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DRINKING WATER QUALITY IN RAWALPINDI / ISLAMABAD AND ADJOINING AREAS IN 2008

By

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Abstract

Background: Public Health and Laboratories Division is the only Public Health Laboratory in Pakistan. Besides performing its other functions the Public Health Laboratories is also monitoring the water quality through its Environmental Health and Microbiology Laboratories. During the year 2008, the department received 475 water samples for Physicochemical and bacteriology analysis. The present study reveals the water quality in the Rawalpindi / Islamabad and adjoining areas.

Aims and Objectives: To evaluate the physicochemical and bacteriological quality of drinking water samples received in the Environmental Health Department from Rawalpindi / Islamabad and adjoining areas.

Material and Methods: All the samples received for drinking purpose were processes for physicochemical analysis includes pH, Turbidity, Hardness, Conductivity, Chlorine, Total Dissolved Solids (TDS), Iron, Zinc, Chloride using Digital meters and LaMotte kits (LaMotte USA). Multiple tube Method was used for microbiological analysis. All the Physicochemical and Microbiological results were interpreted according to WHO guidelines for the Drinking water quality standards.

Results: A total of 475 water samples were processed for Physicochemical and Microbiological analysis. The most common source of drinking water was boring (n=315), followed by tap water (n=31), filter water (n=32) and other sources (n=97). Out of 475, 252 (53.02%) samples were unsatisfactory, 76.58% (n=193) bacteriologically and 23.41% (n=59) physico-chemically. The quality of drinking water was significantly unsatisfactory bacteriologically (p=<.0001) due to the presence of Faecal coliforms.

Conclusions: As 53% of the water samples are below the recommended WHO standards for drinking water, therefore there is a need to take appropriate measures to improve the water quality both physico-chemically and bacteriologically.

Introduction

Pakistan has faced acute water shortage for the last several years, not only for drinking purposes, but also for agriculture and industries. Safe drinking water is the top priority for basic human health. Insufficient quantity of potable water is being supplied, which also gets contaminated before consumption and people are worried about the un-safe drinking water that is being supplied to them in different parts of the country. Pakistan is among those few developing countries where access to safe drinking water falls far

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below satisfactory levels. While figures vary significantly, a recent independent study reports that not more than 25% of the population has sustainable access to quality drinking water[6]. The quality of drinking water in the capital is expected to be (and should be) the best as compared to other cities, however, the same situation exists in Rawalpindi / Islamabad, the capital of Pakistan, although it has relatively less polluted environment as compared to other bigger and older cities like Lahore, Karachi, Faisalbad as well as rural areas. Some studies have been reported on limited issues, which showed that the majority of water samples collected from treatment plants, tap, tube wells and wells were unsatisfactory due to presence of bacteria, nitrate-nitrogen[2].

Public Health Laboratories Division at the National Institute of Health is the only Public Health Laboratory in Pakistan. Besides performing its other Public Health functions, it is also monitoring the water quality through its Environment Health and Microbiology Laboratories. During the year 2008, the department received 475 water samples for physicochemical and bacteriological analysis. The present study deliberates upon the water quality in the Rawalpindi / Islamabad and adjoining areas.

MATERIAL AND METHODS

Sampling procedure

A total of 475 drinking water samples were received in the department for routine analysis and processed for physicochemical and microbiological analysis, representing different areas of Rawalpindi / Islamabad..

Different Source of Samples

The most common source of drinking water was boring (n=315), followed by tap water (n=31), filter water (n=32) and other sources (n=97), which included Tank water, Well water, Stream, Spring, Chashma and Lake water. All the samples were received in sterilized glass bottles and were processed for bacteriological and physicochemical analysis, which included pH, Turbidity, Hardness, Conductivity, Chlorine, Total Dissolved Solids (TDS), Iron, Nitrate, Zinc, Chloride using Digital meters and LaMotte kits (LaMotte USA). Multiple Tube Method was used for microbiological analysis. All the Physicochemical and Microbiological results were interpreted according to WHO guidelines for the Drinking water quality standards.

Analytical Methods of the Parameters

No. of Tests	Parameter	Method / Instrument	Method Description	Places
Physico-chemical Tests	Temperature	Digital Thermometer, Hana, HI-8424	EDTA Trimetric	Laboratory
	Chloride	La Motte Test Kits, Code 7249	Argentometric	Laboratory
	Zinc	La Motte Test Kits, Code 7417	Colorimetric	Laboratory
	Iron	La Motte Test Kits, Code 4447	Colorimetric	Laboratory

	Nitrate	La Motte Test Kits, Code 3110	Colorimetric	Laboratory
	Turbidity	Digital Turbidimeter, HF Scientific		Laboratory
	Conductivity	Digital Conductivity meter		Laboratory
	Total Dissolved Solids	Digital Conductivity meter		Laboratory
	pH	Digital pH meter, Hana, HI-8424	Class Electrode	In situ
	Colour	Simple Observation		
	Odour	Simple Observation		
	Chlorine (Free and Total)	La motte Test Kits, Code 6819	DPD Colorimetric Method	Laboratory
	Hardness	La motte Test Kits, Code 4482	Colorimetric	Laboratory
Microbiological Tests	Coliforms	Multiple Tube Method	MPN Technique	Laboratory
	Faecal Coliforms	Presence / Absence Method	Shorter Method	Laboratory

Analysis

The results of analysis were compiled according to the WHO guidelines about the quality of drinking water, and the decision was made on the quality of sample as "satisfactory" or "unsatisfactory".

Fifteen (15) parameters were tested according to the standard method procedure printed on the kits. Temperature and pH were recorded, chlorine, (free and total) was analyzed by using LaMotte test kit. Taste, odor, and color were tested in situ and Nitrate-nitrogen was determined by diazotization / coupling. Total hardness, chloride conductivity, total dissolved solids, turbidity, zinc, iron were tested in the laboratory. Total Coliform count (multiple tube method, MPN technique) and Faecal Coliform (presence / absence) were also tested.

RESULT AND DISCUSSION

Out of 475, 252 (53.02%) samples were unsatisfactory, 76.58% (n=193), bacteriologically and 23.41% (n=59) physico-chemically. The quality of drinking water was significantly umsatifactory bacteriologically ($p<0.0001$) due to the presence of faecal coliforms.

