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Cotton Exchange Building, 2nd Floor, Cotton Green, Mumbai - 400 033
Phone: 3006 3400 Fax: 2370 0337 Email: cai@caionline.in
www.caionline.in

Fibres for Future - an Indian Perspective

EXPERT's Column

Dr. M. Sabesh
Senior Scientist
(Computer Applications in Agriculture)

Dr. A.H. Prakash
Project Coordinator
(AICRP on Cotton)

ICAR - Central Institute for Cotton Research, Regional Station, Coimbatore

Dr. M. Sabesh, Senior Scientist (Computer Applications in Agriculture) works at Central Institute for Cotton Research. He did his Ph.D. in multi-disciplinary from Madras University. He has 25 years of experience in research mainly on data churning, Socio-economic analyses development of Decision Support System, Expert system and Web Portal. Prior to ICAR, he worked in MIDS (ICSSR), MSE, Rubber Board (Min of Commerce)

Dr. A.H. Prakash, Project Coordinator (AICRP on Cotton) works at Central Institute for Cotton Research. He has 25 years of experience in cotton research and management.

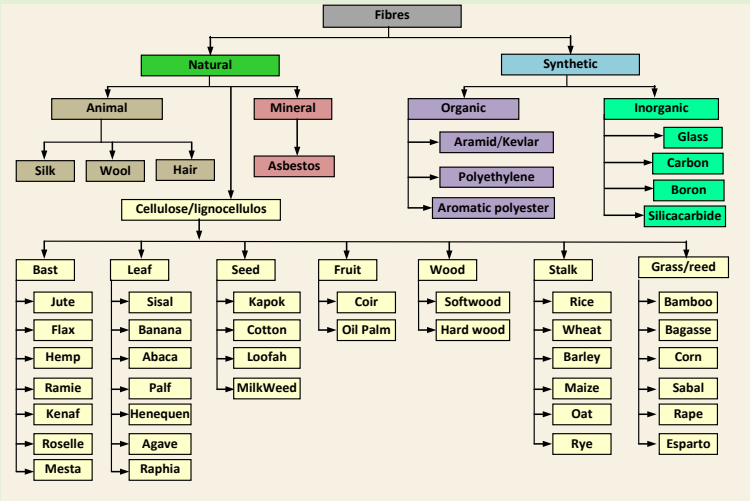
Natural fibres have been in use since the pre-historic era. The oldest indication of the use of fibre is probably the discovery of flax and wool fabrics at excavation sites of the Swiss lake dwellers (7th and 6th centuries BCE). Hemp, the oldest cultivated fibre plant, originated in Southeast Asia, then spread to China, where reports of cultivation date to 4500 BCE. The art of weaving and spinning linen had been well developed in Egypt by 3400 BCE, indicating that flax was cultivated sometime before that date. Reports of the spinning of cotton in India dated back to 3000 BCE. The manufacture of silk and silk products originated in the highly developed Chinese culture during 2640 BCE. In the 18th and 19th centuries, the Industrial Revolution encouraged the further invention of machines for use in processing various natural fibres, resulting in a tremendous upsurge in fibre production. The introduction of regenerated cellulosic fibres such as rayon, followed by the invention of completely synthetic fibres, such as nylon, challenged the monopoly of natural fibres for textile and industrial use. Recognition of the competitive threat from synthetic fibres resulted in intensive research directed toward the breeding of new and better strains of natural-fibre sources with higher yields, improved production and processing methods, and modification of fibre yarn or fabric properties. The improvements achieved have permitted increased total natural fibre production, although actual share of the market has decreased with the influx of the inexpensive, synthetic fibres requiring fewer man-hours for production and process.

