, which increased to 80,352 tonnes in 1999-2000. With the advancement in science and technology as well as the use of high yielding varieties. The yield per hectare is gradually increasing. It was 1,270 Kg per hectares in 1975-76, which rose to 2,252 Kg per hectares in 1999-2000. In NWFP, both Virginia and *desi* varieties are cultivated. But the area under Virginia is increasing compared to *desi* varieties. In 1999-2000, tobacco occupied 1.78% of the total cropped area of NWFP. It is extensively cultivated in the districts of Swabi, Charsadda, Mardan, Mansehra and Buner, while some minor cultivated regions include Nowshera, Haripur, Malakand, Swat and Dir.

TABLE NO.4

AREA, PRODUCTION AND YIELD OF TOBACCO CROP, NWFP.

Year	Area in Hectares	Production in Tonnes	Yield in Kg/ hectares
1975-76	28,538	36,243	1,270
1980-81	24,954	41,420	1,660
1985-86	25,499	50,500	1,980
1990-91	24,720	49,644	2,008
1995-96	26,055	53,538	205
1999-2000	35,682	80,352	2,252

Source: GoNWFP. 2000c.

iii. SUGARCANE:

Sugarcane is an important cash crop of NWFP. Since long, it is used for sweetening purposes. Although, sugarcane is a tropical crop, but it also cultivated in the sub-tropical areas. It is cultivated from ancient times. Moreover, it is the largest and cheapest source of obtaining cane sugar. It also competes with wheat for the use of land (GoNWFP, 2000c). Comparatively, high prices of the sugarcane induced grower to switch land from wheat to sugarcane. Peshawar basin leads all other areas of the province, in terms of per hectare yield and prevalence of natural condition needed for its cultivation. High temperature, assured water supply, and alluvial soil contributed much to the leading position. Sugarcane cultivation begins in February and continues till March, while the harvesting starts in November and last until the month of January.

At the time of independence, there were only two sugar factories in Pakistan, one was in district Gujranwala other at Takht-i-Bai in Mardan district of NWFP.

Currently, there are six sugar mills in NWFP. One each in Peshawar, Mardan, Takht-i-Bahi, Charsadda, Bannu and D.I.Khan. In 1947, the area under sugarcane was only 50,000 hectares, which almost doubled and reached to 1,06,272 hectares in 1999-2000. Looking to the table no. 5 the area, production and yield per hectare is continuously increasing. Since 1975, the area under sugarcane on un-irrigated area is steadily decreasing from 2,172 hectares in 1975-80 to 967 hectares in 1995-2000. At the same period, irrigated area steadily increased from 91,018 hectares in 1975-80 to 104,860 hectares in 1995-2000. This indicates that sugarcane require plenty of water, therefore, area under irrigated acreage increased compared to un- irrigated.

TABLE NO.5

AREA, PRODUCTION AND YIELD OF SUGARCANE, 1975-2000.

Period	Area in Hectare		Production in Tonnes		Yield in Kg.Ihectare	
(5 years average)	Irrigated	Un irrigated	Irrigated	Unirrigated	Irrigated	un irrigated
1975-80	91,018	2,172	3583,445	42,025	39,371	19,349
1980-85	96,433	2,080	3847,138	44,976	39,894	21,625
1985-90	94,542	1,987	3921,587	52,077	41,480	26,203
1990-95	101,220	908	4477,328	31,809	44,233	35,032
1995-2000	104,860	967	4774,152	29,390	45,529	30,380

Source: Agriculture Statistics wing, Agriculture department, PeshawaJ:

iv.MAIZE:

Maize is a Kharif (summer) crop in the province. During sowing, it needs high temperature and moderate amount of rainfall.. It also occupies the land, still beyond the realm of perennial irrigation. Maize is drought resistant, but do better with some irrigation. It is a food crop but is also used as fodder. It is not a staple food, while some poor family still use it as a food. It does not carry the prestige that wheat does, therefore, it is not grown on large scale. Maize is a crop, which can grow even in poor soil. Therefore, it is grown in all districts and frontier agencies (GoNWFP, 2000a).

The maize acreage in NWFP is increasing. The area under maize was high in district Swat (58,700 hectares), Mansehra (58,961 hectares), while Bajaur rank first among the frontier agencies in 2000. Maize is cultivated on 26.89 % of the cropped area, which rank second in cultivation, after wheat crop (40.22%). In 1975-76, total area under maize crop was 306,148 hectares, which increased to 939,215 hectares in 1999-2000. As far as the detail acreage is concerned, in 1975-76 maize cultivation on un-irrigated area was 112,894 hectares, which multiplied nearly 3 fold and marked the figure of 306,007 hectares in 1999-2000, as compared to the irrigated area of 193,254 hectares in 1975-76 and increased to only 233,204 hectares in 1999-2000. The data indicate that due to drought resistant factor, it is extensively cultivated in the rain fed areas.

TABLE NO.6

AREA, PRODUCTION AND YIELD OF MAIZE CROP, 1975-2000

5 years AveraKe	*Area in Hectare*		*Production in tonnes*		*Yield in Kg./hectare*		
Year	Irrigated	Unirrigated	Irrigated	Unirrigated	Irrigated	Unirrigated	Total
1975-80	189951	136108	302588	105265	1593	773	1251
1980-85	224858	195504	360150	174007	1602	890	1271
1985-90	233905	239926	418742	257043	1790	1071	1426
1990-95	241358	278456	458205	322963	1898	1160	1503
1995-2000	243593	290367	465823	354166	1912	1220	1536

Source: GoNWFP, 2000c.

v.RICE

Rice is a Kharif (summer) crop. It is cultivated in small fields in NWFP. The mud dykes surrounding the field hold the water, and level surface facilitate it's even spread with in the fields. In some fields, indigenous varieties of rice are sown or are transplanted from the nurseries. A field is ploughed two or three times and levelled by clod crusher (Rehman, 93). Both broadcast and transplantation methods are common throughout the province. However, skilled farmers do the transplantation. During transplantation, water level is maintained at about one to two inches in the field till the seedlings fully take root.. From germination to harvest, the rice requires protection from birds.

Rice is extensively cultivated in Dir (16,170 hectares), Malakand (6,897 hectares) and Swat district (6,812 hectares) of NWFP, whereas in the frontier agencies, share of Kurrum (5,900 hectares) and Bajaur agency (4,800 hectares) are leading over others. The gross total area under rice crop was 67,129 hectares in 1999-2000 (Table No.7). This makes 3.35 % of the total cropped area. Since 1995, rice crop is only grown in those areas, where irrigation facility available. In 1999-2000, total productions were 129,209 tonnes and yield per hectare were 1,925 Kg, which is highest among the cereal crops. The land use shows that there is fluctuation in the cultivated area, since 1975-76. As the production of rice is concerned, it is continuously increasing from 84,592 tonnes in 1975-76 to 129,209 tonnes in 1999-2000. This is mainly due to the improvements in the high yielding seed varieties, which improved the yield per hectares. According to agriculture department, it was 1,342 kg per hectares in 1975-76, and inclined to 1,925 Kg per hectares in 1999-2000.

TABLE NO.7

AREA, PRODUCTION AND YIELD OF RICE CROP, NWFP

Year	*Area in hectares*	*Production in Tonnes*	*Yield in Kg per hectares*
1975-76	63,019	84,592	1,342
1980-81	66,242	105,088	1,586
1985-86	70,119	113,832	1,623
1990-91	62,269	117,987	1,895
1995-96	63,737	118,222	1,855
1999-2000	67,129	129,209	1,925

Source: GoNWFP, 2000c

7. HORTICULTURE:

Climatically, NWFP is very suitable for horticulture. Surprisingly, this province is blessed with unique agro-ecological zones. This study attempts to identify the opportunities and overcome the problems faced by the growers. In 1985, the Government ofNWFP created a semi-autonomous organization called as Fruits and Vegetable Development Board.

With the efforts of Fruits and Vegetable Development Board, the total area under orchards has increased from 30,128 hectares (1985) to 47,059 hectares in 2000 (Table No.9). Fruits are grown both in Kharif and Rabi season. Major Khariffruits are watermelon, muskmelon, apricot, banana, apple, dates, figs, guava, mango, pear, peach, plum, pomegranate, walnut, almond, persimon, grapes etc, while Rabi fruits are citrus, loquat, mulberry and others.

TABLE NO.9

AREA AND PRODUCTION OF FRUITS IN NWFP 1975-76 TO 2000-2001.

Type	1975-76	1980-81	1985-86	1990-91	1995-96	2000-2001
Kharif						
Area (Hectares)	20,752	29,423	24,402	33,138	35,172	38,490
Production (Tonnes)	266,460	400,182	297,879	416,958	427,087	467,032
Rabi						
Area (Hectares)	3758	5037	5726	6645	7754	8569
Production (Tonnes)	30767	43450	48945	57058	68104	74072

8. LIVESTOCK

NWFP is the smallest province of Pakistan in terms ofland area. The province is roughly 700 kilometres long and 145 kilometres wide piece of mainly mountainous land providing large area of rangeland for grazing of sheep and goats for sedentary farmers, semi-nomadic and nomadic shepherds. Livestock in NWFP are kept under the traditional small mixed farming system integrated with crop production. About 61.2 percent of farms have a size up to 2 hectares, while the size of nearly 26 percent farms is between 2 and 5 hectares, thus making small farms 87 percent of the total cultivable area of the province. The province, comprising mostly of wet hilly terrain in the north and dry hilly terrain in the southwest, has less land for crop production. In this situation, more than 85 percent of small farmers, including landless, are totally dependent on livestock production.

Livestock playa pivotal role in national economy; it provides milk, meat, eggs, hides/ skins, wool/hair and other products. A network of 641 veterinary institutions is providing round the clock animal health care services to farmers through treatment and prophylactic vaccination of their livestock and poultry.

TABLE NO.I0

LIVESTOCK POPULATION IN NWFP, 1996

Livestock	Number
Cattle	3,155,885
Buffalo	1,261,109
Sheep	1,475,391
Goat	4,480,624
Camel	41,568
Horse	44,686
Mule	44,691
Ass	395,789
Domestic Poultry	16,020,638

Source: Livestock Census, 1996.

9. FINDINGS AND CONCLUSION:

NWFP has vast agriculture land that comprises 1.8 million hectares. It is also occupied by over 17.7 million population, making population density of23 8 persons per sq. KIn. Majority of over 80% population directly or indirectly depends on agriculture and allied occupation. In order to formulate effective and practical agricultural development strategy, it is necessary that farmers should be given significant representation in decision making and implementation planning process. Because, it is being recognized all over the world that people participation assures ultimate victory in undertaking any sort of development strategy.

10. RECOMMENDATIONS:

Based on the findings of the study following recommendations are suggested.

i. Application of Science **and Technology:**

Application of science and technology is very essential, in order to accelerate the production and income of the farmers. Consequently, the agriculture department should keep close contact with farmers and arrange refresher courses, workshops and exhibition. To transfer the modern agriculture technology to the farmers and motivate them regarding the benefits of new trends.

ii. Eliminate water logging and salinity:

To eliminate water logging and salinity, there is an urgent need to construct seepage drains in the severely affected areas. Furthermore, it recommended that, the canal and feeders should be made lined to retard seepage. Parallel to this, vertical drainage by installation of tube wells along the major canal is another important measure for reclamation.

Hi.Livestock and grazing grounds.

Livestock and grazing grounds should be properly managed and conserved. In order to enhance the milk production and reduce import. It is also recommended that, the livestock production, research and health care facilities should also be strengthened.

iv. Barani land:

About half of the agriculture land ofNWFP depends on rainfall.. Therefore, incentives and awareness programmes should be launched for the farmers of *Barani* land in order to enhance their production and income level..

v. High yielding seed varieties:

Limited production of high yielding seed varieties in the agriculture farm, largely affected the overall per hectare yield. Therefore, it is strongly recommended that government should ensure the availability and distribution of quality seeds to the farmers at union council level..

vi. Incorporation of agriculture education in the curricula:

Agriculture is the backbone of our economy. To make the education target oriented, it is strongly recommended that agriculture education and latest development should be incorporated in the schools curricula and textbooks. Furthermore, the university staff and students should also be encouraged to carryout research on the pressing agriculture problems.

vii. Crops production:

To keep pace with the growing population it is necessary to improve the productively of important crops. It is only possible through application of modem technology, conducting research, provision of good quality seeds, protection of crops and incentives to support prices.

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Dr. MasoodAhmed
Associate Professor GOvt.. S.E College Bahawalpur

PATTERN OF RESIDENTIAL MOBILITY IN BAHAWALPUR CITY

ABSTRACT

This study focuses on the Intra-Urban residential movement within Bahawalpur City. This movement is not haphazard. It has a pattern governed by recognized forces. As such Intra Urban residential mobility is not only of academic interests but a matter of Interest to town planners investors on land and building, estate agencies and all those interested in urban development.. This is why geographers, economists, sociologists and town planners in the western countries have undertaken many studies on intra-urban mobility of many cities. This study has tried to investigate who are the people who chance residence in Bahawalpur City. The data from the field were collected by a questionnaire method. The city was divided into five mobility zones on the basis of socio-economic homogeneity and physical unity. About 4% of the household move annually. In Bahawalpur City majority of the families make voluntary moves. Life cycle plays an important role in intra urban movement in Bahawalpur City. The majority of moves in Bahawalpur City are educated government employees and businessmen.

INTRODUCTION

The movement of households within urban areas is defined as residential mobility of intra urban migration. It refers to population movement within cities. During recent years residential mobility has attracted the attention of scholars of different disciplines including the sociologists, economists and geographers.

The residential mobility has attracted great interest among researchers in the Western World. There are a number of studies on the topic. A few may be mentioned Short (1978) studies residential mobility in Toronto, Pooley (1979) that of the Victorian City, Margulis (1980) that of Cleveland and Herbert (1973a) that of Swansea. Huff (1978) was interested in residential mobIlity in general.. It is high time that study on residential mobility or intra-urban population movement is conducted in Pakistan also With this end in view intraOurban movement of population in Bahawalpur City has been analysed in this study.

THE GROWTH AND DEVELOPMENT OFBAHAWALPUR

Bahawalpur is a large city located in east Central part of Pakistan on the Western fringe ofthe Cholistan desert.. It lies on the main railway line between Karachi and Lahore and has good road link with these two and other cities. Bahawalpur is a Tahsil, District and Divisional head quarter spread over an area of more than 17 square kilometer.

Bahawalpur City was founded by Nawab Bahawal Khan I in 1748 A.D. at the site of village called Jhoke Ranjh. The city was made the capital of the state. It was fortified with a mud wall build around it. This walled city has six gates namely Farid Gate, More Gate, Multani Gate, Bohar Gate, Shikar Puri Gate and Ahmad Puri Gate.

The development and expansion ofBahawalpur City awaited the reign of Ala-Hazrat the Ameer of Bahawalpur Nawab Sadiq Muhammad Khan Abbasi V (1905-55). He was proclaimed Ameer on the death of his father in 1907. he was a man of ideas. He invited town planners and architects of Nizam of Hyderabad to plan and develop Bahawalpur City. As a result. the Model Town was planned and developed. In 1947 Pakistan came into existence. Many migrants from India came to Bahawalpur. The city has also become a focus of many immigrants from India who came to Bahwalpur. The city has also become a focus of many in-migrants from other parts of Pakistan. To house the migrants Model Town B, Muhajir Colony and Shadra Colony were planned.

In 1955, West Pakistan was decided one unit and Bahawalpur State was merged into it. Bahwalpur City was made district and divisional headquarter. Many government offices were established including a military cantonment.. Job opportunities opened up. A large supporting population was also required. The existing facilities became inadequate and more housing projects like Model Town A, B, Satellite Town and squatter settlements around Yazman Road, (Islami Colony). Ahmad Pur East Road (Bhata No. 1,2,3) Sadiq Colony and Shadra developed. Bahawalpur which had started to expand outside the walled city in the early years of the present century experienced explosion after 1947 and more so after 1955. The march continues. The result. is that city confined within an area of 1.5 square km surrounded by a wall today occupies an area of 17 square km and it is still on the move.

POPULATION

From its inception in 1748 Bahawalpur registered a very slow population growth and continued to be a small town of18,500 by 1901. From (Table No.1) 1901 to 1931 the population increased by less than 20,000. During 1901-11 there was a small fall in population because of epidemic disease. From 1931 to 1941 the population almost doubled itself from 20,000 to 40,000. This was the consequence of the introduction of canal irrigation system in the area in 1925, and Bahawalpur turning into an important grain market..

