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Sustainable Cotton Production, Trade and Environmental Impact: Policy Issues and Options for Pakistan

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List of Acronyms and Abbreviations

ADB	Asian Development Bank
AJK	Azad Jammu Kashmir
APCOM	Agricultural Prices Commission
APTMA	All Pakistan Textile Mills Association
ATC	Agreement on Textile and Clothing
BOD	Biological Oxygen Demand
CCRI	Central Cotton Research Institute
CEC	Cotton Export Corporation
C & F	Cost and Freight
CLCV	Cotton Leaf Curl Virus
COD	Chemical Oxygen Demand
CRI	Cotton Research Institute
EPA	Environment Protection Agency
EPB	Export Promotion Bureau
ESCAP	Economic and Social Commission
FOB	Freight on Board
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
IIBC	International Institute of Biological control
IMF	International Monitoring Fund
IPM	Integrated Pest Management
LCs	Letters of Credit
MEP	Minimum Export Price
MFA	Multi-Fibre Arrangement
MINFAL	Ministry of Food, Agriculture and Livestock
NGO	Non-Government Organisation
NEQS	National Environmental Quality Standards
NIBGE	Nuclear Institute of Biology and Genetic Engineering
NWFP	North West Frontier Province
OECD	Organisation for Economic Co-operation and Development
PARC	Pakistan Agricultural Research Council
PCCC	Pakistan Central Cotton Committee
PIDE	Pakistan Institute of Development Economics
PMRC	Pakistan Medical Research Council
R & D	Research and Development
SDPI	Sustainable Development Policy Institute
SUPARCO	Space and Atmosphere Research Commission
TCAC	Technical Cotton Advisory Committee
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UK	United Kingdom
USA	United States of America
USDA	United States Development Aid
WHO	World Health Organisation
WTO	World Trade Organisation
WWF	Word Wide Fund for Nature

Sustainable Cotton Production, Trade and Environmental Impact: Policy Issues and Options for Pakistan

Shahid Zia, Chaudhry Inayatullah, Mehreen Samee, Tahir Hasnain

Introduction

Pakistan's economy has undergone considerable diversification over time, yet the agriculture sector is still its backbone. With its present contribution to GDP at 23.87%, agriculture accounts for half of the total employed labour force. It also serves as a base sector for the country's major industries, like textile and sugar. The agriculture sector showed a positive growth of 5.27% during 1995-96. The growth would have been much higher, had major crops like cotton and wheat not experienced a setback (Finance Division, 1996).

Cotton is the most important cash crop cultivated in Pakistan. It is, hence, the main source of our foreign exchange earnings -- roughly 62% of the total foreign exchange earnings from major exports are attributed to cotton and its made-ups. Its contribution to value added by major crops is 28%. In addition to the labour force engaged in cotton cultivation, the textile industry provides employment to 40% of industrial labour. Furthermore, cotton seed is the major source of edible oil, accounting for 60% of total edible oil consumption.

Cotton Production

Status of Cotton Production

The area under cotton production increased constantly from 1947-48 to 1991-92 (Table 1). In 1991-92, cotton was planted on 2.836 million hectares yielding record output of 12.822 million bales, at an average yield of 769 kg/ha, which was comparable with other countries (Table 2). Deviations from the increasing trend appeared in 1983 and 1992. The year 1983-84 saw an unprecedented, 48% loss in cotton production -- from 4.8 million bales to 2.9 million bales. The main causes of this setback were extremely heavy rains, flare up of insect pests (especially white fly) and improper and scanty plant protection measures. Cotton cultivation suffered a second setback in 1992 in the form of cotton leaf curl virus (CLCV) which reduced the production from a record 12.8 million bales (1991-92) to 9.05 million bales in 1992-93 and only 8 million bales in 1993-94. Floods also contributed to the 1993-94 losses -- 32,829 hectares in Sindh and 86,956 hectares in Punjab devoted to cotton were destroyed.

Although the area under cotton in Punjab increased during 1992-93 (2.438 million hectares) as compared to 1991-92 (2.287 million hectares), production declined due to poor yields (574 versus 849 kg/ha). Disappointed with the poor performance of cotton crop due to insect pests and leaf curl virus, the farmers in Punjab reduced the area under cotton crop during 1993-94 [2.249 million hectares, which further reduced the production to 7.935 million bales (Table 1)]. Both area and production have increased in the last two years mainly due to control over CLCV.

Table 1: Area and Production of Cotton (Lint) in Pakistan

Period	Area ('000' ha)				Production ('000' bales)			
	Punjab	Sindh	Other	Total	Punjab	Sindh	Other	Total
1947-48	897	337	3	1237	768	385	3	1156
1949-50	755	353	2	1110	915	379	1	1295
1959-60	930	408	5	1343	1177	533	3	1713
1969-70	1344	409	3	1756	2346	801	2	3149
1979-80	1481	597	3	2081	2832	1447	3	4282
1987-88	1936	629	3	2568	7255	1374	4	8633
1989-90	2036	561	1	2598	7454	1104	2	8560
1990-91	2124	537	1	2662	8501	1125	2	9628
1991-92	**2287**	**548**	**1**	**2836**	**11417**	**1403**	**2**	**12822**
1992-93	2438	397	1	2836	8237	816	1	9054
1993-94	2249	554	-	2803	6523	1412	-	7935
1994-95	2244	405	4	2653	7410	1282	5	8697
1995-96	2463	529	5	2997	8720	1861	4	10595

Source: All Pakistan Textile Mills Association. One bale weighs 170 kg

The average yield realised in Pakistan is about 60% less than the potential yield because of poor crop husbandry and lack of institutional support (extension, plant protection and credit). If the gap between actual and potential yield is narrowed, Pakistan can produce about 17 million bales, of which about 9 million bales, worth US $2 billion, can be exported.

Increase in Production

The development of cotton varieties and the realisation of their potential are subject to many limitations imposed by weather, strong pest complex, water availability, crop management and marketing.

Since 1948, 21 varieties of *Gossypium hirsutum* and five varieties of *G. arboreum* have been released in the Punjab. The main objectives behind the development of new varieties are: breeding for short stature, heat tolerance, short season, high yield with desirable fibre characteristics, pest resistance, tolerance to salinity and water-logging, and high oil contents. The genetic yield potential of the varieties released after 1986 (MNH-129, CIM-70, FH-87, S-12, Gohar-87, RH-1, FH-682, BH-36, MNH-147) was over 5,000 kg/ha. Likewise, the genetic yield potential of *desi* varieties 'Ravi' and 'Rohi' was over 4,000 kg/ha compared to potential yield of about 3,000 kg/ha of the earlier varieties. *Desi* varieties are hardy and grown in non-traditional cotton areas (Sialkot, Gujranwala, Lahore, Kasur and Rawalpindi districts). Varietal evolution is, undoubtedly, an important factor in increasing cotton production.

Table 2: Cotton Yield (kg/ha) in the Important Countries of the World

Country	1994	1995	1996	1997
USA	794	602	792	737
China	785	879	884	884
Pakistan	**557**	**629**	**513**	**632**
India	300	304	329	305
Australia	1603	1411	1585	1480
Turkey	1080	1148	1055	1100
Greece	998	1007	730	873
Uzbekistan	816	837	712	784

Continued…

Country	1994	1995	1996	1997
Turkmenistan	547	411	215	458
Syria	1006	979	1119	1106
Brazil	437	430	418	444
Mexico	794	802	792	737

Source: Survey data, Cotton Commissioner office, MINFAL.

Varietal improvement through germplasm utilization has contributed significantly to the increase in cotton production. In Pakistan, about 500 germplasm lines are maintained at various research stations which are a major source of valuable genes for further breeding work. Quality seed of new varieties are produced by the Punjab Seed Corporation, having farms at Khanewal and Sahiwal, and Sindh Seed Corporation at Sakrand.

After the poor performance in 1983, it was realised that cotton cultivation better management to obtain and sustain higher yields. Consequently, several measures, including use of quality seed, line sowing, weed control, zoning of varieties and pest scouting was introduced to produce higher yields. However, due to higher incidence of CLCV, significant improvements in cotton yield could not be realised. Thus, the breeding efforts now focus on the development of varieties for resistance against CLCV and whitefly. The varieties FH-682, MNH-147, BH-36, and CIM-240 have shown partial resistance to CLCV.

Cotton is also a major source of edible oil. About 60% of the edible oil consumed in the country is obtained from cotton. In 1994-96, edible oils made up 9.9% of Pakistan's total import bill and its consumption is predicted to increase at the rate of 9% per annum (Economic Survey 1995-96). Indigenous production of edible oils needs to increase in line with growing demand to reduce the import bill and thus help check the increasing burden on the balance of payments. The present commercial varieties have higher percentage of oil content [ranges from 22.70% (CIM-70) to 27.40% (FH-87)] than the old conventional types. The promising future strains like, FH-639, LH-119 and FH-245 have even higher oil contents (29.6, 29.2 and 29.2%, respectively).

Cotton cultivation largely depends on the use of agro-chemicals. Pesticide use is rampant. Farmers are trapped in the folly of linear thinking. They think that if little is good, more must be better. But this is not true. With the increased use of pesticides, crop yield increases in the beginning, becomes stagnant after a while, and declines in the long run. Evidence of rice production in Indonesia, and movement of cotton production and pesticide use curves in Pakistan (Fig. 1) demonstrate this.

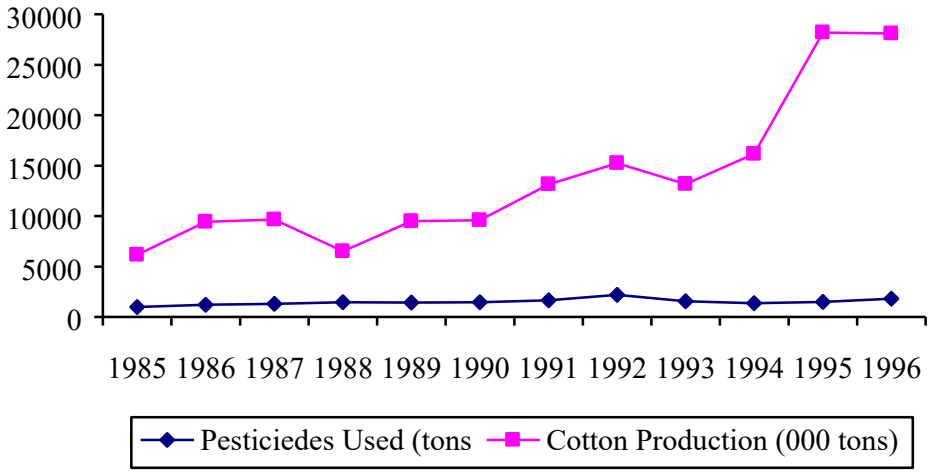
Fertilizer use has also increased manifold overtime (Table 3). Though exact data on fertilizer used on cotton is not available, it is estimated that about 60-70% of the total fertilizer used, is applied to cotton.

Table 3: Fertilizer Used (tonnes) During April-September (Cotton Season) in Pakistan

Season	Nitrogen	Phosphorus	Potash	Total
1991-92	1,462,620	398,007	23,299	1,883,926
1992-93	1,635,362	488,214	24,064	2,147,640
1993-94	1,659,354	464,258	23,174	2,146,786
1994-95	1,738,096	428,406	16,552	2,183,054
1995-96	1,990,852	494,447	29,671	2,514,970
1996-97	1,985,086	419,473	8,427	2,412,986

Source: Survey data, Cotton Commissioner office, MINFAL.

Figure 1: Pesticides use and Cotton Production



Source: Economic Survey 1996-97.

Constraints to Cotton Production

The national yield average of cotton (lint) is about 560 kg/ha, as against the potential yield of 1400 kg/ha. This represents a gap of about 60% and hence a potential of about US $ 2 billion extra income. The research and development focus should be to narrow down this difference between actual and potential yield by using good quality seed and better management practices, instead of using either environmentally hazardous technologies or increasing area under cultivation. Some causes of poor yield in recent times are examined below.

