

Production Problems in 2025

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Abstract

Cotton production plays an important role in terms of its use for everyday life and economical importance. Factors such as increasing population, demand for natural fiber, and improvement in life quality leads to higher demand for cotton fiber. However, only a limited number of countries in the world are suitable for cotton production, and 80 % of cotton in the world is produced in China, USA, India, Pakistan, Uzbekistan, Brazil, and Turkey. Although the cotton cultivated area increased only by 10 % compared to 1960, fiber yield increased by 237%, production 257% and the consumption by 228%.

There may be many problems that will affect the cotton production in the world in 2025 because of the impact of the global warming. These problems can be listed as climate change, problems associated with production techniques, high production costs, and political issues.

Introduction

Cotton, which is used as an input in more than fifty industrial sectors from textile, food, film products to war industry, has experienced a quite big change in terms of production depending on the high increase in world population and socio-economic needs of the societies. While the fibers used in the textile sector in Europe amounted about 1 million tons at the end of the 18. century, the figures reached 14 million tons in 20. century. Over the years, the types of fibers varied as well as production. While 78% of fibers were wool, 18 % linen, and 4% cotton in 19. century, the use of cotton fiber increased to 74%, and wool and linen decreased by 20% and 6 % respectively. The increase observed in cotton use can be explained by its useful features in terms of health compared with other fibers and by other factors such as inventions of automatic machines in 1750, yarn machine in 1767, weaving machine in 1786, rollergin machine in 1783, sawgin machine in 1796, steam engine in 1801, and therefore by its easier processing (Gencer et al., 2005).

World Cotton Production and Developments

Cotton is produced in various geographical regions. The Asia continent is a major area followed by America and Africa. The major 7 producers are China, USA, India, Pakistan, Uzbekistan, Brazil, and Turkey. These countries produce 80% of the world cotton production (Anonymous, 2006).

World cotton area , yield, production, import, consumption and export are presented in Table 1. The world cotton area cultivated increased by 10% in 2004/2005 compared to 1960/1961. However, because of the high yield varieties and improvements in production techniques increased the yield by 237% and production by 257%. In the same period, import increased by 192% while consumption and export increased 228% and 212% respectively.

