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Scope of Disruptive Technologies in Indian Agriculture

GUEST COLUMN

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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.

The ever-increasing demands for food and clothing by a growing human population increases the importance and urgency of introducing disruptive technologies in global agriculture that can change the way agriculture is being practiced. Scientists have been focusing on ways to improve crop productivity and quality, like variable application of nutrients and pesticides to plants, novel delivery mechanisms, biologicals, fertilizer use efficiency, and climate resilience etc,. etc.

Disruptive technologies are shaping various sectors and helping them to achieve phenomenal growth. Agriculture is one sector, where the producers i.e. the farmers are at the bottom of the pyramid as far as the benefit sharing from agriculture and associated industries are concerned. Some of the disruptive innovations in agriculture are in early to mid-stages of introduction or being marketed in selected countries, mostly in developed countries for cultivation under controlled conditions. Adoption challenges aside, scientists in public and private sector have been developing and introducing such technologies, which coupled with digital technologies have potential to change the way agriculture/ cotton cultivation is being practiced.

An Initiative to Apply Disruptive Technology in Indian Agriculture

Awareness of disruptive technology in Indian agriculture has already been initiated. Some examples are as follows:-

a. Consortium of Researchers for Disruptive Technologies in Agriculture (CDTA)

In a major initiative to apply disruptive technology in agriculture in India, during this year (2019), a consortium of researchers has been formed with the partnership of three leading institutions in the country, with the mandate of turning farming from an 'uncertain' to 'assured' activity, according to an article by 'United News of India'.

Named the Consortium of Researchers for Disruptive Technologies in Agriculture (CDTA) it is made up of academicians, researchers, and scientists from the Indian Institute of Information Technology and Management, Kerala (IIITMK); Thiruvananthapuram (a local government unit); GB Pant University of Agricultural Sciences and Technology, Pant Nagar (Uttarkhand); and the Indian Institute Space Technology (IIST).

"The team will advocate and implement application of technologies like artificial intelligence, data analytics, internet of things, cloud computing, aerospace observation, and miniaturised sensors in the agriculture domain," according to a press statement released during Feb 2019.

b. Presentation on Disruptive Technologies

"Disruptive technologies to foster the Next Green Revolution" was the topic of a presentation by Professor Paul Teng from the S. Rajaratan School of International Studies, Singapore on 19 February 2019 at ICAR – Central Institute for Research on Cotton Technologies (CIRCOT), Mumbai.

Thus, as on date it is understood that there are many activities that are taking place on the issue of disruptive technology in agriculture in India. Basically, this article is to make our readers aware about 'disruptive technologies' for Indian agriculture sector. What role such technologies will play in improving cotton scenario of Indian cotton Industry is another issue of concern and of greater importance. To start with, let us first understand what does 'disruptive technologies' mean.

➢ Disruptive Technologies

✓ Disruptive technology refers to any enhanced or completely new technology that replaces and disrupts an existing technology, rendering it obsolete. It is designed to succeed similar technology that is already in use.

✓ Because disruptive technology is new, it has certain advantages, enhancements and functionalities over competitors. For example, cloud computing serves as a disruptive technology for in-house servers and software solutions. It has slowly been adopted by organisations and individuals with the main objective of completely removing traditional computing.

✓ As such technologies are unused, unapplied and untested alternatives, it takes time for them to be dominantly deployed and ultimately degenerating existing technologies.

➢ Scope of Disruptive Technologies

Scope of 'Disruptive Technologies' can be described under the following heads:-

A. Setting the Stage: Disrupting Agriculture

B. What Impact these Disruptive Innovations (Technologies) will have on Modern F^3 (Food, Feed, Fibre) Systems and how?

C. Anticipating Impact: The Future

A. Setting The Stage: Disrupting Agriculture

As mentioned above, a "disruptive technology" is one that displaces an established technology and shakes up the industry or a ground-breaking product that creates a completely new industry. Agriculture has historically depended on disruptive discoveries and innovations to make big strides: Mendel's laws, hybrid seed, mechanisation, fertilization, modern dwarf varieties, synthetic pesticides, biotechnology, precision farming, etc are some of the examples of disruptive discoveries and innovations.

a. Four innovations brought about a change in agriculture in the 20th century:-

- Mechanisation: Tractors freed up perhaps 25 % of extra land to grow human food and clothes, instead of fodder for draught horses and oxen;

- Fertilisers: Invention of a method of synthesising ammonia transformed agricultural productivity.

