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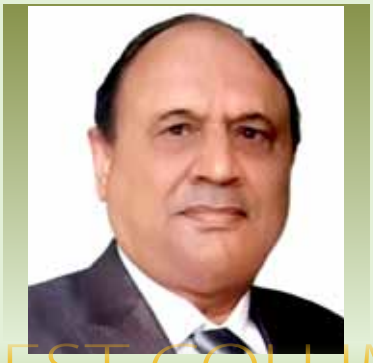
The Concept of Life Cycle Assessment (LCA) of Cotton and Its Implications



GUEST COLUMN

Dr. Brijender Mohan Vithal
Cotton Expert

Dr. Brijender Mohan Vithal has a Ph.D. Agric (Plant Breeding-Cotton) from Punjab Agriculture University (PAU) Ludhiana. He has been associated with cotton R&D activities for more than three decades. He has worked as a Senior Cotton Breeder with PAU, GM Production / Executive Director with National Seeds Corporation and Director, DOCD, Ministry of Agriculture (MOA). He was Officer on Special Duties (OSD) to look after activities related with Tech Mission on Cotton (TMC) in CCI Ltd during its pre-launch period. He joined CCI Ltd - TMC Cell (MMIII & IV) during 1999 and continued working there till the end of the TMC Project in December 2010. He is still associated with cotton through agencies like ISCI.

As environmental sustainability continues to advance in the business world, we all confronted with a fresh array of industry vernacular to understand. Most of us may have run across the term, life cycle assessment, or its short form, LCA. Just what is life cycle assessment, and how is it affecting cotton?

When industries talk about life cycle assessment, they are referring to a scientific research and data analysis tool for examining the potential impacts on the environment during a product's entire life cycle. A product's life cycle begins with the raw materials from which it is made, extending throughout the supply chain of manufacturing the product, all the way to its typical use, ending at its final disposal. Thus, LCA is basically a "cradle to grave" (from creation to disposal) review of a specific product life cycle. In this article, the results of an LCA of cotton clothing conducted by the Cotton Foundation in 2010 and further updated in 2016 have been discussed. The information has been taken from their final report for the information of our readers.

The Cotton Foundation (CF) was created in 1955 as a 501(c) 3 organisation to give U.S. cotton's agribusiness allies opportunities to support the U.S. cotton industry over and above the products and services these firms provide. Membership of CF includes banks, seed companies, chemical and equipment manufacturers, publishers and others, whose success depends at least in part on U.S. cotton and who share a common concern for a healthy U.S. cotton industry.

In 2010, the Cotton Foundation performed the most comprehensive life cycle assessment of cotton clothing ever attempted. An update and expansion to the original LCA was completed in 2016 to provide the most detailed and current data for the sustainability community and sourcing professionals. The findings are now helping Cotton

Scientists to determine areas for future research and development investments.

The updated research provided a more comprehensive snapshot of cotton across all phases of product life and its relationship to the environment. A larger pool of global consumers was included in the update to more accurately reflect the impact of consumer use and disposal of cotton textiles. The data for fibre production represent a global average of the three largest cotton-producing regions (the United States, India, and China) and top three-cotton exporting countries (the United States, India, and Australia). Brief information of said report has been presented below

The Project: Life Cycle Assessment (LCA) Of Cotton

Purpose:

The purpose of this project was to develop and publish detailed global aver¬age Life Cycle Inventories (LCIs) for cradle-to-grave production of cotton fibre and fabric. Additionally, Life Cycle Assessments (LCAs) are performed to evaluate the environmental impacts of these LCIs and of cotton garments, specifically t-shirts, knit casual collared shirts, and woven casual pants. series.