Pest Attacks

The reasons for the outbreak of white fly and CLCV are not completely known. However, based on similar experiences in other countries, it can be safely assumed that overuse of pesticides contributes significantly to its outbreak. For example, heavy use of DDT, methyl parathion and toxaphene (upto 38 applications per season) against bollworm *(Heliothis zea)* in El Salvador led to the resurgence of whitefly. Similarly, heavy use of DDT against jassid in Sudan resulted in resurgence of whitefly (Inayatullah *et. al., 1985).* The nymphs and pupae of white fly, stay on the underside of the leaf. Thus, sprayed insecticide can not effectively target the nymphs and pupae of white fly. This is one of the reasons for its poor control and resurgence.

The Cotton Leaf Curl Virus (CLCV) has been a constant threat to the cotton industry in Africa, whereas it had never been a problem in Asia (until recently) or the Americas. When Pruthi and Samuel (1939) conducted a detailed survey of Punjab, they did not report CLCV. The CLCV was first recorded in Pakistan in 1967 in Multan (Hussain and Ali, 1975) on a few cotton plants. According to Hussain and Mahmood (1988), untill 1986, the virus was observed only occasionally in Pakistan's cotton growing areas. During 1989 and 1990, however, the incidence of CLCV increased dramatically and caused a substantial loss ranging from 22 % to 68% in the affected fields in the Punjab (CRI, 1991). During 1990-91, the CLCV was reported on about 1,400 hectares. It spread to about 24,000 hectares during 1991-92, causing a loss of about 20,000 bales in production (Ali *et al.,* 1992).

Details of the incidence of CLCV in the Multan region for 1992 are given in Table 4. In this region, 3,642 farmers had virus affected cotton fields in an area of about 49,000 hectares, out of which 5,000 hectares were completely affected while 19,000 hectares were partially affected. In Multan, Khanewal and Vehari districts, the incidence of CLCV was upto 100% in some fields.

Table 4: Area Affected and Production Loss due to Cotton Leaf Curl Virus in Punjab (1988-1996)

Year	Affected Area (000 Hectares)			Loss in Production
	Partial	Complete	Total	(000 bales)
1988-89	--	0.06	0.06	0.3
1989-90	--	0.20	0.20	1.0
1990-91	--	0.80	0.80	4.0
1991-92	11.3	2.80	14.10	20.0
1992-93	364.0	121.00	485.00	750.0
1993-94	607.0	282.00	889.00	1880.0
1994-95	407.0	--	407.00	221.0
1995-96	882.0	--	882.00	447.0
1996-97	1623.9	137.40	17621.30	2100.0

Source: Survey data, Cotton Commissioner office, MINFAL.

Poor Quality of Research and Extension Infrastructure

It is often argued that the agriculture development institutions have been inefficient in providing advisory services to farmers, whereas, the pesticide industry is far better organised. Some of the larger companies maintain an effective R & D wing to support their activities. The industry also makes substantial investment to promote use of pesticides. But the electronic media is hardly used to relay any other methods of pest management. In fact, the current policy of pest control favours the use of pesticides rather than the development and implementation of IPM[1]. Research on biological control based IPM has been in progress[2] since 1971 at the PARC-IIBC station (currently named as CABI Biosciences Centre), Rawalpindi, but biological alternatives to cotton pest control are yet not widely practised. Therefore, extension agents are unable to provide farmers with an alternative to pesticide use even though it has been used successfully in other countries.

The pesticide companies impart extensive training to farmers for use of pesticides. The role of such companies in promoting the use of pesticides (for their own benefit) is tremendous. These companies maintain a database of their clients and send them information regularly on the damage caused by pests and pesticides. This is a highly organised sector. On the other hand, government departments (Agriculture Extension, Pest Warning and Pesticide Quality Control), though heavily staffed, are extremely weak in extending the requisite services.

Lack of Credit Availability

It is generally agreed that farmers, particularly small ones, do not have adequate savings to purchase farm inputs. Thus, they apply sub-optimal quantities of inputs and, quite often, fail to apply them in time. Lower doses coupled with delayed application result in low farm output. Credit availability, it is generally believed, can enhance farmers' capacity to purchase farm inputs well in-time and ensure timely

1. **Implementation of cotton IPM in Jiangsu province, China, resulted in the decline of pesticide use by 90%, and decrease of control costs by 84%. Similarly, implementation of IPM in Texas resulted in the decrease of pesticide use by 88% and an increase in net return of $ 77/ha. In Nicaragua, pesticide use has declined by 50%. In Togo, cotton IPM has resulted in the reduction of pesticide use by 50%, an increase in yield by 90-108%, consequently an annual saving of $ 11,000-13,000 per annum.**
2. **Seven year PL-480 project on boll-worms, 3 year PL-480 project on white fly and another project on IPM of cotton pests funded by ADB.**

application of farm inputs in optimal doses. It is all the more important for cotton where pesticide (Rs. 2815/ha) and fertilizer (Rs. 2165/ha) costs are very high.

Development banks allocate credit on the basis of expected future returns. The borrower is required to offer collateral. Unfortunately, this means that small and tenant farmers do not have fair access to credit. As sharecroppers do not own the land and virtually have no collateral to offer, they have almost no access to farm credit. They can only borrow from their landlords or from the private sector at a very high interest rates.

Production Cost

The current production costs of cotton per hectare, including land preparation, seed and sowing practices, irrigation, interculture, plant protection, fertilizer, picking, cutting of cotton sticks and marketing is Rs. 18,914 in Punjab. The estimated yield of seed cotton in Punjab is 1762 kg/ha (Table-6). The estimated costs and yields are relatively low in Sindh. The net cost of cotton cultivation per 40 kg at the market level is about Rs. 430 including land rent and Rs. 305 excluding land rent. The support price of different cotton varieties from 1990 to 1995 is given in Table 5, to compare the profitability.

Table 5: Minimum Support Price (Rs. per 40 kg) of Cotton in Pakistan

Season	Desi Cotton		B-557, F-149 and NIAB-78		Sarmast, Delta and MS-39	
	Seed cotton	Lint cotton	Seed cotton	Lint cotton	Seed cotton	Lint Cotton
1990-91	220	550	245	645	260	690
1991-92	255	662	280	715	290	745
1992-93	275	695	300	770	310	800
1993-94	290	726	315	801	325	831
1994-95	340	795	400	986	423	1055
1995-96	340	795	400	986	423	1055

Source: MINFA (1995)

Table 6: Cost of Production, Output and Net Profit per Hectare in Punjab

Cost of Production (Rs/ha)		Output and Net Profit (Rs/ha)
Land preparation:	1,370	**Yield/ha**
Seed:	640	1,762 kg or 44 md seed cotton
Irrigation:	1,422	
Labour:	400	**Income**
Interculture:	1,170	44 X 800 = 35,200 @ Rs. 800 per 40
Pesticides:	2,815	Kg Seed Cotton
Fertilizers:	2,165	
Management:	460	**Net Profit**
Land rent	5,500	35,500 – 18,914 = Rs. 16,286
Harvesting:	2,202	
Marketing cost:	770	
Total	**Rs. 18,914**	

Source: APCOM (Support Price Policy for Seed Cotton, 1996-97 crop)

The APCOM cotton policy indicates that the government, while fixing the minimum support price, keeps in view the cost of production and the international market so that the growers do not suffer. However, it does not take into account the costs of environmental degradation and natural resource-base depletion,

pollution abatement and rehabilitation of ecosystems. Market prices of cotton lint, thus, do not reflect the real costs of production.

Moreover, in the past, there was a marked difference between domestic and international prices. Pakistani growers receive far less than international prices, which contribute to the non-realisation of potential production. Since 1995, prices have been liberalised, and market prices and international prices have converged.

Environmental Damage

Changing Pest Complex

About 50 years ago, cotton jassid was a major insect pest problem on cotton. Fortunately, hairy varieties of cotton were found to be highly resistant to the jassid and solved this problem to a great extent. Cotton leaf roller was another important cotton pest but its incidence was higher in areas closer to forests or where vegetation was in abundance, because the pests breed on several wild hosts.

For the last few decades, pink and spotted bollworms were another major concern. Cotton whitefly used to rank fourth among major cotton pests. Now it is the most important. Use of pheromone traps and insecticides against the bollworms have considerably suppressed their densities. The American bollworm first appeared with the introduction of deltapine varieties of cotton in the late 1970s and early 1980s, and it is now a major cotton pest.

Extensive use of pesticides during the 1980s has further changed the pest complex. Cotton whitefly and, consequently, the outbreak of cotton leaf curl virus, has become common in the last few years. In addition, outbreak of cotton aphid has also become common. Although it does not inflict much loss in yield initially, it makes cotton lint black and covered with honeydew on which sooty mould fungus grows, thus affecting the quality of fibre.

Development of Resistance

The increased ability of plants to survive the affects of a toxic agent is brought about by genetic selection, either by direct exposure to the selecting agent or by cross resistance resulting from selection by some other toxic agent. The development of resistance is thus dependent on the genetic variability already present in a population or arising during the period of selection. The problem of resistance development was recorded about 80 years ago, however, it became widespread only during the last 40 years, following the discovery and extensive use of synthetic, organic insecticides and acaricides.

It is important to note that the development of resistance to commonly used insecticides has been studied only in two key cotton pest, viz., whitefly and American bollworm. There is no information available on the development of resistance in other pests like, jassid, aphid, pink bollworm, spotted bollworm and mites. Furthermore, the distribution of resistant population in the entire cotton ecosystem and its resistance level is not known. These important questions must be answered before designing any control strategy. Merely using more pesticides to control these pests will further aggravate the problem.

Loss of Biodiversity

Increased profitability in cotton as compared to other crops has led to in an increase in the area under cotton cultivation, thus affecting the density of other plant species at farm level and also in the natural ecosystem. Secondly, increased pesticide use is threatening the extinction of several benign species along with pests.

The indirect services provided by pollinators, parasites and predators to the farmers are tremendous but, usually, they are not accounted for. For example, Latif *et al.* (1960) reported that the honeybee *(Apis cerana indica)* is the most important pollinator of 'toria' *(Brassica campestris toria),* and yields of toria increases by 60% if pollinated by the honeybees. Wafa *et al.* (1971) reported that nectar collected from cotton plants sprayed 2-6 days before with prothoate, thiometon, phosphamidon and metasystox, when fed to the bees, proved highly toxic until after the 14th, 10th, 7th and the 5th day, respectively. Gardezi (1973) and Arshad (1995) also reported that application of pesticides affect the population negatively. Bees and other pollinators play a crucial role in the seed-formation of cross-pollinated crops.

Although no information is available on the direct effect of pesticides on the population dynamics of pollinators in the cotton region, some inferences are possible. In the cotton growing areas of Punjab, where 95-98% of the area is sprayed 4-6 times per year, one can imagine the effect of pesticides on pollinators and, thus, its impact on the yield of cross-pollinated crops such as oilseed, sunflower, cabbage, cauliflower, radish, onion, guava, citrus and phalsa.

Water Pollution

Very little work has been done on water pollution due to pesticides. The only study in this respect is that of Jabbar *et al.* (1993). They reported that the shallow groundwater (drawn from a depth of 10-13 m) in Samundari area (cotton area) was contaminated with pesticide residues. Monocrotophos was detected in the range of 0.04-0.06 ppm, Cyhalothrin traces up to 0.0002 ppm, and Endrin in the range of 0.0001-0.0002 ppm. Although these concentrations are within the limits set by the WHO, they indicate that the groundwater in cotton growing area is being contaminated with pesticides and the situation might become worse with time as the pollution in groundwater is difficult to abate.