- Pesticides: Chemicals derived from hydrocarbons enabled farmers to grow high-density crops, year after year; and

- Genetics (Seeds): In the 1960s, dwarf wheat rapidly replaced the South Asian subcontinent's hunger with surplus in the 'Green Revolution'.

The effect of these four innovations was to allow more and more food, feed and fibre to be produced from less and less land – the developed world became complacent.

b. The innovations which will change agriculture in this century

'Demand' and 'supply' are two deciding factors for making any change in agriculture.

➢ **Demand:-**

- Population Growth: For demand, the world's population is expected to grow to almost 10 billion by 2050, boosting agricultural demand – in a scenario of modest economic growth by some 50% as compared to 2013. On the same line, population of India will also grow.

- Changing Diet Pattern: Income growth in low- and middle-income countries would hasten a dietary transition towards higher consumption of meat, fruits and vegetables, relative to that of cereals, requiring commensurate shifts in output.

➢ **Supply**

For supply, we may have to depend upon a number of factors, such as

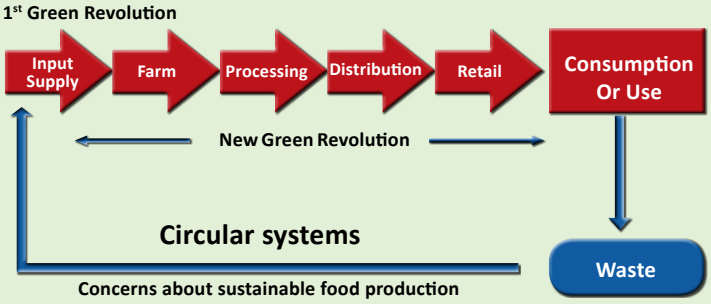
- Labour-Increased out migration
- Capital-Increased uncertainties
- Natural Resources
  - Water Scarcity
  - Climate Change
  - Degraded Land and Environment
- Technology

Almost all private research takes place in high-income countries while in India and China it has taken up recently. United States Economic and Social Council (ECOSOC) is responsible for coordinating the economic, social and related work of UN specialised agencies, their functional and regional commission. In 2004, ECOSOC recommended overall government R&D expenditure for science and technology of at least 1% of national GDP, but developing countries are generally far below the target.

c. Food-Feed-Fibre (F^3) Systems!

The new green revolution is not just about production of food, feed and fibre from agriculture "greening" but it includes taking into account all the activities and outcomes of "food-feed-fibre systems" (F^3). This system includes all the elements (environment, people, inputs, processes, infrastructure, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the output of these activities, including socio-economic and environmental outcomes. Below is 'At a Glance', diagrammatic view of F^3 system:-

A F^3 system may be represented by a supply chain



"Rapid transformation of Supply Chains"