Table No. 1 Population and Population Variation in Bahawalpur City from 1901 to

Year	Population	Variation No.	Variation %
1901	18546		
1911	18414	132	0.7
1921	18494	80	0.4
1931	20443	2449	13.2
1941	40015	19072	91.1
1951	41646	1631	401
1961	87377	42731	102.6
1971	135263	50523	59.5
1981	180263	45263	33.5
1998	403400	223137	
2003	489636	81241	

SOURCE: CENSUS REPORTS

From 1941 to 1951 onward Bahawalpur was faced with population explosion. The population more than doubled itself from 1951 to 1961. during 1961-72, 50,000 persons were added and another 45,000 during 1972-81.. Thus the population of Bahawalpur City increased a little more than two times in 50 years, from 1901 to 1951 and 4.5 times in 30 years from 1951 to 1981. Bahawalpur has a population of 18,500in 1901 and489636in2003.

DATA SOURCE AND METHODOLOGY

Different sources were tapped to collect data on intra-urban movement of population within Bahawalpur City. Population Census Reports of various census years provided information on total population of the city, and population by sex, age group, economic groups and wards. They also furnished data on educational level by family size; number of houses rooms for house and other socio economic characteristics. No data on itra-urban mobility is available in census reports. But they did provide information by which the potential movers nad in some cases causes of movement could be assessed.

Estate agencies were next contacted. These agencies help in sale and purchase of properties and in letting out and hiring houses on rent.. They could have been of great help but the problem in that only two percent of the houses are purchased and hired through the estate agencies. They provided some useful information.

Next the registration office was tapped. Their record is incomplete and is not maintained in a systematic order. Most of the information available with them is on sale and purchase of vacant plots. They do not have much information about constructed houses, further they do not have any record of houses on rent.. Therefore, this office is a poore source of data. Next to be tapped were Bahawalpur Development Authority and Cantonment Board. They do possess some useful data but they do not cover the whole city therefore, they provided scanty data.

Telephone Directories could be a good source of data on intra-urban mobility. The scrutiny of the directories revealed that some useful information could be obtained. But the problem is that only 6% of the households possess telephones. They all belong to upper and middle class and therefore their usefulness is very limited.

In the absence of relevant data from secondary sources, the only method left was to collect data directly from field by survey. For this purpose questionnaire method was employed. The questionnaire included queries regarding number of movers, the time-interval of moves, the distance moved, the reasons of movement and other relevant information.

METHOD OF DATA COLLECTION

Bahawalpur is a fairly large city with a population of 180,263 and 24,663 households. Therefore, it was decided to collect data by stratified random sampling. For this purpose the city was divided into five zones, determined on the bases of socio-economic homogeneity and physical unity.

REASONS OF MOVEMENT

Change of residence within cities may be voluntary or involuntary. Voluntary moves are those where the decision to moves rests with movers. Voluntary moves are generally generated by personal and environmental factors like increase in income, change in the location of job, entry of undesirable neighbours in the neighbourhood and other. Environmental factors may include establishment of obnoxious industries in the area of noisy workshop, litter or garbage, filthy drains and other.

Involuntary moves are referred to as forced moves. Demolitions of Property, eviction, marriage, home too small for the family, danger to life and property and other factors beyond one's control..

Out of 1234 sample households 374 reported to have changed their residences, in other words the perc~ntage of voluntary and involuntary movers is 30.3. In these 374 movers 57 were involuntary movers and their percentage was 15, who had no choice. They had to vacate the house. The majority of the affected person (9%) were government employees who were living in residences after retirement. . Another class of involuntary movers was those who were evicted by the landlords. In this category the students and bachelors form the majority. They numbered 15% in a sample of 374.

Voluntary Moves: Overwhelming majority of residential changes 85% in Bahawalpur City was voluntary. About 47% of the voluntary moves were generated by the shortage of accommodation. (Table-2)

REASONS FOR RESIDENTIAL RELOCATION IN BAHAWALPUR CITY

REASON FOR MOVE	NUMBER OF MOVERS	PERCENTAGE
A. Involuntary moves	57	15
1. Had to Vacate Residence after retirement..	34	9
2. Evicated by landlords	15	04
3. Property Demolition	08	02
B. Voluntary moves	317	85
4. Insufficient Accommodation moved to better house.	149	40
5. Moved from rented to own house.	63	17
6. Physical Condition of the house and bad neigbouhood.	42	11
7. Economic Prosperity	37	10
8. Personal reasons	26	07
TOTAL	374	100

HOUSE HOLD SURVEY CONDUCTED IN MARCH 1992

A heavy movement of population from this area in the peripheral part ofBahawalpur City took place. Model Town A, B, C Shadra, Muhajir Colony in Zone No. II and satellite Town Zone No. V were the chief recipients. About 11% of the total movers which constitute 13% of the voluntary movers in Bahawalpur City expressed dissatisfaction with the physical state of dwellings and their neighbourhoods. The houses were old and dilapidated and were not sufficiently airy. The roads were narrow and not fully paved. Pools of dirty and stagant water and heaps of solid wastes were found in many localities, Sewage disposal system was also greatly damaged. The whole "rea had turned into a slum. Therefore, they had changed their residences. Most of such complaints were made about the Central City (Zone No.1). Many of such movers were those who had acquired wealth. They wanted to live in spacious houses where they could keep their cars and furnish their houses with modem furniture and other amenities. They wanted to live in posh localities not only to breath fresh air but also to acquire a prestigious position in the society. The goal of most of such movers was the Satellite Town (Zone No. V)

About 17% of those who changed residence in Bahawalpur were living in rented houses and they moved after they build their own house. A good number of families 7% oftotal movers or 8% of the voluntary moves out of374 gave personal reasons for change of residence. The majority of such moves about 80% were generated by differences among family members. Joint family system prevails in Bahawalpur City. This system is faced with problems. It is getting difficult for daughter in laws, mother-in-Iaws and sister-in-law to live in the ancestral house. This happened because of a custom prevailing among "Saraikies". The custom is called "Watta Satta" according to which the husband has to give a house to his wife. In case the

family is not well to do, they give the parental house to the bride if quarrel takes place among family members. The bride and her husband stay in the house and other members including the parents move out.

NUMBER OF MOVEMENT

The residents ofBahawalpur City are largely immobile. About 70% of the household have not changed their residence inspite of their long stay in the city. Most of the families that have never moved live in the central city. In a traditional city like Bahawalpur the ancestral households exert great pull and have deep-rooted attraction. About 30% of the households have changed their residence in course of their stary in Bahawalpur City. Sixty three percent of households have changed only one place till now. Majorities of these house holds were owner occupied. They changed their previous residence because of insufficient space, expansion of family and economic prosperity. About 26% house holds in Bahawalpur City changed their house twice.

Majority of these households were tenants who failed to cope with their landlords or their personal reasons compelled them to change their residence. Eight-percent households changed their house three to four times. These were mostly students or persons who had school going children.

ANNUAL MOVE

Annual movement ofhouseholds in the Western Cities is considerable. About 7 to 12 percent of European households move each year, while in Australia, Newzealand and North America the figure is close to 20%. The annual residential change within Bahawalpur City can be divided into three phases. (Table-3), The first phase covers the period from 1901 to 1967 during which the annual change was 0.81 percent which was very low. The main reason of this low movement was that the old settlers ofBahawalpur City liked to live with their kith and kin and members of their clan. It was difficult for them to change to some other place. In the second phase from 1968 to 1979 annual change of residence amounted to 2.1%. The change was slow but as compared to the first phase it was higher. During the third phase 1980 to 1992 the change of residence amounted to 4% annually. Obviously the rate of change of residences had increase considerably. The central zone had become too crowded. Families were forced to move because of inadequate accommodation. In future with the policy of industrialization the city will flourish as regional commercial and economically prosperous city and more residence change will take place. Bahawalpur will continue to be the administrative headquarters of the division so the intra-urban residential mobility will increase!

Table-3:

BAHAWALPUR CITY ANNUAL MOVEMENT

YEARS	NO OF MOVES	PERCENTAGE
1901-Aug.1947	29	7.8
1947-1951	11	2.9
1952-1955	10	2.7
1956-1959	19	2.4
1960-1963	13	3.6
1964-1967	17	4.6
1968-1971	32	8.5
1972-1975	33	8.5
1976-1979	31	8.2
1980-1983	52	13.8
1984-1987	61	16.0
1988-1992	77	

HOUSE HOLD SURVEY CONDUCTED IN MARCH 1992

DISTANCE

One of the important aspects of intra-urban mobility is the distance between present and previous residence. Bahawalpur is a city of relatively small area extent.. From the city centre to the city limits the average distance is 4.5km. longest distance 6.5km. and shortest distance O.lkm. In this context a move of2km. will be considered short, 2.4km. medium and 4-6km. long. In bahawalpur City 62% of the households moved short distance, among them 32% covered less than one kilometer and 30% between 1 to 2km. short distance change have been found most in the central part of the city. (Zone No.1. Many households change house within Mohala, neighbourhood or lane where they lived before. They try to live near their relatives, neighbours and friends. They do not like to go to some other place after leaving their clan.

A small percentage of families 1.2% made long distance move 4.6km. Most of long distance movers moved from Zone II (Model Town area) to Zone V to Zone II. Long distance movers mostly belonged to high-income group. They generally moved into spacious new houses of latest architectural designed with better facilities to enjoy comfort and prestige.

DIRECTION OF MOVEMENT

According to Residential Mobility Households Survey of Bahawalpur City, the highest movement of the people took place form Zone I (old Walled City) to other zones, which was 53% (198 out of374 households). In old town majorities of the structures both residential and commercial are in bad condition. The highest density of population is here. The Central Zone I (Old City) played an important role in changing the structure of the whole city. About 31% households moved from the Central Zone I to Zone II, western part of space requirement..

The highest movement of households was from Zone II to Zone V, which was 44%. These households covered a long distance from their last residence. The second highest change of households was from Zone II to Zone III which was 38% out of32 families.

About 50% of the households moved from Zone III to Zone II. They were mostly government servants and retired service men. Mostly the doctors changed their residence from Medical Colony to Model Town, 33% households turned over from Zone III to central city. These households were mostly middle and low income class. Zone IV is an administrative zone. All the government and private offices are located here the 80% of the households which moved. There were Government or Semi-Government servants. Redistribution of households from Zone V to Zone II were 33% Mostly the households who moved from Zone V to Zone II were high and middle income class.

LIFE CYCLE

Intra-urban movement is directly related with life cycle. (Morgan 1976 and Michelson 1977) Stages oflife cycle passes through several stages in life. Following stages in the life cycle are generally recognized.

1. Pre-Child stage (Below 20 years), 2. Child bearing and rearing stage (l0-20 years) 3. Child launching stage (40-60 years) 4. Post child stage oflate life (60 years).

The general pattern is that young couple needs a small house, as the family members multiply grown up children get married and move out from parental houses and become independent.. They are either students or employed. They usually need bachelor's accommodation.

Child-bearing and child-rearing stages are important in life cycle. In general it may be taken to extend from 21 to 40 years. The maximum number of movements are made during this period. In Bahawalpur City 65.3% of the households moved during this period. In Bahawalpur City 65.3% of the households moved during this period. In Pakistan, the cities are culturally different from the Western Cities. The concept of family, the male-female relationship and the attitude towards aged differ between the Western and Oriental countries. These differences are reflected on intra-urban mobility also.

The predominant age category for the heads to move 20-30 increasing age brings increasing residential stability. This is also true ofBahawalpur City. In the age o £11-30 years 24.6% households changed their residence in Bahawalpur City. This is the early young age, the younger couples move to establish new house. Maximum

movement took place during 31-40 years when 40.7% if the households moved in Bahawalpur City.

The age group of 41-60 years is taken as the child launching age. In this stage the children are grown up, they feel that they must have separate room. They have their own requirements. Therefore the family feels to change to house. According to survey (1992) 33.4% households changed their residence in the age of 40-60 years. Of the 27.3% were in the age group of41 to 50 and6.1 % in 51 to 60 years.

The age group of 60 and above may be taken as post child stage and late life. This is the age when the old husbands and wives have to live alone because their married sons and daughters establish their own home and the family shrinks. Only 0;5% people moved to new houses in post-child and late life in Bahawalpur City. Increasing age brings increasing length of residence in one dwelling which leads to strong emotiomil attachments to the dwelling.

OCCUPATION, INCOME AND **EDUCATION**

Intra-urban residential mobility is closely related with occupation, income and education level of the urban dwellers. These three characteristics are neither independent nor mutually exclusive. The pattern of residential mobility of the various occupational groups in Bahawalpur City is reverse of what is witnessed in the Western Cities. In Bahawalpur City businessmen, traders and professionals have changed their residences more than those by relatively lower paid workers. Intra-urban movement is generated by the economic condition of the households when the economic condition of a person improves, ho moves to a better and larger house. The households which earn Rs.IOOO/- to Rs.2000/- per month income belong to low category, about 35% of this group changed their hou~es in Bahawalpur City. The house holds who earn Rs.2000/- to Rs.7000/- per month can be classified as middle class in Bahawalpur City. Middle class income people moved more than the others. They constituted 57% of the movers (209 out on 74 households). The families which earn Rs.7000/- and above per month belong to high income class. They are small in number. Only 8% ofthem have changed houses in Bahawalpur City. There are 16% uneducated households who have changed their residence in Bahawalpur City. There were 61 out of 374 families. Most of them were laborers, rickshaw pullers, carpenters, masons and small shopkeepers.

About 81% of educated people changed the residence in Bahawalpur City. 15% were primary and middle pass, 45% were metric and F.A and 24% were graduates and highly qualified.

URBAN STRUCTURE AND **POPULATION MOBILITY**

Urban structure comprises various land uses which emerge in a city to meet the needs

of the city dwellers. As the city population increases new residential areas are developed. More shops, offices, schools, hospitals, clubs, playgrounds, factories etc. are established in these circumstances the intra-urban population movement is inevitable.

In the Western cities several patterns of changes in urban structure and related intra-urban mobility have been recognized. Burgess in concentric zone theory of urban structure envisages that the central business district (CBD) forms the nucleus of urban land uses. (burgess 1955), as the city grows, the CBD expands. Its expansion affects the immediate land use ring namely the low class residential area which expands outward. Consequently other concentric zones also move. Homer Hoyet in sector hypothesis of urban land uses cling to the CBD as sectors (Hoyt 1939). Among the various land uses the high class residential area plays the key role. The high class areas occupy one or more sectors. They grow outward along sectors that they occupy. Other land uses follow the expanding high class residential.. Harris and Ullman presented Multiply Nuclei theory of urban structure (Harris and Ullman 1925). According to them every major land use develops and grows around a nucleus. The three theories of urban structure stated above are applicable to the Western Cities. They are not ture ofBahawalpur.

Bahawalpur City is divided into two parts. The old Walled City and the Modem City. The old walled city is the nucleus of the city. The modem city has developed under planning which was initiated by Nawab of Bahawalpur in 1907. as such the theories of urban structure which envisage the city growth without outside interference are not applicable to Bahawalpur City. However, Multiple Nuclei theory loosely fits the situation in Bahawalpur City where residential areas, administrative areas, University, parks and playground have developed as nuclei. These nuclei have become the foci where intra-urban movement of population is taking palce.

CONCLUSION

Residential mobility of many Western Cities has been analyzed. Some studies on non-western and South Asian Cities have also been undertaken. It is time that pattern of cities of Pakistan should also be brought out. With this and in new various facts of residential mobility of Bahawalpur City have been analyzed. Bahawalpur City is a fast growing city. Economic and social changes are also taking place therefore more studies also on Bahawalpur City should be undertaken.

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Title: Landscape of Consumption: Transformation and Restructuring of Tariq Road Complex, Karachi

Author: Azra ParveenAzad
Affiliation: Assistant Professor, Department of Geography, University of Karachi
Address: Department of Geography, University of Karachi, Karachi 75270
Phone: 92-21-9243131-7
E-mail: azra-azad@yahoo.com

Author: Mudassar Hassan Arsalan
Affiliation: Department of Geography, University of Karachi
Address: Department of Geography, University of Karachi, Karachi 75270
Phone: 92-21-9243131-7
E-mail: muharasalan@yahoo.comAbstract

Abstract:

Nearly half of the world's population (47 per cent) lives in urban areas with a growth rate of2 per cent per years during 2000-15 (PRB, 2002). The accumulation of people, their consumption patterns, travel behavior and their urban economic activities have a large impact on the environment in terms of resource consumption and waste discharges. However, cities also offer opportunities to manage a growing population in a sustainable way.

The modern city is a dynamic organism constantly in process of evolution. During the past decades, there has been marked improvement in the scope and refinement of urban studies undertaken by geographers. The major part of existing Karachi metropolitan is a post 1950s phenomenon. In the past five decades the city has witnessed rapid growth of residential neighborhoods in almost all direction. A good many of these were carved out as residential areas; other were unplanned neighborhoods.

Tariq road is a prominent feature of the societies-area in Karachi. It is one of the major business centers of the city. Although this business center is familiar as Tariq road but now it has been developed as a big commercial complex. This process of commercialization in a planned neighborhood is creating a host of problems such as environmental degradation, aesthetic worsening, deterioration of a successful planning and nuisance for the residents (Chapin, 1957).