Soil Pollution

Jabbar *et al.* (1993) reported that the soil of Samundri (cotton growing area) was found contaminated with pesticide residues. Monocrotophos and Cyhalothrin were detected in the top 25 cm of soil, whereas Dimethoate was detected at one site. The traces of Pyrethroids, Fenvalerate, Cypermethrin and Organophosphate Profenofos were present in the top 25 cm layer. The Organochlorine insecticide residues of Aldrin, Dieldrin, Endrin, p'-DDT and its metabolites p, p'-DDD and p, p'-DDE were detected in the lower 50-75 cm layers of the soil. The concentration of these compounds varied from traces upto 0.0096 ppm. In fact, all the studied soils were contaminated with pesticides. This data indicates that persistent Organochlorine pesticides had leached in the soil. Thus, these still must exist in the root zone, even though their use was banned a few years ago. The presence of these chemicals in the soil is a constant threat to soil micro-fauna.

Health Hazards

There is no regular program to monitor the health of workers involved in handling the pesticides. Several deaths, however, have been reported due to improper handling of pesticides. In 1982, 200 employees of the Department of Plant Protection, associated with the Flying and Engineering unit of their Aerial Wing, were checked for cholinestrase activity in their blood. Nearly 50% of them possessed low enzymatic activity (Rahman, 1982). Likewise, a WHO study indicated 2,500 cases of poisoning among 7,500 workers engaged in a malaria eradication program (WHO, 1979). In 1984, an epidemic of Endrin poisoning spread in 18 villages in Talagang. Acute convulsions were recorded in 194 of the affected persons. Children age, 1-9, constituted 70% of the reported cases. Nearly 10% (19 out of 194) patients died. The epidemiology of the outbreak indicated that a shipment of sugar was loaded in trucks that were previously used to ship pesticides in the Multan area.

Health standards of agricultural workers using pesticides are rarely monitored. In Pakistan, women are exposed to pesticide residues while picking cotton. A study conducted in 1992 at Multan revealed that out of a total of 88 females, cotton pickers, only 1% could be termed as out-of-danger, 74% had blood acetylcholinestrase (AChE) inhibition between 12-50%, 25% were in critical condition whose blood AChE inhibition was between 50-87%. According to Habib (1996), women cotton pickers complain of dizziness, cough, nausia, suffocation and blisters due to inhalation of fumes. Likewise, out of 33 male cotton workers studied, 12% were ranked out-of-danger, 51% had blood AChE inhibition between 12.5-50%, and 36% were dangerously exposed (AChE inhibition 50-87.5%). During 1987-88, 100 (96 men and 4 women) pesticide poisoning cases were reported at the Pakistan Medical Research Council, Research Centre, Multan.

Disposal of Pesticide Containers

Ideally, empty pesticide containers should be collected from the farmers and incinerated. Unfortunately, there are no such arrangements. The Agriculture Department and pesticide companies recommend that the containers should be buried in the soil. But this is also not an environmentally sound practice as the pesticides leach down and pollute soil groundwater. Over 90% farmers simply throw away the empty containers in their fields and some even reuse these containers.

Pesticide Residues in Oil/Seed Cake

During 1992, 250 samples of cotton- seed were analysed in the Federal Pesticide Laboratory, Karachi, out of which 179 (71%) were found contaminated with pesticides. Of these samples 39% had pesticide residues above the recommended maximum residue level (PARC, 1992). It is often reported, though not documented, that cattle sometimes refuse to eat cotton seed cake due to pesticide contamination. About 60% of the nation's oil requirements of the nation are met from cotton- seed oil, which means that the residues are also passed on to human bodies.

Obsolete Pesticides

It is estimated that about 5,000 metric tons of pesticides and about 3,000 metric tons of contaminated materials are present on 28 sites in Punjab and Sindh. Most of these stores are located in the Punjab, especially in the Multan division, as the bulk of pesticides are used on the cotton crop. About one dozen huge stores are situated in Sindh and nearly the same number also exist in Balochistan.

It is estimated that about 46,500 litres of liquid and 366,000 kg of solid pesticides are housed at the Malir site alone. Most of this stock was imported for use against cotton pests and belongs to the Government of Punjab. Area 9 contains approximately 1300 five-gallon containers of kelthane MF in an advanced stage of deterioration. Hundreds of 55-gallon drums (empty, partial and full) are scattered around the site.

Evidence shows that the material that has seeped out of the drums and bags has found its way into the groundwater. Studies conducted at HEJ Research Institute of Chemistry, Karachi, show that the groundwater around Malir is host of several pesticides and residual compounds. Likewise, in Sahiwal, soil around the pesticide warehouse is contaminated with pesticides. According to a USDA report, about 70 tons of various pesticides were wasted through leakage and container deterioration.

Land Degradation

The use of groundwater over a long time leads to increased soil salinity and alkalinity. The cotton crop is very sensitive to alkalinity. The optimum *p*H value for the cotton crop is 6.8-7.7 whereas the *p*H value of most soils in the Punjab ranges from 7.2-8.4. Thus irrigation by groundwater is aggravating the problem of soil salinity which is detrimental to crop growth. The long-term effects of this practice are quite

serious, but the unaware the farmers still continue with the same practice. Subsidised energy prices are also considered to be a factor contributing to the injudicious use of groundwater due to excessive use of tubewells.

Organic and Green Cotton

Cotton, though marketed as a 'natural product', has proved to be a 'sink' of the world's agro-chemicals. Eleven per cent of the world's fertilisers and defoliants, and 25% of pesticides are used in cotton fields, which represent less than 5% of the world's staple crop-growing area.

In Pakistan, herbicide use is not common and fertilizer use is still below average. Likewise, no defoliants are used as the produce is picked manually. However, the irrational use of insecticides is extremely high. Thus, there is a growing concern with producing cotton organically.

Organic cotton is grown without using synthetic inorganic fertilisers, fungicides, herbicides, insecticides, growth regulators and defoliants. Moreover, it is duly certified by recognised certifying organisations. It is sold at a premium price of about 20%. To get a certificate, it must be grown for a period of three years. A brief description of some on-going projects in different countries is given in Box 1.

Box1: Organic Cotton Around the Globe

Country	**Progress**
Argentina	During 1993, 6 ha were certified as organic, out of 16 ha sown.
Australia	The certified organic area in 1993 was about 700 ha. Actual yield was very poor and economically unsustainable due to high insect pressure.
Egypt	By using of different IPM techniques, 1,862 ha were grown without insecticides (not organic) in 1993. Local certification is not available yet.
India	During 1992, 687 ha were grown and certified by a company called SKAL on behalf of Bo Weevil. 572 bales of organic cotton were sold at a premium price of 22% over non-organic cotton
Turkey	25 ha in Izmir in 1993
USA	5,829 ha during 1993

The total area under organic cotton in the world is about 8,000 ha, 75% of which is in the USA, and rest is targeted to the USA market. In general, there is 10% increase in production cost of organic cotton over conventional cotton, due to land use for a longer time, more manual labour and expensive biological control agents. The yield loss is about 25% over conventional cotton. It is estimated that it will be impossible to grow organic cotton, unless it fetches a 43% higher price than conventional cotton (Technical Cotton Advisory Committee, 1994).

The already low use of agro-chemicals in Pakistan as compared to other countries and manual picking of cotton (machine picking requires sprays of defoliants) indicate that farmers in Pakistan might have a strong interest in organic cotton, provided adequate technical know-how is made available. Moreover, the export market for organic cotton products, like clothing and other high value added pro items, is emerging and could develop into an important niche market in the future. The high premium earned by organic cotton means that incentives exist for producers to change cropping patterns and the nature of agricultural production. The North offers a large market for organic cotton where consumer preferences have shifted towards less environmentally harmful products. Growers and manufacturers who wish to target this market, require technical and institutional support to meet

the standards of these important markets. Specific reforms are discussed in the section on policy recommendations.

In addition to organic cotton cultivation, there is a growing preference among consumers in the North to exclude chemicals, bleaches and dyes from the manufacturing process. Some chemicals used in the dyeing process are extremely hazardous. To accommodate these concerns, naturally coloured cotton is being cultivated on an experimental basis. The cotton genus *Gossypium* has 39 distinct species with a wide range of characteristics. Its colour ranges form white to beige, brown, reddish browns, greens, greys and mauve. The main drawback of wild coloured cotton is its short fibre length that makes machine spinning difficult. At present, there is not much production or consumption of naturally coloured cottons (also called green cotton). However, the USA is eagerly pursuing biotechnological research in this field.

Some countries like, Argentina, Brazil, Turkey and USA have already introduced the concept of organically grown cotton in their countries and have set up experimental production fields on a limited scale. Unfortunately, Pakistan has not considered this to be an option so far. Research and pilot projects in green cotton cultivation must be undertaken if we are to capture a share of the emerging market in naturally produced cotton, and chemical-free cotton products.

Policies

Agricultural Policy

Soon after independence, the Government of Pakistan decided to pursue import-substitution based industrial growth to broaden the narrow export base of primary goods. On the one hand, high tariffs and import controls coupled with an over-valued exchange rate were introduced to protect the industrial sector. On the other hand, commodity prices were kept below market prices, to provide industry with cheap raw material. This effectively turned the inter-sectoral terms of trade in industry's favour. According to Lewis (1970s), the ratio of the terms of trade between agriculture and industry was less than two-fifths, on average, in the first half of the 1950s. While the situation improved in the 1960s, it never exceeded two-thirds until the 1970s.

Explicit export taxes on cotton were first introduced in 1960-61 at the rate of Rs 75 per bale. However, keeping in view the over-valued exchange rate, cotton duties were reduced gradually and eventually abolished in 1966-67. Export duty was re-introduced in 1972-73 and remained in place, at varying rates, until 1995. The export duty on cotton ranged from 6% to 49% during the last decade. It is estimated that the export duty on cotton, as a percentage of prices, was 4% in 1980-81 but reached 44% in 1990-91, by far the largest increase in taxation of any raw materiel exports of Pakistan (Hamid, Nabi and Nasrin, 1990).

In the 1970s, the agriculture sector received more attention and a number of agricultural inputs including fertilizer were subsidised. The Cotton Export Corporation (CEC) was set up for voluntary procurement and export of cotton, and all cotton-ginning factories were nationalized.

However, the CEC retained its monopoly over cotton exports until 1986-87. Thereafter, the private sector was allowed to export cotton out of CEC stocks. Nevertheless, the CEC still maintained control over cotton exports. In 1993, the export of raw cotton was temporarily suspended due to the domestic crisis in cotton processing. This created great uncertainty in both the international and the

domestic markets and adversely affected the credibility of Pakistani exporters (Business Recorder, January 1, 1994).

Pricing Policy

The support price system was established in 1960. Initially the system only covered wheat. But in 1977, the Cotton Export Corporation (CEC) was created and the support price system was introduced for cotton lint and cotton seed (phutti). Initially, the level of support prices were set on an ad hoc basis. In 1981, the Agricultural Prices Commission (APCOM) was established with the mandate to establish support prices for agricultural commodities. Table 5 shows the trend in support prices of cotton seed.

The CEC was the monopoly exporter for cotton from 1973-74 to 1986-87. It bought cotton at local prices and sold it at higher international prices. This policy was combined with a tax on cotton export to ensure the availability of cheap raw materials to the Pakistani industry. This led to a transfer of resources from the agricultural sector to industry. Table 7 shows the barter terms of trade for agriculture. It clearly illustrates that the terms of trade have been consistently adverse to agriculture.

Table 7: Barter Terms of Trade for Agriculture & Sub-Sectors (1880-81 to 1990-91)

Year	Agriculture	All Crops	Major Crops	Minor Crops
1980-81	100.00	100.00	100.00	100.00
1981-82	111.08	113.75	107.42	132.20
1982-83	108.05	107.36	106.32	110.32
1983-84	107.10	106.73	99.61	123.40
1984-85	108.18	105.92	97.52	128.55
1985-86	103.88	99.14	94.74	111.28
1986-87	100.45	92.87	90.27	99.93
1987-88	105.73	95.36	89.80	111.43
1988-89	107.63	98.97	90.55	122.25
1989-90	101.20	90.27	88.90	93.95
1990-91	102.72	93.83	86.97	112.68

Source: Salam (1992).