Types of samples	Categories and Number of samples				No. of samples
	Physico-chemical		Bacteriological		
	Satisfactory	Un-Satisfactory	Satisfactory	Un-Satisfactory	
Boring water	280	35(59.32%)	207	108(55.95%)	315
Tap water	27	4(6.77%)	17	14(7.25%)	31
Filter water	29	3(5.08%)	19	13(6.73%)	32
Others	80	17(28.81%)	39	58(30.05%)	97
Grand Total	416	59(100%)	282	193(100%)	475

Boring water: A majority of samples were unfit physico-chemically (59.32%) as three parameters, turbidity, conductivity and TDS were not within the normal range. Overall, 55.95% samples were unfit for human consumption due to the presence of coliforms, faecal coliforms and E. coil bacteria.

Tap water: Fewer samples (6.77%) were unfit Physico-chemically as only turbidity was not within the normal range. On the whole, 7.25% samples were unfit for human consumption due to the presence of coliforms, faecal coliforms and E. coil.

Filter water: Least samples (5.08%) were unfit Physico-chemically, again only turbidity was the affected parameter. Taking into consideration the presence of coliforms and faecal coliforms, 6.73% samples were unfit for human consumption.

Others: Sampling from other minor sources revealed 28.81% samples to be unfit Physico-chemically. Four parameters, pH, turbidity, conductivity and TDS were not within the normal range. Taken together, 30.05% samples were unfit for human consumption due to the presence of coliforms, faecal coliforms and E. coil bacteria.

Conclusions

The bacteriological quality of the water samples from all sources, except for boring water, was poor as compared to Physicochemical parameters, due to presence of coliforms, faecal coliforms and E. coil bacteria. The value of three parameters TDS, Turbidity and nitrate were increased in rainy season while the other parameters remained the same. The bacterial contamination and the presence of TDS, Turbidity in these samples was improvement.

Indicators of water quality are important in devising strategies to prevent long term deleterious effects of human health. The data generated from the study under discussion warrants the need to adapt both short term and long term management.

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AN OVERVIEW OF POLYETHYLENE TEREPHTHALATE RECYCLING IN PAKISTAN

By

Dr. Zahiruddin Khan*

1. INTRODUCTION

Effective, economical, and safe disposal of municipal and industrial solid waste makes great sense and the same has been appreciated in developed as well as developing countries. Keeping in view the good economic conditions, high literacy rates and effective media campaigns, developed countries has been successful in developing institutions and regulations pertaining to waste recycling. Waste recycling remains a low priority rather an individual subject in most developing countries.

In terms of municipal solid waste, generation rates per person are low in developing countries e.g., 0.6 kg/person-day in Pakistan vs 2.5 Kg/person-day in USA. In terms of waste composition, paper, clothes, plastic, glass and steel are major fractions of household waste in the developed world, where as vegetable and fruit peelings, plastic, floor dust and dirt dominate household waste in the developing countries. The most dangerous trend in developing countries is the dumping of all kind of household, clinical, commercial, personal, and medicinal and factory waste at open sites. Scavengers, goats, dogs and cats scatter it all around and into the open drains providing breeding sites to mosquitoes and rodents. Sweepers find it easier to burn the waste on-site rather than collecting and hauling it to the nearest transfer station. This is destroying the ambient air quality as well as public health at large.

While plastic bags are a common menace at any waste disposal site in Pakistan, Polyethylene Terephthalate (PET or PETE) bottles are not. Being a saleable commodity, PET bottles are hard to find at any dumpsite.

PET, is a thermoplastic polymer resin of the polyester family. It is manufactured under trade names Arnite, Impet and Rynite, Ertalyte, Hostaphan, Melinex and Mylar films, and Dacron, Diolen, Terylene & Trevira fibers. PET bottles are best (light weight, see-through, easy to handle, cost effective, break-free) to carry potable water and other beverages so they are extensively used all around the world. The use of PET containers is rising everyday and so is its recycling. Recycling plastic bottles from the post-consumer waste stream has been shown to help in conservation of non-renewable fuels and energy, reduced solid waste, reduced emissions of CO_2 and nitrogen oxides[5]. Several worldwide campaigns towards reducing and even eliminating to "zero" beverage container waste are in progress. Almost all of the container deposit laws are based upon charges for return. A few recycling campaigns are loosing steam as return rates are low. Also the cost of virgin resin for the PET products has substantially reduced over the past decade which has adversely affected the recycling markets in the developed world. PET recycling in USA rose to 56 % in 1994, and is decreasing ever since[6]. The developing countries are however, fast approaching to zero PET waste levels due to well

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recognized market value of used PET containers and wide spread poor economic conditions[10]. Figure-1, shows the changes in PET waste recycling in USA and in Pakistan. It is evident that plastic component of solid waste in Pakistan has been on the rise for the last decade.

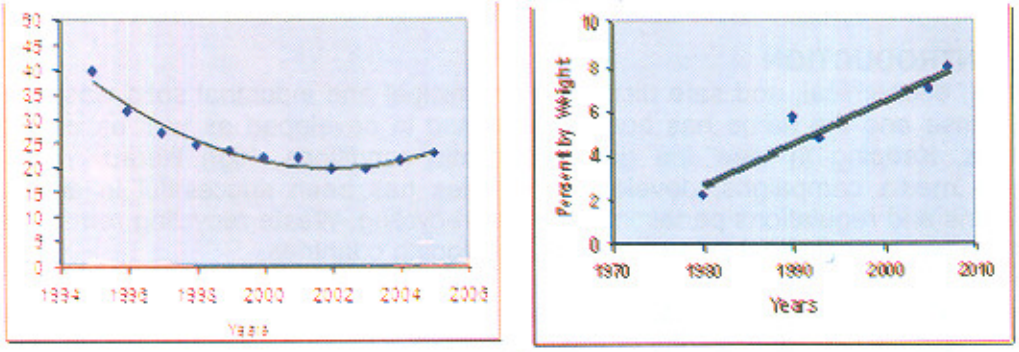


Figure-1: PET Recycling trends in USA[6](Left) & rise in plastic waste component in the Municipal Waste in Pakistan[1](Right).