Goals

The goals of this study were to:

1. Support users of cotton and cotton derived products with current and accurate Life Cycle Inventory (LCI) data for cotton fibre production and textile processing
2. Collect global consumer use data for assessment and decision making
3. Provide a life cycle assessment of textile products (knit casual collared shirt, t-shirt, and casual woven pants)
4. Monitor progress and measure changes for continuous improvement
5. Guide decisions about current research priorities and new research initiatives

Scope of the Study

The sections which describe the general scope of the project to achieve the stated goals (though not limited to the identification of spe¬cific product systems to be assessed) include: Product System(S); Product Function(S) and Functional Unit; System Boundaries (time coverage, technology coverage and geographical coverage); Allocation (Multi-output Allocation and End-of-Life Allocation)

Selection of LCA Methodology

- Global warming potential, including biogenic carbon and non-renewable primary energy de¬mand, were chosen because of their relevance to climate change and energy efficiency, both of which are strongly interlinked, of high public and institutional interest, and deemed to be one of the most pressing environmental issues of our time.
- Eutrophication, (excessive richness of nutrients in any body of water) acidification, and photochemi¬cal ozone creation potentials were chosen because they are closely connected to air, soil, and water quality and capture the environ¬mental burdens associated with commonly regulated emissions such as NOx, SO2, VOC, and others.
- Ozone depletion potential was chosen because of its high political relevance, which eventu¬ally led to the worldwide ban of more active ozone-depleting substances; the phase-out of less active substances is due to be completed by 2030.
- Human health particulate air covers particulate matter emissions of various aerodynamic diameters (with a reference substance of particulate emissions with an aerodynamic diameter less than 2.5 mm or PM2.5) and was chosen because it is a key outdoor air quality indicator and a major contributor to respiratory disease around the world, particularly in urban areas.
- Water consumption (i.e. the anthropogenic removal of water from its watershed through shipment, evaporation, or evapo-transpiration) as well as the Water Scarcity Footprint (WSF), has also been selected due to its high political relevance.
- Additionally, the project includes an evaluation of human toxicity and eco-toxicity potentials from employing the USEtox™ characterisation model.

Type and Format of the Report

The results, data, methods, assumptions, and limitations are presented in a transparent manner and in sufficient detail to convey the complexities, limitations, and trade-offs inher¬ent in the LCA to the reader. This allows the results to be interpreted and used in a manner consistent with the goals of the study. Such information in brief is as follows:

Life Cycle Inventory Analysis

Life cycle inventory was analysed on the basis of:

- Agricultural Data Collection and Modeling

Procedure adopted

- Overview of Agricultural System
- Climate, Water Use and Soil Data

- Grower Practices
- Rainfall and Erosion Data
- Irrigation and Water Use Data
- Energy Use Estimates
- Agricultural Data Sheets: For each region within a country, an Excel Work¬book was created to provide the data to supply think step's questionnaires. Each Workbook contained the sheets with detailed information such as in-season field practices, ginning data, pumping energy calculations, soil data, fuel calculations and climate data

Agricultural Data Collection:

Information under the following heads has been collected from three countries viz, China Australia and India. A detailed report has been prepared having 162 pages. Our readers may be updated through a separate article wherein detailed information provided in the report about India may be provided, however, here is an overview of the total report. The report has been presented under the following heading:-

- LCA Methodology
- Textiles Data Collection and Modeling
- Life Cycle Inventory Analysis Results
- LCIA Results
- Textile Manufacturing
- Post Production: Cut-and-Sew, Consumer Use, and End-of-life
- Cradle-to-grave Impacts
- Conclusions: Cotton Life Cycle (Cradle-to-Grave
- In Interpretation
- Identification of Relevant Findings
- Assumptions and Limitations
- Results of Sensitivity, Scenario, and Uncertainty Analysis
- Data Quality Assessment
- Model Completeness and Consistency
- Conclusions, Limitations, and Recommendations
- References and
- Annexure

The conclusions drawn from the results obtained, limitations and the recommendations made in the report are given below

Conclusions:

Related to Cotton Production (Cradle-To-Grave)