In 1987-88, the private sector was allowed to export cotton out of CEC stocks. In 1988-89, cotton exports were further deregulated and private sector exporters were allowed to purchase directly from the open market. Currently both the CEC and the private sector handle cotton exports. Unlike the case of other crops, the CEC directly intervenes in cotton price stabilisation and acts according to government directives. Until 1995, private exporters followed government regulations and exported at the minimum export price (MEP) daily set by a government committee every day. Since 1995, cotton has been traded at international prices.

Input Pricing

Fertilizer

Since 1980, the government has successfully removed input subsidies. In May 1986, nitrogenous fertilizers were deregulated, in conjunction with the establishment of large and efficient urea plants based on low price natural gas. Due to the subsidy on energy, these plants have a much lower cost of production than international import prices. Thus, the domestic prices of phosphate and potassium fertilizers remain heavily subsidised despite the fact that all such subsidies had to be eliminated by 1985.

Pesticides

The active ingredients of pesticides are imported though some pesticides are formulated locally. Currently there are 20 pesticide formulation plants in Pakistan. Pesticide import began in 1954 with 254 metric tons of formulated products. By 1976-77, the import increased to 16,226 metric tons. Initially import and distribution of pesticides was the government's responsibility. Pesticides were used for controlling locusts, mosquitoes (malaria) and pests of cotton, sugarcane, rice and tobacco pests. All pesticides were distributed at a subsidised rate and aerial spraying was free of charge (Table 8).

Table 8: Pesticide-Usage Policies in Pakistan

Period	Policy
1947-65	Free of cost distribution by the public sector.
1966-74	From a flat rate of Rs. 0.25/litre to 75% subsidized price; distribution by the public sector.
1975-79	50% subsidy on ECs/WPs, 75% subsidy on granules; 25% distribution by the public sector, 75% by the private sector.
1980-85	Complete withdrawal of subsidy except in Balochistan; complete distribution by the private sector, except in Balochistan.
1986-91	Complete withdrawal of subsidy in all provinces, except in Balochistan; complete distribution by the private sector.
1992-93	Duty and surcharge exemption on herbicides.
1993	Duty exemption on pesticides.
1994	Banning of 21 environmentally hazardous pesticides.
1995	Liberalization of import and registration laws.

Source: Updated version of Ahmad (1988).

In 1980, with the transfer of pesticide business to the private sector, pesticide application increased linearly. In 1982, consumption was 5,000 metric tons and it increased to 23,212 metric tons in 1995. The sharp increase in cotton production in the late 1980s and up to 1992, is attributed mainly to the high use of pesticides.

The government has a strong influence over the pricing of pesticides. Currently an 80% mark-up on C&F process is charged. Repeated devaluations have increased the local prices of pesticides. In addition, the following taxes are levied on pesticides: import license fee (6%), surcharge duty (10%), iqra (5%), flood relief (1%), octri (3%), income tax (2%) and these amount to 27%.

The pesticide industry is governed by the Pakistan Agricultural Pesticides Act of 1971, which contains well-defined procedures of registration, formulation, sale and use of pesticides. But the penalty for adulteration in pesticides, as stated in the Act, is a mere Rs. 500. Adulteration in pesticides is a serious issue. Farmers often complain of poor quality pesticides. Despite this, the quality of pesticides is not monitored properly by the concerned departments. To control adulteration the government has warned that offenders will be fined one million rupees. But without an effective monitoring mechanism, quality control is hard to enforce.

Policies to regulate pesticide use have also varied with time. Pesticides were provided free of cost up to 1965; were subsidised at various rates up to 1991; subsidies were withdrawn from 1992; 21 environmentally hazardous chemicals were banned in 1994; and import and registration laws were liberalised in 1995. All policies encouraged the use of pesticides. As a result, pesticide use has increased manifold over time.

Irrigation

Proper water pricing is important to achieve greater economic efficiency and equity in the distribution of resources, conserve the quality of water resources, and ensure cost recovery. In theory, achieving economic efficiency in water pricing would mean that the unit charge should equal the marginal value product. However, in Pakistan, charges vary with the type of crop but do not have a systematic relationship with variations in the quantity of water consumed by different crops. The rate is calculated in line with cropped average of a given crop. It does not vary with distance from the source of supply, cost of water delivery and value of water. Even though water rates increased over the past decade, they did not increase in the same proportion as the value of agricultural commodities. Water is still considered a subsidised input (Table 9). Longmire and Debord (1993) estimated that the average social price of irrigation water is approximately double the current market value of water from tube-wells.

Table 9: Direct Input Subsidies, 1980-81 to 1990-91, Rs. in Millions

Year	Fertilizer	Tube-wells	Plant Protection	Seed	Electricity	Irrigation
1980-81	2448	20	62	44	-87.55	466.1
1981-82	1750	24	/	8	-10.61	615.8
1982-83	1948	24	/	8	-100.06	734.2
1983-84	1466	16	/	/	152.86	954.8
1984-85	1500	16	/	/	102.66	287.2
1985-86	2409	16	/	/	15.66	1520.1
1986-87	1286	18	/	/	374.89	1821.3
1987-88	1995	10	/	/	1112.12	1895.7
1988-89	2415	/	/	/	1138.92	1974.2
1989-90	1257	/	/	/	1330.06	2392.6
1990-91	1248	/	/	/	2044.97	2903.72

Source Table 1-6: "Agricultural Prices Study", John Mellor Associates.

In addition to the existing low water charges, the collection system is inefficient and corrupt. Some farmers, with the help of *Patwaris*, under report the cultivated area, and/or substitute higher rated crops with lower rated ones in the records. This results in reduced revenues and, therefore, inadequate expenditures on maintenance. It also affects the efficiency of the irrigation system.

Electricity

Electricity has been provided at a subsidised rate since 1983. The subsidy increased from 12.39% of total cost in 1980-81 to 39.02% in 1991. It is often argued that this subsidy has caused price distortions that have led to over-consumption and thus caused a negative impact on the environment. The subsidy distorts in the relative price of operating a tube-well in comparison to other water resources. It has encouraged farmers to sink more tube-wells. In many areas, tube-well water is not suitable for irrigation. As mentioned earlier, over-use of tube-well water often damages soil quality in the short-run, makes the soil unfit for cultivation in the long-run.

Seed

The non-availability of good quality seed and poor extension services are major constraints to cotton production. In 1989-90 the supply of improved seed varieties of cotton was deficient by 81.3% (John Mellor Associates and Asianics, 1993). Even though the government sponsored seed organisations in Punjab and Sindh, 80% farmers use their own seed, 15% buy from a local market and only 5% get

seed from government organisations. A modest subsidy on cotton seeds was provided in the 1970s which was abolished in 1983-84.

Policy Recommendations

Over the past two decades, most developing countries have moved from restrictive trade regimes designed to encourage import substituting industrialisation to more open policies which focus on removing policy and price distortions to increase efficiency. In Pakistan, the liberalisation process has begin only recently. Therefore, a stable and focused set of policies that can respond to the changing needs of both the domestic industry and the international market have not been developed so far.

Global policies, such as the ATC, are perceived to have far reaching consequences on the pattern of demand for cotton and cotton manufactures. Under the ATC, quota restrictions on Pakistan's textiles exports are being lifted, and the free import and export of cotton is being allowed. The combination of these policy decisions will determine the demand for Pakistani cotton that in turn will affect the returns received by cotton producers. It is expected that trade liberalisation will lead to an increase in both domestic and international demand for Pakistani cotton products. Consequently, the upward trend in the price of cotton lint will continue.

Two scenarios emerge from the present situation. First, existing resources will be further exploited through greater use of pesticides and fertilizers. Second, increased incomes from cotton production can be used to fund research and investment in more environmentally sound technologies in both agriculture and industry. In the beginning, even both can happen simultaneously.

Input Subsidy Policy

At present, both water and energy are heavily subsidised, which has led to the inefficient use of these scarce resources. If water rates are increased to cover operational and maintenance costs, the irrigation and drainage system will become a lesser burden on the public purse. This will also encourage the optimal use of this scarce resource. In Pakistan, water is scarce in terms of both quantity and quality. Clean water is an important industrial input. If water becomes an expensive input, there will be greater reluctance to degrade it. Moreover, rationalisation of energy prices will force users to optimise their consumption of electricity and encourage energy conservation that will reduce production costs and increase competitiveness. Higher energy prices will also reduce the number of tube-wells as their operation will no longer be cost effective in areas where alternative water resources are available. This will in turn reduce the use of groundwater.

Reduction of subsidies raises the question of equity as it is perceived as an increase in the economic burden of the poor. Water subsidies are calculated using the difference between expenditure and receipts of the irrigation department. This calculation implicitly assumes that i) these figures are reported correctly, and ii) benefits from increased expenditure accrue to the agrarian sector. In reality, expenditures are over reported and receipts are under reported. Surges in irrigation expenditure can also be attributed to over staffing in government departments, salary increases and ‘illicit practices’ (Chaudhry & Sahibzada, 1995). Therefore, a reduced expenditure on water subsidies does not necessarily mean a huge increase in prices for the poor. Institutional reforms are required to ensure that the larger land owners also pay for the use of water and electricity. In addition, the community organisations, such as local irrigation groups must be empowered to counteract the discretionary powers of government departments and establish some kind of accountability.

Technical Reforms

Integrated Pest Management (IPM)

Cotton IPM has been successful in several countries, such as USA, China, Australia, Mexico, Colombia, Nicaragua and Brazil. Using a mix of chemicals, biopesticides (BT), pheromones and natural predators and parasites, these countries have arrested the growth of pests. In China, pesticide use on cotton has declined by 34% and yields have increased. The Chinese strategy included: planting of sorghum between cotton plants to attract natural enemies of cotton pests, changing tillage practices and selectively applying chemicals in the lowest effective doses. In Mississippi, because of the use of IPM, the increase in net returns was $ 122/ha (statewide return $ 29.68 million) whereas it was $ 282/ha in Texas (statewide return $215.83 million). Pesticide use in USA has dropped by 75% (6.63 kg/ha in 1971 and 1.68 kg/ha in 1982) because of strict adherence to the policy of IPM (World Watch Institute, 1987).

Inayatullah *et al*. (1985) have reported a number of pesticides which are least harmful to parasites. The integrated control of whitefly by the use of least harmful chemicals and releases of parasites is practised in many countries. It is anticipated that farmers will take some time to shift from chemical control to IPM, provided the IPM program, at the smallholder level, is initiated on a large scale. More technical research is needed to establish effective and timely, yet eco-friendly, methods of pest control. This research should focus on the following:

1. The development of varieties resistant to key pests. The model of IPM should be built around the resistant variety.
2. The development of weather and pest forecasting models to estimate crop production and timely treatment of pests. The model of pest control should keep in view the intrinsic rate of increase of pests, cost of control and market value of the produce.
3. Alternative methods of pest control.
4. Farm practices or rotation of crops that encourage natural enemies.
5. Training of farmers for pest and natural enemy identification.
6. Use of economic threshold levels to shift pest control from calendar-based treatment schedules to need-based schedules. Farmers must be made aware of consequences of the misuse of chemical inputs.
7. Use of insect attractants and pheromones.
8. Proper training of farmers in the use of pesticides.
9. Program to monitor pesticide residues in soil, water, and cotton seed.
10. Development of a pesticide database.

Biotechnology

The Nuclear Institute of Biotechnology and Genetic Engineering (NIBGE), Faisalabad, is conducting research to identify CLCV and develop varieties resistant to it. A special research program should be initiated to conduct research on genetic engineering. Transgenic lines, developed through genetic engineering in the USA, are resistant to American bollworm and herbicides (Box 1). Likewise, through genetic engineering, seven lines of cotton have been developed which have naturally coloured fibre. The use of naturally coloured cottons reduces chemical requirement in the dyeing process. Naturally coloured cottons are being sold at a premium price in the market, although not on a large scale. This type of research must be initiated in the country on a priority basis.