Introduction

The existing urban structure of any city cannot accommodate the inexorable growth of urban population specially, due to the expansion growth of industries impact of rapid development ever increasing migration from degraded environment water scarcity etc. the importance of land use data in urban planning and management has been recognized by many researchers and planners (Wrigley and Lowe, 1999; Birkin et al., 2002).

Conventionally, land use data are collected through field surveys and administrated at parcels or plot level. Attempts have been made to update land use data through advance technology such as Geographic Information Systems and Remote Sensing with a great success in urban areas at micro geographic-scale.

This attempt deals with the growth and development concerned to the location, land use, land value and amount of land development required for the various functions in the study area. The main objective of the endeavor is to portray the spatial tranition of urban morphology with the help of recent technological tools.

Study Area

Karachi metropolis is the biggest city of Pakistan having complex morphology. It has become a premier commercial city from a tiny village. As a result of decentralization of urban functions, a host of regional, community and neighborhood shopping centers have been developed to fulfil the needs of neighboring areas. Tariq road commercial complex is one of the most renowned regional commercial hearths of the city. This area is a prominent pulmonary stream of the well-planned societies area (Figure 1).

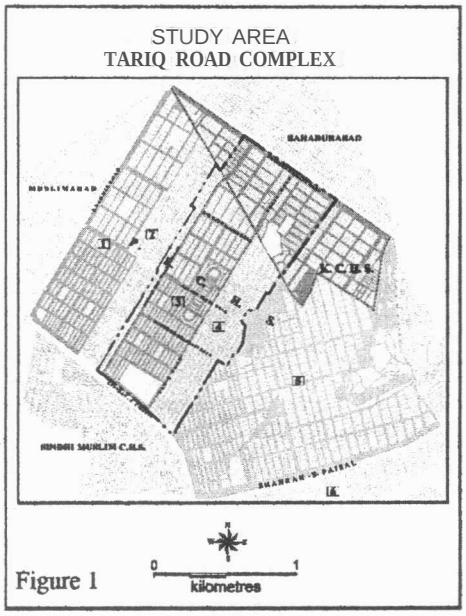

Figure 1

Initially, Tariq road was not planned for such a giant commercial complex, which is being found at present. It was purely a residential area ofP.E.CH.S with a limited planned commercial center, planned for govt. employees in 1949 when Karachi was the capital of the country. The whole area was encompasses 1268 acres having 4704 residential plots, ranging from 100 to 2000 square yards (KDA, 1974). Despite the short history, the area experienced a rapid development from residential to commercial land use. In 1960 only a few showrooms and restaurants were

developed there but after 1960 due to the needs and demands of the people of the area, some more shops and service functions were established but most of them provided low order goods and service. There exists in Karachi a four-level hierarchy of commercial centers: "metropolitan" centers, "sub-metropolitan" centers, "township" centers and "local" centers (KDA, 1974). Surprisingly, Tariq road complex was not included in the above-mentioned hierarchy till 1974. while, Saddar, Liaqatabad, PIB colony, Golimar, Aurangi, Qasba, North Nazimabad, Drigh colony and Liaqat market were included in the same. The process of conversion from residential to commercial land use increased tremendously after 1973 and since that time the area has been emerged as one ofthe most popular shopping areas ofthe city.

Although, this area is familiar as Tariq Road however, it has been developed as a big commercial complex and this process of commercialization is still going on. It is worth noted that the rapid growth of Tariq road and other malls have somewhat outrun old shopping area ofBohri Bazzar (Central Commercial area of Karachi).

Conceptual Framework

This study strives to explore the commercial structure of the study area. This aim reveals that there is a need for carefully designed research on such a complex investigation. GIS technology provides an excellent platform upon which different types of spatially referenced data can be united for analysis and display purposes. The central data integrator for GIS is the database that accepts and merges diverse data sets and different types of information. Another major strength of GIS is the interactive link between the database and the map.

Taking available societies area parcel bases planned map, the required map for study area has been produced. This map was consisting of the major infrastructure of the area such as main roads, society demarcations, plot parcels etc. (Figure I). That analog to vectorized-digital conversion has been generated through MapInfo Professional. .

There is no detailed land use information available as any published or unpublished sources. This information has been collected by conducting field surveys through the questionnaires, interviews and personal observations. The data reveal the existing land use category and establishments etc. nearby Tariq road. Before, conducting proper survey, functional codes were allotted to the all-existing commercial activities in the study area.

The analytical processes of this research composed of four kinds of works, which were carried out simultaneously. The first was related to the existing commercial establishment concentrations. Secondly, employment engaged in various commercial functions was carried out. Thirdly, commercial floor area of every plot and activity was determined and last but not least a comparison of planned and existing land use has been taken into account..

Results and Discussion

Urban communities have developed as a part of our social and economic system. The amount of land utilized by specific activities and their spatial distribution reflects the requirements of this system. In our communities, however, the existing arrangement ofland uses, though essentially functional, is not a criterion of modern community design.

The generalized land use maps show the planned land use of Tariq Road complex. The major categories ofland use were distributed as Table 1. Initially, more than 75 percent was allocated for residential purposes and only less than 12% was for commercial uses Figure 4.

Table 1: Planned Land Use Distribution

Land Use	Percent Share
Residential	76.4
Commercial	11.8
Recreational	2.1
Religious	0.7
Education	0.4
Health	0.1
Other	8.5

A survey conducted in 1991 (Khan, 1991) indicates that about 60.8 percent ground area was occupied by residential whereas more than 32 percent area was under commercial use. This transition of land use within 5 decades, has been about 20 percent from planned residential to commercial..

Table 2: Commercialization of Tariq Road Complex

Year	Residential (%)	Commercial (%)	Commercialization (Transition)
1950s (at the time of planning)	76.4	11.8	
1991 (Khan, 1991)	60.8	32.7	20.9
2001 (KDA,2001)	-	38.2	5.5
2003 (Authors' survey)	52.1	40.3	2.1

According to the land use survey of the study area, about 28.5% of the ground area has been added in commercial land use mainly from planned residential since its planning (Table 2). The major factors that control the land use planning development and transition in the area are, its geographical location, land value, accessibility, and human behavior. Table 3 indicates that this area has emerged to cater the consumers' demand of stylish garments, jewelry, shoes etc. to satisfy the fashion parade of the

society. Thus, this area has become a focus of a great deal of investors, fashion designers, jewelers and light manufacturers of garments.

Table 3: Top Ten Function of Tariq Road

Function	Establishment	Floor Area (Sq. feet)
Gents garment	653	137377
Ladies cloth	253	35993
Auto repair (car)	240	60862
Gents tailors	234	33224
Ladies garments	177	33926
Kid's garments	163	34237
Jewelers	149	29177
General stores	113	17354
Ladies tailors	97	17028
Food places	76	29559

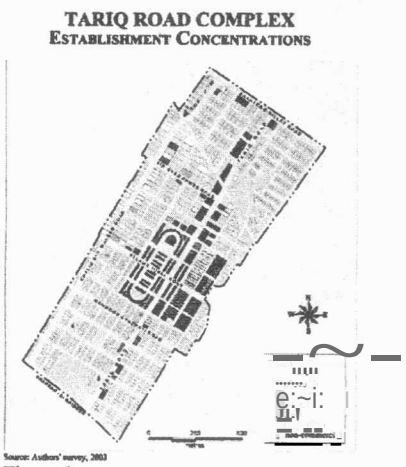

Figure 2

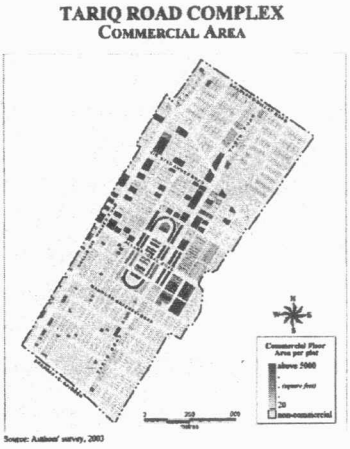

Figure 3

Site of Tariq road complex is a great factor as far as initial growth of study area is concerned; good sites attract Karachiites to wards this commercial center. Situation of Tariq Road is also very much significant with respect to its neighborhoods that comprise a large number of shoppers. The maps (figure 2 & 3) reveal the arterial development (as described by Berry 1959, 1963 & 1967) of famous and glamorous shopping malls i.e. Dolmen mall, Dolmen center, Rabi center,, Tariq Center, Mateen center, Dubai shopping mall etc. The land value of Tariq road has increased in a very short period of time. This rapid increase in land value could be determined by the fact collected from estate agencies for instance, along the main Tariq road a plot of 1000 square yards was sold for Rs.0.5 million in 1960s. The same plot was sold again in 1972 for Rs.2 million, the value was Rs.10 million in 1984 and now at present, the

same plot has a value of Rs.40 to 50 million.

Although many urban planners are concerned with accessibility as an element inherent in the physical organization of space movement system but much of the recent work on accessibility concepts has been primarily focused on transportation. Tariq road as a famous shopping center attracts much of the traffic volume passing through its intersections. Tariq road commercial complex is situated within the region of high car ownership so the people of surrounding high-income area and high-income localities do not need public transport to reach there. Besides this fact, being a market of variety of styles and designs this complex attracts the people of high income from many other parts of the city. The development of this area has brought a change in the volume of public transport. Few years ago, there was only one bus and two or three wagons brought the people to this area, but now this mode of transportation is increasing day by day.

Due to human behavior at large, it is obvious that a well-planned residential area has been converted without any planning into a big and one of the major shopping complexes ofthe city within a short period of time. The rapid growth and expansion in commercial land use has been noticed after 1973 when many Karachiites were shifted from Tariq road to Defence Housing Society and Clifton.

Due to high land value most of the shopping centers are multi-storeyed buildings, however, there is still diversity in shop rants and their values floor-wise. Most of the upper floors having empty shops are still waiting for the business. Interestingly, Garments under the category of retail and light manufacturing ranks on the top of array. Same commercial functions attract a large number of employments from different areas of Karachi (figure 4).

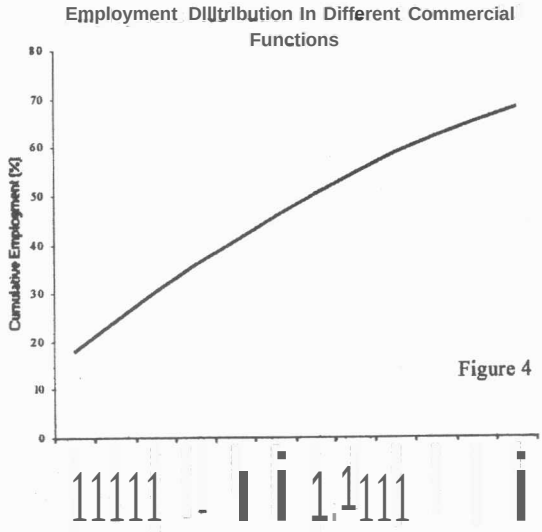

Figure 4

Conclusions

Tariq Road Complex has emerged as a famous regional shopping center after the transition of five decades. It is relatively accessible from every parts of the city and now accessibility is increasing day by day, which causes the rapid growth in commercial activity of this area.

Within Tariq Road Commercial Complex retail is the most prominent function with all its requirements such as gents garments, ladies garments, ladies and gents tailors, jewelers, general stores, food places, car showrooms etc. besides retail, some services and light manufacturing are also prominent..

Its rate of transition indicates that this area is still passing through the process of conversion and evolution with respect to commercial activity. However, this haphazard commercialization of such a well planned residential neighborhood is creating a number of problems such as environmental degradation, aesthetic worsening, deterioration of a successful planning and nuisance for the resients.

Acknowledgments

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Spatial Dimensions of Recreation Facilities in Karachi: A Geographical Analysis of Parks and Playgrounds in Federal 'B' Area (Mansoora)

Dr. (Mrs.) Farkhunda Burke
Chairperson & Associate Professor
Department of Geography
University of Karachi
Karachi, Pakistan

Abstract:

With the ever increasing environmental pollution and escalations in the cost of living, the need for green open spaces, providing free of cost recreation is an essential urban requisite. However, it has been observed that these scarce green spaces i.e. packs and playground have become a prey not only to mismanagement but encroachment as well.. Our immediate attention to stop this urban malaise is of prior importance. In view of this an attempt has been made, in this paper to highlight the multifaceted nature of this problem gripping Karachi, the fastest expanding city of Pakistan.

Introduction:

Parks and playgrounds not only act as lungs for cities. They help not only in improving environmental conditions but also in reducing global warming. With the cost of living shooting up and reduction in revenue resources visits to distant recreational areas e.g. the beaches or commercial parks is an expensive affair. Parks with adequate greenery, lawns and appropriate seating and lighting arrangement should be within walking distance so that families especially children and aged can enjoy their evenings in a healthy environment..

Parks and playgrounds are not only beneficial for physical health but are critical for the spiritual and emotional well being of the people. The disorder of a junk lot or a graffi ti splashed park can contri bute to a sense of permissiveness and foster criminal behaviour. In addition to the role in reducing crime, parks and recreational areas pay dividends in increasing tourism, maintaining water quality, controlling urban sprawl; creating better business climate and increasing tax revenues and contributing to a high quality of life. Proximity to open areas has been shown to increase real estate values. [1] Open spaces and greenery is a common feature of rural areas but needs to be planned and maintained in urban areas. Cutbacks in park maintenance

have contributed in making parks unsafe. Studies of developed countries has revealed that cleaning up of public spaces have successfully reduced crimes. [2]

The Study Area:

The Karachi Development Authority Scheme No. 16, is generally known as Mansoora, Federal'B' Area. This Scheme is located between the Layari River and the Gujro Nala, north ofLiaquatabad. This scheme was planned in 1976, covering a total area of2833 acres in 22 Blocks of different sizes in which approximately 120.53 sq. mls. of area was allocated for parks and playgrounds and its ultimate population is estimated to be approximately 1.33 lakhs. The status of this scheme is that local control is under KDA and maintenance is under KMC. The planning of the residential areas has been done on the neighbourhood unit principle. There are in all 19 neighbourhoods 3 of which are for upper, 7 for mixed and the rest for low income groups. Each neighbourhood was designed to contain within its heart a large "open space" in which the necessary vitals of the neighbourhood i.e. mosque, markets, parks, schools, etc. are located. Sites for 20 local and 4 regional mosques and 1 lama Mosque were reserved and those mosques are invariably located within parks.

The plan provides for parks, open spaces, playgrounds, maidans, etc. at the rate of about 4 acers/'OOOpopulation, in addition to 1 acre/'OOOpopulation parks including Children Parks were planned in each neighbourhood. Two main recreation grounds were provided at the 2 ends of the Township. The area reserved for these is approximately 30 acres each. Thus, we can see that the KDA provided open space on a very generous scale. The proportion of leaseable area was much less than in other Schemes but the investment in open spaces was planned to give lasting benefits in terms of health and convenience to the population. [3]

Objectives:

Karachi which has a population of9.85 million has an allotment of parks and open spaces at the rate of about 4 acres per thousand population. A comparison of Karachi a Class I City, while compared to New York with a population of 8.008 million population has a total of 49,854 acres of parks and open spaces within the city i.e. a proportion of 6.2 acres of parks and open spaces per thousand residents. So we can see the shortfall in planning and actuality between developing and developed countries (Trust for Public Land). [4]

1. In this paper an attempt has been made to make a presentation of parks and playgrounds of the Federal 'B' Area based on G.I.S. method. A GIS is a computer system capable of assembling, storing, manipulating and displaying graphically referenced information i.e. identified to their location. [5]

2. The study is based on Ground Truthing of parks ofEB. Area. This area is one of the areas of residence of middle class population with one of the highest population concentrations as can be seen from the following Table No.1.

Districts	Population 1981	Population1998
South	1251.30	1745.04
Central	1357.00	2277.93
West	912.70	2015.92
East	1487.41	2746.01
Malir	429.59	981.41

Source:(Population Census Report- Karachi,1998)

Federal'B ' Area is located in District Central.. Apart from this Clifton and Malir lie in the Cantonment Area, with population of 182489 and 44464 in 1998, respectively, and by virtue of being Cantonment Areas are relatively batter maintained; parks and playgrounds too are better maintained.

Federal'B' Area being a residential area for middle class people, there is a greater demand for recreation close to the residential area, while people of high income brackets can afford to travel greater distance within the city itself or out of the city for recreational purposes.

3. Ground Truthing of Parks and Playgrounds ofF ederal'B' Area has been made firstly to confirm the presence of all parks and playgrounds, shown on the Layout Plan of Scheme No. 16.

4. An attempt has been made to highlight the maintenance level of these open spaces, as encroachment is a chronic problem.

