SUSTAINABLE COTTON PROJECT

Sustainable Cotton Production and Processing- Water Issues

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The specific local or regional impacts of cotton cultivation differ widely according to a number of factors including climate, natural resources available, pest complexes, chemical and water inputs/outputs, access to capital and farm production efficiency. Looking at the two most cited impacts of cotton production – water and chemical use – from a regional perspective, some interesting options and ‘sustainable’ strategies emerge. Cotton’s volume of water consumption frequently tops the headlines as a major issue. Yet cotton’s effect on water takes several forms: drawdown of natural water bodies for irrigation (inputs), contamination of fresh water from fertilizer and pesticide runoffs (outputs), and water management. Water management affects soil quality particularly when salinization occurs. Salinization is the process by which water-soluble salts accumulate in the soil. This is a resource concern because excess salts hinder the growth of crops by limiting their ability to take up water. The causes of salinization include the natural presence of soluble salts in the soil, a high water table, a high rate of evaporation or low annual rainfall. It is estimated that 4% of the world’s total arable land is abandoned owing to former intensive cotton cultivation with soil salinization being the main reason (Kooistra and Termorshuizen, 2006).

The most well-known case of cotton’s impacts on water is in Uzbekistan where water drawdown, contamination and poor irrigation practices all contributed to a well-documented social and ecological disaster. Surface water diverted for cultivation of cotton in the Araal Sea Basin reduced the sea to a fraction of its former size and the once-thriving fishing villages in the region are now surrounded by desert. More to the point, pesticides and fertilizer residues on the Araal Sea bed blow into surrounding communities. The population in this region suffers from chronic poor health as a result of exposure to agricultural chemicals and unsafe drinking water (EJF, 2007). Furthermore, the soil in this area has been so intensively farmed that it has now degenerated beyond its capacity to support future cultivation (IIED, 2004).

The case of the Araal Sea region represents the impact of cotton cultivation on water systems at its very worst and has contributed to cotton’s global reputation as a thirsty crop. It is perhaps due to the extremity of this case, that countermeasures proposed by some marketers have been equally extreme: eliminating cotton production altogether or replacing all cotton fields with hemp, for example. While provocative statements might highlight differences and benefits between fibers to potentially influence market share, they do little to promote deeper understanding. Finding pragmatic and practical ways to achieve optimal water use is the imperative. Then, communicating the details to the end customer to provide education on real issues will help shape the market.

Real solutions to water challenges demand knowledge of the particular region where the fiber is sourced. Local climate, regional natural resources, access to technology and general farm practice are just a few of the contributing factors. Consider West Africa, for example, where seasonal tropical storms bring 32–50 inches (80–125 cm) of water to the cotton crop (IIED, 2004; Toulmin, 2006); and Texas, where almost all cotton is dry farmed. In Brazil, 50% of cotton production comes from rain-fed farms. In these areas, the drawdown of water from local sources is not such a critical issue, despite our perception to the contrary.

Responsible water management is not only defined by rain-fed areas. For example, in Israel, the cotton crop is irrigated, but water scarcity and cost has spurred technical innovation resulting in the most efficient watering systems in the world. Similarly, in California, where farmers face drastically increased water costs, a variety of solutions are emerging, including timely 'water deficit' and subsurface irrigation. In fact, in many areas, cotton is a moderate water user, accounting for less water consumption than perennial crops such as grapes, almonds, pistachios and stone fruits, and considerably less than field crops such as alfalfa (D. Munk, farm advisor, University of California, personal communication, 2008).

Water options

A list of the options available to the grower for reducing water inputs is given below. While each of them may be appropriate in one area with a particular set of circumstances and conditions, they may be equally inappropriate for different areas and conditions. All strategies offer opportunities for marketing the end product. Knowing the source of the cotton fiber in our products and the regional impacts specific to that area is a prerequisite for accurate and authentic marketing.

Increased costs for water
Where water cost is low, over-irrigation may result (as in Uzbekistan). High water costs, however, will usually prompt the conservation to keep the costs of production low (as in Israel). However, increasing water costs as a blanket strategy may over-burden farmers and particularly smallholders beyond what they can financially bear (IIED, 2004). This is already apparent in California where the cotton crop has declined from more than 1 million acres (405 hectares) to less than 300 000 acres (121 500 hectares) over the last decade. This is in part due to the low commodity price, which no longer supports the cost of production, and in particular due to increased water costs (M. Fickett and F. William, California farmers, personal communication, 2008).

Rain-fed cotton
Rain-fed cotton offers an alternative to irrigated and diverted water supplies. However, rain-fed cotton tends to produce irregular fiber quality owing to the inconsistency of watering, and yields tend to be 50% of that of irrigated fiber (D. Munk, personal communication, 2008). Rain-fed cotton is also in relatively short supply, representing 27% of global cotton production.

Changing cultural practices in the field
Shallow soil cultivation, mulching, minimal or zero tillage and organic production all improve soil structure and higher water retention is attained as a result. However, yields may also be adversely affected in some cases.

Deficit watering
Cotton benefits from stress more than other crops, since if it becomes too leafy, it produces less fruit (bolls) and fiber. Timely deficit watering, withholding water from the plant at non-critical times and supplying water to it at critical times, can suppress leaf growth and encourage the fruiting cycle. This both reduces water loss through evapotranspiration in the leaves and increases fiber yield (D. Munk, personal communication, 2008).

Irrigation systems
Highly efficient irrigation systems such as those employed in Israel tend to be expensive to set up and maintain. These systems are therefore only possible to implement if funding is available, or if the price of the fiber allows for some discretionary capital investments. Longer-staple cottons command a higher premium and so producers may be more able to offset the cost of investment.

Subsurface drip irrigation

These systems are also expensive to install and maintain, and growers usually make the investment over a variety of crops in addition to cotton. Subsurface delivery of water reduces evaporation off the field and can be adjusted according to soil moisture content and other environmental considerations, including weather. Continuous maintenance of irrigation equipment is necessary after set-up so technical support is important, especially for smallholder farmers.

Alternate furrow watering

Alternate furrow irrigation can reduce some water losses by limiting evaporation from the field when the cotton plant is small in the early part of the season. Reduced losses through deep percolation are sometimes also effected. However, this is soil and location dependent; in short, results are time and location specific.

Traditional breeding of germ plasm for drought tolerance

Classic breeding of seed for drought tolerance in addition to fiber quality may take 10–20 years. Marker-assisted research allows geneticists to conduct genetic crosses in as little as 5 years (Allen, 2008).

Although all of the above options address drawdown of regional water bodies (inputs), contamination caused by farm outputs, still warrant attention. Hazardous pesticides associated with global cotton production are known to contaminate rivers in the United States, India, Pakistan, Uzbekistan, Brazil, Australia, Greece and West Africa (EJF, 2007); while in Australia and India, cotton irrigation also contributes to salinity, water logging and groundwater pollution (IIED, 2004). Chemical use reduction best addresses these issues.