2. PET Bottle Manufacturing Process

Polymerization of PET resin is carried out through a polycondensation reaction of the monomers (done immediately after esterification / transesterification) with ethylene glycol as the by-product. There are two basic molding methods, one-step and two-step molding[5]. In, the most common, two-step molding, two separate machines are used. The first machine injection molds the pre-form. The pre-form looks like a test tube, as shown here[8]. The bottle-cap threads are already molded into place and the body of the tube is significantly thicker. In the second step, the pre-forms (un-inflated bottles) are heated rapidly and then inflated against a two-part mold to form them into the final shape of the bottle. In one-step machines, the entire process from raw material to finished container is conducted within one machine. Its greatest merit is the reduction in space, product handling and energy, and far higher visual quality than can be achieved by the two-step molding[6].



3. PET Production in Pakistan

Use of PET beverage bottles in Pakistan started in mid-eighties when PEPSI Cola and Coca Cola introduced their 1.5L and 2L beverage containers. About the same time, bottled water, as mineral water, surfaced for the general public consumption. Nestle was the first well known and reliable company to enter this common market. With media playing a vital role about environmental awareness, in general, and water related diseases in particular, use of bottled water rose exponentially, first in offices and slowly amongst the generally public. Use of bottled water lived as a status symbol for a very short period until it became a popular consumer product. Within a matter of few years, dozens of new bottlers jumped into the market and PET water bottling became a great business with high returns. Improved awareness about the water related diseases and adverse impacts of carbonated drinks, reduced the use of carbonated drinks to such an

extent that drink-giants such as PESI Cola and Coca Cola were forced to introduce their own bottled water under the brand-names of Aquafina and Kinley respectively. Today, PET beverage bottles are being consumed everywhere in Pakistan. Ironically, such a great consumption rate in a care-free society is not producing any noticeable environmental pollution as used PET containers have been recognized as a commodity that sells well in the national as well as international markets[13].

PET bottles are best (light weight, see-through, easy to handle, cost effective, break-free) to carry potable water and other beverages so they are extensively used all around the world. No statistics are available on the exact consumption of plastics raw materials in the Pakistan, but a modest estimation indicates that more than one million tons of different plastics are required every year. The present production capacity of the four raw material producers is about 300,000 tons. This can barely meet 30% of the estimated demand, leaving a shortfall of 700,000 tons. This gives room for imports which constitutes a burden on the national economy. The following table shows a crude estimate of present production of PET and other plastic raw material in Pakistan.

Table-1: Estimated Production of Plastic Raw Material in Pakistan.

Plastics Raw Material Production in Pakistan		
Company	Product	Capacity
Garton Industries	PET	120,000 Tons
Crystallite Industries	PET Bottles	30,000 Tons
Engro Asahi Polymers	PVC	100000 Tons
Pak Petro Chemicals	HIPS & PS	34,000 Tons
Dynea Pakistan Ltd.	Methanol Urea Melamine	34,000 Tons

Worldwide, approximately 1.5 million tons of consumers returned PET containers are collected every year. PETCORE, the European trade association that fosters the collection and recycling of PET, forecasts that in Europe alone, collection will exceed one million tons by 2010[11].

Findings from a recent environmental impact assessment conducted by REPRISE clearly demonstrate that the total energy requirement to recycle plastic bottles in the UK scheme studied (i.e. from placing a bottle in a collection bank or curb-side container to the production of plastic flake) is 4.39 MJ/kg. This compares to, on average, 36.16 MJ/kg (source: APME) necessary to produce equivalent virgin material. Table-2 explains the sources and uses of recycled PET material.

Table-2: Common Sources and Uses of PET Plastic[7]

Description	Properties	Product Applications	Products
Polythylene Terephthalate (PET, PETE). PET is clear, tough, and has good gas and moisture barrier properties. This	• Clear and optically smooth surfaces for oriented films and bottles • Excellent barrier to oxygen, water and	Plastic bottles for soft drinks, water juice, sports drinks, beer, mouthwash, catsup and salad dressings. Food jars for peanut	Fiber for carpet, fleece jackets, comforter fill, and tote bags.

resin is commonly used in beverage bottles and many injection-molded consumer product containers. Cleaned, recycled PET flakers and pellets are in great demand for spinning fiber for carpet yarns, producing fiberfill and geo-textiles. Nickname: Polyester.	carbon dioxide • High impact capability and shatter resistance • Excellent resistance to most solvents • Capability for hot filling	butter, jelly, jam and pickles. Oven-able film and microwavable food trays. In addition to packaging, PET's major uses are textile monofilament, carpet, strapping, films and engineering moldings.	Containers for food, beverages (bottles), and non-food items, Film and sheet. Strapping.

The use of PET in Pakistan has risen manifold over the last decade, and its value as a recycling material has risen even faster. Today, it is difficult to find PET waste especially the colorless PET bottles anywhere around the waste dumpsites. This paper undertakes a thorough review of PET material production in Pakistan, legislation, recycling processes and reuse aspects with emphasis on environmental and OHS issues in the PET recycling industry.

4. PET Legislation[7,9,12,13]

According to 2004 U.S. Census Bureau statistics, approximately 30% of the U.S. population currently reside in states or territories with existing container deposit laws: California (5-10 cents; 1987; increased 25% in 2007), Connecticut (5 cents, 1980)Delaware (5 cents, 1982), Hawaii (5 cents, 2005), Iowa (5 cents, 1979), Maine (5-15 cents, 1978), Massachusetts (5 cents, 1983), Michigan (10 cents, 1978), New York (5 cents, 1982), Oregon (5 cents, 1972), Vermont (5 cents, 1973). New Bottle Bill Legislation is being proposed in Arizona, Arkansas, Illinois, Kentucky, New Hampshire, North California, Oklahoma, Pennsylvania, South Dacota, Texas and Puerto Rico.

Many provinces in Canada have deposit refund systems in place for alcoholic and non-alcoholic beverage containers: glass, plastic, and teterapak containers have deposit requirements in various provinces. Deposits range from 5¢ to 40¢ per unit

In Germany container deposit legislation, known in colloquial usage as Einwegpfand (single-use deposit), was implemented on January 1, 2003. Deposit rate of reusable plastic bottles (regardless of volume): € 0.15. Container deposit legislation is widespread in Scandinavia. In some cases it replaced legislations which forbid the selling of some types of beverage containers, particularly aluminum beverage cans.

