



Water Use Efficiency

Comparing Water Use Efficiency in Sugarcane
and Cotton Production

ABEDULLAH ANJUM

UZMA ZIA ²

Sugar requires 1500-2000 litres of water per kg, while lint cotton requires 10,000 litres of water per kg. Based on these information it is misleading to conclude that sugarcane is a more water-efficient crop.

The average yield of cotton lint and sugar are 358kg/acre and 6167 kg/acre, respectively. We converted lint cotton to seed cotton (phutti) and sugar to sugarcane by using the conversion factor of 0.43 and 0.25, respectively. By using yield and per kg water requirement we estimated the per acreage water requirement for both cotton and sugarcane (Table 1). We then estimate the water ratio of sugarcane verses cotton (3.4) by dividing the water requirement of sugarcane by cotton in one acreage. Our estimation reveals that relieving one acre from sugarcane can provide water to about 3.4 acres of the cotton crop.

Cotton-wheat cropping system competes with sugarcane, implying that sugarcane is substituting two crops i.e. cotton and wheat. For this purpose, we estimated water use efficiency per annum basis. Our results reveal that relieving one acre of sugarcane can support 2.1 acres of both cotton and wheat, implying that cotton-wheat as a system is also more water-efficient than sugarcane alone.

Water use efficiency should not be based on quantity rather monetary value it generates because price of one kg of cotton is 25 times higher than one kg of sugarcane. Therefore, water use efficiency criterion based on the quantity [weight] of crop produced presents an erroneous picture because higher quantity [weight/acre] produced does not warrant higher monetary value.

Table 1: Water Requirements and monetary benefits

| Crops | Water requirement (litter/kg) | Yield (kg/acre) | Per acre water requirement (litter/acre) | Water use ratio per acre (sugar/cotton) |
|-----------------|---|-----------------|--|---|
| Cotton (phutti) | 4300 | 833 | 3581473=a | b/a=3.4 |
| Sugarcane | 500 | 24,668 | 12334028=b | |
| Wheat | 1909 | 1167 | 2227250=c | (b/(a+c)) =2.1 |
| Crops | Monetary benefits from water usage [Rs/Litter] | | | |
| | Net benefit at the farm-gate (Rs/litter) | Benefit ratio | Retail level (Revenue Rs./ liter) | Benefit ratio= (e/d) |
| | Cotton (Lint)(b) | (d/e)=3.9 | 0.013=g | g/h=3.8 |
| | Sugar | | 0.004=h | |
| | Wheat (c) | | 0.021=i | ((g+i)/2)/h=4.9 |

Source: Authors' results

By employing farm-gate prices for the year 2018-19 and cost of production SBP (2020), this study estimates the net return of each litre of water used in sugarcane and raw cotton. At the farm-gate, one litre of water in sugarcane and cotton production generates a monetary value of Rs.0.0026/liter and Rs.0.0100/liter, respectively. This simple analysis demonstrates that cotton production is about 4 times more water-efficient than sugarcane production. Our yearly analysis reveal that one liter of water used in cotton-wheat system generates 2.3 times higher net return than sugarcane.

This difference in the monetary value reduces slightly when the same analysis is repeated at the second stage of value chain i.e. after converting sugarcane to sugar and raw cotton to cotton lint. The difference reduces because, in the case of sugar, value addition takes place while in case of cotton lint only cottonseed is separated from raw cotton. It is important to note that one kg of sugarcane is producing less than 100 grams of sugar (SRDB, 2019) having a market value of Rs.7 (under the assumption that retail price is

² The authors thank to Dr. Nadeem Ul Haque and Dr. Durre Nayab for their valuable inputs, and Mr. Mudassar Ali for providing useful tips in the analysis. Any error is the sole responsibility of the authors.

Rs.70/kg), while one kg of cotton contains 43% fibre (cotton lint) and 54% seed and remaining 3% wastes. Cottonseed is used to extract edible oil, with 10 kgs of seed cotton giving one litre of edible oil (CIRAD, 2009).

In our analysis, the total revenue is estimated from edible oil and cotton lint by using standard market prices. Wheat is converted into wheat flour, and the price of wheat flour used in the analysis is Rs.40/kg. Our results demonstrate that each liter of water used in raw cotton production generates 3.8 times higher revenue than sugarcane at the second stage of the value chain. However, our analysis on per annum basis demonstrates that each liter of water used in cotton-wheat system generates 3.9 times higher revenue than sugarcane (Table 1).

It is well documented that 250 grams of cotton produce one shirt (Hoekstra, 2013) and each shirt has an average market value in the range of Rs.1000 to Rs.2000. If we assume the average price of a shirt at Rs.1500, then 10,000 litres of water would generate Rs.6000, which is equivalent to Rs.0.6/litre at the retail level. However, one litre in the sugarcane production generates a monetary benefit of only Rs.0.004 at the retail level. Again, analysis at the retail level unravels that each litre of water used in cotton production generates about 150 times higher monetary benefits than sugarcane (Table 1).

Moreover, the textile industry processes raw cotton to finished products by providing employment that is manifolds higher than the sugar industry. However, these additional employment benefits

are not included here. This demonstrates that the monetary benefits of water use efficiency in cotton production are significantly higher than that of sugarcane at both farm and retail levels if measured accurately.

One question remains unanswered that why cotton is not competing with sugarcane at the farm level. To let cotton production compete with other crops, the government needs to refrain from interfering in the free market mechanism by eliminating subsidies and price support.

Sensitivity Analysis

- Using the per-acre cost estimated by the SBP (2019), we find that at the current abiana fixed rate, the net profit per acre of cotton and sugarcane is Rs.35975 and Rs.31,839, respectively_a small difference.
- When we increase the water price from a fixed-rate (of Rs. 200 per annum) to Rs.0.0026 per litre (the actual cost) the net profit of sugarcane approaches to negative while the net profit of cotton reduces by 24% from Rs.35975 to Rs.26663 per acre. It is important to note that the price of 5000 liters of water tanker ranges between Rs.1000 to Rs.3000 in Islamabad while the price we induced in the sensitivity analysis is just Rs.13 per tanker of the same capacity.

PIDE's Recommendations

- Let the sugar market work without government intervention, by allowing it to generate signals for the farmers to respond to the market.
- Remove support price, subsidy on export and control/slash high tariffs on the import of sugar.
- Abolish the current flat rate for water and appropriately price it by usage and covering the costs of maintenance and storage.