

# ESCALATING WATER AND FOOD SCARCITY DUE TO INEFFICIENT WATER UTILIZATION (CASE STUDY OF PAKISTAN)

## INTENSIFICATION DE PENURIE D'EAU ET ALIMENTAIRE EN RAISON D'UTILISATION INEFFICIENTE DE L'EAU (ETUDE DE CAS DU PAKISTAN)

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### ABSTRACT

*Pakistan is an agriculture based country with up to 76% of its population in rural areas being directly dependent on agriculture. The water scarcity and inefficient water utilization has raised doubt about the sustainability of agriculture to meet the food demand for the growing population. Due to non-remunerative agriculture and severe constraints that it faces, large population are moving from rural to urban areas. To accommodate them, the urban areas are expanding, thus converting green into brown lands. With agrarian background and diversified challenges in post Indus water treaty era, like rapid population growth, overexploitation of groundwater, reduction in storage of reservoirs, reduced per capita availability of water, Pakistan is likely to become a water-scarce country in the near future. Uneconomical water utilization practices, nominal water pricing, unawareness of farmers, loose legislation network to collect revenue has further aggravated the situation. Water use in agriculture is not demand oriented. Future development of storage reservoirs should be nearest to the agricultural lands to avoid water conveyance losses and pilferages. This paper examines the core issues of inefficient water utilization, its management options, and resource conservation. It further examines the measures taken to avoid urbanization through provision of facilities to surrounding towns, fixing metropolitan limits, regulation to avoid sub division of land, adoption of corporate style agricultural methods and management of available water resources.*

**Key words:** *Water Scarcity, Metropolitan Limits, Poverty Line, Institutional Crisis.*

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## RESUME

*Le Pakistan est un pays agricole, 76 % de sa population rurale dépendant de l'agriculture. La pénurie d'eau et l'utilisation inefficace de l'eau ont augmenté le risque de la durabilité agricole de satisfaire les besoins alimentaires de la population. En raison de l'agriculture non-rémunératrice et les contraintes sévères, la grande partie de la population se déplace des régions rurales aux régions urbaines. Les régions urbaines s'étendent en convertissant les régions vertes en régions brunes. Même après la signature du Traité de l'Indu, en raison de la base agricole et les divers défis qui se posent tels que la croissance démographique, la surexploitation des ressources en eau souterraines, la réduction des réserves d'eau dans les barrages, la disponibilité limitée de l'eau per capita, il est possible que dans l'avenir le Pakistan devienne un pays affronté par la pénurie d'eau.*

*Les problèmes tels que les pratiques peu économiques d'utilisation de l'eau, la tarification nominale de l'eau, le manque de connaissance chez les fermiers, le réseau de législation incapable de recueillir le revenu ont encore aggravé la situation. L'utilisation de l'eau dans l'agriculture n'est pas orientée vers la demande. Il est nécessaire de construire les réservoirs près des terres agricoles pour éviter les pertes de transport d'eau, et les chapardages. Le rapport examine les questions principales d'utilisation inefficace de l'eau, de sa gestion et de conservation de cette ressource. Il étudie également les mesures prises pour réduire l'urbanisation par l'installation des facilités dans les villes voisines, fixer les limites métropolitaines, éviter la sous division de terre, adopter les méthodes agricoles collectives et gérer les ressources en eau disponibles.*

**Mots clés :** *Pénurie d'eau, limites métropolitaines, Seuil de pauvreté, Crise Institutionnelle.*

## 1. INTRODUCTION

### 1.1 Agrarian Economy

Pakistan's economy is of Agrarian nature which consumes up to 90% of its fresh water resources for agriculture. In future non agricultural water requirement may increase depending upon population; leaving less water for irrigation. Agriculture sector is one of the largest sectors of the economy. The irrigated area of Pakistan is above 78% of cultivated area. It is the source of the livelihood of almost 44.7% of the total employed labor force in the country. Pakistan's agricultural output is closely linked with the supply of irrigation water.

Agricultural Sector contributes 24% to the Gross National product (GNP) and employs 78% of labor force in rural areas and 50% at the national level (Bhutta 2010).