Crop Forecasting

The uncertainty in crop production, its non-availability in the domestic market, and, instability of yarn prices is reflected in poor trade. During the recent ‘Heimtextile Fair’ (held in Germany, January,

1995) in which buyers from 60 countries participated, Pakistani traders failed to get any significant supply order because of their inability to quote a price (The News, January 16, 1995). Inaccurate estimates of cotton production create a great deal of uncertainty in the market which affects the textile sector and the credibility of both government and exporters. SUPARCO and the Agriculture Department should collaborate to develop a crop forecasting system using remote sensing techniques.

Administrative

Pesticides

The present condition of pests, the use of pesticides and non-implementation of the Pakistan Agricultural Pesticides Act, 1972, indicate the need to establish an independent Pesticides Monitoring Authority with 50% membership from NGOs. This authority should be responsible for:

- The annual review and de-registration of ineffective pesticides.
- Quality control of pesticides.
- Registration of dealers.
- Maintenance of poison control centres.
- Biological monitoring of poisoning.
- Co-ordination among government departments.
- Monitoring of occupational health and safety in pesticide formulation plants.
- Environmental monitoring of pesticide formulation plants.
- Incineration of used pesticide containers and expired pesticides.
- Review of the present pesticide import policy (see below)

Privatisation of Research

In Pakistan, agricultural research and extension is sponsored and conducted by government agencies. An array of problems, financial, political, parochial and lobbying, exist in many institutions that ultimately affect the efficiency of these departments. For instance, research on mechanical picking of cotton, development of varieties resistant to heat, water-logging/salinity, pest forecasting and IPM, maintenance of quality of cotton and information on export opportunities is seriously lacking. Lobbying of people having interest in pesticide sales has hampered the research on pest forecasting and integrated management (IPM). Despite having heavily funded projects on cotton pest management from international agencies (since 1970s), IPM for cotton pests is almost non-existent.

NGOs can play a significant role to promote cotton production and assure higher profit to the growers. For instance, the Farmers Associates of Pakistan (an NGO) has successfully fetched the international price of cotton. This has increased the profitability of growing cotton that resulted in increased production during the current cotton season. In other countries also various crop growers associations, fund research projects of pressing needs. The growers associations should be mobilised to fund and monitor research projects on issue like IPM, development of transgenic lines, crop and price forecasting.

Quality Control

Pakistani fibre is known for its good quality and strength. However, its intrinsic qualities suffer from improper grading and the lack of standardisation of lint. The country suffers estimated losses of about 10-20% of the true commercial value of its raw cotton exports because of poor quality control and the inability to adequately separate cotton lots according to grade and staple length. The Pakistan Cotton Standard Institute has initiated a campaign to educate growers, ginners and textile mill-workers to ensure quality control. The institute emphasises that the price of cotton should be based on the fibre's staple length rather than on variety. Pest attack and bad weather can significantly affect

these fibre characteristics which are of commercial value. Those buying directly from the producer, i.e. the ginning factories, should buy according to quality and not weight of raw cotton.

Textile Industry

The textile industry in Pakistan is the largest and most important sub-sector of the economy. Currently, it employs 40% of the industrial labour force. It generated approximately 60% of total export receipts in Pakistan in 1995-96 (Economic Survey, 1996-97). The majority of this revenue is earned by exports of yarn (31.9% in 1994-95, 28.1% in 1995-96) and cotton cloth (23.6% in 1994-95, 22.1% in 1995-96). The higher value added products like ready-made garments make up 11.4% of export receipts. It contributes 17% to the total value addition in large scale manufacturing. It is also a major source of revenue and contributes 6% to the national exchequer in the form of direct taxes (Finance Division, 1994). Its value of fixed assets accounts for 19% of the total industrial assets. Other industry specific statistics are provided in Table 10.

Table 10: Main Statistics of Textile Industry

	1992-93*	1993-94**	1996-97***
Number of Units	**319**	**342**	**440**
Spinning	274	293	392
Composite	45	49	48
Closed Units	38	62	80
Installed Capacity	**6,650,028**	**7,055,209**	**8,447,264**
Spindles	6,549,028	6,944,203	8,293229
Rotors	86,468	97,361	143,960
Looms	14,556	13,645	10,75
Capacity Worked	**5,731,711**	**5,652,305**	**6,702,870**
Spindles	5,650,170	5,573,380	6,610,953
Rotors	74,171	72,888	87,050
Looms	7,370	6,037	4,867

Source: Textile Commissioner's Organisation
Note: * as on December, 1992; ** as on December, 1993;
*** as on August, 1997

In 1993, there were 991 ginneries (88 in Sindh and 903 in Punjab) and 281 textile mills (Sindh 86; Punjab 173; Balochistan 8; NWFP, 9; AJK, 5) in working condition in the country (PCCC, 1994). The textile sector is a catalyst for industrial growth through its spin-off effects. From being a producer of low quality yarn and grey cloth, it has now moved to fairly higher quality counts, hosiery, garments and made-ups. However, there is still room for improvement as the country has failed to graduate to the production of fine and superfine quality cotton yarn.

During 1993-94, the textile industry suffered a serious setback. The production of yarn increased only by 3% as compared to a 7% increase in the last year. The production of cloth (mill-made) declined by 3.2% (Table 11). This was attributed to the interaction of both domestic and international factors including: (i) low crop production against the estimated production of 12 million bales, (ii) global shortage of cotton, and (iii) increase in domestic price of lint cotton over the previous year (Rs. 2,700/kg vs. Rs. 950/kg). The textile industry suffered due to the uncertainty about production estimates, untimely and short-term reversible policies regarding the export of raw cotton; lack of information about quotas and export guidelines; and vested interests of certain groups.

In May to December 1994, shortage of raw cotton led to the closure of about 150 textile mills and 70% of the power looms and hosieries. Consequently, thousands of labourers became unemployed. The price of cotton in the domestic market increased from Rs. 850 to Rs. 2,700 per 40 kg. In January 1995, the Cotton Export Corporation imported raw cotton from USA at the rate of US $ 1,500 per ton to meet domestic demand.

Table 11: Total Production of Cotton Yarn and Cloth, 1980-81 to 1995-96

Year	Total yarn produced 000 kg	% increase over previous year	Total cloth produced 000 sq mtr	% increase over previous year
1981-82	430,154	14.72	325,021	5.57
1982-83	448,430	4.25	335,537	3.24
1983-84	431,581	-3.76	296,596	-11.61
1984-85	431,731	0.03	271,831	-8.65
1985-86	482,186	11.69	253,480	-6.75
1986-87	586,371	21.61	237,879	-6.15
1987-88	685,031	16.83	281,620	18.39
1988-89	757,903	10.64	269,862	-4.18
1989-90	911,588	20.28	294,839	9.26
1990-91	1,041,248	14.22	292,911	-0.65
1991-92	1,170,736	4.12	307,933	5.13
1992-93	1,218,975	7.44	325,396	5.67
1993-94	1,309,622	3.04	314,914	-3.22
1994-95	1,369,715	1.05	321,841	-7.78
1995-96	1,464,932	1.07	327,032	1.02

Source: Economic Survey 1996-97.

Costs and returns in ginning, spinning, weaving, and cloth finishing are given in Table 12. In ginning, returns to investment are lowest in the chain. Ginners get Rs 1.2 for each rupee they invest, while in manufacturing they earn Rs. 1.7 for each rupee invested. Statistics show that Pakistan is the most efficient in weaving, thanks to cheap labour and low interest rates (Textile Commissioner Office, 1995).

Table 12: COTTON ECONOMIC PROFILE (Channel wise in Rs.)

Cost of Production Rs/ha		Output & net Profit Rs/ha	Ginning per 1,762 kg S. cotton	Spinning Per 581 kg lint	Weaving per 500 kg yarn	Processing per 5,801 M2 cloth
• **Cost at farm level:** Land preparation: Seed: Irrigation: Labour: Interculture: Pesticides: Fertilizers: Management: Land rent: Harvesting: Total Rs. • **Marketing Cost:** • **Cost at Market/** Ginnery: Rs.	1,370 640 1,422 400 1,170 2,815 2,165 460 5,500 2,202 18,144 (44x17.5)=770 18,914	**Yield/ha:** 1,762 kg or 44 md seed cotton **Income/ha:** 44 * 800 = Rs. **35,200** @ Rs. 800/ 40 kg seed cotton **Net Profit:** 35,200 - 18,914 = Rs. **16,286**	**Cost:** • Seed cotton: 35,200 @ Rs. 800/ 40 kg s. cotton • Ginning cost: 3,084 @ Rs. 70/ 40 kg s. cotton • Sale commission: 1,188 @ Rs. 27/ 40 kg s. cotton Total cost: Rs. **39,272** **Income:** (1,762 kg s. cotton = 581 kg lint + 1162 kg Cotton- seed + 18 kg waste) • Value of 581 kg lint = Rs. 36,312 @ Rs. 2500/ 40 kg lint • Value of 1162 kg C .seed = Rs. 8,715 @ Rs. 300/ 40 kg lint • Total income:Rs. **45,028** **Net Profit:** 45,028 - 39,272 = **5,756**	**Cost:** • 581 kg lint: 37,765 @ 2,600 per 40 kg lt. • Spinning cost: 2,286 @ 669/bale (170 kg) Total cost: **40,051** **Income:** (581 kg lint = 500 kg yarn + 81 kg waste) • Value of 500 Yarn = **46,256** @ 420/yarn bundle (4.54 kg) **Net Profit:** 46,256 - 40,051 = **6,205**	**Cost:** • 500 kg yarn: 53,965 @ 490/yarn bundle (4.54 kg) • Weaving cost: 16,740 @ 152/yarn bundle (4.54 kg) Total cost: **70,705** **Income:** (500 kg yarn = 5,801 M2 grey cloth of size 76X76/40X60) • Value of 5,801 M2 grey cloth= **104,418** @ 18/ M2 grey cloth **Net Profit:** 104,418 - 70,705 = **33,713**	**Cost:** • 5,801 M2 cloth = 1,16,020 @ 20/ M2 grey cloth • Processing cost = 46,408 @ 8/M2 cloth Total cost: **162,428** **Income:** • Value of 5,801 M2 finished cloth = **174,030** @ 30/ M2 finished cloth **Net Profit:** 174,030 - 162,428 = **11,602**

Source: Survey data, SDPI (1997-98) Sustainable Cotton Project WWF/SDPI Page 20

Environmental Risks Associated with Cotton Production

A finished product is produced after the chemical and mechanical treatment of raw cotton. Waste chemicals from the process or those washed from finished textiles, constitute a major source of pollutants. The SDPI has recently conducted an environmental examination of the textile industry in Pakistan (SDPI, 1995) which showed alarming results. The worst example is Lahore, where several textile units are located along the canal at a distance of approximately 5 km from Thokar Niaz Beg. The survey revealed that these units use numerous dye formulations and colorants, oxidizing and bleaching agents which pollute the air, water and soil. Colours and toxic effluents are discharged into the canal throughout the year. The characteristics of textile effluents released by various sections of the textile industry are given in Table 13. The extent of pollutants produced by a standard textile mill of 50 tons/day fabric capacity is given in Table 14. A description of important abnormalities is given below:

***p*H:** The pH of effluents, produced by different sections of textile processing varies from 8.2 to 9.84 (Table 15). Various standards allow *p*H in the range of 6 to 10.

Temperature: The main drain effluent temperature is 52^{O}C. The acceptable limit set by NEQS and other international standards is 40^{O}C.

BOD (Biological Oxygen Demand): The amount of oxygen consumed during degradation of organic materials present in any effluent is called the BOD. The depletion of dissolved oxygen is detrimental to the survival of fish and other aquatic life. The measured level of BOD in textile effluents is 112 to 120 mg/l. By international standards, the acceptable range is 30 mg/l to 100 mg/l.

COD (Chemical Oxygen Demand): COD is the amount of oxygen required to chemically oxidize organic substances in an effluent. High COD, causes death of most aerobic organisms including fish. The level of COD in textile effluents is 430 to 480 mg/l. The acceptable range set by the Pakistan and Indian standards is 150 mg/l to 250 mg/l.