Today drink containers can be returned and deposits retrieved at over 9000 establishments in Norway, and there are almost 3000 deposit machines were drink containers can be exchanged for receipts that can be cashed in at the counter. In Sweden, there are deposits on nearly all containers for consumption-ready beverages.

86%[8] of the aluminum cans and PET bottles affected by the deposit that are sold, are returned.

The state of South Australia has a refund of 5 cents per can or bottle. Bottle deposit legislation has been changed since the 1970s when deposits ranged from 20c for a 30 oz bottle and 10c for a 10 oz and 6 1/2 oz bottle. Attempts to introduce similar legislation in other states have been thwarted by the lobbying power of the beverage industry.[6]

As reported above, most of the PET related legislation is limited to 10-12 states of US, two states in Australia, Japan and a few European Countries. Overall emphasis of these legislations are towards OHS issues and the effluent treatment from the facilities involved in washing and drying of PET flakes. Operations at PET plastics recycling facilities are subject to a wide range of codes and regulations at the federal, state and local level. The regulations that reply will vary with the type of PET processing operations taking place at the facility. The design, construction, and operations of PET recycling facilities are subject to a number of zoning and building codes. PET recycling facilities are subject to compliance with local building and fire codes for such things as material storage, loading considerations, space allowances, and required fire protection equipment within a facility[3].

Many laws and regulations deal with worker safety at the federal, state and local levels, of government. The most important law in workplace safety is the Federal Occupational Safety and Health Act in USA and Factory Act 1934 in Pakistan. PET recycling facilities that undertake cleaning operations will require test results demonstrating compliance with certain regulatory discharge thresholds for discharging waste water into the local sewer system. This will usually involve providing test results that the water discharge is within regulatory limits for such measurable items as pH (acidity), TSS (total suspended solids), BOD (biological oxygen demand), COD (chemical oxygen demand), oil & grease, and what are known as priority pollutant metals, such as lead, cadmium and mercury.

5. PET Recycling in Pakistan[13]

As evident from Firgure-2, PET containers are generally produced from a mix of virgin resin and a small fraction of crushed-cleaned PET flakes.

Once used and disposed off, these containers are picked up by the scavengers and sold to scarp dealers. Many scrap dealers have their own PET crushers where all PET materials are crushed into flakes after removal of wrappers and neck rings. A few exporters of flakes, for example, Shazel International, collect PET bottles from all around the country and crush and clean at their own facility. Overall, there are ten types of businesses involved in PET processing. These include: 1) importers of PET resin, 2) manufacturers PET bottles, 3) fillers of PET bottles (including beverage fillers), 4) users of PET beverages, 5) scavengers, 6) scrap dealers, 7) crushers, 8) flake dealers, 9) local re-users of PET flakes and 10) exporters. Scavenger compete with municipal waste collectors in collecting PET bottles. That's why, beverage and PET bottles are hard to found at any waste dumpsite. Most PET manufacturers use virgin raisin with a fraction of clean flakes. Local re-users of PET flakes include carpet fiber manufacturers and PET