5. To focus on the level of effective utilisation of parks and playgrounds by the people. If the parks are in shambles the people found hanging around in these are sleazy, shady and suspicious characters, but not the people who have come from the surrounding houses.

6. To find out and locate the occupied and mismanaged parts of the open spaces on the map. Some parks are so ill maintained that children can no longer use the parks.

7. To make an assessment of the shortfall of parks and playgrounds from the stipulated 4 acres/'OOOpopulation of open space in the area.

8. To make an assessment of the disparity of parks and playgrounds to the total

area of the Charges (i.e. administrative unit).

9. To trace the reasons of the mismanagement and dismal conditions ofthe open spaces.

10. To put forward suggestions for improving conditions of the parks and playgrounds.

Methodology:

The study is based on

1. Ground Truthing, which was done several times during different parts of the years i.e. December 2000 till October 200 1, on different days ofthe week at varying, daytime and evening hours.

2, Interviews of gardeners and residents were made to collect first hand information related to recreational facilities. However, during several interviews, gardeners hesitated is providing information of the real situation as they were afraid oflosing their jobs on narrating the mismanagement meted out lay the authorities.

3. Comparative study has been based on the data collected in the field and some Census data. [6]

4. GIS, which is considered to be the most powerful tool of Information Technology of this millennium, has been used. Different stages involved in GIS are Geo-reference and Digitisation. [7]

5. Cartographic Techniques with the help of cartographic and GIS techniques, Charge and Circle boundaries have been demarcated; distribution of parks and playgrounds in the different circles have been made. Based on Field Survey a categorisation of parks and playgrounds based on their maintenance level has been made; the areas of different categories of parks and playgrounds have been computed; the areas of different charges have been computed for comparative study, and GIS technique have been used for plotting and mapping the information retrieved.

Finding:

The MansooraArea (Federal'B' Area) KDA Scheme No. 16 is composed of 12 Charges namely 12, 13, 14, 15, 16, 17,25,26,27,28,29and48.

According to the 1981 Census, these Charges were formed by a combination of Circles. All Charges do not have the same number of Circles and all Circles of some ofthe Charges do not come under the area of study.

Although, there are 111 parks and playgrounds but on the basis of Field Surveys, they have been categorised into different types so that a number of sections of parks have emerged. The following Table No.2 is a break up of parks.

Table No. 2 Breakup of Parks and Playgrounds based on their status

Park No.	Parts	Park No.	Parts
1	3	58	2
7	3	65	3
28	2	105	3
32	4	108	3
53	3		

The Table No. 3 is a detailed break up of parks and playgrounds

Table No.3 A detailed break up of the Parks and Playgrounds.

	Area (Acres)	Total Number of Parks
Total Area of Parks and Playgrounds	349.65	129
Total Area of Parks	144.80	90
Total Area of Playgrounds	204.85	39
Total Area of Well Kept Parks and Playgrounds	79.10	25
Total Area of Clean Parks and Playgrounds	78.35	38
Total Area of Occupied Parks and Playgrounds	41.38	18
Total Area of Unusable Parks and Playgrounds	150.82	48

According to the informatiolil by the KDA based on the map,[8] the total number of parks in F.B. Area are 88 and playgrounds 40. However, we could find only 36 playgrounds and 75 parks in the area. Map No. 1 shows parks and playgrounds of F.B. Area (Mansoora) Karachi.

What is more important that out of 75 parks, 38 and out of 36 playgrounds only 19 are in a Useable (i.e. well kept) and clean condition. In other words 50% of parks and playgrounds covering an area of 157. 458 acres are in a good condition including the privately managed playground of UBL (United Bank Limited) Map

No.2 shows the status of parks and playgrounds of F.B. Area (Manso ora) Karachi. Map No.3 gives details of the in-depth study of outdoor recreational facilities.

Table No.4 showing the Details of Parks and Playgrounds Situation in 1998 reveals very interesting results.

Table No. 4 Details of Parks and Playgrounds Situation -1998

S. No.	Charge No.	Area of parks (in acres)	Population	Area of parks & playgrounds / 1000 population	Area of charge (In acres)	Density percentage of parks & playgrounds (charge,wise)	Area of well-kept & clean parks & playgrounds (in acres)	Area of well-kept & clean parks & playgrounds / 1000 population	Density percentage of well-kept & clean parks & playgrounds (charge-wise)
1	28	15.22	25482	0.59	163.02	9.33	5.38	0.21	3.3
2	27	18.88	42381	0,44	313.69	6.01	15.94	0.37	5.08
3	15	19.22	28090	0.68	153.14	12.55	8.39	0.29	5,47
4	16	20.31	41473	0.48	202.54	10.02	13.02	0.31	6,42
5	13	221.9	37958	0.57	217.36	10.07	16.52	0,43	7.6
6	14	22.7	43070	0.52	365.56	6.2	7.13	0.16	1.95
7	29	23.57	8412	2.8	116.08	20.3	1,43	0.16	1.23
8	26	24.73	44545	0.55	180.31	13.71	0.15	0.003	0.33
9	12	31.51	54838	0.57	392.73	8.02	16.25	0,29	4.13
10	25	39.76	18589	2.13	326.04	12.19	17.2	0.92	5.27
11	17	54.8	40554	1,35	447.07	12.25	17.92	0,44	4
12	48	57	54838	2.29	335.92	16.96	38.08	0.79	11.33

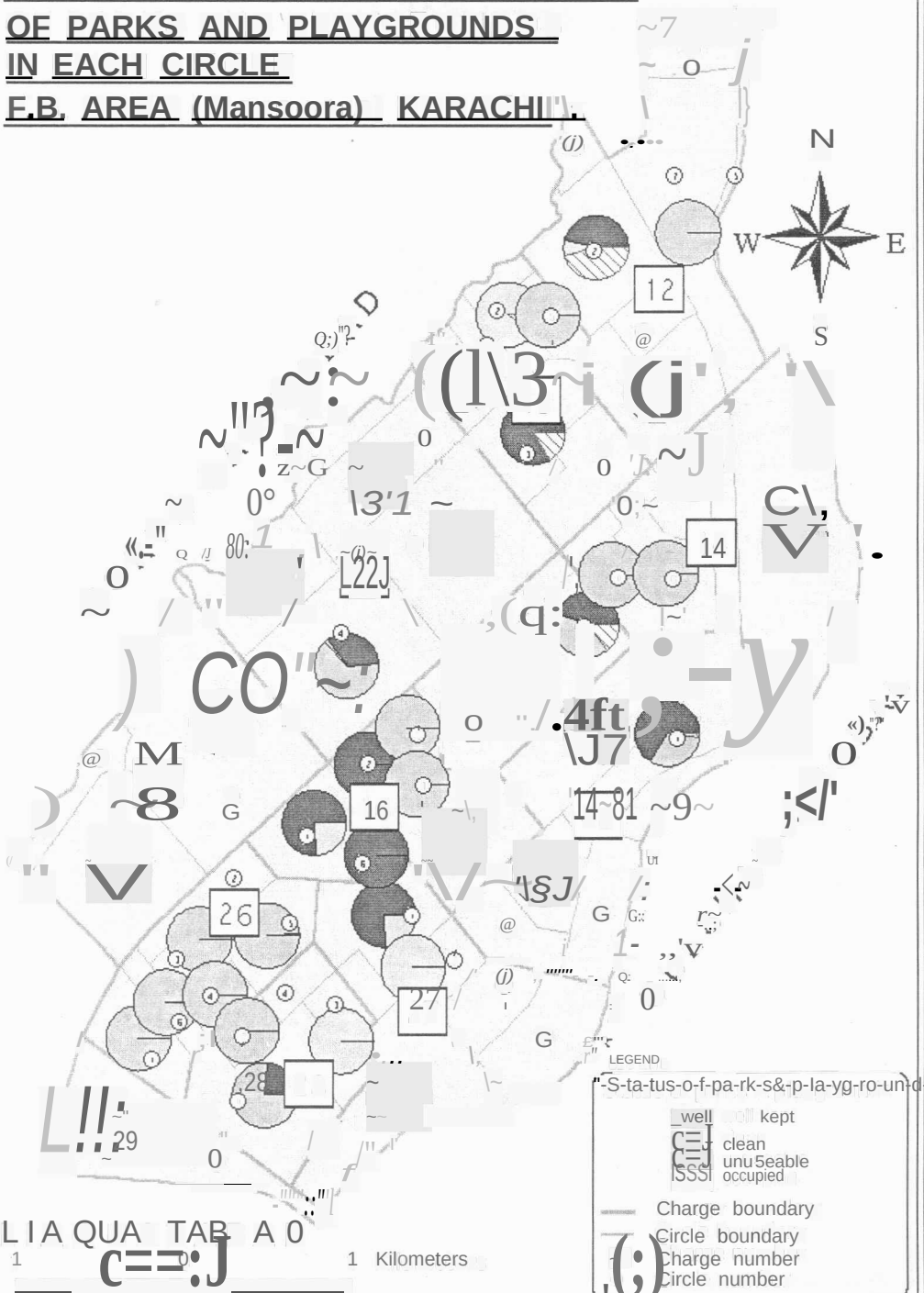
The highest allocation of parks in proportion to Charges is in Charge no. 29 followed by 48, 26, 15, 17 and 25. Although in the absolute allocation of area of parks the highest allocation is for Charge 48 and Charge 29 has 6th ranking, which reveals that the total area of Charge 29 is much smaller than that of Charge 48. Charge wise allocation of Charge 29 is in a better position, which also has the highest ranking of parks/IOOOpopulation. However, it is the total area of clean and well-kept parks, which is of value for recreation. In this regards the most well placed Charge is No. 25, both in terms of density of Clean and Well Kept parks/total area of Charge as well as Clean and Well-Kept parks/'OOOpopulation followed by Charges 48, 17 & 13. Table No. shows that in aggregate terms Charge 26 is the worst placed. Charge 29 which has only 1 Circle in our study area also comes under the worst category.

PARKS AND PLAYGROUNDS OF F.B. AREA (Mansoora) KARACHI

STATUS OF PARKS AND PLAYGROUNDS
F.B. AREA (Mansoora) KARACHI

PIE GRAPHS SHOWING THE STATUS OF PARKS AND PLAYGROUNDS IN EACH CIRCLE

F.B. AREA (Mansoora) KARACHI



A very interesting result that has been revealed from a study of the data that in terms of allocation of parks in proportion to the Charge as well as in terms of proportion of population is highest in Charge 29 but the proportion ofCle.an and Well-Kept parks is one of the lowest both in terms of the facility it is providing to the population as well as in the service to the total area ofthe Charge.

The picture becomes much clearer if we take an overview of the percentage of Clean and Well Kept parks to the total area of parks shown in Table No 5.

Table No.5 - Detaflso f Parksan d Playgroull ds SltuatlOll -1998

S. No.	Charge No.	Population	Total area of parks & playgrounds (in acres)	Total area of well-kept & clean parks & Playgrounds (in acres)	Percentage of well-kept & clean parks & playground / total area of parks & playground	Area of parks & playground / 1000 population	Area of well-kept & clean parks & playground / 1000 population
1	12	54383	31.51	16.25	51.6	0.57	0.29
2	13	37958	21.9	16.52	75.4	0.57	0.43
3	14	43070	22.7	7.13	31.4	0.53	0.16
4	15	28090	19.22	8.39	43.6	0.68	0.29
5	16	41473	20.31	13.02	64.1	0.48	0.31
6	17	40554	54.8	17.92	32.7	1.35	0.44
7	25	18589	39.76	17.2	43.2	2.13	0.92
8	26	44545	24.73	0.15	0.68	0.55	0.003
9	27	42381	18.88	15.94	84.4	0.44	0.37
10	28	25482	15.22	5.38	35.3	059	0.21
11	29	8412	23.57	1,43	6.06	2.8	0.16
12	48	47640	57	38.08	66.8	2.29	0.79

The lowest ranking is of Charge 26, (only 0.60% of the park area is Useable), followed by parks in Charge Nos. 29, 14, 17,28,25, 15, 12, 16,48, 13 & 27). The table reveals some very interesting results that Charge No. 48 which has the highest acreage of both total area of Clean and Well Kept parks, however, does not show the highest comparative percentage. The highest ranking is for Charge No. 27 with 84.40% of Clean and Well Kept parks to total area of parks, followed by Charge 13 which has 75.43%, followed by Charge 48 (66.8%).

A study of the population density figures reveals some very interesting results that Charge 29, showing the lowest area for its Charge, coupled with lowest percentage (because only 1 Circle is included in our Study Area) has the second lowest density of population. While Charge No. 25, has a different proportion of both resulting in lowest density of population as shown in Table No.6.

Table No. 6 Population Density -1998

S. No.	Charge No.	Area		Population 1998	Population Density Ipersons / sq.km.
		Acres	Sq. km.		
1	25	326.04	1.32	18589	14082
2	29	116.08	0.47	8412	17897
3	17	447.07	1.81	40554	22405
4	14	365.56	1.48	43070	29101
5	27	33.37	1.27	42381	33370
6	12	392.73	1.59	54838	34489
7	48	335.92	1.36	47640	35029
8	28	163.02	0.66	25482	38609
9	13	217.36	0.88	37958	43134
10	15	45.306	0.62	28090	45306
11	16	50.576	0.82	41473	50576
12	26	61.02	0.73	44545	61020

But the position of Clean and Well Kept parks is worst in Charge 29. The whole recreation area of Charge 29 is occupied by a 'Kachi Abadi' i.e. Gharibabad. Besides this the Charge No. 29 is along the railway line, and whatever, parks remain have become a dumping ground for garbage.

Significant observations:

Some significant observations have emerged from the study:-

1. The scheme was planned in 1976 with provision of about 4 acres of open space for each 1000 population. But now after 26 years not only has the population increased but the provided area of parks and playgrounds has also decreased due to occupation of about 41.38 acres and unusable land of about 150.82 acres in the whole FB.Area.

2. The spatial distribution of parks and playgrounds is not appropriate. In most of the cases these are found concentrated in certain parts of a residential block/area depriving others of this necessity, e.g. in Charge 25 & 17 where the park is concentrated in the centre, depriving residents in the peripheral area of Charge 13.

3. Not only is there disparity in the spatial distribution but the distribution according to size is also unjustified, e.g. in Charge 26, the size of a park is as small as 170 yards, while the size of another park in Charge 117is as large as 2720 yards.

4. According to the information by KDA, based on the map, the total number of parks in F.B. Area is 58 and playgrounds 40. However, on the basis of ground truthing we could find only 36 playgrounds and 75 parks shown on the Plan. Out of75, only 38 parks and out of36 only 19 playgrounds are in a Useable condition, i.e. only 50% of parks and playgrounds are in a good condition, including the parks managed by u.B.L.

5. The influence of residents can also pay a significant role in the level of development of parks and playgrounds in any area, e.g. in Charges 28 & 26, intensively used and mismanaged parks and playgrounds are found due to the presence of poor and highly concentrated Agha Khan community.

Near the squatter fields along the Layari River, the playgrounds are in their worst condition. On the contrary Charge 27 has very clean and well-managed parks and playgrounds due to its political significance.

The small sized parks and playgrounds connected with mosques are will kept and quite clean. In other words, large size parks and playgrounds e.g. Nos. 64, 65 & 17 are in a better condition.

7. The playground in the proximity of schools plays a dual role i.e. they not only serve as a source of recreation for the residents of the block, but as playgrounds for school children, as well.

8. Most of the parks and playgrounds are used as parking lots or short cut routes because of their broken boundary walls. Occupation of open spaces for commercial purposes is also quite common, e.g. for bus stands, schools, colleges, weekly bazaars, and sometimes for hospitals and offices, etc.

Problems in Maintenance:

1. The deplorable condition of parks and playgrounds is because of a myriad of problems, e.g.
The demand of water supply in view of the increasing density of population beyond the stipulated amount.. As a results it is very difficult to provide sufficient amount of water for the development and maintenance of the greenery of parks and playgrounds in Karachi, and more so for F.B. Area.

2. Karachi Municipal Corporation is fully equipped to develop and maintain parks and playgrounds in the city, while the suburban local bodies are ill equipped for under taking the development of parks and playfields. The town committees have neither the resources nor the staff for development or maintenance of parks and

playgrounds.

3. The negative social behaviour is another major problem, therefore we find that

a. The people of the locality use these open spaces as a dumping ground for garbage without fear of being reprimanded by any authority or other people of the locality.

b. Burning of garbage by the local people to reduce its quantity by turning it into ashes. This burning of the garbage produces deadly gases, which is a serious health hazard especially for children, the old and infirm.

c. There is a lot of social apathy among the people and there is no sense of responsibility to keep the area, locality or open spaces clean on a self-service basis. The easiest way out is to blame the government for negligence and mismanagement. .

4. At some places, the soil type is so unproductive that provision of sufficient amount of water does not bring any change, e.g. Park No 97 on the map.