- Field emissions were a major contributor to several environmental impact categories: eutrophication potential was strongly influ¬enced by nitrate, acidification potential was influenced by ammonia, and global warming potential was influenced by nitrous oxide. The photochemical ozone creation potential was reduced by nitrogen monoxide emis-sions which are known to have a reductive effect on the creation of ozone. All these substances originate from the transformation process of biogenic and chemical nitrogen. Precision management of nitrogen fertilizer will continue to be a high priority for the cot-ton producers around the world.
- Fertilizer production is another important contributor with a high impact on primary energy demand, global warming potential, and photochemical ozone creation potential. Nitrogen fertilizer represents a majority of that contribution, reinforcing the need for careful nitrogen management.
- Despite a high uncertainty of toxicity ef¬fects in the impact categories of ecotoxicity potential and human toxicity potential, it is evident that field application of pesticides was the main contributor to impact based on the parameters in the current C model. Further studies will be conducted to determine how well USEtox™ represents the fate and transport of pesticides.
- The net GHG emissions during the agricul¬tural phase of the LCA were relatively low and close to the same magnitude of the carbon dioxide equivalents represented by the carbon contained in the fiber. The potential benefits of storing carbon in cotton products was not examined in this work, however, could reduce the GWP impacts.
- The global mean water scarcity index for cotton growing regions was higher than the global average. The scarcity index for cotton was used to generate a water scarcity footprint that relates water use to the water resources available in the cotton growing regions. Water use is dominated by the irriga¬tion stage with less than 1% resulting from upstream processes.

To be continued...

(The views expressed in this column are of the author and not that of Cotton Association of India)

CAI Reduces Crop Estimate for 2018-19 Season to 330 Lakh Bales

Cotton Association of India (CAI) has released its January 2019 estimate of the cotton crop for the season 2018-19 beginning from 1st October 2018.

The CAI has estimated cotton crop for 2018-19 season at 330 lakh bales of 170 kgs. each which is lower by 5 lakh bales than its previous estimate of 335 lakh bales made during last month. Statements containing the State-wise estimate of the cotton crop and the Balance Sheet for the crop year 2018-19 with the corresponding data for the previous year are given below. The CAI has reduced the crop estimate for Telangana by 2.50 lakh bales, Andhra Pradesh by 50,000 bales and Karnataka by 2 lakh bales.

The main reason for lower crop is that in the Southern Zone farmers have uprooted their cotton plants due to moisture deficiency as a result of which there is no scope for 3rd and 4th pickings.

The total cotton supply projected by the CAI during the months of October 2018 to January 2019 is 198.80 lakh bales, which consists of the arrival of 170.32 lakh bales upto 31st January 2019, imports of 5.48 lakh bales upto 31st January 2019 and the opening stock at the beginning of the season estimated at 23 lakh bales.

Further, the CAI has estimated cotton consumption during the months of October 2018 to January 2019 at 105.34 lakh bales while the export shipment of cotton upto 31st January 2019 has been estimated at 24 lakh bales. Stock at the end of January 2019 is estimated by the CAI at 69.46 lakh bales including 39 lakh bales with textile mills and the remaining 30.46 lakh bales with CCI and others (MNCs, traders, ginners, etc.).

The CAI has also projected yearly Balance Sheet for the cotton season 2018-19 wherein total cotton supply till end of the cotton season i.e. upto 30th September 2019 has been estimated at 380 lakh bales of 170 kgs. each consisting of the opening stock of 23 lakh bales at the beginning of the season, cotton crop for the season estimated at 330 lakh bales and imports estimated by the CAI at 27 lakh bales, which are higher by 12 lakh bales compared to the previous year's import estimated at 15 lakh bales. The CAI has estimated domestic consumption of 316 lakh bales which is lower by 4 lakh bales compared to the consumption figure estimated during the last month, while the CAI has estimated exports for the season 2018-19 at 50 lakh bales, which are lower by 19 lakh bales compared to the export of 69 lakh bales estimated during the last year. The carry-over stock at the end of the 2018-19 season is estimated by the CAI at 14 lakh bales.