### 1.2 Diminishing Water Resources

Water resources of Pakistan are diminishing; per capita availability of water has decreased from 5260m<sup>3</sup> in 1951 to 1050m<sup>3</sup> in 2009. Share of agriculture in GDP of Pakistan is 62%. Water use efficiencies are at lowest levels, so there is potential for water saving through better utilization of water resources. The water scarcity is the only constraint to fulfill future

water demands for agriculture and fiber requirement of more than 200 million people by the year 2025. Low agricultural yields, high population growth rate, low water use efficacies are other issues to be dealt with.

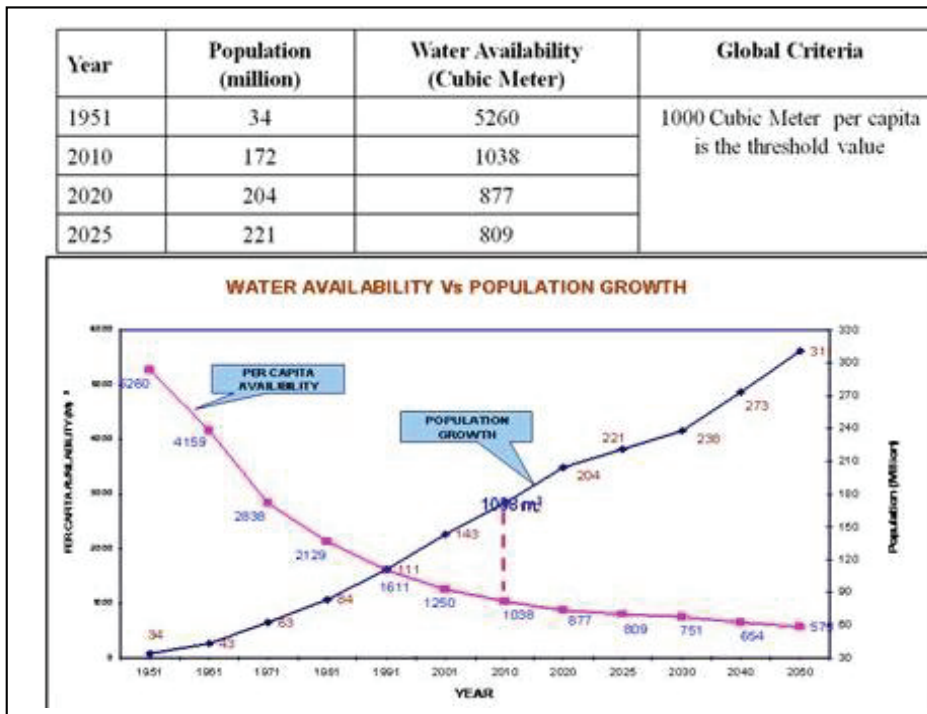


Fig. 1. Water availability and population growth

(Source: Pakistan Water & Power Development Authority 2010)

### 1.3 Optimum Utilization of Water

Water sustains all life on earth and is a key element of sustainable development. Fresh Water is globally a scarce commodity. The optimum utilization of water resources is of utmost importance. For Pakistan all its developed water resources are inadequate to meet water requirement of future. Rapid population growth with limited land and water resources has raised pressure on economy.

### 1.4 Present Scenario of Water Resources

The water resources of Pakistan are 172.7 BCM, with a variation of high flows of 230.42 BCM & Low as 120.57 BCM (Based on data from 1922-23 to 1996-97); The main flows occur during six months of summer cropping season; of 142.09 BCM whereas in remaining six months there were 27.12 BCM (10% of Annual Supply); IWASRI-1998.

The storage capacity of existing Reservoirs is decreasing day by day due to sedimentation. At present against initially designed capacity of 15.74 MAF, Only 11.61 MAF is available. Storage losses are elaborated in Table 1.

Table 1. Reservoir Sedimentation, Million acre feet (MAF)

RESERVOIR	LIVE STORAGE CAPACITY		STORAGE LOSS		
	ORIGINAL	YEAR 2009	YEAR 2009	YEAR 2012	YEAR 2025
TARBELA	9.68 (1974)	6.78 (70%)	2.90 (30%)	3.18 (33%)	4.30 (44%)
MANGLA	5.34 (1967)	4.46 (83%)	0.88 (17%)	0.90 (17%)	1.14 (21%)
CHASHMA	0.72 (1971)	0.37 (51%)	0.35 (49%)	0.29 (40%)	0.38 (52%)
TOTAL	15.74	11.61 (74%)	4.13 (26%)	4.37 (28%)	5.82 (37%)

Source: - Dr. Sufi (WAPDA) 2009

1 Acre foot – 0.1234 hectare meter (approximately)

Against the normal surface water availability at canal heads of 103.5 million-acre feet (MAF), the overall (both for *Kharif* and *Rabi*) water availability has been less in the range of 2.5 percent (2005-06) to 20.6 percent (2004-05).