Fibres – Classification

Fibres are classified into natural and manmade fibres. Natural fibres can be defined as fibres from vegetable and animal origin. Based on their origin, natural fibres can also be classified as cellulosic (from plants), protein (from animals) and mineral fibres such as asbestos that occur naturally but are not bio-based. Cellulose fibres have certain common properties like low resilience, high density, and good conductor of heat. They are highly absorbent and are resistant to high temperature. Cotton, flax, jute, hemp and ramie are the examples of natural fibres. Animal fibres like wool and silk are made up of protein molecules. Animal fibres have high resiliency, but are weak when wet because they are bad conductors of heat. Synthetic or man-made fibres have high strength, strong when wet with low moisture absorption characteristics. Rayon, acetate rayon, nylon, polyester, etc. are example of man-made fibres.

Depending on raw material, the fibres classified as cellulosic fibres, protein fibres and synthetic fibres. Natural fibres are more environment friendly than man-made fibres both in terms of production and process. Natural fibres are completely bio-degradable, thus play a key role in the emerging green economy. The detailed classification of fibres is presented in graphical form in Figure 1.

Figure 1:
Classification of Natural and Synthetic Fibres



Globally, cotton is the largest natural fibre produced with an estimated average production of 25 million tonnes per year in recent years, while jute and wool accounts for around 2 to 3 million tonnes per year. Other natural fibres are produced in considerably smaller volumes. In the international trade market and export of natural fibres such as sisal, henequen, jute, kenaf, flax and hemp have seen a decline in the recent past due to the expanded production of inexpensive synthetic fibres.

Table 1:
Estimated Global Production of Natural Fibre
(in million metric tonnes per year in 2000s)

Fibre	Million Tonnes	Main Producing Countries
Cotton	25.00	India, China, USA, Pakistan
Jute	2.50	India, Bangladesh
Wool	2.20	Australia, China, New Zealand
Flax	0.50	China, France, Belgium, Belarus, Ukraine
Kenaf	0.45	China, India, Thailand
Coir	0.45	India, Sri Lanka
Sisal	0.30	Brazil, China, Tanzania, Kenya
Ramie	0.15	China
Hemp	0.10	China
Abaca	0.10	Philippines, Ecuador
Silk	0.10	China, India

Source: Jan E.G. van Dam Wageningen University, the Netherlands,

Proceedings of the Symposium on Natural Fibres.

Features of Major Natural Fibres

Cotton: An estimated 60% of cotton fibre is used as yarn and threads in a wide range of clothing, most notably in shirts, T-shirts and jeans, but also in coats, jackets, underwear and foundation garments. Cultivated in 77 countries, cotton is one of the world's most widely produced crops and uses about 2.5% of the world's arable land area. The world produces around 25 million tonnes of cotton every year. Six countries - China, Brazil, India, Pakistan, the USA and Uzbekistan - account for more than 80% of total production.

According to OECD-FAO Agricultural Outlook 2019-2028, world cotton production is expected to reach 29.2 million metric tonnes and India will remain the world's largest cotton producer with production of 7.21 million metric tonnes (424 lakh bales) in 2028 (Table 2). World cotton yields will grow slowly as the production domain gradually shifts from high yielding countries, especially China, to low-yielding ones in South Asia and West Africa.

Over the past decades, global demand for textile fibres has grown strongly, but most of this demand has been met by chemical fibres. Consumption of synthetic fibres overtook that of cotton since 1990s, and has continued to grow strongly. Presently, the share of synthetic fibres is estimated at 70%, cotton is around 28% and rest is accounted for by the other natural fibres. According to OECD-FAO, the global consumption of cotton is expected to reach 29.17