CAI's Estimates of Cotton Crop as on 31st January 2019 for the Seasons 2018-19 and 2017-18

(in lakh bales)

State	Production *		Arrivals as on 31st January 2019 (2018-19)
	2018-19	2017-18	
Punjab	10.00	9.00	6.01
Haryana	25.00	23.60	17.12
Upper Rajasthan	12.00	11.15	10.45
Lower Rajasthan	13.00	12.25	11.07
Total North Zone	**60.00**	**56.00**	**44.65**
Gujarat	83.50	105.00	37.70
Maharashtra	77.00	83.00	34.60
Madhya Pradesh	24.25	21.50	15.50
Total Central Zone	**184.75**	**209.50**	**87.80**
Telangana	45.00	51.50	23.50
Andhra Pradesh	16.00	18.50	5.55
Karnataka	15.00	18.75	6.50
Tamil Nadu	5.00	5.75	1.00
Total South Zone	**81.00**	**94.50**	**36.55**

Orissa	3.25	4.00	1.22
Others	1.00	1.00	0.10
Total	**330.00**	**365.00**	**170.32**

** Including loose*

The Balance Sheet drawn by the Association for 2018-19 and 2017-18 is reproduced below:-

(in lakh bales)

Details	**2018-19**	**2017-18**
Opening Stock	23.00	36.00
Production	330.00	365.00
Imports	27.00	15.00
Total Supply	**380.00**	**416.00**
Mill Consumption	276.00	280.00
Consumption by SSI Units	28.00	29.00
Non-Mill Use	12.00	15.00
Total Domestic Demand	**316.00**	**324.00**
Available Surplus	**64.00**	**92.00**
Exports	50.00	69.00
Closing Stock	**14.00**	**23.00**

Balance Sheet of 4 months i.e. from 1.10.2018 to 31.01.2019 for the season 2018-19

Details	**(in lakh b/s of 170 kg)**	**(in '000 Tons)**
Opening Stock as on 01.10.2018	23.00	391.00
Arrivals upto 31.01.2019	170.32	2895.44
Imports upto 31.01.2019	5.48	93.16
Total Available	**198.80**	**3379.60**
Consumption	105.34	1790.78
Export Shipment 31.01.2019	24.00	408.00
Stock with Mills	39.00	663.00
Stock with CCI, MNCs, MCX & Ginners	30.46	517.82
Total	**198.80**	**3379.60**

As per Cotton Association of India Stock on 31.01.2019

(Figures in lakh bales of 170 kg.)

State	**Ginners**	**MNC**	**CCI**	**MCX**	**Total**
PUNJAB	0.25	0.05	NIL	NIL	0.30
HARYANA	0.55	0.05	NIL	NIL	0.60
RAJASTHAN	2.25	0.25	NIL	NIL	2.50
GUJARAT	6.84	1.50	0.30	0.38	9.02
MAHARASHTRA	3.08	2.00	0.90	0.60	6.58
ANDHRA PRADESH	0.25	NIL	0.05	NIL	0.30
TELANGANA	1.50	1.25	5.75	0.06	8.56
MADHYA PRADESH	1.10	NIL	0.40	NIL	1.50
ORISSA	0.30	NIL	0.25	NIL	0.55
KARNATAKA	0.50	NIL	0.05	NIL	0.55
TOTAL	**16.62**	**5.10**	**7.70**	**1.04**	**30.46**

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UPCOUNTRY SPOT RATES

(Rs./Qtl)