.. Thomas Reardon, 2011

B. What Impact Disruptive Innovations (Technologies) Will Make on Modern F^3 (Food, Feed, Fibre) Systems and How?

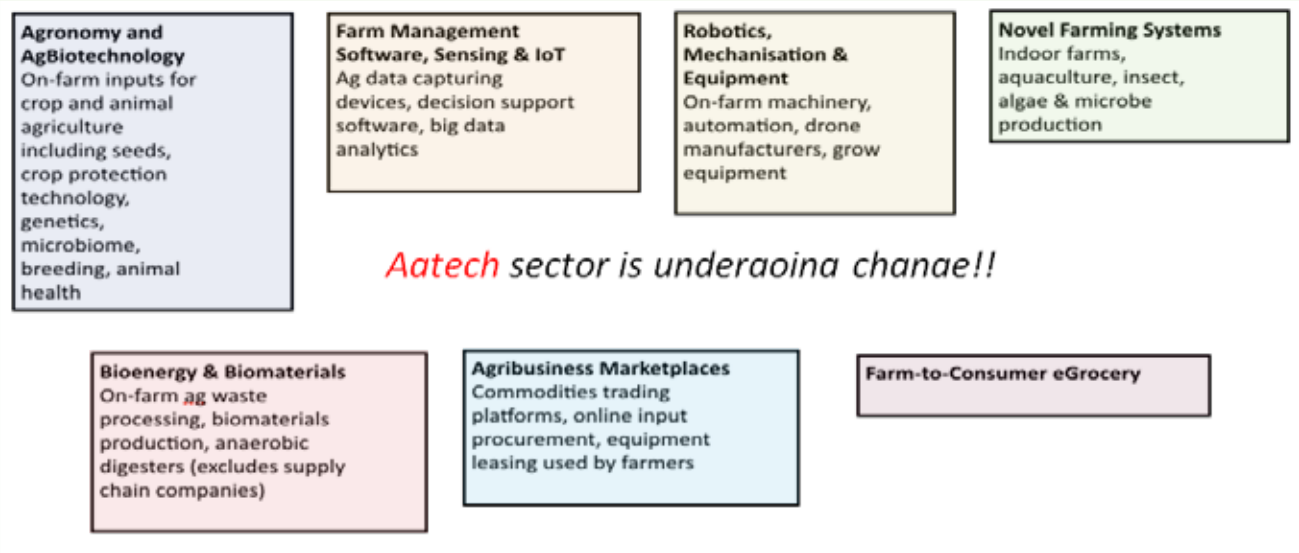
How agriculture sector is undergoing change, can be explained in four waves:-

✓ First wave: Green Revolution technologies of improved seed, fertilizer, pesticides, irrigation and mechanisation……1950s

✓ Second wave: Biotechnology……1996

✓ Third wave: Digital – Biological integrated technologies……..2010s

✓ Fourth wave: Food (Feed?) without agriculture;



"At a glance" view of how agriculture sector is undergoing change, has been presented below:-

Various Disruptive Innovations:-

I. Disruptive innovation #1 DIGITAL - AGTECH

Agriculture is the least digitised industry. Use of this innovation being made here and there or where it can be used in future in agriculture promotion has been illustrated below:-

a. **The 4th Industrial Revolution---Digital Technology:** - The maximum use of digital technology is being made by Information Communication and Technology (ICT) industry, followed by media and then finance, wholesale trade, chemicals, mining, education, entertainment, government, health care, hospitality and the least by agriculture.

b. **Digital agriculture: "Internet of things" (IoT):** - Data-Enabled Agriculture in Mobile computing, Data Sensor Input, Satellite & Imagery, Drones and Genetics, thus technology made knowledge Intensive Agriculture

c. **Management Information Systems (MIS):- Food Production system:** - Now a days, in many countries, farmer are planning and forecasting and then making their comparisons between
   - Forecast with Intervention measures taken now and
   - Forecast without Intervention measures

d. **Automated Disease Detection Technology**
Farmers conversant with this system protect their crop by:-
   - Taking photos of damaged plant part,
   - Matching it with set symptoms of diseases/ pest attack and
   - Applications as per recommended treatment

e. **Knowledge and Skills**
Logistics, Management and Finance, Experiential Learning and Storage are some of the fields where knowledge and skills play an important role.

f. **High Technologies for Precision and Smart Agriculture**
High Technologies like Remote Sensing, GIS/ GPS, Drone, Fertigation, Biotech, LED, Big Data, Data Analytics, Green House, Robotics etc. are being used in different parts of the world, for modern agriculture

g. **Fin-tech** Computer programs and other technology are used to support and enable banking and financial services.

II. Disruptive Innovation # 2 :

a. Biotechnology -- new breeding technologies from the new biology -Beyond GMOs

b. Gene-Editing biotechnologies--Genome-edited crops being improved include, soybean, maize, wheat, rice, potato, tomato, peanuts and cotton

c. Modern biotechnology does address the challenges and needs of agriculture and society thus resulting in :-
   - Surplus production: more production

with less resources, price stability, climate adaptation, new higher-yield crop varieties, etc,
- Labour saving production technology
- Nutrition and safety
- Trade
- Negative externalities, e.g. pesticide pollution
- Environmental stress (drought, floods)
- Biotic stress (pests, diseases)

III. Disruptive Innovation #3

Controlled environment food farming fusing ICT and biology:

- Plant Factory technology (Urban) – new farming systems. "PFAL" = Plant Factory Artificial Light.