### 1.5 Groundwater

Ground water is a vital resource to fulfill water requirements. The estimated ground water in fresh water zone of Pakistan is 66.75 MAF. Out of this ground water, 64.8% exists in Punjab, 27.3% in Sindh, 4.7% in NWFP and 3.2% in Baluchistan. The main sources of recharge are rivers, tributaries, canal irrigation network and rain.

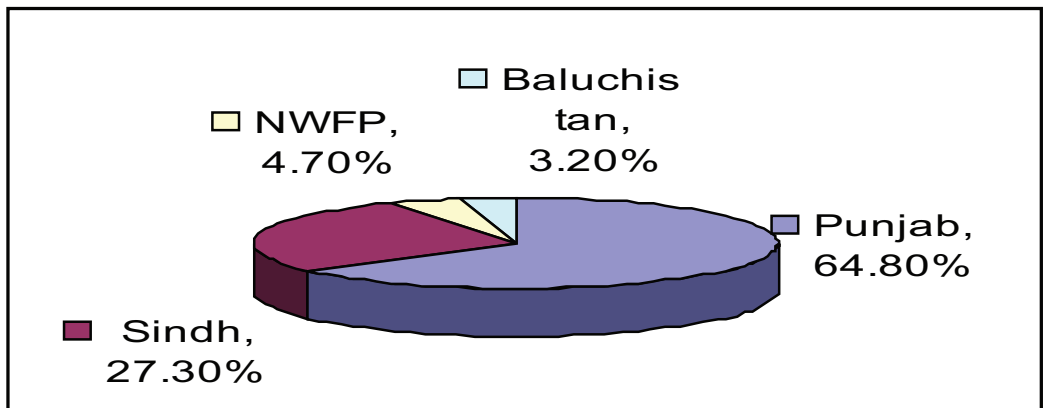


Fig. 2. Fresh Water Aquifers in Pakistan

(Source : Dr. Sufi Allah Baksh (2008) Ground Water for Irrigated Agriculture)

### 1.6 Dependence on Aquifers/ Depletion of Groundwater

Mostly the areas depend on ground water for its water supply system. Due to excessive pumping in comparison to poor recharge (especially after handing over water rights of River Ravi to India), the water aquifers are depleting day by day, as a result the depth of fresh water table in Lahore has fallen to 600 - 700ft below the ground.

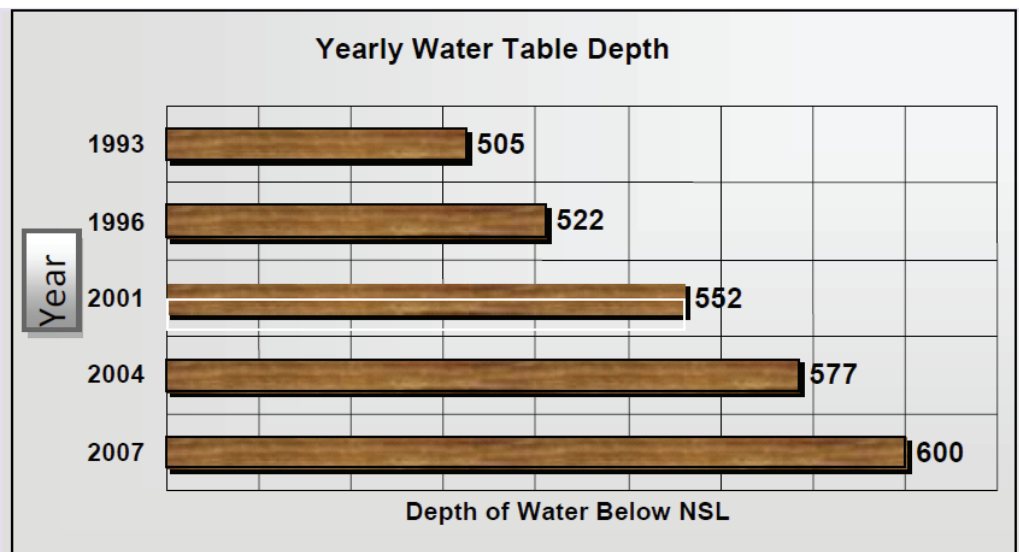


Fig. 3. Depth (in feet) of Fresh Water in Lahore

Source :WASA (2008)