TSS (Total Suspended Solids): Suspended solids are non-filterable residues. Suspended solids threaten many aquatic organisms. The measured TSS level was 25 mg/l to 1200 mg/l. The acceptable range is 77 mg/l to 200 mg/l, by international standards.

TDS (Total Dissolved Solids): TDS is a measure of the total inorganic salts and substances dissolved in water. Higher levels adversely affect fish and other aquatic life and make water unfit for drinking. The measured level is 2,300 mg/l to 3,600 mg/l. The acceptable range set by international standards is 2,100 mg/l to 3,500 mg/l.

Sulphide: The measured level of sulfides is 0.07 mg/l to 15 mg/l. The un-treated liquid effluents from woven fabric finishing generally contain 3 mg/l. The acceptable range set by the international standards is 1 mg/l to 2 mg/l.

Phenol: Phenolic compounds, when combine with chlorine, produce an extremely foul taste and odour and are suspected to be carcinogenic. Phenols were not detected in the effluents. The acceptable range set by International standards is from 0.9 mg/l to 1 mg/l.

Chromium: Hexavalent causes cancer in the human digestive tract. Chromium was detected in the range of 0.05 mg/l to 0.30 mg/l in the effluents. The acceptable range set by the International standards is 1 mg/l to 2 mg/l.

Table 13: Environmental Characteristics of Untreated Effluents Produced from Different Sections of Textile Finishing

Process	Temp (^oC)	*p*H	BOD (mg/l)	COD (mg/l)	TSS (mg/l)	TDS (mg/l)	Sulphide (mg/l)	*Cr.* (mg/l)
Desizing	75	9.70	59	136	10	1000	0.18	-
Bleaching	60	9.80	191	729	18	982	0.2	-
Mercerizing	-	-	-	-	-	-	-	-
Dyeing	50	9.84	191	714	19	2235	0.26	0.02
Printing	25	8.2	310	1171	42	819	0.21	0.04
Main Drain	52	9.13	120	480	25	2300	0.07	0.05

Source: SDPI, 1995.

Table 14: Quantities of Untreated Effluents Produced from Different Processes of the Textile Finishing Section (capacity 50 tons/day)

Process	Flow (m^3/day)	BOD (tons/day)	COD (tons/day)	TSS (tons/day)	TDS (tons/day)	Sulphide (kg/day)	*Cr.* (kg/day)
Desizing	168	0.01	0.02	0.002	0.17	0.03	-
Bleaching	289	0.06	0.21	0.005	0.28	0.06	-
Mercerizing	121	-	-	-	-	-	-
Dyeing	504	0.10	0.36	0.01	1.13	0.13	0.01
Printing	168	0.05	0.20	0.007	0.14	0.04	0.01
Main Drain	1488	0.18	0.71	0.04	3.42	0.10	0.07

Source: SDPI, 1995.

Fibre dust originates during ginning, spinning and weaving operations, if the source equipment is without filters or other devices. According to Malmberg (1985), cotton-dust can cause acute and chronic diseases (chest tightness, cough, fever and decrease in pulmonary functions). The aggregate of symptoms is named byssionosis. The dust from the card room is most dangerous, followed by the dust from spinning and weaving areas of a cotton mill. According to the SDPI survey (1995), the yarn spinning sections of the larger mills are equipped with auxiliary waste recovery units, therefore, cotton-dust emissions do not pose any threat to workers' health. However, in the smaller textile mills where processing units are not equipped with auxiliary units, workers are exposed to dangerous levels of contaminated air. Aziz *et al.* (1992) reported the frequency of byssionosis in 276 workers from 5 ginning factories of rural Sindh. Twenty-four (8.7%) had byssionosis, 178 (64.5%) were asymptomatic and the remaining 74 (26.8%) had other respiratory problems.

Table 15: Contamination Levels (mg/litre) and NEQS for Textile Effluents

Parameter	Measured Level	NEQ Standard	World Bank Guidelines	Indian Standards		Indian	US EPA Standards
				Inland Surface	Onland irrigation	Standard for Cotton Textile	
*P*H	8-9	6-10	6-9	5.5-9.0	5.5-9.0	5.5-9.0	6-9
BOD	112-120	80	58	30	100	150	58
COD	430-480	150	524	250	-	-	524
TSS	25-1200	150	157	100	200	100	157

Continued…

Parameter	Measured Level	NEQ Standard	World Bank Guidelines	Indian Standards		Indian	US EPA Standards
				Inland Surface	Onland irrigation	Standard for Cotton Textile	
TDS	2300-3600	3500	-	-	-	-	-
Total chromium	0.05-0.30	1	0.90	2	-	2	0.9
Phenol	ND	0.1	0.90	1	-	1	0.9
Sulphide	0.07-15.0	1	1.75	2	-	2	1.75
Temperature (^{o}C)	52	40	5+ambient	40	40	40	5+ambient

Source: SDPI, 1995.
Note: The World Bank Guidelines calculated for all parameters are based on 1,488 m3/day, for 13 tons/day of cloth production.

In the un-organized sector, thousands of power looms are installed in residential areas. For instance, in Faisalabad, hardly any measure is taken to avoid exposure to cotton-dust. Likewise, in Multan region, where several ginneries are in operation, respiratory diseases are quite common. Ghayur and Zar (1993) surveyed the working conditions in 28 textile mills [62% of the All Pakistan Textile Mills Association (APTMA) members] in the organized sector at Karachi. They reported regular medical check-ups and vaccinations of mill workers are common practices, but further attention to worker's health and safety is negligible. Furthermore, they reported that protection against dust and fumes, adequate humidification and eye-protection is absent among the workers.

The yarn spinning machinery in Pakistan is of German, British and Japanese origin. It is equipped with self-contained waste recovery units that reduce particulate emission and health risks to workers. Moreover, they not only improve the working environment, but also add to the profitability of the company. However, small textile units in the unorganized sector do face a serious air pollution problem. Workers at these units are exposed to dangerous levels of contaminated air.

At present, the textile units (except a few) in Pakistan do not have any facility to treat their effluents. They discharge all their effluents into a main drain. This main drain flows through villages and eventually falls into rivers. These drains are also a source of irrigation water for the farmlands located downstream. Thus the pollutants also contaminating the soil.

Cleaner Textiles Production

SDPI (1995) conducted a study of environmental problems caused by the textile industry. Based on its results, the Institute recommends that the industry would do well to invest in primary and secondary treatment plants to reduce BOD and COD levels in their effluents. However, since chemicals and dyes do not, as yet, pose a major threat to the environment, the industry could postpone investment in tertiary treatment plants for their recovery. This would reduce the immediate investment burden on the industry, keeping in view the prohibitive costs of installing tertiary treatment plants. The long-term option would be to invest in environmentally sound technology based the use of natural dyes and which aims to eliminate bleach.

The study also estimated the installation cost of effluent treatment plants. A mill of 15 tons/day production capacity (20 million meter of finished fabric per day) requires a plant for primary and secondary treatment to remove suspended solids, BOD, COD and reduce toxicity and colour. This will cost Rs. 39 million i.e. about 2.5% of the total investment in a new textile dyeing, printing and finishing line of similar capacity (total cost of Rs. 16,000 million). On the one hand, this plant will raise the cost of

production by Rs. 0.52 per meter (about 0.9% of the total cost). On the other hand, it will reduce BOD level up to 94%, COD level up to 80% and partially reduce toxicity and colour removal (Table 16).

The SDPI (1995) further worked out the cost of effluent treatment plant considering four options: (i) 60% duty and taxes on imported machines, (ii) no import taxes, (iii) loan at 13% mark up (against 16% in the market) for locally manufactured machinery, and (iv) 100% grant case. The capital cost for first three cases was Rs. 38.75, Rs. 32.24 and Rs. 27.76 million, respectively. The annual operation and maintenance cost of treatment plant ranges form Rs. 2.91 to Rs. 3.14 million. The average incremental cost per unit of production is Rs. 0.52, Rs. 0.45, Rs. 0.38 and Rs. 0.16 per meter, respectively, for case (I) through (iii) (Table 17). The cost per unit of production is calculated on the basis of 20 million meters of finished product per year. The government instead of imposing taxes on effluent treatment plants, should provide credit to the industry for this purpose. Support should be provided to install common effluent treatment plants for industries located in the same area.

Table 16: Recommended Technology Options for the Installation of Textile Effluents Treatment Plant

Options No.	Process	Cost for 15 TPD Textile Mill (Rs. Million)	Result of Treatment
1	Primary and Secondary Treatment	39	• Reduction in BOD level upto 94% • Reduction COD level upto 80% • Partial reduction in toxicity and color removal
2	Tertiary Treatment	Not available	• Reduction in BOD level upto 94% • Reduction COD level upto 90% • Reduction in toxicity and color to meet the standards

Source: SDPI, 1995

Table 17: Summary of the Financial Analysis for the Installation of Textile Effluents Treatment Plant

	Base Case	Case 1	Case 2	Case 3
	60% duties & taxes on imported machinery	No duties & taxes on imported machinery	Interested rate reduced from 16% to 13%	100% grant to cover capital cost
Capital Cost (Rs. Million)	38.75	32.24	27.76	0.00
Increase in cost of production (Rs. Million/year)	10.42	9.05	7.70	3.14
• Financial charges	7.28	6.06	4.79	0.00
• Operating & Maintenance cost	3.14	2.99	2.91	3.14
Average incremental cost per unit of production (Rs./ meter)	0.52	0.45	0.38	0.16

Source: SDPI, 1995
Note: Basis for calculation of cost per unit of production: 20 million meters of finished cloth per year.

Present Textile Policies

The import-substituting industrialisation policy favoured by the government insulated the price of raw cotton from international prices and gave the textile industry a guaranteed source of raw material at a price well below the international price. John Mellor (1994) estimated that the average price of cotton in

Pakistan was 65% below the international price and 25% below the export parity price from 1984 to 1994[3].

Although 1987 heralded a trend towards de-regulation, a major policy change was only adopted in the Seventh Five Year Plan (1988-1993). The Seventh Plan was strongly influenced by the requirements to meet the IMF conditionalities of process and exchange rate rationalisation. Consequently, cotton prices were raised (Table 18) and traders were permitted to export cotton at the international market price to encourage competition and efficient resource allocation. Import liberalisation measures were introduced to allow Pakistan's textile industry to improve the quality of its exports by importing better quality raw materials. However, 5% regulatory duty on cotton imports, with no equivalent duty on exports was imposed to increase government revenue.

Table 18: Index of the Wholesale Price of Cotton (1980-81=100)

Years	Wholesale price index of cotton
1984-85	121.65
1985-86	107.5
1986-87	114.04
1987-88	126.95
1988-89	133.07
1989-90	155.1
1990-91	176.56
1991-92	184.26
1992-93	204.95
1993-94	309.62
1994-95	391.42

Source: Economic Survey, 1995-96

In December 1993, the Task Force on Agriculture proposed to deregulate the cotton market. The industrial lobby opposed liberalisation of the raw cotton market, but the agriculturist lobby, headed by the Chair of the Task Force, won the day. Therefore, since 1993, cotton prices are determined by market.

These policies led to a sharp increase in domestic cotton prices leaving the Pakistani textile industry without a cheap domestic source of raw material. In addition, the import duty on cotton rendered imported cotton more expensive for the domestic industry. The hitherto protected textile industry was thrown into turmoil and so far has remained unsuccessful in adjusting to the changed domestic and international environment.

Moreover, within the textile sector, government policy has favoured spinning units against weaving and processing units. Most of the DFI credit (over 50%) has rendered the processing and finishing sectors unattractive. Despite this undue advantage, the spinning sector has failed to produce fine and superfine counts of cotton. The majority of spinning units produce coarse and medium counts of yarn. The latter category comprises 80% of the total yarn production in the country. Import duty on fine quality yarn has impeded the manufacture of high value-added products. Pakistan, thus, has remained a producer of low quality manufactures and garments.