Table 2: Projected Cotton Area, Production and Yield

	Area Lakh ha			Production Lakh Bales			Yield Kg/ha		
	India	China	USA	India	China	USA	India	China	USA
2015	118.77	34.13	32.66	338.00	305.88	165.09	484	1524	859
2016	108.45	31.00	38.49	345.00	288.24	219.90	541	1581	971
2017	122.35	33.50	45.93	373.53	346.47	267.93	519	1758	992
2018	123.70	33.67	43.99	355.88	336.70	235.65	489	1700	911
2019	125.06	33.40	42.80	362.30	335.64	241.14	493	1708	958
2020	126.39	33.01	42.45	368.21	332.47	241.15	495	1712	966
2021	127.71	32.59	42.40	374.47	329.37	243.20	498	1718	975
2022	129.13	32.22	42.36	381.37	327.30	246.53	502	1727	989
2023	130.54	31.92	42.02	388.38	326.11	247.30	506	1737	1001
2024	131.96	31.68	41.61	395.51	325.48	247.67	510	1747	1012
2025	133.39	31.44	41.41	402.70	324.69	249.14	513	1756	1023
2026	134.82	31.15	41.15	409.74	323.10	250.11	517	1763	1033
2027	136.26	30.82	40.85	416.89	320.96	250.77	520	1770	1044
2028	137.73	30.47	40.52	424.21	318.59	251.25	524	1777	1054

Data Source: OECD-FAO Agricultural Outlook 2019-2028

million metric ton and the demand in India expected to be high. Continued escalation of cost of cultivation and competition from food crops and limitation of land and other natural resources place significant constraints on growth of cotton production in the country. On the other hand, higher productivity driven by technological progress and the adoption of improved production practices, including the use of certified seeds, high density planting systems, canopy management and short duration varieties, creates significant potential for cotton production to expand in the next decade in India.

Jute: Jute is extracted from the bark of the white jute plant, *Corchorus capsularis* and to a lesser extent from to ssajute *(C. olitorius)*. Jute has low thermal conductivity and is insulating and anti-static. Geotextiles made from jute are biodegradable, flexible, absorb moisture and drain well. They are used to prevent soil erosion and landslides. Annual output ranges from 2.3 to 2.8 million tonnes, on par with wool. India produces 60% of the world's jute production, with Bangladesh accounting for most of the rest.

Flax: Flax fibres obtained from the stems of the plant *Linumusitatissimum* are used mainly to make linen. Flax fibres are stronger, crisper and stiffer to handle compared to cotton. Fine and regular long flax fibres are spun into yarns for linen textiles. More than 70% of linen goes to clothing manufacture, where it is valued for its exceptional coolness in hot weather. It is produced largely in Madhya Pradesh, Uttar Pradesh, Bihar, Chhattisgarh, Jharkhand and Orissa.

Ramie: Native to East Asia and commonly known as China grass, ramie *(Boehmerianivea)* is a flowering plant of the nettle family. Ramie fibre is one of the strongest natural fibres. White in colour, with a silky lustre, it has low elasticity and can be dyed easily, making it suitable for a wide range of garments, including jeans. Coarse ramie fibres are suitable for making twine, rope and nets. Ramie is commercially produced in Assam, Maharashtra and northern Bengal.

Hem: Hemp fibre is obtained from the plant *Cannabis SatviaL*. Hemp is good conductor of heat and has natural anti-bacterial properties. Used to make rope, canvas and paper, hemp is also woven to make a linen-like fabric. It is cultivated in some part of Uttarakhand, Kashmir and Travancore.

Silk: Silk is produced by the silk worm, *Bombyx mori.* Fed on mulberry leaves, it produces liquid silk that hardens into filaments to form its cocoon. Silk's natural beauty and other properties - such as comfort in warm weather and warmth during colder months – has made it much sought after for use in high-fashion clothes, lingerie and underwear. It is also being used as surgical sutures and does not cause inflammatory reactions and is absorbed or degraded after wounds heal. Silk is produced in more than 20 countries; with the major producers being in Asia. During the year 2017-18, India produced 32 MT of silk. India, Italy and Japan are the main importers of raw silk for processing. The unit price for raw silk is around twenty times that of raw cotton.