## 2. POPULATION EXPLOSION

There are three population projections, estimated by the National Institute of populations Studies (NIPS), namely low, medium and high for 2025. These projects range from 208 millions under low projection to 237 million under high projection. Under historic trends in population growth rates, the projected population is 268 millions. Similarly, the United Nation Organization projected Pakistan’s population in the range 246 millions to 263 millions upto 2025.

Table: 2. Population Increase in Pakistan

Sr #	Year	Population (Million)
1	1951	33.74
2	1961	42.88
3	1972	65.31
4	1981	85.09
5	1998	130.5
6	2001	144.0
7	2006-07	160.40
8	Projected by 2030	220

Ref: Dr. Sufi (WAPDA) 2009

Growth Rate = 2.5%

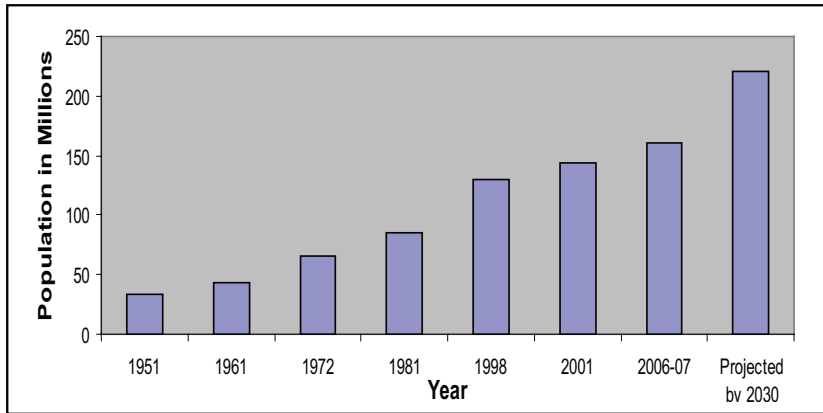


Fig. 4. Population over the years in Lahore

### 3. FOOD REQUIREMENT OF PAKISTAN

It was estimated that 40% more food would be required by the year 2025. In Pakistan, daily average per capita nutrition supply is 2409 cal., 83% of which are met through agricultural products; grain products contribute 55.5% and non-grain contribution is 27.5%.

Table 3. Production of Important Crops (000 tonnes)

Fiscal year	Wheat	Rice	Bajra	Jowar	Maize	Barley	Total food grains
1990-91	14,565	3,261	196	239	1,185	142	19,588
1991-92	15,684	3,243	139	225	1,203	140	20,634
1992-93	16,157	3,116	203	238	1,184	158	21,056
1993-94	15,213	3,995	138	212	1,213	146	20,917
1994-95	17,002	3,447	228	263	1,318	164	22,422
1995-96	16,907	3,966	162	255	1,504	174	22,968
1996-97	16,651	4,305	146	219	1,491	150	22,962
1997-98	18,694	4,333	211	231	1,517	174	25,160
1998-99	17,858	4,674	213	228	1,665	137	24,773
1999-00	21,079	5,156	156	220	1,652	118	28,380
2000-01	19,024	4,803	199	219	1,643	99	25,987
2001-02	18,226	3,882	216	222	1,664	100	24,311
2002-03	19,183	4,478	189	202	1,737	100	25,889
2003-04	19,500	4,848	274	238	1,897	98	26,855
2004-05	21,612	5,025	193	186	2,797	92	29,905
2005-06	21,277	5,547	221	153	2,110	88	30,396
2006-07	23,295	5,438	238	180	3,088	94	32,337
2007-08	20,959	5,563	305	170	3,605	87	31,198
2008-09 P	23,421	6,952	296	165	4,036	83	34,953