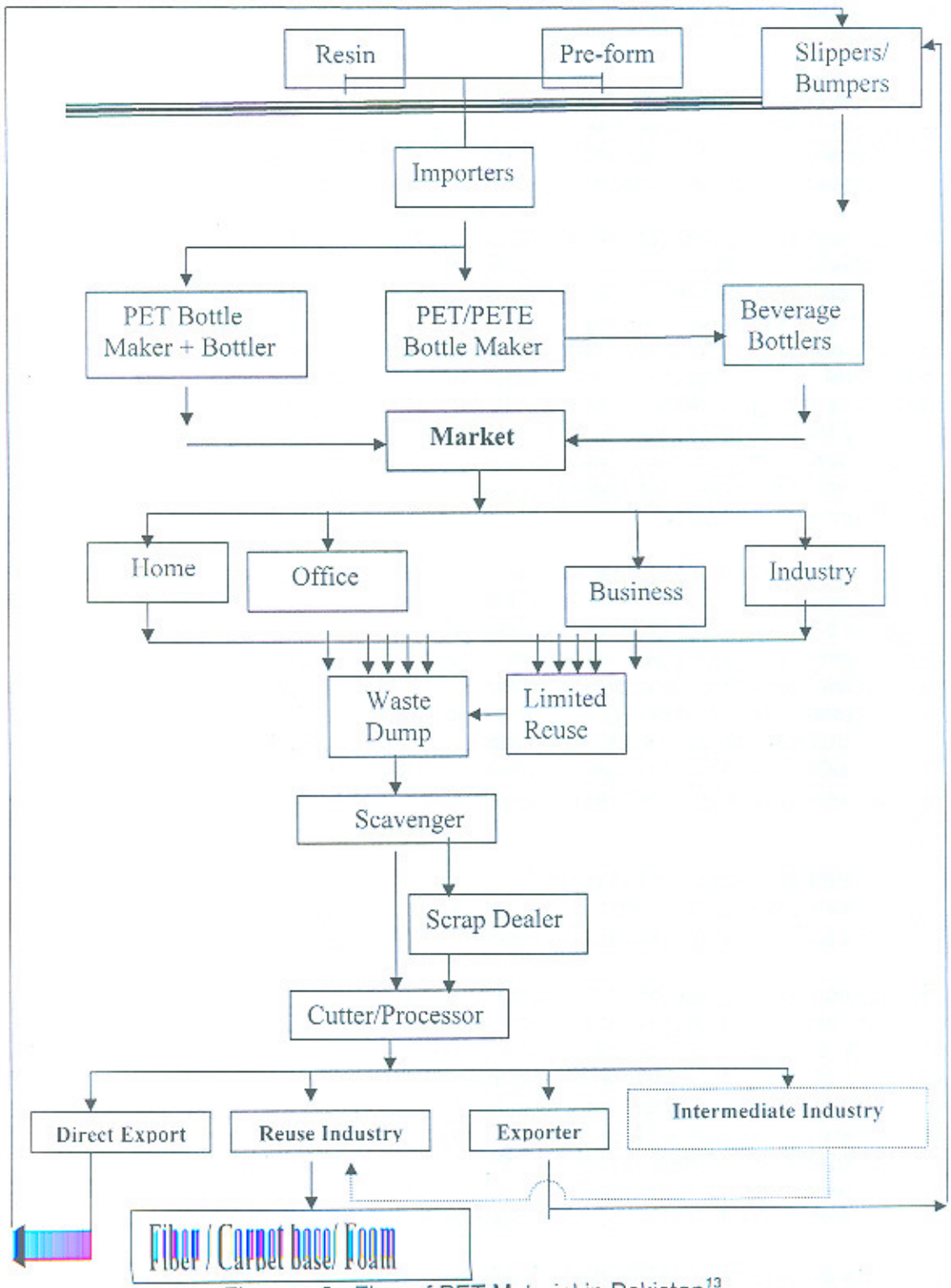


Figure – 2 : Flow of PET Material in Pakistan[13]

wool makers with a small fraction of illegal re-fillers of PET. PET wool is locally used as underlay for the winter jackets, comforters, blankets etc.

A recent survey in Lahore, Karachi and Rawalpindi/ Islamabad revealed the approximate distribution of all types of businesses involved in PET recycling as given in Table 3 below:

Table 3: Types of business involved in PET Recycling in Pakistan

Type	Business	Rawalpindi/ Islamabad	Lahore	Karachi
1	Importers (Pre-forms only)	1	3	Several
2	Bottle Manufacturers	2	5	Pepsi/Amrat/Nestle
3	Fillers of Bottles	4	12	23
4	Distributors	5	10	20
5	Scavengers	Over 1000	Over 2000	Over 5000
6	Scrap dealers	32	50	80
7	Processors	25	30	30-40
8	Re-users	1	7	1-2
9	Intermediate Businesses	5	5	5
10	Exporters	3	4	20

A comprehensive survey of four major cities of Pakistan revealed that major activity on PET recycling started in 1994. The pace of activities was however different at all cities. Figures 3 and 4, 5 show the progress in PET scrap dealers PET processors, and PET flakes exporters in four major cities of Pakistan from 1994 to 2006.

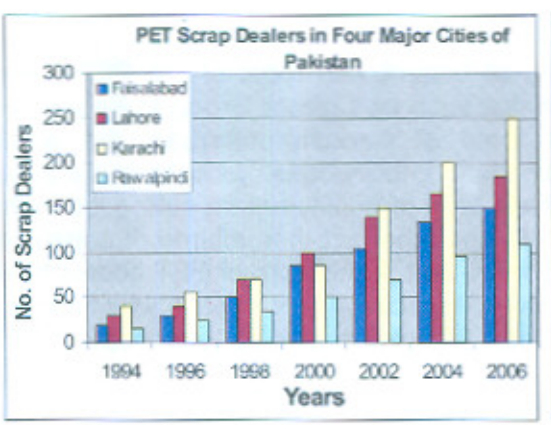


Figure-3: PET scrap dealers in four major cities of Pakistan

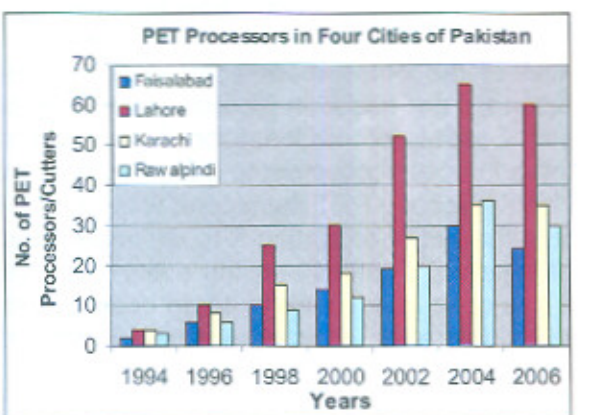


Figure-4: PET processors in four cities of Pakistan

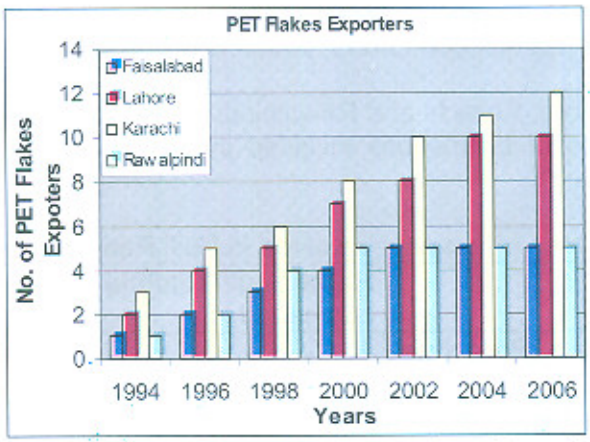


Figure-5: PET flakes exporters in four major cities of Pakistan.

Boom in colorless PET businesses commenced with the introduction of bottled water in mid 1980s. For many years these bottles were either disposed off as rubbish or reused at home for coldwater storage. As the awareness about water borne diseases rose by effective marketing techniques of water bottlers, the use of bottled water rose exponentially and it was not before early 1990s when the huge production of customer returned PET containers was realized as a great recycling business. Scavengers picked volume of used PET containers has been rising in all major cities of the country ever since. This gave rise to more scrap dealers in the PET field as evident by Figure-3. Today, the number of PET scrap dealers has almost touched its top as most scrap dealers receive cash advances for used PET containers supply. Many crushers of PET material have lost their business as scrap dealers supply material only to those paying in advance. Summer season brings a good news for such businesses as the supply of used PET bottles picks up by 1.5-1.8 times in summer and many scavengers sell directly to crushers rather than the scarp dealers.

Most of the bottle manufacturers are located at Lahore and most of the PET flakes exporters are based in Karachi. A few companies such as Chawla Group in Faisalabad and Quality International or Shazil International at Karachi undertake the whole operation from collection to export by their own staff. Intermediate businesses are those which purchase PET flakes and wash it to certain level of quality before selling it into the local market or exporting it to China or Italy. Despite the fact that volume of consumer returned PET bottles is rising every year, exporters and processors of PET bottles have to pay cash in advance to scrap dealers and even the scavengers. That's why finding a PET bottle at an open dumpsite is a difficult job. Figure-6 shows various steps in PET bottle recycling[13].