Table 1. World Cotton Area , Yield, Production, Import, Consumption and Export *

Marketing Year	Area	Yield	Production	Imports	Consumption	Exports
	000 ha	kg/ha	000 metric tons			
1960/1961	32.445	314	10.201	3.804	10.231	3.667
1961/1962	33.057	297	9.832	3.463	9.982	3.367
1962/1963	32.633	320	10.444	3.638	9.845	3.450
1963/1964	32.968	330	10.877	3.879	10.362	3.910
1964/1965	33.366	345	11.504	3.811	11.165	3.721
1965/1966	33.133	359	11.898	3.809	11.429	3.712
1966/1967	30.915	350	10.836	3.934	11.618	3.974
1967/1968	30.670	351	10.780	3.828	11.752	3.805
1968/1969	31.692	374	11.856	3.718	11.772	3.640
1969/1970	32.658	348	11.379	3.932	12.010	3.880
1970/1971	31.778	369	11.740	4.086	12.173	3.875
1971/1972	33.024	392	12.938	4.031	12.721	4.111
1972/1973	33.818	402	13.595	4.528	13.034	4.640
1973/1974	32.558	418	13.615	4.408	13.469	4.294
1974/1975	33.285	418	13.926	3.734	12.641	3.814
1975/1976	30.001	390	11.706	4.188	13.336	4.183
1976/1977	31.513	393	12.385	3.951	13.122	3.806
1977/1978	34.966	396	13.860	4.250	13.133	4.239
1978/1979	34.000	380	12.933	4.320	13.703	4.346
1979/1980	33.100	425	14.084	5.093	14.127	5.073
1980/1981	33.667	411	13.831	4.555	14.215	4.414
1981/1982	33.948	442	14.991	4.405	14.147	4.373
1982/1983	32.569	445	14.479	4.350	14.452	4.261
1983/1984	32.137	451	14.499	4.617	14.655	4.309
1984/1985	35.217	546	19.247	4.602	15.108	4.520
1985/1986	32.792	532	17.461	4.763	16.589	4.479
1986/1987	29.503	518	15.269	5.516	18.198	5.755
1987/1988	31.238	564	17.609	5.094	18.117	5.121
1988/1989	33.522	546	18.301	5.654	18.470	5.726
1989/1990	31.640	549	17.365	5.431	18.675	5.293
1990/1991	33.050	574	18.978	5.220	18.574	5.073
1991/1992	34.710	596	20.677	6.497	18.636	6.091
1992/1993	32.238	557	17.943	5.690	18.634	5.525
1993/1994	30.430	554	16.861	5.766	18.496	5.911
1994/1995	32.114	584	18.762	6.458	18.278	6.312
1995/1996	36.056	564	20.330	5.805	18.405	5.999
1996/1997	34.111	575	19.599	6.134	19.049	6.049
1997/1998	33.800	594	20.094	5.756	19.004	5.973
1998/1999	32.846	569	18.705	5.405	18.464	5.508
1999/2000	32.110	595	19.095	6.068	19.607	6.111
2000/2001	31.766	612	19.457	5.755	19.882	5.881
2001/2002	33.397	644	21.500	6.195	20.069	6.449
2002/2003	29.872	646	19.292	6.586	20.872	6.645
2003/2004	32.092	645	20.714	7.261	21.281	7.233
2004/2005	35.197	747	26.295	7.326	23.395	7.780
2005/2006 Est.	35.927	730	24.756	9.527	24.892	9.645
2006/2007 Proj.	34.646	713	24.696	9.456	25.737	9.456
2007/2008 Proj.	35.757	739	26.422	9.510	26.254	9.510
2008/2009 Proj.	35.611	750	26.693	9.718	26.520	9.718
2009/2010 Proj.	35.740	760	27.154	9.838	26.649	9.838
2010/2011 Proj.	35.660	766	27.324	10.016	26.718	10.016

*ICAC, Cotton World Statistics, September 2006

The Structure of the Cotton Production in the World

All of the cotton produced in the world belongs to the species of *Gossypium hirsutum* L., *G. barbadense* L., *G. herbaceum* L., and *G. arboreum* L. More than 90 % of the cotton is produced by *G. hirsutum* L.

Differences in cotton production techniques as well as the ecological differences have caused quite different genetic characteristics in same varieties in the world cotton zone. Cotton production is mechanized except hoeing and harvest in most countries while totally mechanized only in a few countries.

The future goals in cotton production can be listed as, high yield, fiber quality, earliness, ginning percentage, resistance to diseases, heat, and water stress, and decrease in production cost (Gencer et al., 2005).

Main Problems in World Cotton Production

The main problems that will impact cotton production in the world are

- I. Climate problems
- II. Problems associated with production techniques
- III. High production costs
- IV. Standardization problems
- V. Problems related to politics

These problems and suggestions for solutions are listed below

I- Climate Problems

The increase in heat caused by high level of green house gases in atmosphere and consequently global warming will have mostly negative impacts on cotton production. It has been estimated that the average temperature will increase by 1 °C by 2025 if current emission levels continue to increase (Sinha, 1998).

The higher CO₂ level leads to increase in photosynthesis and yield. C3 plants (cotton) benefit from this situation compared with C4 plants (maize). High concentration of CO₂ increases the water use efficiency of the cotton. This situation indicates that cotton will consume less water with the higher CO₂ level in atmosphere provided that other conditions are optimum (Reddy et al., 1995). When the impacts of water and CO₂ on the photosynthesis are examined, it is observed that the CO₂ increases the photosynthesis in the parallel way in the case of lack of water or normal irrigation (Reddy et al., 1997). This situation shows that the drought in the future can cause problem. When the impacts of both heat and carbon dioxide on the photosynthesis are examined, it is observed that the heat level until 27 °C and until a certain level of CO₂ positively impacts the photosynthesis (Reddy et al., 1996). Therefore, the extreme heats will decrease the productivity.