Source: Ministry of Food and Agriculture & Federal Bureau of Statistics.  
Bajra is Pearl millet and Jowar is Sorghum

ROWTH RATE = 2.1 % (Wheat Based)

### 3.1 Human Use

Grain consumption as food = 23.5 MMT

Major Contributions: Wheat 91%, Rice 72%, Pulses 68%

#### Other Uses

Animal feed = 5% of total food grain (1.1 MMT); Utilize as seed = 10% of total food grain (2.33 MMT)

Table 4. Sources of Nutrition

Item	Daily calories supply
Milk and milk products	27.5%
Butter / Ghee	58% & 18%
Grain products	55.5%

### 3.2 Food Scarcity

In spite of the vital significance of Agricultural Sector, the economy is facing challenges of food deficiency. Out of 120 districts in Pakistan 80 districts are food-insecure. A total of 23 million tons of wheat are produced in Pakistan and to meet the deficiency nearly 3 million tons of wheat is annually imported. An agriculture-based country is incurring a huge foreign exchange expenditure for wheat import. Out of total area of 798000 square kilometer {i.e. 79.61 million hectares (2002-2003)}, an area of 59.48 million hectares (Mha) is cultivable. This area has reduced to 57.23 Mha in the year 2006-2007. During 1997-1998 an area of 18.00 Mha was irrigated through various sources and irrigation through canals and canal tube wells was the major source of water supply for farm irrigation. There has been no increase in the water supply during the whole decade and the area watered through irrigation system rather declined. Our agriculture is largely dependent on rain fall. Since there has been no further development in the irrigation during this period, there has been no addition to cultivable land and hence no increase in the agricultural production.

With no development in irrigation system and no improvement in the cultivable waste land the production / produce of the major cereal crops did not grow in proportion of the demand. Rice crop increased by 8.3% in the year 2003-2004 but its growth rate came down to 2.3% in the year 2007-2008. However, the most important food item i.e. wheat production fell by 6.6% during the year 2007-2008. This phenomenon adversely affected the whole socio-economic scenario.

Table 5. Area, Production and Yield per Hectare of Agricultural Crops

Crop/Year	Punjab	Sindh	KP	Balochistan	Pakistan
<b>WHEAT</b>		<b>Area in "000" Hectares</b>			
1997-98	5934.6	1120.2	918.1	381.7	8354.6
2000-01	6255.5	810.7	790.3	324.3	8180.8
2004-05	6378.9	887.4	748.6	343.1	8358.0
2006-07	6432.8	982.2	754.2	408.9	8578.1
		<b>Production in "000" TONNES</b>			
1997-98	13807.0	2659.4	1356.0	871.6	18694.0
2000-01	15419.0	2226.5	764.0	614.2	19023.7
2004-05	17375.0	2508.6	1091.1	637.6	21612.3
2006-07	17853.0	3409.1	1160.4	872.1	23294.6

Source: Statistical book 2008

Table 6. Area, Production and Yield per Hectare of Agricultural Crops

Crop/Year	Punjab	Sindh	KP	Balochistan	Pakistan
<b>RICE</b>		<b>Area in "000" Hectares</b>			
1997-98	1409.9	689.3	66.8	151.3	2317.3
2000-01	1627.2	540.1	66.4	142.9	2376.6
2004-05	1754.2	543.9	59.9	161.5	2519.5
2005-06	1728.4	598.1	60.8	193.9	2581.2
		<b>Production in "000" Tonnes</b>			
1997-98	1948.0	1840.9	130.2	413.9	4333.0
2000-01	2577.0	1682.3	131.2	412.1	4802.6
2004-05	2980.3	1499.6	123.2	421.6	5024.7
2006-07	3075.5	1761.8	122.9	478.2	5438.4

Source: Statistical book 2008

### 3.3 Problems of Farmers in KPK Province

The situation of KPK Province is worse due to a lot of problems among which following are most significant.

a) Cultivable Area: Total reported area is 10.424 million acres (Ma) out of which 6.55 Ma is being cultivated. Of the cultivated area only 40% is irrigated and rest is depending on the mercy of nature for timely and appropriate quantity of rain. The area under cultivation consists



of tiny plots where large scale and mechanized agriculture is not possible. Resultantly the production per acre is low and cultivation cost is so high that most of the farmers are preferring to grow cash crops to cope with their cost of land management.