Lahore being centrally located in the country is the hub of PET businesses especially for PET crushing. Largest number of PET crushing facilities are located in Lahore and operated by single owners. In Karachi and Faisalabad, most of the crushing facilities are operated by one or two groups of companies. In Rawalpindi / Islamabad too, most crushing facilities are operated by a few individuals.

Figure-6: Steps in PET Recycling



PET Collection



PET Local Transport



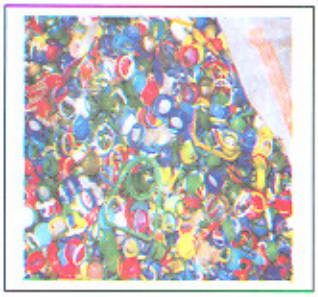
Weighing B4 Sorting



PET Sorting



Label removal



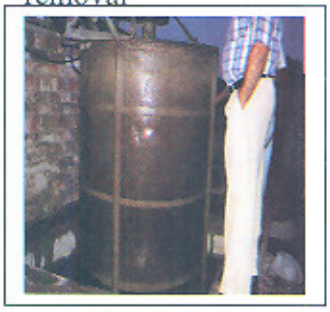
Cover & ring removal
removal



Crushing into flakes



Flakes washing



Dewatering



Flakes Drying



Packaging export



Reuse to new material

Most of the PET flakes exporters are located in Karachi and despite the fact that volume of used PET is increasing day-by-day, number of exporters in most cities including Karachi remains pretty much constant.

6. OHS ISSUES in PET RECYCLING

Most of the PET bottles are collected by scavengers which are mostly bare handed as well as bare footed. PET recycling facilities store their raw material in open which results into wet areas all around and such surroundings become breeding sites of mosquitoes and other vectors. Ring and wrapper removal involves long sittings in these areas and workers are always subjected to mosquito bites, sun-burn and cuts & bruises from handling of empty but dirty PET bottles. Next, the bottles are fed to shredders where noise is always greater than 80 dB_A and workers sometime spend 8-10 hours in one go around the crusher especially during the summer. Long hours of standing in the noisy environment adversely affect worker's posture and ear drums. Most of such workers are victims of deafness for short duration. Washing of crushed flakes and filling into bags results in further cuts and bruises. Despite the fact that thousands of unskilled workers are employed at such industries but very environmental and OHS conditions are affecting the health and well being of these workers. There is a dire need that personal protection gear such as gloves, shoes, nose-masks, hard hats and ear-plugs be provided to such workers so that adverse health impacts can be reduced.

7. CONCLUSIONS

1. Keeping in view the excellent PET recycling activities in progress in Pakistan, there is a dire need to provide OHS training to the scavengers and all those involved in pre-crush, crushing and post crush activities.
2. Legislation, as promulgated in most of the developed as well as developing countries, be drafted and enforced to institutionalize this industry.
3. Import of consumer returned empty PET containers from gulf states and Saudi Arabia be allowed in order to help the unemployed unskilled labor.
4. Wastewater from flakes washing facilities contains detergents, solids, and organics. All such facilities should be provided with free of cost information to treat wastewater before disposal.

8. ACKNOWLEDGEMENT

Most of the information included in this review has been taken from a project report on Environmental Impacts of PET Recycling in Pakistan. The project was funded by WWF Pakistan. The author gratefully acknowledges the support of WWF in this regard.

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POVERTY ALLEVIATION: A CHALLENGE FOR PAKISTAN

By

Shahida Saleem*

ABSTRACT

This paper is an attempt to study the different dimensions of poverty in Pakistan at the national and provincial level. It provides a trend analysis of the total, rural and urban poverty in Pakistan. The study indicates that though total poverty in terms of head count rates has reduced over the past forty years, poverty in the rural areas is much higher than the poverty in the urban areas. The study also shows that the majority of the rural poor are not farmers. Almost sixty percent of them are engaged in non farming activities and it is this resource which must be utilized for poverty reduction in the rural areas. Moreover, the study reveals that the social indicators are less favourable in the backward regions of Pakistan which negatively impacts on a breakthrough in poverty alleviation.

INTRODUCTION

One of the greatest challenges being faced by the world at large is the eradication of extreme poverty from the poorest regions of the world. According to the World Bank estimates less than 1 billion people living in the richest countries of the world account for three fourth of the world's wealth. On the other hand, a billion people living in the poorest countries of the world are surviving on less than 2% of the world's wealth {WDR2009}.

Poverty is a complex and multidimensional phenomena. The concept of poverty extends from low levels of income and consumption to poor health facilities, limited educational opportunities, cultural backwardness, poor housing, lack of access to safe water, low life expectancy, limited access to public and private resources, and limited participation in community development. Hence in order to measure poverty, both economic and non-economic indicators have to be taken into account.

The most popular measure of poverty is the headcount ratio i.e. the percentage of people living below the nationally or internationally defined consumption poverty line. The national poverty line is estimated on the basis of the minimum level of income and consumption required for meeting the basic needs of the people. It, therefore, varies from country to country and from time to time. For international comparisons the World Bank uses reference lines set at dollar one per day for extreme poverty and dollar two per day for moderate poverty. If we consider the international poverty line of $1 a day, then in 2002 17% of the population in Pakistan was living below the poverty line and if we take $2 a day, as the poverty line, 73.6% people were living below the poverty line in 2002. (World Bank report 2007). This shows a very bleak picture of poverty in Pakistan.