Suggestions:

After surveying and studying the problems faced by the parks and playgrounds and consequently by the residents, some suggestions for the improvement of the area have been made. Some of these, hopefully, would be considered in the future planning of the KDA Scheme.

1. The map as well as Ground Truthing has shown that there are 2 problems in the allocation of parks. Firstly, there is a concentration of parks and playgrounds to one part of a Circle, in addition to this there is cohesion of2-3 parks to make a single large park within a Circle.

This should not be the strategy in the future plans ofKDAand parks and playgrounds of considerable sizes should be equally placed and distributed in the whole Charge/Circle so that..

a. All people, whether living at the periphery or at the centre of the Charge, could have easy access to this basic need.

b. They could be easily managed by the gardener and management, as the survey has revealed that all small size parks and playgrounds, especially those

attached to mosques are quite well managed.

c. Spacing of parks evenly in the Charges could reduce the risk of occupation, as uneven spacing especially oflarge open spaces is a great lure for encroaches.

d. It is necessary to construct the boundary walls properly, so that not only vehicles but also animals like cows and dogs should not stray into these open spaces meant for recreation.

2. Local non-government volunteer committees comprising of old and retired people should be encouraged and be given sufficient authority by the KDA, which will prove to be economically beneficial to the KDA & dependence of Government, KDAor KMC will be minimised.

3. Separate parks for women and children should be made so that they can refresh and recreate themselves without hindrance.

4. Playgrounds around schools should be given under the management of schools, which will be beneficial not only for the school children but the park and playgrounds as well..

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Spatio-temporal Disparities of Transport Connectivity: A Case Study of Karachi

Dr. Farkhunda Burke
Chairperson & Associate Professor
Department of Geography,
University of Karachi

Abstract

Mobility is the essence of life. With increasing population, demand for mobility increases rapidly, especially in urban areas. However, there is a wide gap between demand and supply especially in Third World Countries. In this paper an attempt has been made to assess the spatial as well as temporal disparities of Transport Connectivity in Karachi, using Kansky's method and it has revealed very interesting results.

Introduction

Transport Systems are the response to the ever-growing needs for contacts between individuals and societies and for the movement of commodities as part of national and global economics(1).

Transportation is a necessity of life. A wide variety of transport nodes have been devised to effect this transport and these modes have necessitated the laying down of various transportation routes e.g. people and goods are moved from place to place by means of roads, rail, sea and air-routes. For the geographer, the importance of transport lies in its being one of the principal factors affecting the distribution of social and economic activity (2).

Karachi has shown an increase in area as well as population. Exact figures for area and population for the years 1969 and 2000 are not available. However, they have been calculated. The area of Karachi has increased by 477.47 sq. Kilometres i.e. 2.15% growth rate per annum in 31 years. While population has increased by 7187578 between 1969 (Population 3194822) and 2000 population (10382400) i.e. 2.23 % growth rate per annum in 31 years(3).

Objective:

The analysis of transport networks has become an important part of geographical studies. Transport networks vary in their size, connectivity and complexity. In this paper an attempt has been made to make a spatio-temporal comparison of changes of Network Connectivity in Karachi for the years 1969 and 1993.

Sets of transportation lines or routes, which join and cross at a junction, form a

transportation network [4]. To study a network a pure qualitative approach is inadequate and geographers seek to examine networks on the basis of quantification.

The connectivity of a network may be defined as the degree of completeness of the link between modes. The more arcs there are in any transportation network the more complete will be the linkages between the various nodes. The greater the degree of connectivity within a transportation network, the more efficient will that system be.

Methodology

Yasui, K [5], has used three indices: alpha, beta and gamma indices. Alpha index indicates to what degree a new link is an extension of an existing link. Beta index measures orthogonality between new and existing link. Gamma index shows whether a new link forms a crossing road at the node with an existing link. The method is applied to analysis of the road network of Kyoto, a Japanese ancient capital..

However in this study a spatio-temporal comparison of the network has been made in order to measure the efficiency of the network in relation to service to the population and the expanding size of the city.

KJ. Kansky [6], an American, studied the structure of transportation networks and developed several descriptive indices for measuring the connectivity of networks. Apart from the Beta, Gamma indices, the Cyclomatic number, the Diameter method. Kansky, modified the previous Diameter Index into a more suitable and accurate form. The description of a network in terms of its diameter involves the counting of the number of arcs on the shortest possible path between the two nodes lying farthest apart on the network. In general terms the diameter increases with increasing size of the network, although any addition of connecting arcs may result in the diameter being decreased. The diameter may be related to actual distances in a network by using Kansky's Pi (IT) Index

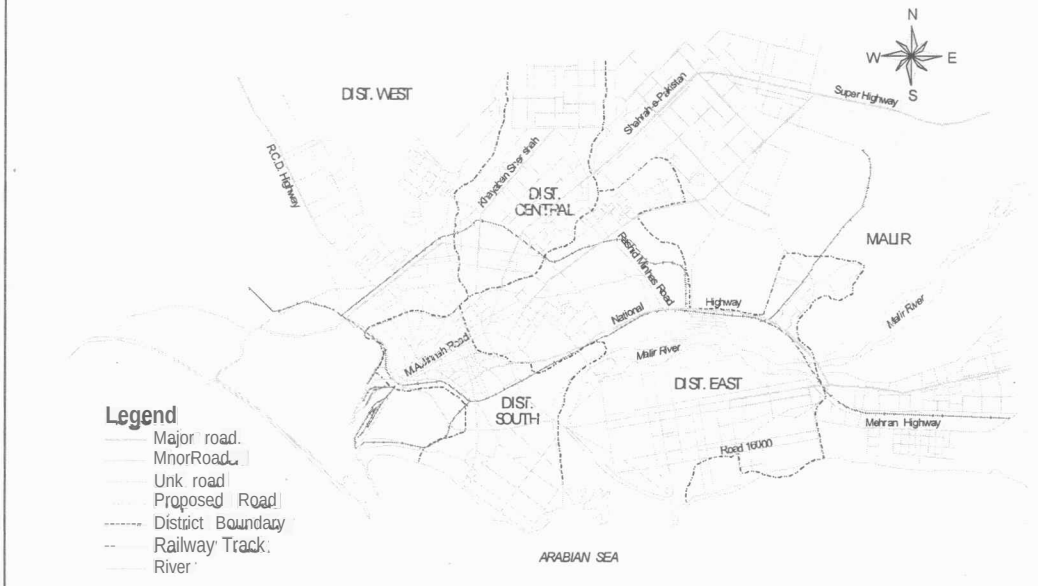
$$\text{Pi (IT)} = \frac{\text{Total distance of network}}{\text{Distance of Diameter}}$$

It should be noted that higher the value of Pi (IT) Index the lesser is the connectivity.

In order to make a spatio-temporal comparison. Road Maps of Karachi, for the year 1969 and 1993 have been used as these were the maps available, shown respectively Map No. 1 and Map No. 2.

In 1969, Karachi was not divided into districts, while in 1993 it was divided into 5 districts. However, in order to make comparison effective the 1993 district boundaries have been superimposed on the 1969 map.

KARACHI ROAD NEIWORK
1969



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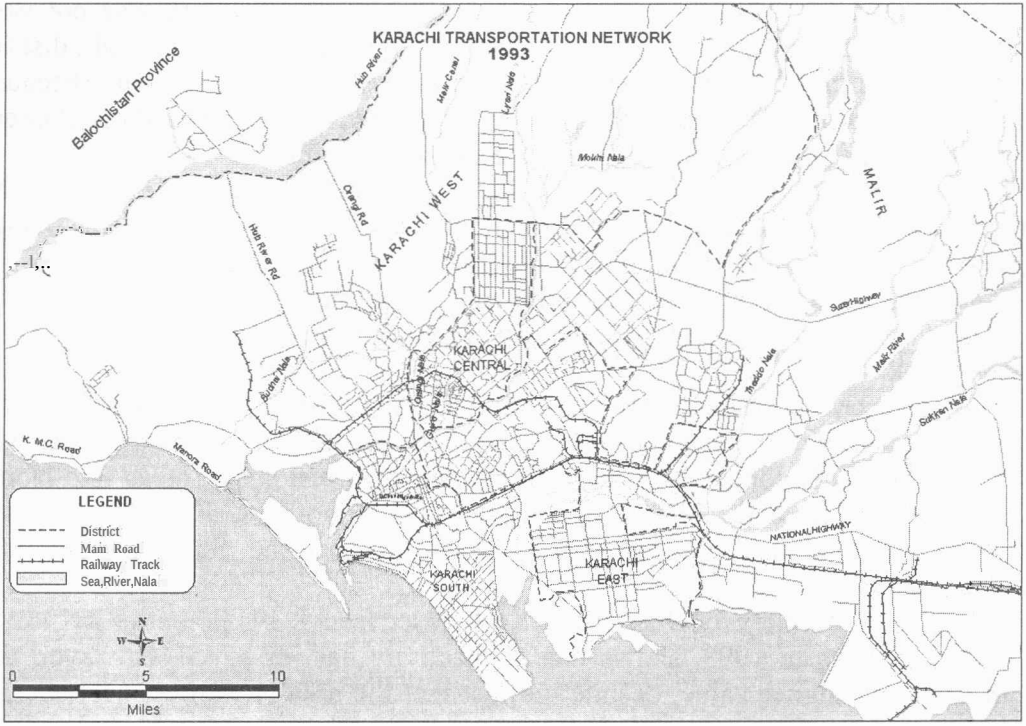

The following Table No. 2 shows the Degree of Connectivity of the districts.

Districts of Karachi	1969	1993
East	4Kms.	3.759 Kms.
West	4.38 Kms.	7.458 Kms.
Central	7.83 Kms.	3.032 Kms.
South	8.39 Kms.	6.096 Kms.
Malir	42.5 Kms.	15.967 Kms.
Karachi	6.77 Kms.	5.501 Kms.

ConCluSIOn

The highest value for Malir districts shows that the area was not well developed in 1969. The whole district contained any 3 nodes at Landhi Industrial Area and was not well connected to other districts. The network was not well connected to other districts. The network was not so well developed as Malir district was an agricultural district at that time. Even in 1993, it has the highest value because it is basically a peripheral urban area having cultivated land, goths and cantonment area. The district is a large one and roads are sparsely distributed.

In 1969, the least value of Pi (0) Index is for district East.. Here we find the well connected nodes at Shaheed-e-Millat road, Khalid-bin- Walid Road, Shahrah-e-Quaideen, Shahrah-e-Mehran, Gulshan-e-Iqbal, Main University road and Rashid Minhas road. District East has more efficient transportation network because of the higher number of nodes and higher density of routes. **In** 1993, this district shows the second rank.

In 1993, the best connected district is Karachi Central and the reason being that the area is centrally planned, with a well-developed network. Thus, the routes are straighter and less congested. This district comprises residential areas like North Karachi, New Karachi, Nazimabad, Liaquatabad, Golimar, EB. Area, Super Highway, S.M. Taufiq Road, Nawab Siddiq Ali Khan Road, Shahrah-e-Mumtaz Mehal, Shahrah-e- Noor Jahan,etc.

The Pi (0) Index for District South decreased from 8.39 kilometres in 1969 to 6.096 kilometres in 1993, shows that connectivity has improved. However, the comparatively higher value, despite the fact that the area is well-connected. The reason for the diverse picture is that, the roads present here are very congested, having many bottle-necks, e.g. at Lucky Star and Tower. The routes are sinuous rather than straight.. The dense and sinuous nature of the network is due to its high level trade activities and presence of government institutions and foreign missions. Several of the large shopping centres like Zaibun-Nisa Street, Zainab Market, Jorya Bazar, Bohri Bazar, Empress Market, Abdullah Haroon Road, Chundrigar Road, Cantt Station, M.A.. Jinnah Road, Nishtar Road, Shahrah-e-Liaquat are located here. The most advanced and fashionable area of Defence is located here. The region connects the Korangi Industrial Area to the district East by Korangi Road.

Karachi West shows 4th rank in 1993, because the district covers a very large

area, and roads are insufficient to serve such a large area. The area possesses SITE Sind Industrial Trade Estate) and Orangi Town, in which industries and some technical institutes are located.

The result for Karachi, as a whole shows improving trend of connectivity. Pi (5) index has decreased from 6.77 kilometres in 1969 to 5.5 kilometres in 1993. The value is above the two districts East and Central but lower than the other 3 districts, so we can say that the connectivity of the whole city is affected by the higher value of three districts. But if we take into account the well-urbani sed areas (Districts Central, East, South) then we see that over all the city is well connected, but needs further development of major nodes and lagging areas ofMalir and District West.

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In the vale of Peshawar

by:
Dr. Inam Ullah Khan

ABSTRACT.
Loess is a wind blown deposit which is widely distributed in North America, Europe and Asia. Loess is now believed to be closely associated with the Pleistocene glaciations.
However, the exact climatic provenance of loess is debatable. Some researches believe (Woldsted 1967, Butzer, 1971 and Fairbridge 1972)that the loess was deposited during glacial maxima, while some scholars (Visher 1922, Smalley 1971, and Moran 1977) suggested that the loess was deposited during melting and retreat of glaciers in warm inter-glacial period ofthe Pleistocene glaciation.

Loess in found to be very important lithological constituent of different landforms of the Peshawar vale. Therefore, the aim of the present study is to search out all the possible geomorphologic and morphogenetic factors which contributed in the formation and deposition ofloess in the Peshawar vale.

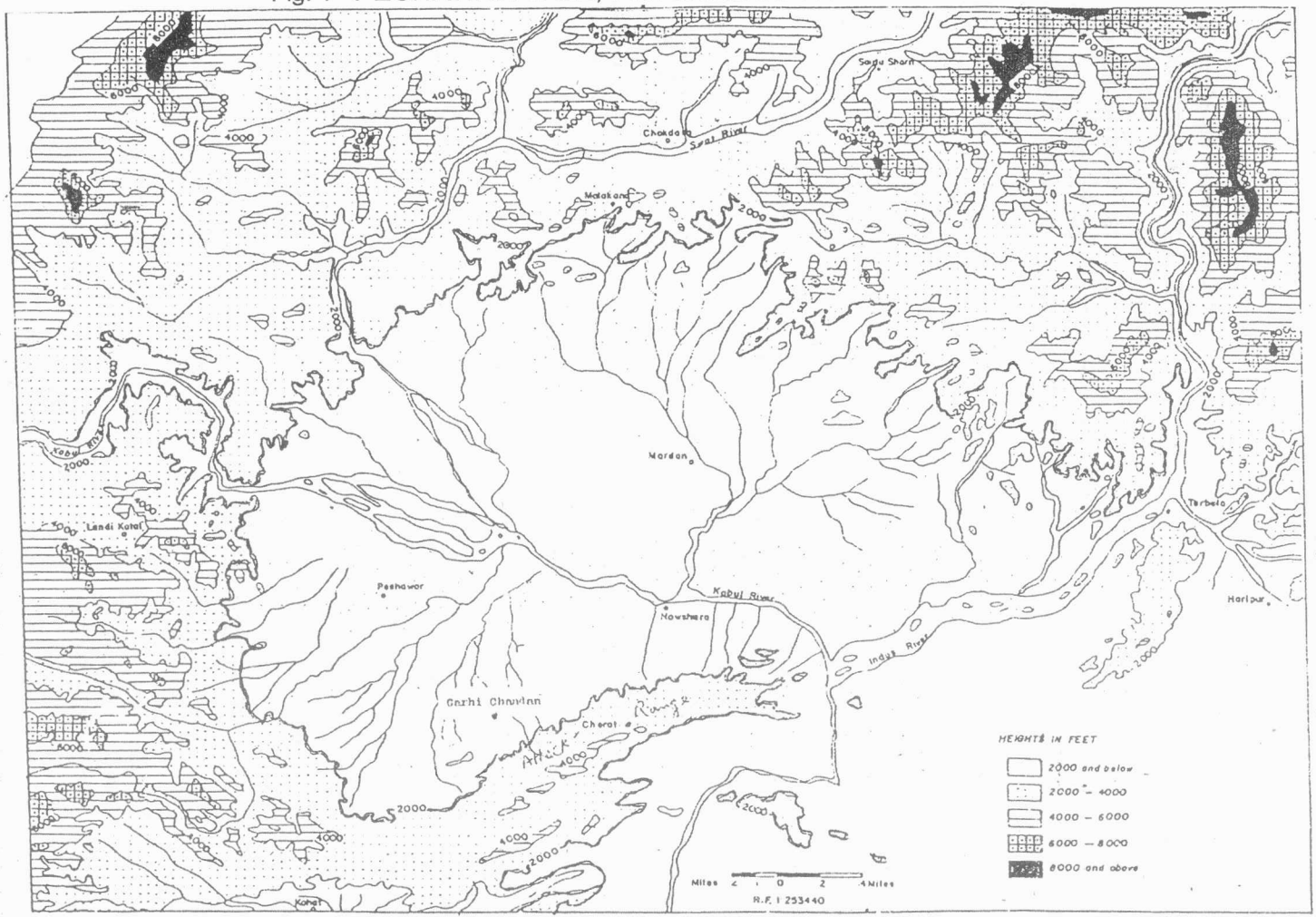
To achieve this objective, a systematic study of loess exposed in various stratigraphical sections was carried out in the field and laboratory for detail analysis and interpretation.