b) Low income: It is major constraint in the way of modernization of agriculture. Hence per acre yield could not be improved in spite of availability of certified seed but at a cost beyond the reach of poor farmers.

c) Population: Fast growing population has set a severe challenge for additional food which will certainly aggravate the situation in the near future. Again increase in nominal income as a consequence of increase in inflation rate has been changing the taste of the people and adding to the aggregate demand.

d) Certified Seeds: Non availability of required quantity of certified seeds has been retarding agriculture growth because of low yield per acre. Also, the certified seed is too expensive. Hence farmer is constrained to continue with traditional seeds giving low yield per acre.

e) Fertilizer: Better yield largely depends upon timely manuring. Due to non development of livestock and dairy sector the natural manure is insufficient to meet the requirement of all crops. Farmers are, therefore, constrained to depend on chemicals fertilizer. Ever rising cost of chemical fertilizer and also its non availability at critical time, has been another cause of low yield.

f) Irrigation : Only 40% of the total cropped area is irrigated by canals water. Rest 60% of land is *barani* (dry land; rainfed agriculture). Since assured irrigation from the canals is restricted, most of the land remains either uncultivated or grow crops in one season with negligible yield. Although Jawar, bajra and barley also form part of food, yet wheat is the only crop, which provides maximum nutritional ingredients and therefore, taken as the basic food item.

Table 7. Showing area, production and average yield of wheat sown in KPK Province.

Year	Area (Million Acres)	Production (Million tons)	Average Yield Mond* / Acres
2003-04	1.854	1.025	11.00
2004-05	1.872	1.091	11.6
2005-06	1.803	1.100	12.2
2006-07	1.885	1.160	12.3
2007-08	1.848	1.075	11.6
2008-09	1.885	1.179	12.5

Source: Business recorder N.W.F.P. dated: 27-03-2009. \*1 Mond = 37.3242 kg

### 3.4 Food Insufficiency

To feed a population of more than 30.108 million KPR province needs a total of 3.734 million tons of wheat against a local production of 1.075 million tons. This is a bare need @ 124 kg

per head per annum. The deficit of 2.555 million tons is being met by importing mostly from the province of Punjab. The total quantity of other crops like Bajra, Barley, Jawar, Maize and Rice is 1.081 million tons which although reduces the quantum of shortfall to 1.474 million tons yet cannot be a good supplement because the cost of rice is beyond the reach of common man and the other cereal is not commonly acceptable due to its hardness.

## 4. URBANIZATION AND WATER CRISIS ISSUES

- i) The rapidly growing urbanization trend in the developed and developing countries has made provision of safe water supply a challenging task. Asia has 1.4 billion urban dwellers. As per latest projections of UN, by the year 2030, 82.5% of population will be urban in developed regions whereas 56% will be urban in developing countries.
- ii) Within the next 30 years Pakistan's urban population shall increase from 72.5 to 86 million. Punjab's 39% population is settled in cities. The population of Lahore city in 2003 was 7,25,0000 which have now become 8,09,2000 (2006-07 Survey report).

## 5. LAND REFORMS IN PAKISTAN

Two land reform measures were taken in 1959 and 1972. But these reforms did not succeed in changing the status quo in Pakistan and had no significant impact on productivity either. Per acre use of non-traditional inputs – such as fertilizers, hired labour and farm machinery – is probably higher on large farms than on small farms. Small farms are usually more labour-intensive. Small farmers can also exploit more marginal land, and they try to cultivate a larger proportion of their land in comparison to the larger farms.

### 5.1 Large Farms and Tenant Farmers

In 1993 the most recent agricultural census shows that between 1960 and 1980, the number of farms declined by 17%. This decline in the number of farms was confined to marginal farms of 2 hectares or smaller, which in 1980 represented 34% of all farms, constituting 7% of the farm hectarage. At the other extreme, the number of very large farms of sixty hectares or more was 14,000—both in 1960 and in 1980. The number of farms between 2 and 10 hectares increased during this time.