Sr. No.	Growth	Grade Standard	Grade	Staple	Micronaire	Strength /GPT	Spot Rate (Upcountry) 2018-19 Crop February 2019 4th	5th	6th	7th	8th	9th
	Standard Descriptions with Basic Grade & Staple in Millimetres based on Upper Half Mean Length [By law 66 (A) (a) (4)]											
1	P/H/R	ICS-101	Fine	Below 22mm	5.0-7.0	15	11360 (40400)	11360 (40400)	11360 (40400)	11360 (40400)	11360 (40400)	11360 (40400)
2	P/H/R	ICS-201	Fine	Below 22mm	5.0-7.0	15	11501 (40900)	11501 (40900)	11501 (40900)	11501 (40900)	11501 (40900)	11501 (40900)
3	GUJ	ICS-102	Fine	22mm	4.0-6.0	20	8436 (30000)	8436 (30000)	8436 (30000)	8436 (30000)	8436 (30000)	8436 (30000)
4	KAR	ICS-103	Fine	23mm	4.0-5.5	21	10264 (36500)	10264 (36500)	10264 (36500)	10264 (36500)	10264 (36500)	10264 (36500)
5	M/M	ICS-104	Fine	24mm	4.0-5.0	23	10826 (38500)	10742 (38200)	10742 (38200)	10742 (38200)	10742 (38200)	10742 (38200)
6	P/H/R	ICS-202	Fine	26mm	3.5-4.9	26	11614 (41300)	11529 (41000)	11585 (41200)	11585 (41200)	11585 (41200)	11585 (41200)
7	M/M/A	ICS-105	Fine	26mm	3.0-3.4	25	10601 (37700)	10573 (37600)	10629 (37800)	10629 (37800)	10601 (37700)	10601 (37700)
8	M/M/A	ICS-105	Fine	26mm	3.5-4.9	25	10826 (38500)	10770 (38300)	10826 (38500)	10826 (38500)	10798 (38400)	10798 (38400)
9	P/H/R	ICS-105	Fine	27mm	3.5.4.9	26	11895 (42300)	11810 (42000)	11867 (42200)	11867 (42200)	11867 (42200)	11867 (42200)
10	M/M/A	ICS-105	Fine	27mm	3.0-3.4	26	10911 (38800)	10854 (38600)	10911 (38800)	10911 (38800)	10882 (38700)	10882 (38700)
11	M/M/A	ICS-105	Fine	27mm	3.5-4.9	26	11135 (39600)	11079 (39400)	11135 (39600)	11135 (39600)	11107 (39500)	11107 (39500)
12	P/H/R	ICS-105	Fine	28mm	3.5-4.9	27	12035 (42800)	11951 (42500)	12007 (42700)	12007 (42700)	12007 (42700)	12007 (42700)
13	M/M/A	ICS-105	Fine	28mm	3.5-4.9	27	11473 (40800)	11417 (40600)	11473 (40800)	11473 (40800)	11445 (40700)	11417 (40600)
14	GUJ	ICS-105	Fine	28mm	3.5-4.9	27	11726 (41700)	11642 (41400)	11726 (41700)	11754 (41800)	11754 (41800)	11754 (41800)
15	M/M/A/K	ICS-105	Fine	29mm	3.5-4.9	28	11726 (41700)	11614 (41300)	11670 (41500)	11670 (41500)	11642 (41400)	11614 (41300)
16	GUJ	ICS-105	Fine	29mm	3.5-4.9	28	11895 (42300)	11754 (41800)	11838 (42100)	11867 (42200)	11867 (42200)	11867 (42200)
17	M/M/A/K	ICS-105	Fine	30mm	3.5-4.9	29	11951 (42500)	11838 (42100)	11923 (42400)	11923 (42400)	11895 (42300)	11895 (42300)
18	M/M/A/K/T/O	ICS-105	Fine	31mm	3.5-4.9	30	12232 (43500)	12120 (43100)	12204 (43400)	12204 (43400)	12176 (43300)	12176 (43300)
19	A/K/T/O	ICS-106	Fine	32mm	3.5-4.9	31	12654 (45000)	12513 (44500)	12570 (44700)	12570 (44700)	12513 (44500)	12513 (44500)
20	M(P)/K/T	ICS-107	Fine	34mm	3.0-3.8	33	14904 (53000)	14622 (52000)	14341 (51000)	14060 (50000)	14060 (50000)	14060 (50000)

(Note: Figures in bracket indicate prices in Rs./Candy)