3. **The substantial difference between the export parity and international price is a result of the abnormally high transaction costs imposed by poor infrastructure, especially in rural areas, and a historical lack of competition in the marketing of cotton.**

The All Pakistan Textiles Mills Association (APTMA) attributed the current crisis in the textile industry to the increase in cotton prices. However, other factors like plant and machinery obsolescence, high production costs due to high financial charges, inefficient management engendered by years of protectionism, high utility prices and interest rates, have made the textile sector uncompetitive.

In 1995, the government introduced an incentive package to revitalize the ailing textile industry. The package included the following: zero tariff for the import of raw material; loan rescheduling; export rebates and duty drawbacks; freight concession up to 50%; streamlining of export procedures; and exemption from export development surcharge. To date, the incentive package has failed to spark the desired recovery in the textile industry. In 1996, the interim caretaker government of Malik Meraj Khalid announced a new textile policy package. The salient feature for the cotton and cotton-based textile industry was the withdrawal of 5% import duty on cotton (Business Recorder, November 24, 1996).

Recommended Textile Policies

Environmental Surcharge

At present, there is no duty on the import and export of raw cotton. We propose the levy of an 'Environmental Surcharge' of 1% on the exports of raw cotton as well as on finished textile products. This money should be used for further research in sustainable cotton production, restoration of the degraded ecosystem, to provide incentives to farmers for growing cotton in an eco-friendly manner, and in the textile industry for taking appropriate measures to treat the effluents.

Environmental Monitoring

The EPA, must monitor pollution in the textile industry and encourage the installation of effluent treatment plants. For this purpose, it will require technical assistance to set up monitoring systems, establish laboratories, and train personnel to take samples and conduct tests.

Cotton and Cotton Textile Trade

Exports

Pakistan is the world's largest exporter of cotton yarn and the third largest exporter of raw cotton. Cotton and its made-ups are major foreign exchange earners for the country. Their share in export earnings was 66.6% in 1996-97. Cotton yarn continued to be the major export item under the cotton group. In 1996-97, it controlled 25 and 22% respectively, of the export earnings. Higher value added products, such as ready-made garments, contributed 13.2%. The major buyers of cotton yarn and cloth are mentioned in Table 19 and of cotton in Table 20.

Table 19: Pakistan's Exports of Cotton by Countries

Product	Countries	Value of Exports ($ Million)
Cotton Yarn	Hong Kong	446
	Japan	366
	South Korea	159
Cotton Cloth	Hong Kong	218
	USA	133
	UK	77
	Australia	63

Source: Export Promotion Bureau, 1996

Table 20 shows the trend in the value of cotton exports. It is obvious from the table that export earnings of raw cotton have fluctuated since the early 1980s. The most significant of these fluctuations was the drop in the value of raw cotton between 1991-92 and 1993-94 (from Rs 12,945 million to Rs 2,383 million). The reduction in export value is clearly linked to the sharp decrease in traded volume of cotton due to the on-set of CLCV.

Table 20: Value of Cotton Exports (Million Rupees)

Years	Raw Cotton	Cotton Waste	Cotton Yarn	Cotton Thread	Cloth
1970-71	270	15	344	13	311
1980-81	5203	19	2050	101	2390
1985-86	8291	85	4511	61	5083
1990-91	9553	1255	26675	76	15199
1991-92	12944	1482	29170	43	20372
1992-93	7001	1281	29183	125	22431
1993-94	2383	1878	38076	121	24789
1994-95	1924	1952	47191	59	33373
1995-96	17421	1913	52164	50	43279

Source: Economic Survey, 1996-97

The total requirement of Pakistan's local textile industry is roughly eight million bales. Local production has always been adequate to meet the local requirements except in 1993-94 when, due to the CLCV, cotton production declined to 7.9 million bales. During 1990-91, the export of raw cotton earned Rs. 9,553 million which increased to Rs. 12,944 million in 1991-92 (bumper crop year) but again declined to Rs.7,001 million in 1992-93 and Rs. 2,383 million in 1993-94 (Table 20). The export of cotton waste, cotton yarn, cotton thread, and cotton cloth shows a consistent overall increasing trend since 1990-91. The total value of these exports was Rs. 65,373.7 million in 1990-91. It rose to Rs. 89,522.7 million in 1993-94 indicating an overall constant increase in the value of exports of the cotton group.

During the 1992-93 season, low export value was due to the decline in exports of raw cotton and cotton waste. Several spinning and weaving units remained closed due to the non-availability of raw material. This high dependence on domestic sources of raw cotton has destabilised the production of cotton manufactures in recent years. The estimated loss of foreign exchange due to the shortfall in cotton exports during 1992-93 exceeds one billion dollars (The Nation, December 16, 1993). The estimate is based on a shortfall of three million bales (170 kg per bale) of exportable cotton, in 1992-93, at an average price of $0.50 per pound (FOB).

Despite being the most important manufacturing sub-sector in Pakistan, our textile industry has remained insignificant in the global market as an exporter of garments. This implies that our textile industry is mostly concentrated in the preliminary stages of the processing chain. The large scale organised sector concentrates on spinning activities and the highly fragmented cottage/small-scale sector predominates the downstream, ranging from weaving to garment making. As a result of deregulation and other fiscal measures taken by the government, revitalisation and investment efforts have brought the total installed capacity to 8.2 million spindles and 143,960 rotors (APTMA, 1996-97). The unorganised small units continue to generate the bulk of country's low value added grey cloth due to: a) lack of institutional finance for modernisation efforts; b) availability of coarse to medium counts of cotton yarn; and c) the government's failure to encourage weaving and processing sectors. Garments exported command the lowest price in the trade because of varying cloth quality, poor stitching and designing, lack of standardisation, absence of quality control, and poor marketing. Despite an excellent cotton resource

base, a strong spinning sector and impressive export performance in cotton yarn, the industry's structure remains unbalanced and concentrated in low-value products.

Protectionism in the Cotton Market

Since the 1930s, developed countries (mainly the United States and the European Union) have placed some form of quantitative restrictions on import of textiles and clothing that remained outside the scope of the GATT until the recent Uruguay Round. The first international cotton textiles agreement was negotiated in 1961 under the GATT auspices on the request of the United States. The purpose was to control the disruption in domestic markets of industrialised countries, caused by cotton imports from low-wage countries. In October 1962, quotas were imposed on cotton exports to industrialised countries for a period of ten years. The 1962 agreement allowed importing countries to bi-laterally negotiate quotas. In some cases, importing countries were even allowed to impose quotas unilaterally with impunity.

The most far reaching of these quantitative restrictions, the Multi-Fibre Arrangement (MFA), was enforced in 1974. Its scope included synthetic fibres and several emerging textile producers such as the NICS, which had been excluded from the 1962 agreement. Successive rounds of the MFA tightened quota restrictions to include some additional fibres.

These non-tariff barriers have affected Pakistan's ability to access markets for its cotton exports. However, a substantial part of textile exports in Pakistan is geared towards restricted markets. More than 85% of Pakistan's exports to the OECD comprise textile and clothing. In 1994, Pakistan exported 5% of yarn, 28 % of fabrics and 71 % of textile made-ups to countries that imposed textile quotas under the MFA. Since quota utilisation rates remain high (89.6% for the USA and 107.2% for the European Union between 1985-98), it follows that the industry would be at an advantage if there are no supply side constraints, and the ATC is adhered to.

Liberalization and the Cotton Market

At the conclusion of the Uruguay Round in 1994, the Agreement on Textile and Clothing (ATC) was reached to gradually liberalise world trade in textiles. The ATC aims to reduce non-tariff restrictions under the MFA as well as non-MFA restrictions on trade. The agreement advocates: progressive expansion of existing quotas; integration of textiles and clothing products into GATT rules; and safe-guards to deal with cases of market disruption during transition. The phase-out will be implemented in stages over the next ten years.

The MFA related qualitative restrictions will be phased out in three stages up to 2000s. In each stage, importers will transfer, from the MFA to normal GATT rules, a tranche of products related to the share of items in their total 1990 import volume. This will delay the bulk of transfers into the next century. The integration into GATT rules will be implemented in three phases. In the first phase, countries would integrate into the GATT, products from the specific list in the Agreement, which in 1990 accounted for at least 16% of the total volume of imports. The second phase, commencing January 1, 1998, will integrate products, specified in the agreement, which accounted for at least 17% of the total import volume of 1990. The third phase, beginning January 1, 2001, will integrate products in the specified list that accounted for at least 18% of the import total volume of 1990. The remaining products will be integrated at the end of the implementation period - January 1, 2000s. A formula has been developed to increase the existing growth rates for quotas of products that remain under bilateral restraint. In the first phase, growth rates will be raised annually by an amount less than the growth rate established for the respective

restriction plus 16%. In phase two, the growth rates will be the phase I rates increased by 25%. In the third phase, the growth rates will be phase II rates raised by 27% (GATT, 1994).

However, importing countries have the power to choose which areas they wish to integrate and in what order. As the integration is based on total imports, not those restricted by the MFA and since the basis of integration is the volume of exports, importers will be able to increase quotas on goods which are high in volume but low in value or of those goods which have little or no quota restrictions. In addition, the quota growth rate is a function of the growth rate before the accelerated expansion. Although the MFA recommends a 6% annual growth rate, this was rarely adhered to. Consequently, it is observed that "economies given high rates of quota growth have tended to be the less dynamic exporters" (ESCAP, 1996).

It is estimated that under the ATC, by the year 2004, the clothing quotas facing Pakistan will increase by roughly 119% and textile quotas will increase by 79 % (Ingco and Winters, 1995). The ability to capitalise on these quota expansions will depend upon the domestic cotton policy, its implications for expansion of textile production, and the competitiveness and efficiency of domestic producers.

However, it is feared that market access to northern countries may be restricted on account of certain articles included in the Marrakesh Agreement. The Agreement on Technical Barriers to Trade provides for the preparation, adoption and application of technical regulations by governments of member countries to promote the harmonisation of process and production methods. These articles pave the way for standards and regulations developed under the ISO 9000 and 14000 to be applied to domestic production processes and methods, packaging and recycling regulations; and environmental and labour standards in the exporting countries. The emphasis on uniformity of production and process methods and the environmental effects of production processes area interpreted by the South as efforts to restrict its access to the markets of North (WTO, October 1995). Importing countries can put restrictions, under article XX of the GATT, to protect human, animal or plant life or health. This article also allows countries to ban imports of goods made by prison labour. In 1995, US stopped the import of garments made by children below 15. In Bangladesh alone, 1.5 million families were affected by this decision (CUTS, 1997).

Trade Policy

There is an urgent requirement to review the current import policy to curb unsustainable production techniques. The present duty on pesticides is 10%, whereas the total amount of taxes (including indirect taxes) is 27%. Duty on all kinds of pesticides should be increased to discourage their unnecessary use.

Contrary to the government's current policy that allows the import of any pesticide registered in any other country, we recommend the banning of all pesticides that are banned by the US EPA. For example, chlorinated pesticides like Aldrin, BHC, Heptachlor and Chlordane are banned in the US and the UK, but not in Pakistan. Furthermore, those pesticides against which one or more pests have developed resistance in the region should be banned immediately. This is also in the interest of the pesticide industry. Total resistance against a pesticide signals the farmers that the product is no more effective.

The government should be aware that structural change resulting from exposure to international competition, are by their very nature, both an opportunity for certain economic agents and a curse for others. Any policy decisions ensuring growth in trade revenues should be accompanied by environmentally responsible policies that must be adhered to. In fact the changing nature of preferences

of Pakistan's major trading partners in the OECD, have created an opportunity for exporters to tap the growing, high value market for 'green' products. International trade policy has also shifted in line with these changed preferences and there is greater emphasis on the harmonisation of quality, safety and environmental standards between countries. Such changes should be perceived as opportunities that need effective policies so that they can be exploited. As a policy, research efforts must focus on the development of new production technologies that can help produce 'green' products for which niche markets exist.