On the basis of fieldwork and laboratory examination, it was suggested that the loess was deposited in three phases during the inter-glacial periods of the lower, Middle and the upper Pleistocene. The study also shows close similarities ofloess deposition between the Peshawar vale, the Potwar Plateau and Kashmir Valley.

DEFINITION AND GENERALCHARECTERISTICS OF LOESS

Loess is a wind blown sediment, commonly non-stratified and unconsolidated. It is mostly composed of silt size particles with a low percentage of sand and clay.

Fig. 1 PESHAWAR VALE, PHYSIOGRAPHY



micas, hornblende, calcite and pyrogene. Carbonate minerals may be present variably ranging as high as 40% by weight of the sediment (Flint, 1961).

It is now commonly agreed that the loess was deposited during the Pleistocene glaciation. As most of the loess deposits are found near by those areas, which are peripheries of the formerly heavily glaciated areas during the Pleistocene period.

Important are of loess deposition are found in the Central North America, the Western and Central Europe extending extensively in the Ukraine region of Russia. Large deposits are also found in China, Central Asia, Kashmir, North West Pakistan particularly the Salt Range and the Vale of Peshawar.

As to the origin of loess, it has always remained a hotly debated subject, various views have been put forwarded as to its definition, mode of formation and origin as being alluvial, fluvial-colluvial (Russel, 1940; and Fisk 1951), Aeolian (Lighten and Wilman, 1950), residual (Berg 1964), glacial-Aeolian (Wilman, 1950), residual (Berg 1964), glacial-Aeolian (Smalley, 1966; Smalley and Vita Finzi, 1968) or fluvial-Aeolian (De Terra and Patterson, 1939, Wadia, 1966, and Elberson, 1967

THE LOESS OF PESHAWAR VALE

During the course of research regarding the "Genesis of the Quaternary deposits of the vale of Peshawar, south of river Kabul", (Khan, 1990). It was surprisingly found that the loess, formed a prominent lithological constituent of different landforms of the vale of Peshawar. Therefore, the objectives of the present study was to carry out a systematic study of loess in the field and the laboratory, so as to explore all the possible geomorphological and morphogeneticv factors which have contributed in the formation and the deposition ofloess in the Peshawar vale, during the Pleistocene period. And to achieve these objectives, the following procedure and techniques were adopted:-

TECHNIQUES:

1. Each bed ofloess, exposed in different stratigraphic section was examined in the field, and all its physical characteristics recorded, and samples were taken to laboratory for detail analysis, It included:-

(i) Measurement of the thickness of each bed, its colour, texture, structure, worms and roote holes, fossils and organic matter.

(ii) The loess samples were air dried in the laboratory for colour identification. The colour was matched and noted with the Munsell chart and the identification in terms of hue, value and chroma.

(iii) Grain size analysis was carried out to understand its textural composition which helped in determining the source and the processes involved in its formation, transportation and deposition.

(iv) Some ofthe loess samples were also examined chemically to determine its calcium and iron contents and organic matter ~ounderstand the post-depositional processes and environments.

The following methods were used to get their percentage:-

a. ca++ ---------- by titration against EDTA (Ethylene diamine Tetre-Acitic Acid) solution.

b. Organic matter ---------- by Walley and Black method (by titrating against ferrous ammonium sulphate solution).

c. Total iron contents ---------- determining on Atomic Absorption Spectro-photo-metre after digesting the soil in a tri-acid mixture of H2S04, Hno 3 and 70% HCL04 in the ratio of!: 10: 4.

d. A thin section microcopic study was carried out to examine the general mineral composition of the loess. It was supplemented by taking 275 times enlarged photographs of the grains which helped in determining the shape of the grain (Plates **No.4,** 5, 6 and 7).

e. Two samples of loess (Plates. No.1 and 3). were examined through SEM (Scanning Electron Microscope) to see the shape and internal s~rface texture of the individual grain at high magnification, (up to 3000). After following Pye (1983), the loess samples were air dried and treated with 50% HCL, to remove the carbonates, then the surface was coated with aluminum to produce a conductive layers, micrographs were taken at different magnification, (Plates No. 1,2, and 3).

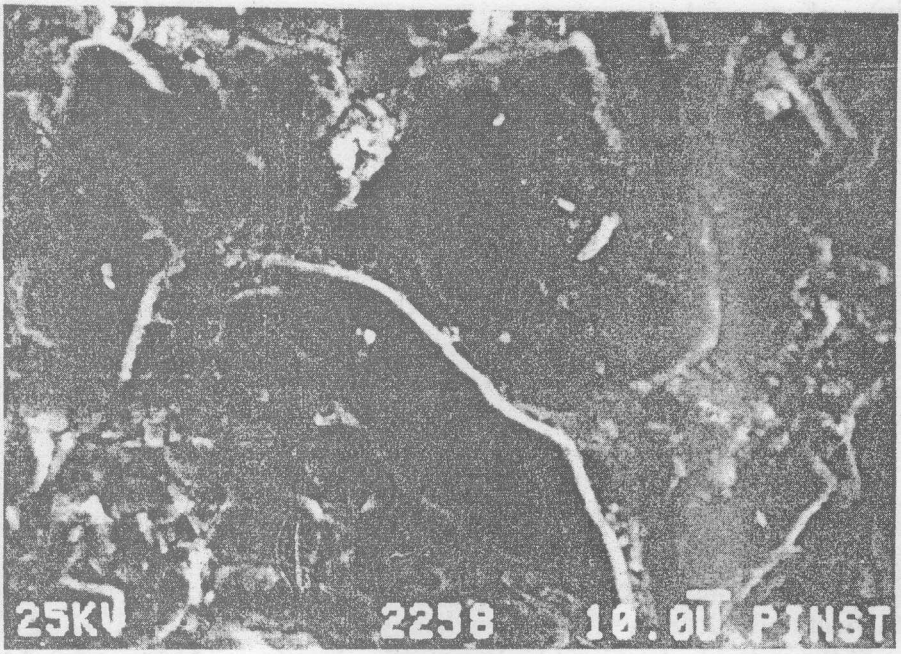


Plate NO.1. Micrograph showing shapes of the grains of loess. Daka Mar Khwar. (G.R. 16853)

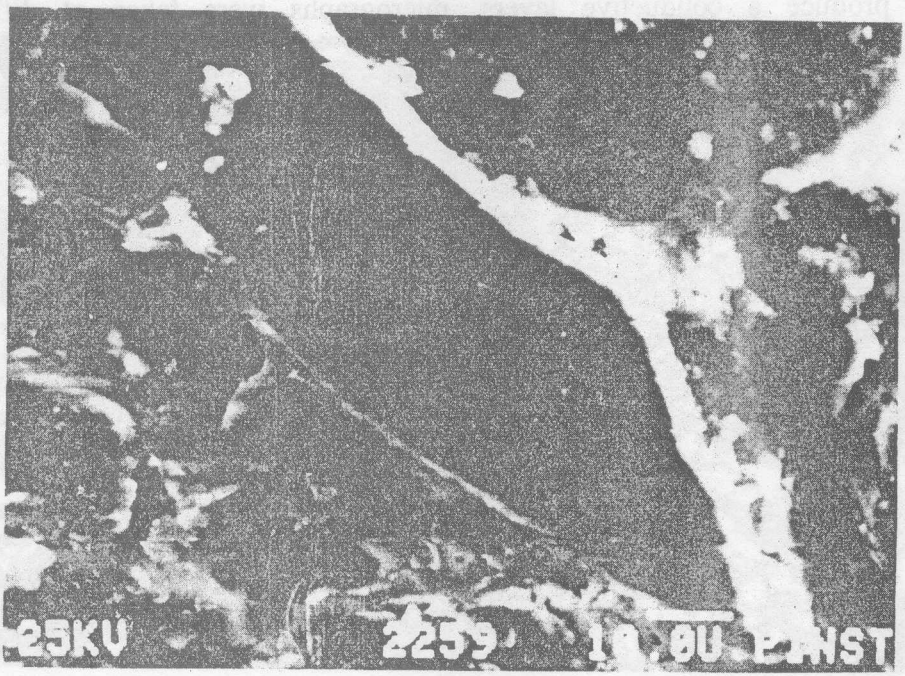


Plate NO.2. Micrograph showing the internal surface texture of the individual grain of loess. Daka Mar Khwar. (G.R. 16853)

Plate NO.3. Micrograph showing internal surface texture of the individual grain of loess. Tangi Kandao *(GR.* 047848)

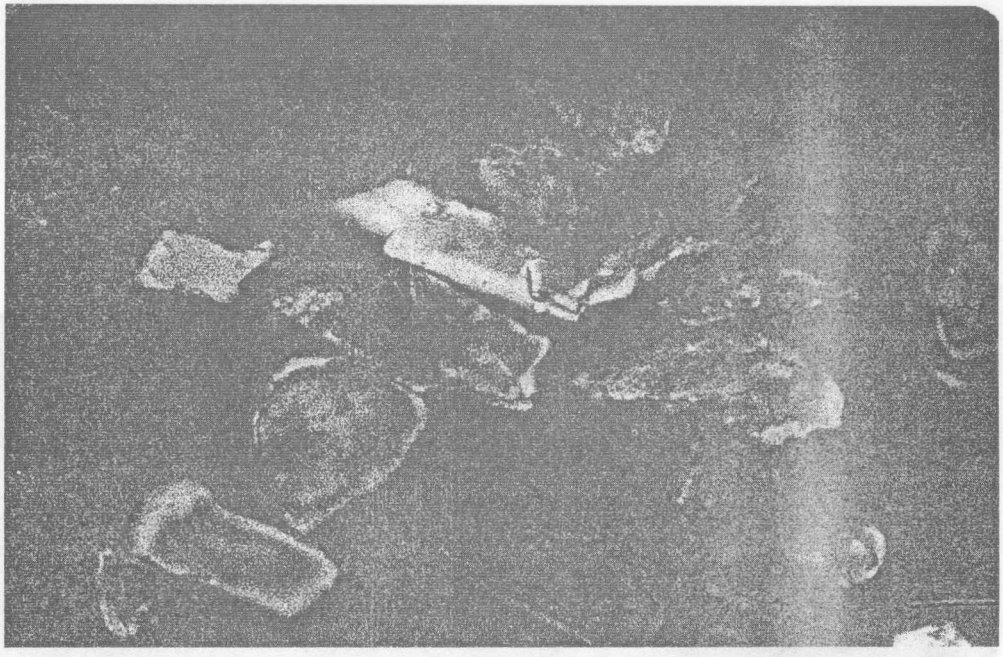


Plate NO.4. shows angularity of the grain of loess. Left bank of Babu Khwar. (G.R.. 093874)

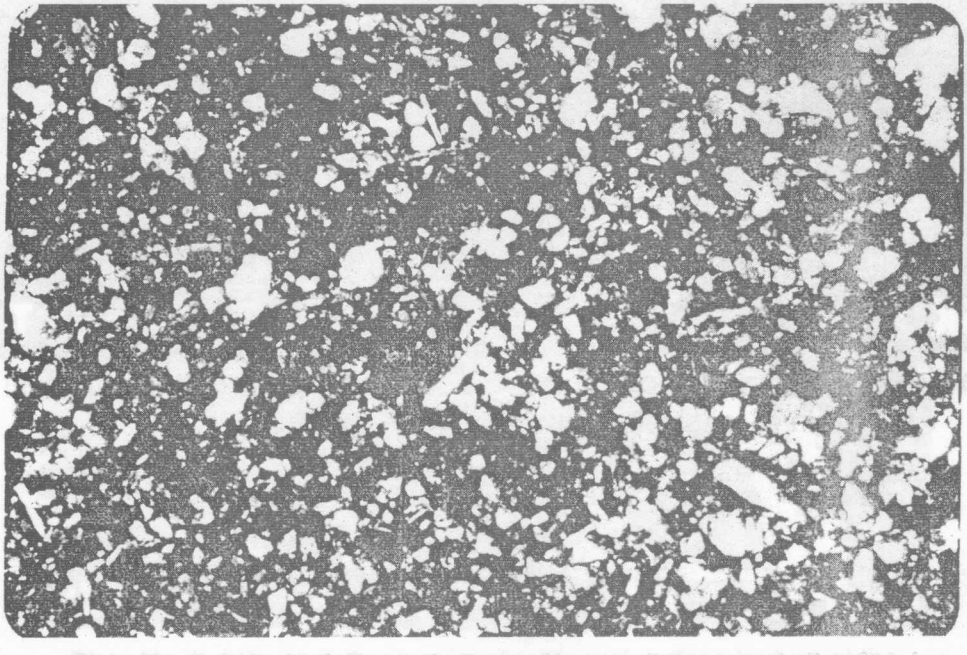


Plate NO.5. Lake bed, Second phase of loess, shows angularity of grains. Left bank of Babu Khwar. (G.R. 093874)

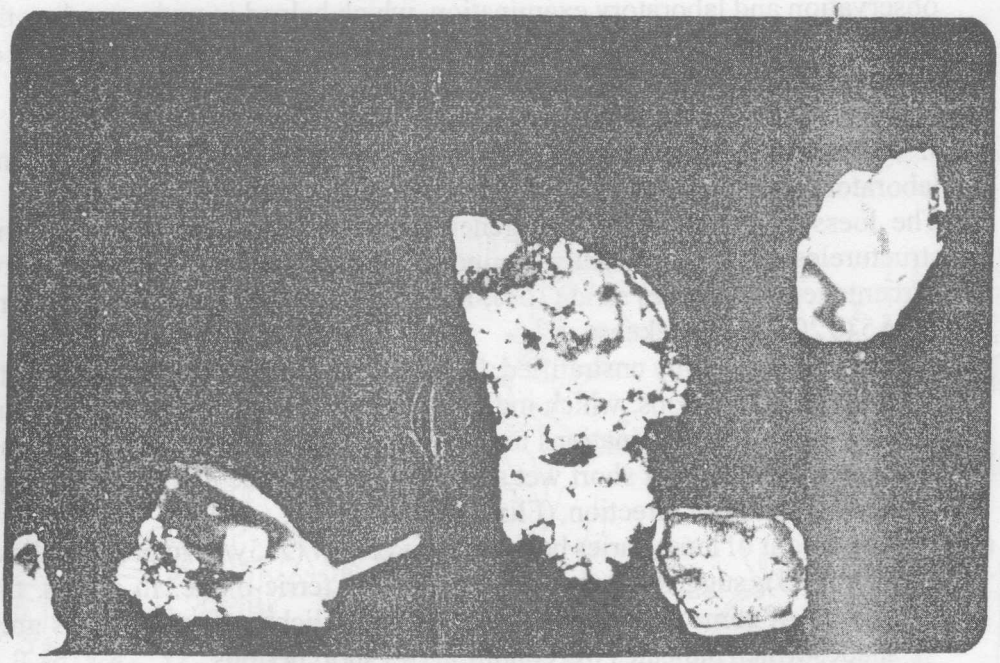


Plate No.6. Lake bed, Second phase of loess, shows angularity of grains.
Right bank of Babu Khwar (G.R. 09783)

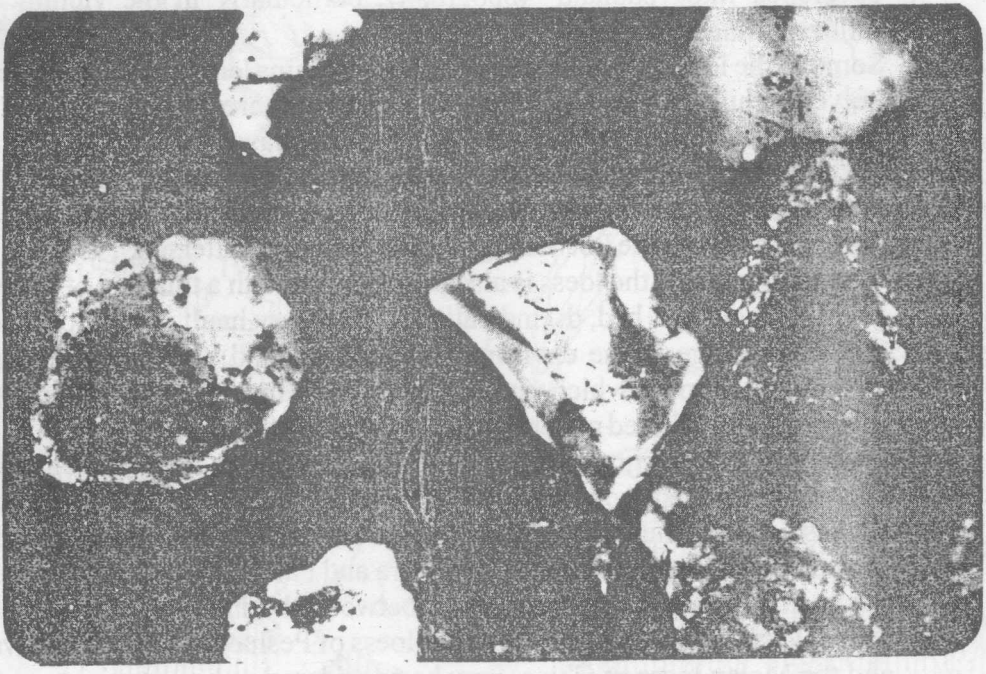


Plate No.7. Loess, shows the angularity of grains.
Right bank of Babu Khwar (G.R. 09783)

observation and laboratory examination, which helped in understanding the possible factors facilitating the genesis of loess deposition in the vale of Peshawar.