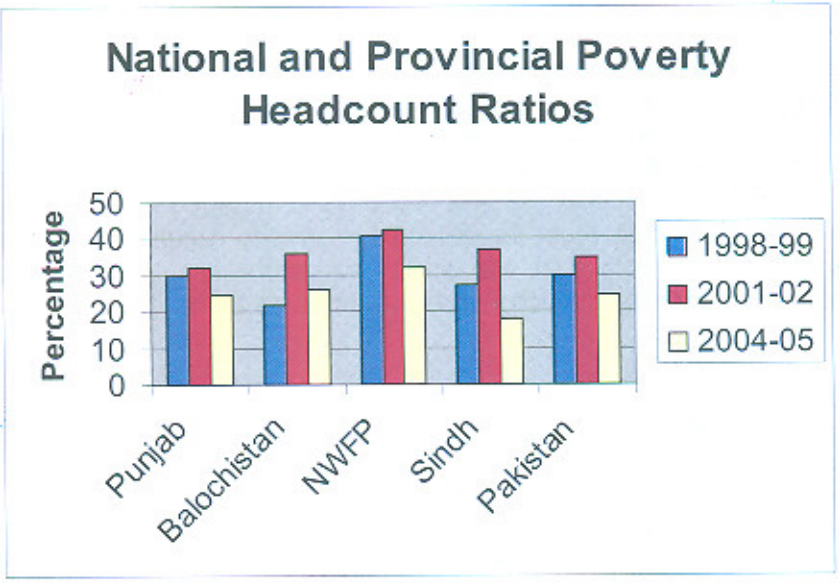
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POVERTY PROFILE OF PAKISTAN

Pakistan is a developing economy having a population of 162 million people growing at a rate of 2.3 % per annum and with a per capita income of 870$ per annum. (World Development Report 2009). Agriculture is the largest sector of Pakistan's economy providing employment to almost half of the labour force.

Figure No. 1



Source: World Bank et al. (2007)

The above figure shows considerable fluctuations in Pakistan's poverty headcount ratios with poverty increasing in 2001 and then declining in 2005. The provincial poverty ratios, too, indicate that poverty increased in all the provinces in 2001 and then declined in 2005.

A comparison of the poverty levels in the four provinces reveals that NWFP has had the highest rates of poverty. In case of Balochistan, the situation was such that poverty increased from 1998 to 2005 while in other provinces it declined during the same period. It may also be mentioned here that both NWFP and Balochistan are relatively less developed as compared to Punjab and Sindh.

POVERTY TRENDS IN PAKISTAN

During the early 60's the percentage of people living in abstract poverty in the rural areas was much less as compared to the urban areas. After 1965, rural poverty started increasing and finally became more than the urban poverty. This caused an upward pressure on total poverty. Later during the 70s and the 80s there was a significant fall in overall poverty levels, mainly due to high economic growth rates, development of the social sectors, increased development expenditure and flow of remittances from the Middle East. However, this declining trend was reversed during the 1990s as poverty started increasing gradually because of slow rate of economic growth, expanding foreign

debt and economic mismanagement, combined with a failure to invest in areas like education, health care and social services. In fact, the poverty rates doubled from 17.32% in 1987-88 to 34.46% in 2001-02. One of the major reasons for the dismal poverty situation during the 90s was the adoption of the Structural Adjustment policies which brought down the developmental expenditure in the pursuit of following a contractionary fiscal policy. The resulting recessionary trend in the economy put an upward pressure on the poverty levels.

The situation in the rural areas has been even worse where almost two-third of the population of our country dwells. It has been observed that high levels of total poverty have always been associated with high levels of rural poverty. Though there was some decline in rural poverty during the 80s, the overall picture shows that the rural poverty has always been high while the urban poverty has declined substantially since the 60s.

Figure No.2. Total, Rural and Urban Poverty Head Count Rate in Pakistan



Source: World Bank 2007

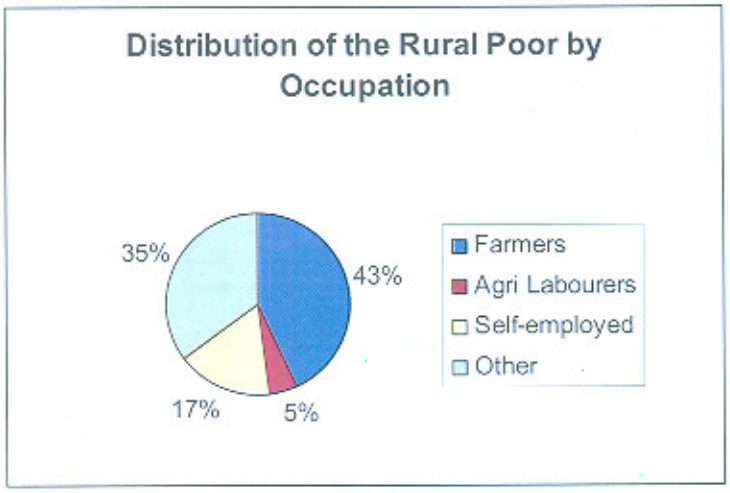
The above figure shows that in 1963-64, urban poverty was more than rural poverty. After 1966, urban poverty became less than the rural poverty and since then the gap between the rural and urban poverty has been increasing consistently. This implies that poverty targeted interventions like job creation, social development, credit availability etc, in the past have been focused mainly on the urban sector and were severely limited in the rural areas.

Secondly, it shows that there is a high degree of association between the rural poverty and the total poverty. When rural poverty declines, total poverty declines as well. Consequently, this leads us to the conclusion that if poverty is to be alleviated, it can be done only by targeting rural poverty.

It can also be observed that whenever urban poverty levels of Pakistan fell and put a downward pressure on the overall poverty levels, the rising rural poverty offset that effect and brought overall poverty levels back to their rising trend. This implies that whatever poverty reduction policies take place in Pakistan, they just focus on the urban sector. Besides there have been no land reforms in Pakistan since 1972.The prices of inputs have increased substantially and farmers fail to receive remunerative prices for their commodities due to the exploitation by the middlemen. Hence the poor farmers have to bear the entire brunt of high prices of inputs and indirect taxes with little opportunities to have access to land, credit and irrigation facilities. It is extremely crucial to serve the basic needs of the poor who reside in the rural areas because the poor farmers live in such extreme poverty that they cannot even afford a proper meal two times a day.