- Proximity to sources of production in urban areas: freshness, nutrition quality, energy miles - controlled environment farm.

IV. Disruptive Innovation # 4 :

Food/Feed/Fibre technologies (Preventing Product Fraud):- Modern F^3

V. Disruptive Innovation # 5 :

Supply Chain Connectivity – Digital Platforms

3. Anticipating Impact: The Future

A number of global trends are influencing food security, poverty, and the overall sustainability of food and agricultural systems. Future of agriculture in India (Asia) and Pacific can be better understood through:-

a. Traditional Approach: Increasing Productivity through:-
   - Labour Intensive
   - Resource Intensive
   - Input-Based Agriculture

b. Knowledge Intensive Agriculture:- Accelerating Innovation through:-
   - Smart Farming
   - Green Technology
   - Commercial Farming
   - Entrepreneurship Support

   (e.g., potential in precision agriculture)

We have oceans of data, rivers of information, small puddles of knowledge and odd drop wisdom. Knowledge is king to bring Industrial Revolution 4.0", (IR4.0) in agriculture such as :-

- Information-Communication Technology
- Miniaturisation, Mobile devices
- The "Internet of Things"(IoT)

Agriculture 4.0: The Future of Farming Technology

The Industrial Revolution signified major developments in the world of manufacturing and technology, spanning between 17th to 20th centuries. Industry1.0 (mechanisation of steam and water power) and Industry 2.0 (mass production and electricity). The beginning of the 21st century saw the third Industrial Revolution or Industry 3.0 which saw the advent and rise of Information Technology, internet, renewable energy as well as mobile and other connected devices. This phase saw remarkable innovations and changed the way the modern world functions and who knows how many more revolutions we could witness in the times we are living?

Several years have passed and now we stand on the cusp of another Industrial Revolution. The fourth industrial revolution or Industry 4.0 has become quite a buzzword. Economies across the globe are all set to adopt it and India is also treading the path in its own way.

What Is Industry 4.0?

"Industry 4.0" is a blend of advanced analytics, Big Data, Robotics & Automation, Artificial Intelligence, Internet of Things (IoT) and Process Digitisation, across the business value chain.

Why should India adopt Industry 4.0?

If yes, how is India preparing and adopting smarter strategies for smart changes in agriculture? But prior to that, it is of utmost importance to know and understand about available disruptive technologies, their adoption at global level, and also their role in the transformation of world agriculture and cotton scenario etc. etc. More information on such issues will be made available for the knowledge of our readers in another articles shortly.

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

Glimses of Varun Yagna

Here are a few glimpses of the Varun Yagna held by the Bombay Cotton Merchants' & Muccadams' Association Ltd. (BCMMA), on Thursday, 30th May, 2019.

Since 1921,
we are dedicated to the cause of Indian cotton.

Just one of the reasons, you should use our Laboratory Testing Services.

The Cotton Association of India (CAI) is respected as the chief trade body in the hierarchy of the Indian cotton economy. Since its origin in 1921, CAI's contribution has been unparalleled in the development of cotton across India.

The CAI is setting benchmarks across a wide spectrum of services targeting the entire cotton value chain. These range from research and development at the grass root level to education, providing an arbitration mechanism, maintaining Indian cotton grade standards, issuing Certificates of Origin to collecting and disseminating statistics and information. Moreover, CAI is an autonomous organization portraying professionalism and reliability in cotton testing.

The CAI's network of independent cotton testing & research laboratories are strategically spread across major cotton centres in India and are equipped with:

- State-of-the-art technology & world-class Premier and MAG cotton testing machines
- HVI test mode with trash% tested gravimetrically

LABORATORY LOCATIONS

Current locations : • **Maharashtra :** Mumbai; Yavatmal; Aurangabad • **Gujarat :** Rajkot; Kadi; Ahmedabad • **Andhra Pradesh :** Adoni • **Madhya Pradesh :** Khargone • **Karnataka :** Hubli • **Punjab :** Bathinda • **Telangana:** Warangal, Adilabad