RULES: The following is a summery of the results of field observations and laboratory analysis ofthe loess of Peshawar vale:-

(i) The loess of Peshawar vale is generally uncertified unconsolidated and structureless. It is dominantly composed of silt size particles with a low percentage of (average) sand (16%) and clay (12%). The deposit may vary from 5 to 20 feet in thickness.

(ii) Though commonly unstratified, in places, it shows two to three beds with intemallaminations, which indicates temporary periods of break in the deposition. The laminations may represent sedimentations in small and temporary ponds of short wet spells, or may also be due to variation in wind velocity, or direction, (Flint, 1961).

(iii) The colour ofloess varies between pale yellow (7. 5y/4) to brown yellow (10yR6/5), suggesting the development of ferric-oxide. In places, the surface of some of the loess is occupied by lichen, here it shows grey shades which indicates wet conditions for short periods.

(iv) The loess tends to split along vertcle joints, stands and maintains steep face due to gully erosion. It also shows columnar structure, which has developed into "badland" topography, particularly in the vicinity of Jallozai village, near Pabbi, Noshehra.

(v) Some ofthe loess (Section 1, bed, e.) also contains lenses of sand and fine gravels, while angular fragments of slate or shale are found occasionally. This would suggest that some of the loess may have been "redeposited", as slopewash, from the near by Attock-Cherat range during wet spells. It may be noted that similar "redeposited loess" has also been found at different places in the Potwar region (De Terra and Patterson, 1939).

In some localities, the loess is also inter bedded with a thin bed oftorrent gravels (Section 3, bed, d.) indicating a temporary hault in its deposition due to a change in the environment from dry and semi-dry to humid conditions, during which the torrents from the near by mountains transported weathered material and deposited on the loess bed.

(vi)It is also interesting to note that like the Potwar, in the Peshawar vale too, the loess mostly overlies beds of gravels (Section 1, bed, d.). which suggests similarities and uniformities of environments of deposition in both the areas under discussion. De Terra and Patters (1939) also pointed out such stratigraphic resemblances between the Potwar loess and the Malan loess of China. In this way, the loess of Peshawar vale, the Potwar and the Malan loess of China, may be considered as homotaxial to each other.

(vii) Mineralogically, the loess of Peshawar vale, consists, predominantly of quarts and feldspar with high concentration of carbonates (which however, are of secondary encrustation formed after deposition (Smalley, 1971), followed by a gradual decrease in biotite, muscovite and amphibole (Table. 1.). this composition also closely resembles with the mineralogical analysis of the Potwar loess, carried out by Krynine, (De Terra and Teilhard, 1936).

(viii) Microscopic study carried out by SEM, Scanning Electron Microscope) shows that the individual grains are mostly sharp and angular. The grains of quartz also show rough surface texture with very clear marks of etching (Plates, 1,2, and 3) which is very similar to the loess deposits, studied in Europe (Smalley and Caberara, 1970, and Cagla, et al. 1971,) in West Germany and Pland (pye, 1983) and in Tajikistan, (Goudie, et al. 1984).

(ix) Most of the loess of Peshawar vale also contains nodules and concretions of calcium carbonate, of varying sizes and shapes. This indicates a high rate of weathering during which, the leaching of calcium carbonate took place, while the ring shape calichi indicates solution holes due to chemical action in humid environments.

(x) Most of the loess deposits also show fine rootholes containing some decayed brownish grey organic matter of low percentage (average, 0.12%) which suggests the growth of sparse vegetation, like low shrubs and grasses, indicating a semi-dry climate, during its deposition. This is also true for the Potwar loess (Wedia, 1966. pp409).

(xi) It is also interesting to know that like the Potwar loess (De Terra and Patterson, 1939), the loess of Peshawar vale is also devoid of any verterberate remains. This may be due to having an effect of a significant percentage of calcium carbonate. And loess being very porous, and percolation of water charged with lime seems to be very effective in its bleaching action. However, some ofthe loess beds in their upper parts of the stratigraphic section along Babu Khwar, near Noshehra, contain terrestrial fresh water snails and molluasks, which indicates a post-deposition wet conditions for some times. **TABLE NO.1**

MINERALOGICAL ANALYSIS

A: TEXTURE: PERCENTAGE

Location of Sections	Loess Beds			Lake Beds		
	Sand	**Silt**	**Clay**	**Sand**	**Silt**	**Clay**
1. Left bank of Babu Khwar (GR. 093874).	13	81	6	27	73	0
2. Right bank of Babu Khwar (GR. 097863)	25	57	18	25	75	0
3. Daka Mar Khwar (GR. 016853)	10	65	25	11	72	17
4. Tangi Khwar (GR. 047848)	11	73	16	12	73	15

B: Mineralogical Composition Approximate percentage

		Section. 1.		Section. 2.		Section. 3.		Section. 4.	
		Loess	**Lake**	**Loess**	**Lake**	**Loess**	**Lake**	**Loess**	**Lake**
Quartz	=	26	31	28	29	23	30	25	28
Feldspar	=	28	25	20	22	30	18	22	25
Clays	=	4	5	2	8	12	3	4	10
Biotite	=	8	15	12	19	8	11	12	10
Muscovite	=	2	2	1	2	5	3	2	2
Carbonates	=	38	12	36	14	13	32	32	20
Amphibole	=	4	8	-	5	5	2	2	3
Chlorite	=	1	-	-	-	3	-	Tr	Tr
Rutile	=	Tr	Tr	-	Tr	-	Tr	Tr	-
Tourmaline	=	Tr	Tr	-	Tr	Tr	-	-	1

DISCUSSION:

In order to explain the formation and deposition of loess, Smalley (1971) formed a mode, which consists of:-

(i) a formation stage, (ii) a transportation stage and (iii) a deposition stage. These stages form a meehanical system by which the genesis of loess of Pewhawar vale can also be vicedly visualized.

On the basis of lithological and physical characteristics of the loess of Peshawar vale, the following views are suggested with regard its genesis and mode offormation:-

(i) The plotting of mineral data from various loess beds (Fig, 2) indicates a low variation pattern, signifying a single source. Loess of Peshawar vale are characterised by a high concentration of quartz and feldspar, suggesting their derivation from a quartho-feldspathic parents. The comparison of average mineral composition of loess (excluding carbonates which are of secondary origin,) with an average granite/granite-gneiss in Tabel 2 suggests a daughter-parent relationship (see the close correspondence between the concentrations of major minerals in both the compositions). Therefore, the loess has been formed in are as which are particularly composed of biotite-granite, granodiorite/gneiss which are distributed widely in the northern provenance which were formery very extensively glaciated.

(ii) Loess may be considered as "rock flour" produced by the glacerirs (Smalley, 1971). The general argularity, irregular surface texture, and marks of etching, on the individual grains suggests the glacial grinding is the only effecting means of producing sufficient silt size quartz to supply the loess deposits (Smith and North, 1935; Smalley, 1966 Smalley and Vita Finzi, 1968; Smalley and Caberera, 1971; and Smalley, 1971).

(iii) The transportations of loess from the glaciated areas to the non-glaciated peripheral ares, requires a well developed system of ascending air current to deflate and uplift the silt from the exposed morainic material and glacial out wash plain as high as about 3 KM up in the atmosphere. (Flint, 1961, pg 185). Also a system of subsiding is required for the settlement of suspended silt outside the glaciated areas.

De Terra and Patterson (1939), Wadia (1966) and Elberson (1967) are of the opinion that the loess has been uplifted from the floodplains ofIndus Basin during the summer season, when due to the high temperature and resulting low pressure with ascending currents, the silt particles are uplifted to great heights. The summer monsoons are the possible source of carrying silt over the Himalayas and surrounding regions, where the wind blown silt is dropped down, as loess, under the spells of rain fall over different parts of northern Pakistan and the Kashmir

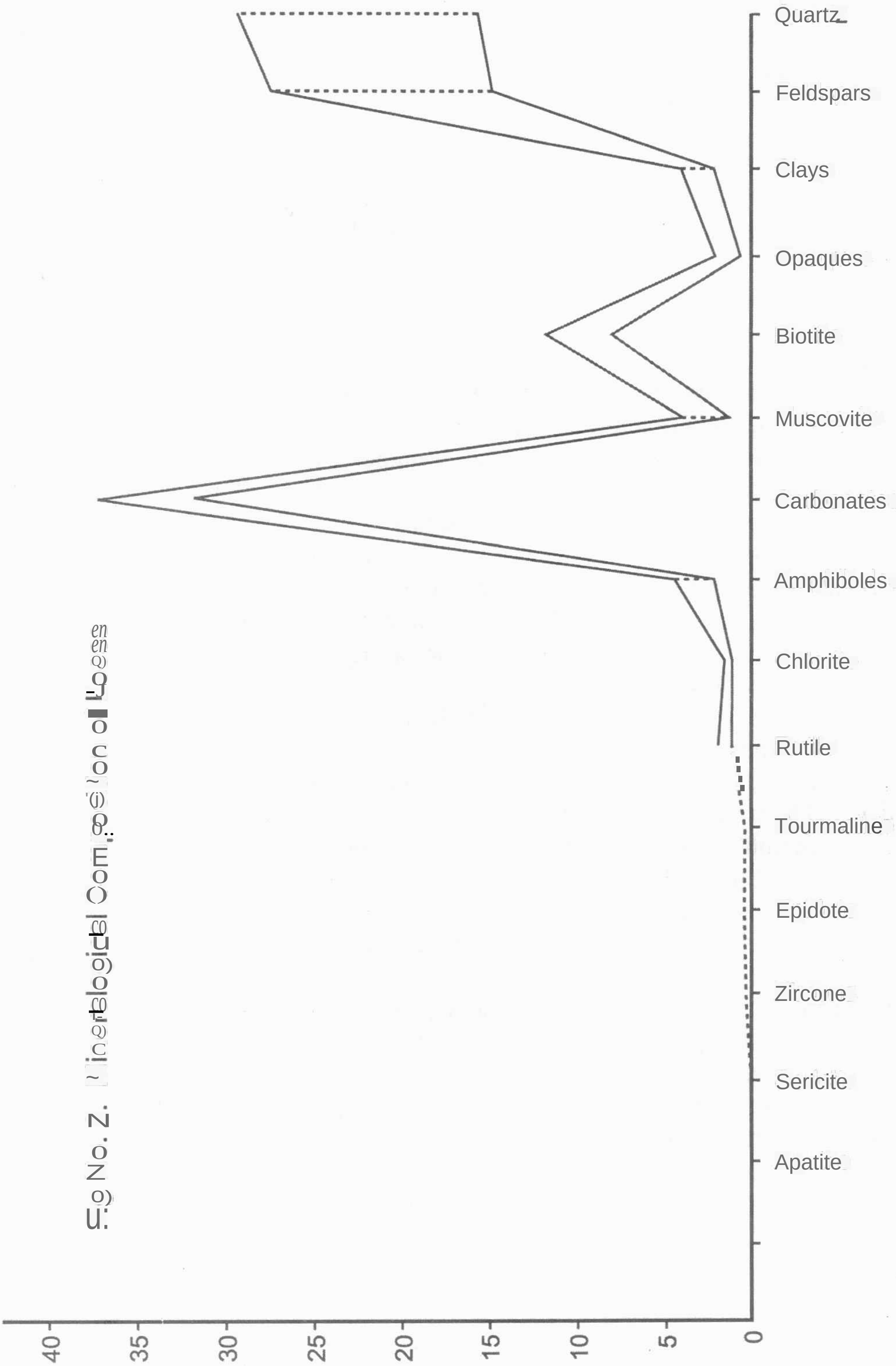
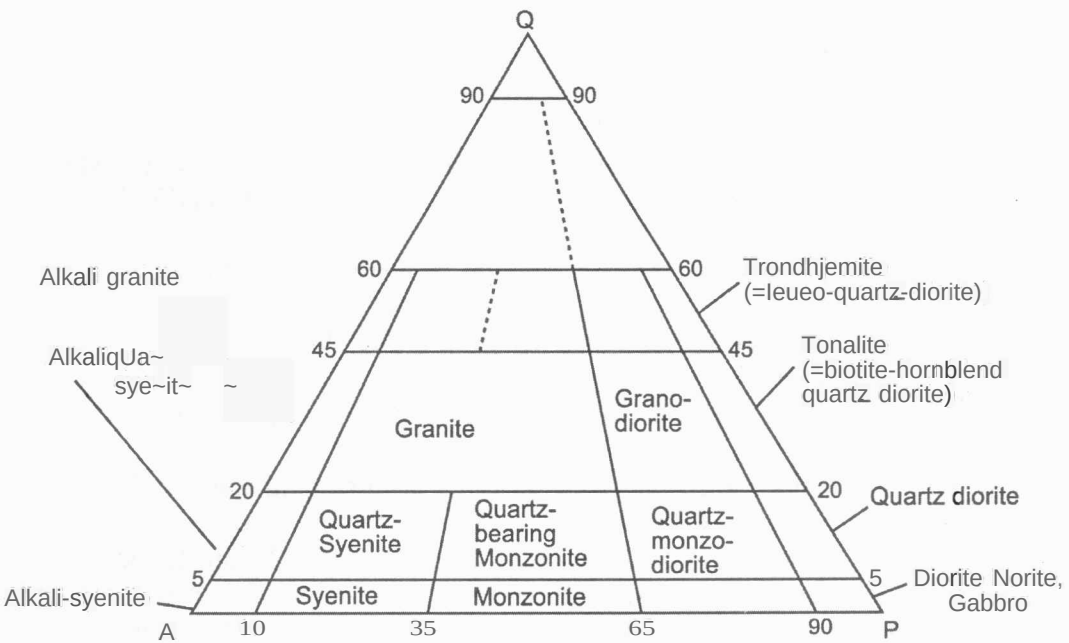


Fig No. 2. Mineralogical Composition of [illegible]

TABLE: 2

Comparison of the mineral composition (average ofloess from the Peshawar vale with average granite)

LOESS		GRANITE AS PER FIGURE BELOW	
Quartz	37 (%age)	20-40	
Feldspars	30	15-30	alkali feldspar
Clays	4	10-25	Plagioclase and very commonly
Opaques	3		biotitic and muscovite with
Biotitic	16		accessory minerals including
Muscovite	9		apatite, zircon and
Amphiboles	4		magnetite
Chlorite			
Rutile			



Q = Quartz; A = Alkali feldspar; P = Plagioclase.

Fig. Classification of Plutonic rocks in the triangle QAP

Source: Streckeisen. Geotimes, Oct 1973, p.26 for final report of the LUGS.

Q=quartz; A-Alikali feidspar; P=Plagioclase.

Fig. Classification ofPlutonc rocks in the triangle QAP.

Source: Streckeisen, Geotimes, Oct 1973, p. 26 for final report of the LUGS.

Flint (Ibid) considers that uplift of the silt particles may take place due to an outburst of cold Polar air and are deposited as the wedge of air spreads out and loses energy. Settling of this silt is by dry sedimentation, but if the cold wedge is overrun by warm maritime air, silt particles may form raindrop unclie and reach the ground in rain. This contention may be true for Europe and, North America where vast cold Temperate areas were extensively glaciated are under a normal glacial climatic regime for the formation of glaciers, is climatically controlled alternately by the Monsoons and the Westerlies. The belt of these winds migrates seasonally a few degrees north and south has profound effect on the atmospheric circulation oflow as well as high altitude areas.

It is interesting to note, that recently Chinese scientists have demonstrated that the rapid elevation of Qinghai-Xisang Plateau (Tibet) and the Himalayan mountains during the Quaternary period has resulted not only in growth oflaciers but also changed the entire atmospheric circulation of the region. Glacier growth has responded to these changes in morphology and atmospheric circulation. The elevation of this mountainous region resulted in its power full heating effect which has a strong impact on the atmospheric circulation. In summer, the Himalayas and the surrounding region, forms a special atmospheric situation, which is charecterised with a low near the surface of the mountains and a cold high above it, which punctuates the sub-Tropical planetary high pressure zone (Li Jijun and Xushying, 1980).