The most important conclusion to be drawn from all this is that in order to reduce the poverty levels of Pakistan, it is of utmost importance to reduce the rural poverty of Pakistan. History has shown that any poverty reduction taking place in the urban sector has failed to achieve its desired impact due to the negative impact of rural poverty on the overall poverty level. Hence in addition to reducing the urban poverty levels of Pakistan, the policy makers should also focus on the rural sector. Unless and until the rural poverty levels are lowered, the overall poverty level of Pakistan will remain high. Thus reducing the rural poverty levels is the main challenge for Pakistan.

Figure No.3



Source: PSLM 2004-05

The growth structure of the economy has undergone a lot of change over the past few decades and as a result of that a very large non-farm rural sector has emerged.

The above figure shows that 43% of the rural poor {i.e. the bottom 40 percent of the rural households} are engaged in farming, while the remaining 57% are engaged in non-farm income generating activities. Of these 5% are agricultural labourers, 17% are self employed and 35% are engaged in performing different services like livestock herding etc. This indicates that there is a very large non-farm rural sector which has the potential to play an important part in rural development if utilized properly.

Social Indicators

Poverty is not purely an economic phenomena, it has a social dimension too. Hence, it is important to look at social indicators like health and education facilities, access to safe drinking water and sanitation facilities, as these help to improve the quality of life.

Indicators of Education

Table No.1

	Adult Literacy Rate 10 Years older (%)		Population that has completed Primary Level Education or higher (%)	
	1998-99	2006-07	1998-99	2006-07
Punjab	46	58	38	49
Sindh	51	55	41	47
NWFP	37	47	21	38
Balochistan	36	42	25	29

Source: PIHS and PSLM

The adult literacy rate in Pakistan has increased from 45 % in 1998 to 55% in 2006 – 07 {PSLM}. In Punjab, where half of the population of the country resides, it is only 58% which is the highest in the country. NWFP and Balochistan have the lowest literacy rates.

The proportion of population that has completed primary level of education is again highest in Punjab followed by Sindh, but very low in NWFP and Balochistan. The data also shows that there is no significant improvement in the percentage of people with primary or higher level of education in Pakistan.

Health Indicators

Pakistan's health indicators show very little improvement. The immunization coverage has increased substantially in Punjab, but sadly, in other provinces the percentage of fully

Table No. 2

	Fully Immunized Children under 12-23 months (%)		Pre Natal Consultations (%)	
	1998-99	2005-06	1998-99	2005-06
Punjab	39	58	33	53
Sindh	17	32	37	56
NWFP	38	47	22	43
Balochistan	10	32	18	36

Source: PIHS and PSLM

immunized children is quite low. Prenatal consultations are very essential for the early detection of high risk pregnancies or any antenatal complications, their prevention and management. The figures show that only 56% of the females go for any prenatal visits in Punjab and Sindh, where as in NWFP and Balochistan, this percentage is only 46% and 31% respectively. This indicates that a major chunk of the population is deprived of this basic health facility either due to lack of awareness or lack of availability.

The given data also shows that there has been a considerable improvement in the education and health indicators between 1998 and 2007. However, the figures for Balochistan and NWFP are the lowest. This means that these two provinces need to spend more on providing better health and education facilities for the development of their human resources.

Health indicators of Pakistan

Table No. 3

	1990	2007
Prevalence of Child Malnutrition (% of child under 5)	39	31.3
Under 5 Mortality Rate (per thousand)	130	97
Births attended by skilled health staff (% of total)	19	31

Source: World Bank 2009

The proportion of children who are under weight is the most common indicator of malnutrition. The above data indicates that the proportion of children suffering from malnutrition in Pakistan has declined from 39% in 1990 to 31% in 2007. Under five mortality rate is still quite low though it has declined from 130 /1000 to 97/1000. Similarly the number of births attended by skilled health staff shows improvement but it is quite dissatisfactory.

Water Supply

Table No. 4

	1998-99					2006-07				
	Tap Water	Hand pump	Motor Pump	Dug well	Others	Tap Water	Hand Pump	Motor Pump	Dug Well	Othe
Punjab	20	56	19	3	2	29	35	31	2	3
Sindh	32	35	6	8	18	47	32	8	4	10
NWFP	38	9	18	18	24	44	11	9	14	22
Balochistan	25	2	6	38	28	37	6	3	16	38

Source: PIHS and PSLM

The main source of drinking water is tap water followed by hand pumps and motor pumps. However, the quality of water supply does not fulfill hygiene requirements as people are facing acute health problems due to impure and contaminated drinking water.

According to PSLM 2005-06, only 58% of the total population in Pakistan has access to proper sanitation facilities. The World Development Report 2009 shows considerable rural-urban disparities in this respect as 92 % of the people in the urban areas have proper sanitation facilities, while in the rural areas, only 41% of the population has access to it.

CONCLUSIONS

Poverty is one of the greatest challenges being faced by Pakistan as it has been increasing since the 90's.The final conclusion of the study is that over the past forty years, the poverty headcount rates in Pakistan have declined significantly as compared to what they were in the late sixties. However, inter provincial comparisons indicate that there is a lot of variation in poverty levels across the country, with poverty being the lowest in Punjab and Sindh, and highest in NWFP and Balochistan.

An analysis of trends in rural-urban poverty shows that rural poverty has been a major component of total poverty in Pakistan. Further it indicates that the gap between rural-urban poverty has been consistently widening since the 70's with rural poverty always being more than the urban poverty. This suggests that poverty cannot be eliminated without targeting the rural poverty.

The study also concludes that there is a very large non-farm rural sector which has the potential to play an important part in rural development if utilized properly.

The outcomes of social indicators are quite disappointing especially in the provinces of Baluchistan and NWFP where the adult literacy rates are the lowest and the poor people do not have access to safe drinking water, proper health care and medication. Poor performance of the social sectors has been a major hindrance to a break through in poverty alleviation.

RECOMMENDATIONS

Alleviating poverty is not an easy task. It requires a very holistic and sincere effort on part of the policy makers for attaining sustainable economic growth.

In the light of the above findings it is suggested that the policy for poverty alleviation must focus on:

- Removing rural poverty by formulating well designed programmes of agricultural development, and skill development which would target only the rural poor.
- Providing suitable incentives for the proper development and utilization of the large non-farm rural sector. An in-depth study of the rural economy especially the non-farm economy would be of utmost importance as it can make a major contribution towards income generation and poverty reduction.