Wool: Sheep *(Ovisaries)* were first domesticated 10,000 years ago. After scouring to remove grease and dirt, wool is carded and combed, then spun into yarn for fabrics or knitted garments. Its ability to absorb and release moisture makes woolen garments comfortable as well as warm. Wool is used in the manufacture of garments, including sweaters, dresses, coats, suits and "active sportswear". Industrial uses of wool include sheets of bonded coarse wool used for thermal and acoustic insulation in home construction, as well as pads for soaking up

oil spills. The world's leading animal fiber, wool is produced in about 100 countries on half a million farms. In India, the woolen textiles and clothing industry is relatively small compared to the cotton and man-made fibre-based textiles and clothing industry. India has the 3rd largest sheep populated country in the world having 65.07 million sheep producing 43.50 million kg of raw wool in 2017-18.

Rayon: Rayon is an artificial textile material composed of regenerated and purified cellulose derived from plant sources. Developed in the late 19th century as a substitute for silk, rayon was the first man-made fibre.

Potential Natural Fibre for Future

Combining agro-fibres (lingo-cellulosics) with other resources represents a strategy for producing advanced composite materials that takes advantage of the properties of both types of resources. Among the various natural fibres, five fibres (hemp, flax, banana fibre, sisal fibre, pineapple fibre) have been identified as holding great potential in the near future in Indian agriculture. There is an increasing awareness of hemp fibre and a wide spectrum of hemp products is now available in the market. Hemp is used for a variety of textile products including bedspreads, blankets, back packs, carpets, clothing, hats, luggage, mattresses, shoes, tents and towels. Coarse flax fibres are used for manufacturing strong ropes, shipping cord, twines. Fine flax is used for manufacturing good quality suiting, shirting materials, bedsheets, curtains, writing paper, tents and canvas. India is importing flax as there is demand from the defense sector. This demand could be fulfilled by domestic supply by enhancement of flax production.

India is the biggest producer of banana across the globe. Banana fibre is used for manufacturing doormats, carpets, yarn, geo-textiles, luggage carriers and interior decorative items. It can be exported to far-east Asian and south Asian countries. India has the potential of producing around 2.2 million tonnes per year.

Sisal is a perennial plant, grown in arid and semi-arid regions of Andhra Pradesh, Bihar, Orissa, Karnataka, Maharashtra and West Bengal. Sisal fibre is used to make twines and ropes due to its strength also used to make papers, geotextile mattresses and carpets. Its properties include stretchability, affinity for dyeing and resistance to varied weather condition. There is a huge potential for sisal fibre in the geotextile and automobile segments in India.

There is huge potential for pineapple fibre also due to its eco-friendly properties especially in making furnishing materials. India has the potential to tap 0.16 million tonnes/year of pineapple fibre.

An estimated 60 million households were engaged in natural fibre production during 2016, including some 45 million households producing cotton, six million producing jute, kenaf and allied fibres, about five million wool producers, one million involved in production of coir, and another one million involved in other natural fibres, such as abaca, hemp, sisal and silk. According to Discover Natural Fiber Initiatives, globally, the natural fibre production is estimated at 32 million tonnes, valued at 52 billion US $ and total employment for 292 million which includes family labour, hired workers and employees in associated service industries such as transportation and storage in the natural fibre value chains.

The availability of genetic modification technology could scale-up and introduce environmental and eco-friendly cotton to the global users. Not just cotton, but the work on utilizing GM technologies for other natural fibres been carried out in different countries. Australia and New Zealand have carried out extensive studies to make use of biotechnological methods for enhancing the quality and yield of wool fibres. Biotechnology has already led to the development of newer products with reduction in cost and environmental pollution in the production and processing stages. Textile industry is a key sector where immense possibilities exists for biotech applications in production and processing without harming either the food chain or the life cycle of any other living creature in the biosphere.

With the growing population pressure and increased demand for cloth, the cotton production around the world is not able to meet the demand. India is the second largest producer of man-made fibres next to China, globally. At the same time, the rise in petroleum price (where most of the man-made fibres are produced from petroleum-crude) along with growing environmental awareness is leading to revival for products made from natural fibres at the global level.

There is great potential for production of natural fibres including cotton in India. Adequate policy decisions involving both governmental and private agencies in research and development strategies would sustain natural fibre production in the country and assure remunerative return to farming community.