Exchange Rate Policy

Pakistan retains a 'managed float' exchange rate regime, which means that there should only be gradual adjustments to the exchange rate and, therefore, rules out any major currency devaluation. However, the political implications of devaluation i.e., increased prices of imported necessity items such as edible oil and wheat flour, imply that successive Pakistani governments delayed minor adjustments until the eleventh hour when they were forced to undertake massive devaluation. The exports of Pakistani textile made ups and clothing rely on imported intermediate goods such as buttons and zips. Therefore, the managed float regime should be properly administered to prevent unnecessary fluctuations in import and export prices.

The current foreign exchange crisis, after May 28 nuclear tests, has resulted in substantial unofficial devaluation, making prices of imported intermediate goods exorbitantly high. A strict control on imports has further exacerbated the situation. The Finance Minister is proposing a unilateral default on the external account. The immediate consequence of such an action will be the refusal to accept Pakistani letters of credit (LCs) by banks abroad, resulting in the complete cessation of imports. It will seriously affect the export of Pakistani textile made ups that rely on imported intermediate goods.

Bio-treatment of Effluents

At the Nuclear Institute of Biology and Genetic Engineering (NIBGE), research is in progress to develop bacteria that can be used to treat textile effluents. In Europe, activated charcoal is used to treat industrial effluents, and it is re-activated by the use of bacteria (bio-regeneration). Research should be promoted and the industrial sector should be encouraged to adopt such waste treatment processes.

International Trade Policies

The medium to long run strategy must ensure that changes resulting from international trade agreements, which require investment in technology and training, i.e., harmonisation of standards, should be phased in gradually. To encourage more eco-friendly production techniques, the government should have an integrated national policy. International trade organisations and those markets wishing to restrict the flow of imports produced through unsustainable techniques, must make commitments to provide training and technical assistance to developing countries to meet environmental and quality standards; otherwise 'green protectionism' could severely damage many fragile, resource based economies of the South.

Generally, there is a need for greater policy co-ordination between government departments such as the Ministry of Commerce, which handles multilateral trade negotiations, and the Ministry of Finance which implements tariff, tax and subsidy policies.

National Trade Policies

In conjunction with the new bilateral and multilateral trade policies, there is a requirement for domestic policies that facilitate the adjustment of industry and agriculture to these changes.

In Pakistan, few private companies have the resources to undertake extensive market research. The government must undertake research on potential high value markets such as that of organic cotton and its products. The information can then be sold/given to interested companies. The textiles sector must be made aware of international standards, harmonisation schemes, and the changes required under new regulations.

Incentives to farmers and manufacturers of 'green cotton' products must be provided to discourage unsustainable production techniques. The present support price mechanism can be used to encourage the growth of organic cotton production. Under the existing system, organic cotton must be grown for three years before it is certified 'green'. In addition to finance, institutional support such as government sponsored training in marketing and quality control is also required. In case of small companies, these services should be managed by a collective body constituting private industry, research organisations, civil society and government representatives. It is possible to reform the role of the CEC from a minor exporter to a central training and marketing board.

In the long-run, eco-labelling and social accounting will become important. At present, developed countries have schemes, which control the foreign country sales and marketing of developing country exports. As the sales and marketing of exports commands the highest profit margins, there is a need to initiate indigenous eco-labelling to recapture the value added lost to schemes in competing countries.

Conclusions

Cotton is cultivated on more than 30 million hectares in 80 countries. In Pakistan it is grown on approximately 2.8 million hectares, out of a total cultivated area of 20 million hectares. It accounts for more than 50 per cent of our foreign exchange earnings. Cotton production supports 281 textile mills, 991 ginneries and 281 oil expellers. It is estimated that there are about 15,000-20,000 indigenous oil expellers *(kohlus)*. About one third of the industrial labour is employed in various cotton-based industries. There is a strong relationship between cotton growth and the country's overall GDP growth.

Cotton is the most important agricultural product in Pakistan. It serves as both, a cash crop as well as cheap raw material for the industry. About one third of industrial labour is employed in various cotton-based industries. Moreover, the cotton and textiles sector is the most dynamic component of our export industry. Export of raw cotton and cotton manufactures account for more than 50 per cent of Pakistan's foreign exchange earnings. However, over the past decade, a combination of policy shifts and lack of policy coherence have caused both cotton production and exports to fluctuate.

To stimulate cotton production, in late 1980s, the government removed all controls on the import and export of cotton. This led to a steady increase in domestic prices as they converged with the international price of cotton. There were two major effects of this policy. First, the price of cotton as a raw material for domestic industry rose dramatically; second, since the early 1980s, cotton production increased from 4.2 to 12.8 million bales[4] in 1991-92. The bulk increase in production was due to increased yields that rose from 360 kg/ha in 1983 to over 750 kg/ha in 1992. The increase in yield occurred mainly by the enhanced use of quality seed (new varieties) and agro-chemicals.

Although pesticides help control harmful insects/pests, they impose serious environmental risks, especially if not used properly. They leave residues in soil, groundwater, seed-oil, and seed-cake, which

4. **One bale weighs 170 kg.**

lead to loss of biodiversity (killing of soil fauna, pollinators, parasites, predators and birds). Moreover, workers involved in pesticide handling and application are exposed to health risks. Disturbance in the agro-ecosystem also leads to new pest problems through the development of resistance in the naturally occurring pest populations. In Pakistan, little work has been done on the effect of pesticides on non-target organisms and pesticide residues in the environment. Studies indicate that several major pests have developed resistance against the commonly used pesticides. Unfortunately, these products are still in use in the country.

The status of hygiene and occupational health and safety in cotton-associated industries (pesticide formulation plants, cotton ginneries, oil expellers and textile mills) is not well documented but would not be dissimilar to those in other developing countries. In cotton ginneries and textile mills, large amounts of cotton-dust heavily loaded with gram-negative bacteria and other endotoxins are produced. The smaller textile mills and power-looms are not equipped with filters for trapping cotton-dust. In humans, exposure to such dust results in bronchoconstriction and symptoms of chest tightness, dyspnoea and byssionosis. A study conducted in 1992 indicated that in the five ginneries in rural Sindh, out of 276 workers, 9% had severe byssionosis, 64% were asymptotic and the rest had other respiratory symptoms.

The effluents from textile mills contain large amounts of hazardous chemicals. Several dye formulations and colorants, oxidizing and bleaching agents are used while processing cotton. The effluents are generally hot with a high *p*H and contain grease, fibre, chromium, sulphides, and phenols. The BOD and COD of the effluents is also very high. Since the textile mills do not have effluent treatment plants, the effluents are discharged directly into drains, canals and rivers.

In the past, export duty resulted in low farm production due to lower incentives. Due to a shortage of cotton in the market, 150 textile mills closed, rendering hundreds and thousands of workers jobless. This caused social unrest in the country.

In the light of the above, it can safely be concluded that; (i) potential of cotton production in Pakistan is much higher than the existing output, (ii) the social costs of cotton cultivation are not accounted for in the present accounting system, (iii) the cotton ecosystem has been degraded over time, and (iv) trade policies have adversely affected crop production. This has happened due to lack of institutional awareness about the environmental impact of interventions intended to boost production.

The current textile policy is likely to help the textile sector re-establish itself. At the same time, cotton policy of 1995 (for the forthcoming three years) ensures free trade of cotton without any duty and quantitative restrictions. This policy has ensured the international price of cotton for the growers. In 1995, farmers grew more cotton and used more pesticides. However, current farming practices are leading towards a monoculture, declining crop diversity thus adversely affecting overall bio-diversity in the cotton.

This report highlights numerous measures, including further technical research, administrative measures, reforms in credit, subsidies, taxes and trade policies infrastructure development, social mobilization, and institutional reforms to make cotton production sustainable. To minimise the adverse effects of pesticide use on the environment, the report recommends that research must begin immediately to develop transgenic lines having *Bt* genes so that plants can self produce toxins which kill different pests. Likewise, the use of traditional alternative methods is also recommended. The use of herbicides is not common, however, artificial fertilizers are used extensively. No data exists on the degree of pollution of

groundwater because of nitrates. Thus, studies must be initiated to monitor nitrate levels in the groundwater.

Marginal crop production (almost equal to local consumption) coupled with poor production forecasts create uncertainty in the market. Traders have little timely information available to make sensible decisions about import or export of cotton. Due to uncertainty, the ancillary sector remains unable to quote prices of its products in the international market. Therefore, a crop forecasting system based on improved data and satellite image must be established.

In the areas of credit, subsidies, taxes and trade policy, we recommend the duty on pesticides should be increased, data on the toxicity of pesticides should be evaluated annually; registration of ineffective pesticides must be cancelled; pesticide trade policy should be revised; old stock of pesticides should be incinerated to curb illegal supply of chlorinated and organophosphate pesticides. On raw cotton and all finished textile products, 1-2% 'environmental surcharge' should be imposed. The money should be used for further research in sustainable cotton production, and to restore the deteriorated ecosystem. NEQS should be implemented in accordance to the 1997 Environmental Act. The textile mills that do not have any effluent treatment plant should also be taxed. Duty-free import of pollution abatement equipment should be allowed.

The installation cost of effluent treatment plants was also evaluated considering four options: (i) 60% duty and taxes on imported machines, (ii) no import taxes, (iii) loan at 13% mark up (against 16% in the market) for locally manufactured machinery, and (iv) 100% grant. The capital cost for the first three cases was Rs. 38.75 million, Rs. 32.24 million and Rs. 27.76 million, respectively. The operation and maintenance cost of plant per year ranged from Rs. 2.91 to Rs. 3.14 million. The average incremental cost per unit of production is Rs. 0.52, 0.45, 0.38 and 0.16 per meter, respectively, for case (i) through (iii). The calculation of cost per unit of production is based on, 20 million meters of finished product per year. Taxes should not be levied on effluent-treatment plants, rather credit should be provided to the industry for this purpose. Support should be provided to install common effluent-treatment plants for industries located in the same area.

There are over 14 research institutions involved in different aspects of cotton research, but there is a lack of co-ordination among the scientists and the institutions. Thus, much of their work is redundant. This report argues for institutional reforms and enhanced co-ordination at the individual scientist as well as institutional level.

In the past, Pakistan could utilise only 80-90% of its export quota of exports to the developed countries (under MFA). However, evidence shows that traders were also exporting their products on the quota of other countries. This is mainly because of uncertainty in the local market and lack of a sound information database. The current WTO policies might make it difficult for the ancillary sector to compete in the international market, because this sector used to procure raw material at prices substantially lower than international market prices in the domestic market. With an increase in costs of production (raw material, labor, electricity, inefficient machinery, etc.), they will find it hard to compete in the international market, at least in the short-run.

Different experts have different views on the impact of MFA abolition. Some believe that MFA phase-out will not drive-up the demand but would enhance efficiency in the textile and garment sector, which may result in a shift towards increased garment production in developing countries. This could be beneficial. However, others opine that some developing countries could experience a loss as a result of

the phase-out of the MFA because they will lose quotas and have to compete openly. The most competitive will, therefore, benefit most from the phase-out.

In addition to problems of increased production costs, the textile sector now also faces another set of problems that have emerged partially as a result of signing the WTO agreement. The textile industry may have to face measures such as environmental restrictions[5]. The sector will now have to rely on better management practice that means quality control at every stage of production i.e., from farm to factory to marketing. The key to sustain exports under competition is to reduce production costs, improve efficiency of resource use and improved quality of raw cotton[6] and value-added products. While confronting export pressure, Pakistan will have to introduce sustainable cotton production practices which we will be in its long term interests.

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5. **Germany has recently introduced Azo dying testing system. According to the German law, all textile garments and made-ups should pass the Azo test, otherwise it may not enter the German market.**
6. **Pakistani fibre is known for its good quality, particularly strength. But its intrinsic qualities suffer from improper grading and standardisation of lint. The country suffers estimated losses of 10-20% of the true commercial value of its raw cotton exports because of poor quality control and inability to adequately separate cotton lots according to grade and staple length.**

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