The high heat levels and increasing CO₂ have complex effects on plants. In many studies, the harmful impact of high heat on the late blossom level couldn't be recovered by the increasing CO₂ level (Unay and Basal, 2005). The impact of heat on the growing of cotton is quite high. It has been determined that the days of blossom and growth decrease with high temperature (Halevy and Bazelet, 1989).

Hake et al. (1996) indicated that heat stress is quite dangerous at high temperatures of day and night. The reason is that plants can not get cool through evaporation and therefore plant temperature equals weather temperature. Also, the heat stress which develops during July and August causes excessive vegetative growth, decrease in boll size and number of seed in boll.

Reddy et al. (2000) determined that boll growth decrease significantly and fruit is shed in 3-5 days after blossom in the heat over 32 °C. That way, the upper limit of cotton for blossom and fruit period is 32 °C.

It has been observed that the reason for low yield of cotton in the Aegean Region of Turkey is the high heat over 32 °C observed during the blossom and fruit period. There were no significant differences in other factors except the heat level. The heat levels over 32 °C in July and August were presented in Table 2 as an hour in 10 day periods (Anonymous, 2000-2001).

Table 2. The Periods of over 32 °C Heat in July and August in 10 Day Scale (Hours)

Periods	2000	2001	Difference (%)
1-10 July	75	110	47
11-20 July	76	97	28
21-31 July	88	105	19
Total	239	312	31
1-10 August	62	94	52
11-20 August	70	68	-3
21-31 August	56	74	32
Total	188	236	13

In Table 2, cotton was subject to heat over 32 °C in 2001 more than any other years. The period of impact as well as the heat level is important. It has been observed that the heat levels over 32 °C was 239 hours in 2000 July, 188 hours in August, 312 hours in July 2001 (31 %more), and 236 hours in August (13% more). The heat level over 32 °C during the period of blossom and fruit in July and August in 10 day period varied 52 % in 2001 compared to 2000. In addition, average daily heat was 2 °C more during July 10-August 10.

In the future, planting season will be earlier due to climate change, and therefore there will be a longer growing season. The increasing CO₂ level will lead to high photosynthesis, but it will not be transferred to the yield completely. The photosynthesis will increase at the beginning of the season but will decrease in the middle of the summer with the increasing heat. The high heat will increase vegetative growth but fruit growth will not be observed. At the heat level over 27 °C at nights, overheating will cause shedding of the fruits. Although fiber quality gets less impact by higher heat, the fiber thickness will increase.

In the future, the following precautions should be taken in case high heats are observed.

- 1- If the winter rains are not enough and heat levels are over the season average during the cotton growing period, irrigation should be made earlier instead of blossom period, and made frequently in small amounts.
- 2- If vegetative-generative growth is unbalanced, plant growth regulators should be used.
- 3- Fertilizing, insecticide, pesticide applications etc. should be made.
- 4- Extension services should be made for farmers regarding the cotton production.

II- Problems associated with the Production Techniques

In order to market textile products in today's competitive markets, costs should be lower and quality must be high. Cotton fiber quality is important as well as processing techniques. In other words, cotton fibers should be thinnest, longest, homogeneous, and should have best yarn quality (Gencer et al., 2005). The most important problems encountered with production techniques are given below.

Variety:

As of 2006 the rate of GMO cotton varieties takes the share of 34%, and the increase of GMO cotton will be beneficial for cotton production. Although there are many discussions about the GMOs, the lower costs makes them important. Lower costs in cotton will increase

farmers net income and it will positively impact the area cultivated. It is essential that new because of the climate change, transgenic varieties resistant to the insects and high heat levels and requiring low water should be developed. That way cotton production is less affected by global warming.

Irrigation:

Decrease in cotton area due to the lack of water caused by global warming will be an important issue. In order to continue the cotton production, it should be grown in limited and low water conditions. Water saving is essential in cotton like in other crops. However, as water is saved, cotton quality decreases. In the future, the water should be given with pressure which use water more efficiently and to the root of the cotton when needed to benefit more from water. Also, new varieties requiring less water and resistant to the water stress should be developed and used in production.