Authors Note: The views expressed above by the authors are prepared based on the numerous research articles published across the countries and individual analyses of facts and figures on cotton and other natural fibres.

(The views expressed in this column are of the authors and not that of Cotton Association of India)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Excerpts from India Meteorological Department's Weather Report of 12th September 2019

Forecast for next two weeks

Weather systems & associated Precipitation during Week 1 (12 to 18 September, 2019) and Week 2 (19 to 25 September, 2019)

Rainfall for week 1: (12 to 18 September, 2019)

- Under the influence of low Pressure area over north Madhya Pradesh & adjoining southwest Uttar Pradesh and associated cyclonic circulation, fairly widespread to widespread rainfall with isolated heavy to very heavy falls very likely over Madhya Pradesh and fairly widespread with isolated heavy falls over East Uttar Pradesh during most days of week 1.

- Fairly widespread to widespread rainfall very likely to occur East India (Odisha, Gangetic West Bengal, Bihar Jharkhand) during the week 1 with isolated heavy falls on 12th & 13th.

- Due to southerly flow from north Bay of Bengal over northeastern states, fairly widespread to widespread rainfall very likely to occur over northeastern states and Sub-Himalayan West Bengal Sikkim during the week 1 with isolated heavy falls during its 1st half.

- Light/moderate fairly widespread to widespread rainfall is very likely along West Coast during the week.

- Light/moderate scattered to fairly widespread to widespread rainfall is very likely over remaining parts of the country except Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana and west Rajasthan, where light isolated rainfall or no rain likely to occur during the week 1 (Annexure III).

Annexure III