## 6. BASIC CONSTRAINTS IN THE DEVELOPMENT OF AGRICULTURE SECTOR

Most of the land areas of Pakistan are in arid to semi arid regions. The culturable area of Pakistan is 35.4 Mha, forest land 3.5 Mha, culturable waste 8.6 Mha, cultivated area 22 Mha, water logged / salinity effected area within Indus Basin is 6.8 Mha & outside it is 6.3 Mha. Agricultural production in Pakistan is less as compared to developed countries by a factor of 3 to 4.

The inadequate and unreliable irrigation supplies are basic constraints. The country's major agricultural areas lie within the smooth plains formed naturally by mighty Indus River since time

immemorial and its several tributaries such as Kabul, Jhelum, Chenab, Ravi and Sutlej. Due to mismanagement of water resources, inadequate drainage systems, poor performance of existing irrigation and drainage systems, the agricultural production is far below its potential.

At present, only 14.5 Mha are under canal irrigation being fed by Tarbella, Managla and Chashma reservoirs. Water available at the farm gate after accounting for farm losses and run offs has increased from 50 MAF in 1960-61 to 101 MAF in 1985-86. Estimates show that about 60% of water is lost during conveyance through canals distributions and water courses. Water available from tube wells amounts to 46 MAF. So, the total water available for 21 Mha is 144 MAF of which 97% is used in agriculture and the remaining 3% for domestic and industrial purposes. Out of 144 MAF, around 106 MAF is annually diverted into one of the largest irrigation system.

## 6.1 Constraints Causing Decreasing Productivity

1. Soil fertility is decreasing day by day due to intensive cropping
2. Salinity and waterlogging limit the crop production, out of 22 Mha 6.3Mha is salt affected.
3. Major part of salt effected soils (3.5 Mha) is cultivated for Rice, Wheat, Cotton, Sugarcane with substantial reduction in yield.
4. An extensive drainage programme is required to be implemented.
5. Water shortage is major factor impeding growth of Agricultural Sector.

## 7. CONCLUSIONS

- I. All the available water resources need to be developed by constructing small/medium and/or large storage reservoirs and this available water be utilized economically for Pakistan's self-sufficiency in food grain production. .
- II. Complete modernization and up-gradation of agriculture infrastructure, for production of high value crops and complete shift in traditional agricultural production practices is also a prerequisite for self-sufficiency in food production.
- III. Conveyance losses in irrigation system are to be minimized; the irrigation practices are to be modernized and cropping pattern has to be scientific.
- IV. Awareness about appropriate technologies and to facilitate research and technology developments that can assist small holders to improve irrigated production.
- V. To identify deep groundwater areas for recharging of ground water storages.
- VI. For dried up rivers, eco system needs to be rehabilitated through diversion of flood waters into these rivers.

- VII. Population of country directly influences the food requirements and ultimately the water required to achieve the required grain productions. As a first step to shift Pakistan from the water scarce category, it should adopt measures to work in an integrated manner and try to control population.
- VIII. Population growth and rapid urbanization needs to be checked to avoid water scarcity, conversion of green into brown lands and other administrative reasons. To chalk out a plan for small towns, to provide basic facilities of education, jobs, medical to avoid shifting trend to urban areas.
- IX. Legislation to avoid planning of housing colonies on agricultural land and to fix metropolitan limits.
- X. To chalk out Water Education Plans for awareness among people to conserve water in daily life and among farmers for optimal utilization of irrigation water. Meager education of small farmers, access to credit facilities, timely application of fertilizers, tail end lack of irrigation water, improving efficiency of farmers.
- XI. Other proposals to avoid starvation are:
- i. The Govt. must lower the sale price of agriculture inputs particularly that of fertilizer
  - ii. Ensure availability of certified seeds as per requirement of each crop.
  - iii. Facilitate mechanization of agriculture through co operative farming.
  - iv. Facilitate leveling of barren land with help of govt. subsidized machinery
  - v. Immediately start construction of following irrigation schemes, in KPK Province (Table 8).

Table 8. Suggested irrigation schemes in the KPK province

Sr.No	Name of Scheme	Area to be irrigated in acres
1	Balambat	11364
2	Bazai	20200
3	Sanam Palai dam	6300
4	Kurram tangi Dam	361000
5	Gomal zam Dam	163086
6	1st Lift of CRBC	285000
7	Munda Dam	16919

By completing these schemes an additional area of 0.898 millions acres of land will be brought under regular cultivation and will eventually add 65% more to the existing production.

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