UPCOMING LOCATIONS

• **Telangana:** Mahbubnagar

COTTON ASSOCIATION OF INDIA
Established 1921

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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 June 2019 3rd	4th	5th	6th	7th	8th
1	P/H/R	ICS-101	Fine	Below 22mm	5.0-7.0	15	11614 (41300)	11614 (41300)	11614 (41300)	11614 (41300)	11614 (41300)	11614 (41300)
2	P/H/R	ICS-201	Fine	Below 22mm	5.0-7.0	15	11754 (41800)	11754 (41800)	11754 (41800)	11754 (41800)	11754 (41800)	11754 (41800)
3	GUJ	ICS-102	Fine	22mm	4.0-6.0	20	10039 (35700)	10039 (35700)	10039 (35700)	9954 (35400)	9898 (35200)	9842 (35000)
4	KAR	ICS-103	Fine	23mm	4.0-5.5	21	11164 (39700)	11164 (39700)	11164 (39700)	11079 (39400)	11023 (39200)	10967 (39000)
5	M/M	ICS-104	Fine	24mm	4.0-5.0	23	11389 (40500)	11389 (40500)	11389 (40500)	11389 (40500)	11332 (40300)	11248 (40000)
6	P/H/R	ICS-202	Fine	26mm	3.5-4.9	26	12991 (46200)	12991 (46200)	12991 (46200)	12963 (46100)	12963 (46100)	12963 (46100)
7	M/M/A	ICS-105	Fine	26mm	3.0-3.4	25	11698 (41600)	11698 (41600)	11698 (41600)	11698 (41600)	11698 (41600)	11614 (41300)
8	M/M/A	ICS-105	Fine	26mm	3.5-4.9	25	11951 (42500)	11951 (42500)	11951 (42500)	11951 (42500)	11951 (42500)	11867 (42200)
9	P/H/R	ICS-105	Fine	27mm	3.5.4.9	26	13076 (46500)	13076 (46500)	13076 (46500)	13048 (46400)	13048 (46400)	13048 (46400)
10	M/M/A	ICS-105	Fine	27mm	3.0-3.4	26	11867 (42200)	11867 (42200)	11867 (42200)	11867 (42200)	11867 (42200)	11782 (41900)
11	M/M/A	ICS-105	Fine	27mm	3.5-4.9	26	12092 (43000)	12092 (43000)	12092 (43000)	12092 (43000)	12092 (43000)	12007 (42700)
12	P/H/R	ICS-105	Fine	28mm	3.5-4.9	27	13132 (46700)	13132 (46700)	13132 (46700)	13104 (46600)	13104 (46600)	13104 (46600)
13	M/M/A	ICS-105	Fine	28mm	3.5-4.9	27	12570 (44700)	12570 (44700)	12570 (44700)	12570 (44700)	12570 (44700)	12485 (44400)
14	GUJ	ICS-105	Fine	28mm	3.5-4.9	27	12682 (45100)	12682 (45100)	12682 (45100)	12682 (45100)	12654 (45000)	12570 (44700)
15	M/M/A/K	ICS-105	Fine	29mm	3.5-4.9	28	12851 (45700)	12879 (45800)	12879 (45800)	12879 (45800)	12851 (45700)	12766 (45400)
16	GUJ	ICS-105	Fine	29mm	3.5-4.9	28	12823 (45600)	12851 (45700)	12851 (45700)	12851 (45700)	12823 (45600)	12738 (45300)
17	M/M/A/K	ICS-105	Fine	30mm	3.5-4.9	29	13188 (46900)	13188 (46900)	13188 (46900)	13188 (46900)	13160 (46800)	13076 (46500)
18	M/M/A/K/T/O	ICS-105	Fine	31mm	3.5-4.9	30	13441 (47800)	13441 (47800)	13441 (47800)	13441 (47800)	13441 (47800)	13357 (47500)
19	A/K/T/O	ICS-106	Fine	32mm	3.5-4.9	31	13694 (48700)	13694 (48700)	13694 (48700)	13694 (48700)	13694 (48700)	13610 (48400)
20	M(P)/K/T	ICS-107	Fine	34mm	3.0-3.8	33	15747 (56000)	15607 (55500)	15466 (55000)	15325 (54500)	15325 (54500)	15325 (54500)

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