METEOROLOGICAL SUB-DIVISIONWISE WEEKLY RAINFALL FORECAST & Wx. WARNINGS-2019

Sr. No	MET.SUB-DIVISIONS	12 SEP	13 SEP	14 SEP	15 SEP	16 SEP	17 SEP	18 SEP
1	ANDAMAN & NICO.ISLANDS	FWS	FWS	WS*	WS*	WS*	WS*	WS*
2	ARUNACHAL PRADESH	WS**	FWS*	FWS	FWS	FWS	FWS	FWS
3	ASSAM & MEGHALAYA	WS**	FWS*	SCT	FWS	FWS	FWS	FWS
4	NAGA.MANI.MIZO.& TRIPURA	FWS*	SCT	SCT	FWS	FWS	FWS	FWS
5	SUB-HIM.W. BENG. & SIKKIM	WS**TS	WS*	FWS	FWS	FWS	FWS	FWS
6	GANGETIC WEST BENGAL	WS*	FWS	FWS	FWS	SCT	SCT	SCT
7	ODISHA	WS**	FWS*	FWS	FWS	FWS	FWS	SCT
8	JHARKHAND	WS*TS	FWS*TS	FWS	SCT	SCT	SCT	SCT
9	BIHAR	FWS*TS	FWS*TS	SCT	SCT	FWS	FWS	FWS
10	EAST UTTAR PRADESH	FWS*	FWS*	FWS*	FWS*	FWS*	SCT*	SCT
11	WEST UTTAR PRADESH	SCT*	SCT*	SCT	SCT	SCT	SCT	ISOL
12	UTTARAKHAND	WS*	FWS*	FWS	SCT	SCT	SCT	SCT
13	HARYANA CHD. & DELHI	ISOL	ISOL	ISOL	ISOL	ISOL	SCT	SCT
14	PUNJAB	ISOL	ISOL	ISOL	ISOL	ISOL	ISOL	DRY
15	HIMACHAL PRADESH	ISOL	ISOL	ISOL	SCT	SCT	ISOL	ISOL
16	JAMMU & KASHMIR	DRY	ISOL	ISOL	SCT	SCT	ISOL	ISOL
17	WEST RAJASTHAN	ISOL	ISOL	DRY	DRY	DRY	DRY	DRY
18	EAST RAJASTHAN	SCT**	FWS*	SCT*	SCT	ISOL	ISOL	ISOL
19	WEST MADHYA PRADESH	WS**	WS**	WS**	WS*	WS*	FWS*	FWS
20	EAST MADHYA PRADESH	WS**	WS**	WS*	FWS*	FWS*	FWS*	FWS
21	GUJARAT REGION D.D. & N.H.	FWS**	FWS*	SCT	SCT	ISOL	SCT	SCT
22	SAURASTRA KUTCH & DIU	FWS*	SCT	SCT	ISOL	ISOL	ISOL	ISOL
23	KONKAN & GOA	WS*	WS*	WS	WS	WS	WS	WS
24	MADHYA MAHARASHTRA	FWS*	SCT	SCT	SCT	SCT	FWS	FWS
25	MARATHAWADA	FWS*	SCT	SCT	SCT	SCT	FWS	FWS
26	VIDARBHA	WS*	FWS	SCT	SCT	SCT	FWS	FWS
27	CHHATTISGARH	FWS*	SCT	SCT	SCT	SCT	FWS	FWS
28	COASTAL A. PR. & YANAM	FWS*	SCT	SCT	FWS	FWS*	FWS*	FWS*
29	TELANGANA	FWS*	SCT	SCT	SCT	FWS*	FWS*	FWS*
30	RAYALASEEMA	SCT	ISOL	ISOL	ISOL	SCT	SCT	SCT
31	TAMIL. PUDU. & KARAIKAL	FWS*	SCT*	SCT	SCT	FWS*	FWS	FWS
32	COASTAL KARNATAKA	WS*	FWS	FWS	FWS	WS*	WS	WS
33	NORTH INT.KARNATAKA	SCT	SCT	SCT	SCT	SCT	FWS*	FWS
34	SOUTH INT.KARNATAKA	FWS*	SCT	SCT	SCT	FWS	FWS	FWS
35	KERALA & MAHE	WS*	FWS	FWS	FWS	WS*	WS*	FWS
36	LAKSHADWEEP	SCT	SCT	SCT	SCT	FWS	FWS	FWS