Pests:

Increasing CO₂ level decreases the nutritional value of the leaves for the pests due to increasing C/N ratio in plant tissues. That is why increasing CO₂ level and temperature fluctuations were assumed to affect pest population (Conroy, 1992).

Global warming will have some inevitable affect on pests because of the fact that pests can adapt their body temperature according to environment. Several studies exhibited that global warming will influence the pest' metabolism, increase their population rate, spreading to the cooler terrains in the north and the existence of different plant variations and novel species as a result. Due to there effects inevitable increase in the pest population and the number of the off-springs will be observed. Besides, discoloration and drying in the leaves because of the drought condition will prepare suitable environment for pest to feed. According to some authors due to increase in the pest intensity some disease will be threat to human health (Mattson and Haack, 1987; Rubenstein, 1992 and Akbulut, 2000). In addition changes in the vectorial pest population causing the plant disease. This situation will cause more pesticide usage in the cotton production contributing the increase in the cost and create environmental pollution. Therefore, in order to alleviate the harmful effect of pests it is necessary to increase the transgenic cotton plantation areas.

Diseases:

Global warming will affect the three main factors which are responsible for the emerging disease (pathogen, environment and host). As a result of global warming changing in the climate also will affect the success of some disease control methods. Because of the global warming, most of the pathogens' emerging time will change and adjusting planting time accordingly may not give positive results. Furthermore, effect of chemical pesticides used on agriculture may not be as effective as before. It is possible that those chemicals decompose and destroy the pathogens rapidly, however; they will lost their efficiency more quickly. Also increase in some fungicides toxicity against plants could be observed.

Moreover, global warming affects the hosts' morphology, physiology and productivity. Increase CO₂ level in the atmosphere causes rapid growth in the host plant as it happens in cotton. Furthermore increase in the CO₂ level increase the severity of disease, induce fungal growth, spore formation and destroy more plant tissues as a result (Chakraborty et al., 2002). Climate change will lead to diseases which have not seen before. This situation will exhibit the importance of the production of disease resistant varieties.

Weeds:

It has been expected that warming climates cause changes in the product-weed relationship in cotton planted areas. Although some weed species already exist in cotton planted areas, they are not considered as important species. However, species of weeds carrying tropical characteristics can benefit from increasing temperature and turn into dangerous species. Seedling is the very critical period in cotton in terms of competition with weeds. In spite of the fact that cotton plantation and development will start earlier as temperature rise, the same development will be observed in weeds. The critical period in development of cotton and weeds will coincide at the same time.

Unlike cotton which is a C3 plants, most of the weeds are C4 plants give less reaction to CO₂ and more benefit from it. That is why, cotton can compete with weeds more effectively in the conditions of where there is enough water and nutrition. Increasing CO₂ can cause variation in biomass distribution among plant organs. It was determined by several studies 87% of the plants subject to high amounts of CO₂ cause increase in the biomass of the stems. This result will make it difficult to mechanical fight with weeds. The weeds the pass the controllable and susceptible period quickly and decreasing effectiveness of the herbicides due to rising biomass and reduction of stoma openness would be the other observed effects of increasing CO₂ and temperature. Therefore, it is necessary to arrange the pesticide programe. Climate change will be more beneficial to weeds due to the fact that the genetic variations and selective ecologic adaptation are more developed in weeds than cultural plants (Grenz and Uludag, 2006).

Fertilization and Plant Growth Regulators:

Increasing CO₂ production rises the productivity only when the high usage of N and P (Conroy, 1992). This result indicates that importance of the cotton fertilization during the growth period. N and P in soil should be in absorble form for the plants and nutritional needs for plants have to be rearranged. In addition new varieties should be developed to receive more minerals such as N, P and K from soil. Global warming will increase the soil salt content of the cotton planted areas causing the significant decrease in absorption of the micro nutritional elements (K, Ca and micronutritional elements) from the soil leading to more fertilization as a result. Furthermore, alkalinity will be rised, which cause to increase in pH in the soil and subsequently decreasing amount of available nutrient elements in the soil (mainly P, Fe, Zn, Mn ext.). On the other hand considering cotton as a C3 plant, increasing CO₂ and temperature induces more vegetative growth causing the rising of intensive chemical growth blocker usage.