Probably, it is this low pressure which is chareeterised by a system of ascending air currents, during which the silt particles are deflated and lifted to a great height, till they are encountered with the upper high pressure zone. The descending currents which facilitates outward horizontal movement to some distance after which, due to subsiding air of high pressure, the silt begins to settle and deposit outside the glaciated region. It has also been found that the base of low pressure is sometime punctuated directly by subsiding air over the glaciated area during warmer phase. This also explains deposition of loess over the moraines in Swat Himalayas (Porter, 1970).

The physical characteristics of loess as discussed in the previous pages indicate that during its deposition the climate was characterized by warm and dry conditions punctuated with occasional wet phases which may be due to incursion of Monsoons. It is inferred that wet conditions also facilitated the silt particles to settle down. Similarly, the general unstratified and massive nature of the loess deposits indicate that is accumulation occurred slowly and continuously over a very long period of time (Flint, 1971 pg. 267) which probably spread over a period from 66Ka to 22Ka (Rendell, 1988-89).

The exact climate province of glacial loess is uncertain. Although it is now recognized that most glacial loess have been derived from the outwash of streams acting as flacial sluice ways (Smalley, 1966) but whether the loess is indicative of waxing or waning glacial time is a matter of contention (Alford, 1982). It was

suggested by woldsted (1967), Butzer (1971), and Fairbridge (1972) that loess deposits were formed at glacial maxima, while Visher (1922) and Moran (1977) stressed that loess was associated with retreat of continental glaciers and accumulated when the climate shifted from glacial to inter-glacial pattern. Smalley (1971, p.83) strongly advocated the later views and remarked "at the time of glacial maxima, all the rock debris, apart from some in the end morain, will be covered by the ice sheet and trapped. When the ice sheet disappears, the bulk of the rock detritus is released and the fine material is lifted by the wind and carried to become loess". These views are strongly in accordance with the observations in Central Alaska today, where the loess accumulated chiefly during the summer, when high temperature is a season of ablation of glaciers and the sediments exposed are at their maximum, (Flint, 1961,p.185).

It may be noted, that both physical characteristics of loess and its time of deposition, which spreads over a span of about 44000 years, (from 66ka to 22ka, Rendell, 1988-89) suggests that the loess in the Peshawar vale is contemporaneous with the meetings of glaciers in the near by Himalayan Mountain System, particularly, the Swat Himalayas, in the middle of the last glacial phase. The deposition of a gravel bed of shale and slate within younger loess (Section, 3, bed. d-d1.), indicates a short haul in its deposition. It appears that perhaps, the climate became a little more humid, during which the climate became a little more humid during which the torrents were activated and carried weathered material from the Attock-Cherat range and deposited on the loess bed as "Recent gravels". This however persisted for a short while and the deposition ofloess was resumed at about 22ka (Rendell, 1988-89).

During the Holocene, the weathering of loess and the development of a "pedocal" all over the loess is indicated by the leaching and concentration of calcium carbonate, as nodule and concretions. The presence of fine root-holes suggests the growth of grasses and small shrubs in a warm and semi-dry climatic conditions.

Due to intermittent uplift of the Attock-Cherat range, the falling base level initiated a long phase of erosion. As a result. the loess cover was eroded from the upper slopes and deposited lower. Down. This also resulted in the exposure of piedmont in places while in the lower areas, particularly along the torrent beds, the gully formation began to take place.

It is likely that wide spend deforestation and overgrazing in the historical times, accelerated the process of erosion and gully formation, leading to the development of badland topography, south and south east of the Peshawar vale, particularly south of Jallozai area.

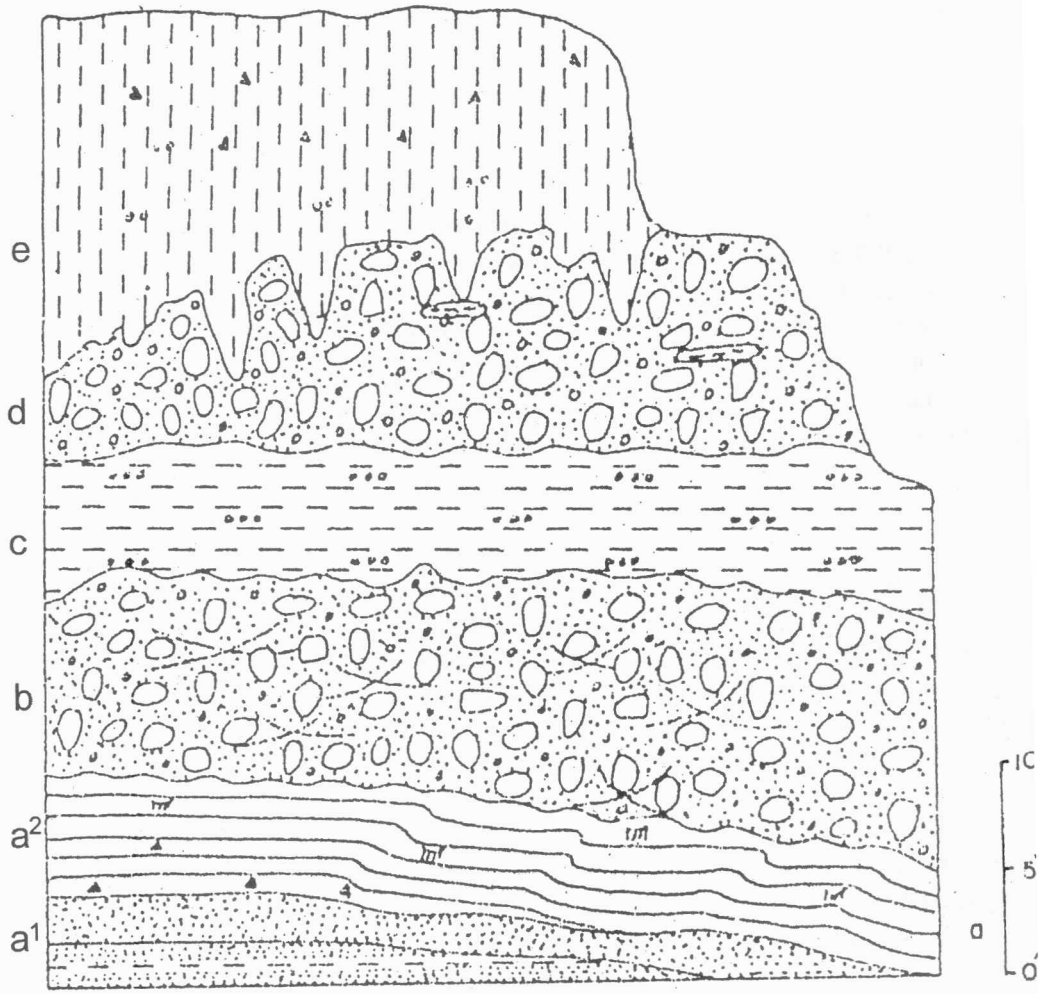


Fig. 3 Left bank of Babu Khwar G.R. 093874

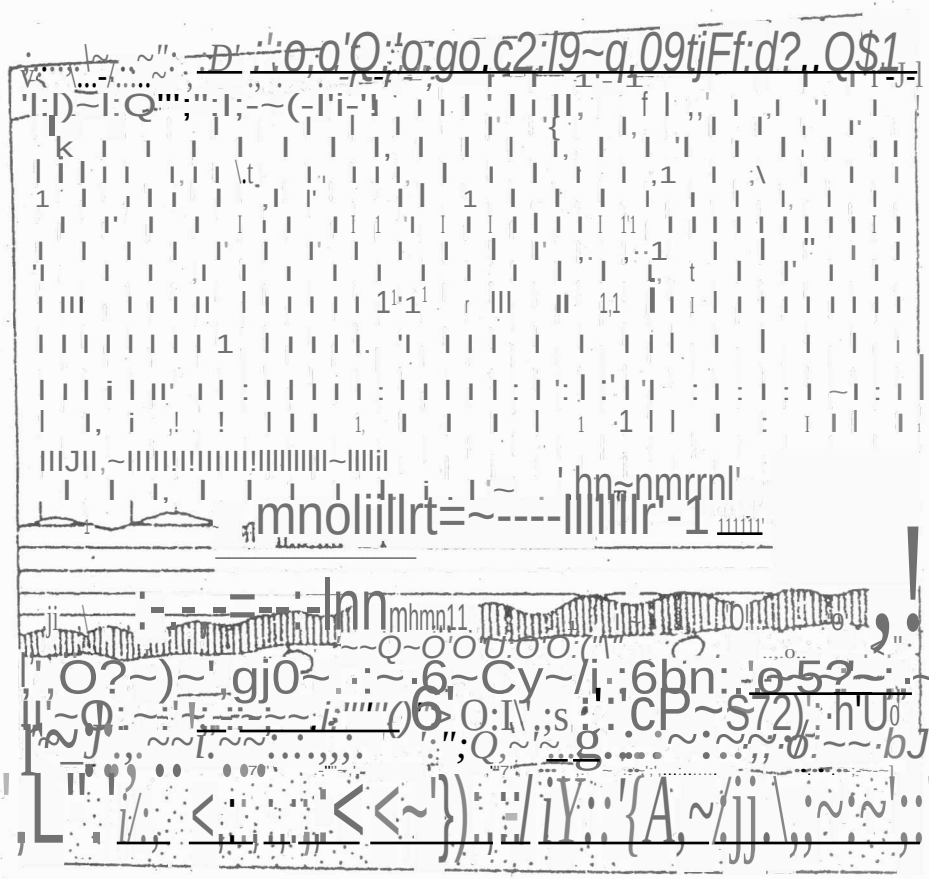


Fig. 4 **Right bank of Babu Khwar G.R. 097863**

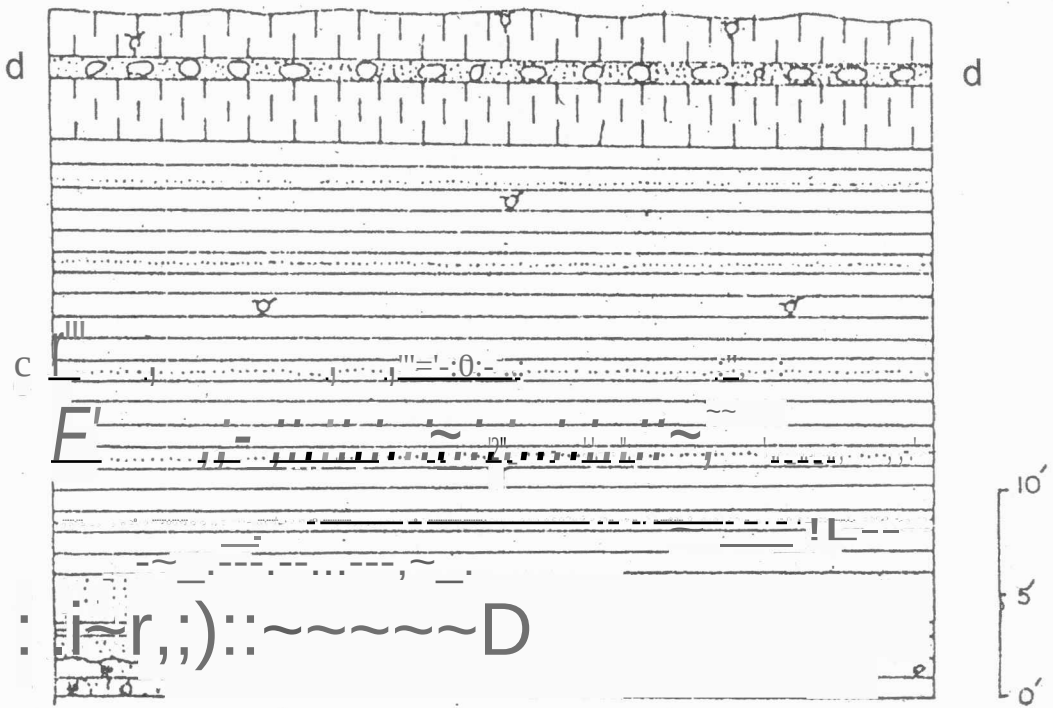


Fig. 5 **Daka Mar Khwar, Bed d G.R. 016853**

CONCLUSION

The present study identified at least three phases of loess deposition in the vale of Peshawar, which occurred during the warm inter-glacial periods of the Lower, the Middle and the Upper Pleistocene.

1. The First and the Oldest loess has been found intermixed with the sediments ofthe First lake of Peshawar vale and the overbank facies of the ancient Kabul river which was probably flowing in a north south direction. The First lake is believed to be formed due to the up lift of the Attock-Cherat range, due to which a reversal of drainage took place, and water pounded in to a lake in the south western part of the vale of Peshawar and sedimentation begane to take place to form the First lacustrine facies of the Peshawar vale, at about 2.8, m.ys.a, (Yeast and Lawrence, 1982, Burbank and Tahirkheli, 1985). During the subsequent warm inter glacial period of the Lower Pleistocene the silt from the exposed moraine material, left by the retreating glaciers, was picked up by the winds and carried across the Himalayas and deposited as loessic silt over the vale of Peshawar and the surrounding regions, including the Potwar. These beds are exposed in a few stratigraphic sections around Garhi Chandan area about 20 Km, south east of Peshawar city. These deposits exhibit brown silt loam which has a great characteristics of loess (Elberson, 1967). This loessic silt has also been found in the test hole wells No. WRK-5, near Matani and WRK-6 at Miriamzai, at depths between 100 to about 575 feet, (WASID, 1968), as well as in "several gullies near Luandhwkwar, and in the cut of the Warsak High Level Density Cannal about 6 KM, downstream from its crossing with the Peshawar-Kohat road" (Elberson, 1967, p. 104). These deposits are composed of (average) silt 60%, sand 11% and clay 28%.

On lithological and stratigraphical considerations, this loess may be correlated with the deposits of Upper Krewa lake beds of Kashmir and the Pinjor formation of Potwar.

2. The second phase of loess deposition seems to occur a warm inter glacial period of the Middle Pleistocene. During this time, due to the uplift of the north eastern ridge of the Attock-Cherat range at kund, blocked the flow of the Kabul river and a vast lake was formed in the Peshawar vale in the which the lacustrine facies of the Second lake was deposited. These lake sediments are, predominantly compsed of (average) silt with sand 16% and clay 8% (section, 1, bed a 2). The laboratory analysis of the quaerts grain in the silt a haws a prominent angularity (Plate No.5, lake bed, Babu Khawar) which indicate that a considerable amount ofloess has been deposited in the lake which later on hardened and formed in to siltstone. Said and Majid (1977) named it "Azakhel Siltstone" after the name ofthe locality.

The mineralogical composition of this lacustrine facie and the loess shows a great similarity (table No.1). On petrographic similarities, this loess may be correlated with the Potwar loess, which according to De Terra and Pattersonn (1936) and Wadia, (1966) was deposited during the Second Himalayan glaciations. Sial and Afzal (1972) consider it to be the first loess of Peshawar vale. The siltstone of the

Second loess is exposed in many stratigraphical sections, located along Kakarai Khwar near Spinkana (GR. 029794), along left bank ofZindai Khwar (GR.. 605723), Nakki Khwar, (Gr. 926735), Tarakai Ghar near Ziarat Kaka Sahib (GR.. 78816) and the left bank ofBabu Khwar near Noshehra cantt, (GR.. 093874).

The mineralogical composition of this loess indicates that the material has been derived from the igneous and metamorphic rock of the northern provenance, which was heavily glaciated during the Middle Pleistocene. On the whole these beds are soft and weathered and frequently show nodules and concretions of calcium carbonate.

2. Third phase of loess deposition is believed to occur during the warm inter-glacial period of the Upper Pleistocene, During its deposition, it almost blanketed all the landforms of the Peshawar vale including the tops of surrounding hills and mountains. Presently, it occupies, mostly, the upper stratigraphic position and overlies a gravelly bed with a prominent erosional unconformities which is a very important geomorphological feature. At places, this loess shows, laminations rock fragments and thin reavel beds, and on this bases and with its typical stratigraphical position, this can be easily correlated with the "re-deposited loess" of the Potwar region, studied by De Terra and patterson, (1939). Said and Majid (1977) named it as "Sangrobi loess". The mineralogical composition of this loess (Table No.1) suggests its derivation from the igne ous and metamorphic suit of the northern provenance (Table. 2, and fig. 2). Due to intermittent uplifts of the Attock-Cherat range in initiated along phase of erosion during which the loess cover was eroded from most of the areas of Peshawar vale and exposed the present landforms. It is the third or the younger loess which remained a seat of human activities. The deforestation and over-grazing lead to gulley erosion and formation of badland tepography.

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