Harvesting and Trash Content:

Because of the problem encountered in manpower during hoeing and harvesting, manufacturers tend to mechanize. However, besides lack of knowledge and infrastructure expensive harvesting machine prevents mechanization. In order to cope with these problems mechanization should be supported by government by providing the manufacturers low rate interest and long term credits.

Trash content in cotton are one of the very important problems. Trash content could come from cotton related or external sources. Separating the cotton from the problematic Trash content in textile is related to picking of cotton and education of manufacturer and harvester. All the partners associated to cotton should be educated and worked harmoniously to have a good arrangement (Gencer et al., 2005).

III- High Production Costs

Principle reasons for high production cost in developing countries are harvesting and hoeing process depend on man power and high production inputs. Also, high production cost diminishes the profit margins of the cotton and competition power against other products. Protecting the profit margins from cotton and diminishing the production costs should be a requirement for governments. Decrease in production cost in cotton depends upon;

- enlargement of polyculture cotton plantation areas
- Minimum soil process, decreasing man power, optimization the level of production input, mechanization in harvest, and education of the manufacturer.
- development of resistant varieties for stress, pests, drought, high temperature and other growth preventers.
- choosing the agricultural process to decrease the fight in field.
- determination of principles pests and their bioecology and economical harmful margins (Gencer et al., 2005).
- increasing GMO cotton plantations.

IV- Standardization Problems

There is no harmonization in standard of cotton fiber among producing countries in the world. Some countries categorize cotton according to decree others characters. The color of cotton, the trash content, and preparation conditions are taken into the consideration but not other characters related to processing cotton into threads. This causes some problem in marketing and processing of the cotton fiber. Therefore, in the future it is important to spread those devices which measures fiber quality and features of HVI attributes in manufacturing countries. However, there is not enough financial sources for these devices in every country.

V- Problems related to Politics

Cotton production is effected by agricultural, industrial and commercial politics because its an important material for import and export in the world. All of these politics will be shaped according to priorities of manufacturing countries and obligation of World Trade Organization agriculture treaty.

In the future general tendency towards agricultural politics will gradually constitute a more competitive environment. Cotton price will be low if some countries continue to give high rate subvention for cotton production in world. Low cotton price may result desertion from cotton production in the countries those given less subvention and high production cost.

Another important issue facing the cotton production is a finance problem. Cotton production became very expensive and risky in some countries those have high production cost. Besides uncertainty in the production stages, instability in the price and market conditions have negative effect on the production. Rising production cost will increase financial needs of producers (Gencer et al., 2005).

Cotton Production and Consumption Projections in 2025

World cotton consumption affected by economic growth, increasing population, trade rules and fiber prices. That is why predicting the cotton planting areas, production and consumption rate will be getting difficult.

Although it is going to be difficult to asses the amount, increasing cotton planting areas will depend on competition of cotton against other products and new found water fields in coming years. However, consumption can be calculated according to current existing conditions.

The predicted consumption in 2025 considering the last five years average rising is 3.6 % per year and other conditions fixed until 2004 approximately will increase 49.000.000

tons. To meet this amount of consumption about 65.500.000 ha planting areas will be needed when taken into the consideration of year 2004 yield amount. This means 30.000.000 ha addition of more planting areas compared to 2004 will be needed. Cotton production zone, especially new cotton areas opening to plantation mostly depends increasing watering possibility. It is almost impossible that many areas open to watered agriculture to the year 2025. Production meets consumption only when we increase yield and profit then. When the plantation areas remain constant and increase the yield to 1000 kg/ha, 25% increase in production can successfully be achieved.

Significant increase in the utilization of GMO seed and the decrease in the production cost will affect cotton production in a positive way. However, besides the problems mentioned above, limited water resources and competition of cotton against other crops will diminish cotton plantation areas and production.

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