LEGENDS:

WS	WIDE SPREAD / MOST PLACES (76-100%)	FWS	FAIRLY WIDE SPREAD / MANY PLACES (51% to 75%)		
SCT	SCATTERED / FEW PLACES (26% to 50%)	ISOL	ISOLATED (up to 25%)	D/DRY	NIL RAINFALL

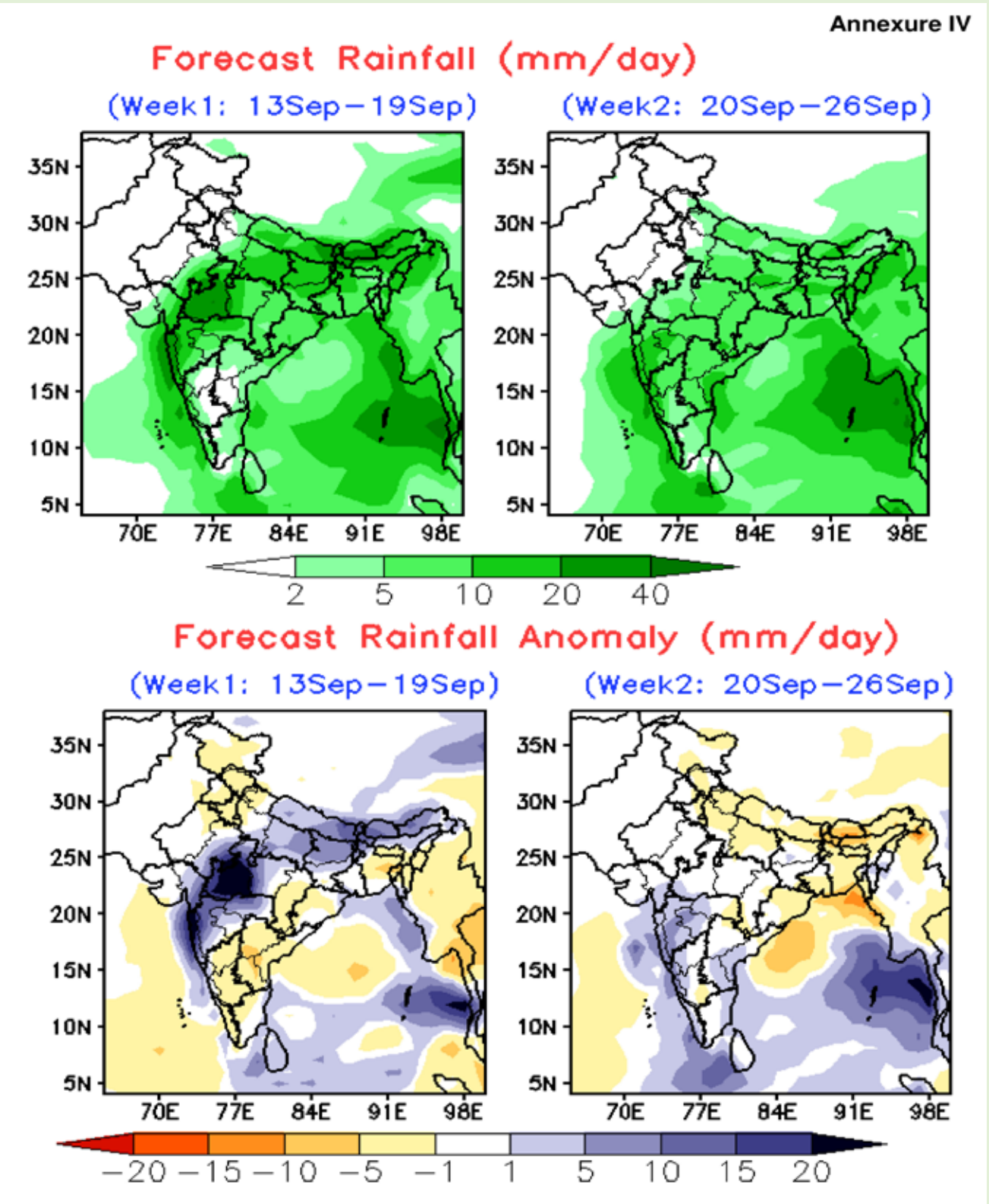
*Heavy Rainfall (64.5-115.5 mm)	**Heavy to Very Heavy Rainfall (115.6-204.4 mm)	***Extremely Heavy Rainfall (204.5 mm or more)		
FOG	*SNOWFALL	#HAILSTORM	HEAT WAVE (+4.5 °C to +6.4 °C)	SEVERE HEAT WAVE (> +6.4)
$THUNDERSTORM WITH SQUALL/GUSTY WIND	DU/TS DUST/THUNDERSTORM	COLD WAVE (-4.5 °C to -6.4 °C)	SEVERE COLD WAVE (< -6.4)	

● Cumulatively, above normal rainfall likely over Gujarat, West Coast except Kerala, East Rajasthan, East Uttar Pradesh, Madhya Pradesh, Bihar, Sub-Himalayan West Bengal & Sikkim and Arunachal Pradesh. It is very likely to be normal to below normal over remaining parts of the country during week 1 (Annexure IV).

Rainfall for week 2: (19 to 25 September, 2019)

● During week 2, rainfall activity is likely to decrease over most parts of the country, however, it is very likely to above normal rainfall along west coast, Karnataka, Tamilnadu and Coastal Andhra Pradesh. It is very likely to be normal to below normal over remaining parts of the country during week 2 (Annexure IV).

Annexure IV



UPCOUNTRY SPOT RATES

(Rs./Qtl)

Sr. No.	Growth	Grade Standard	Grade	Staple	Micronaire	Gravimetric Trash	Strength /GPT	Spot Rate (Upcountry) 2018-19 Crop September 2019					
								9th	10th	11th	12th	13th	14th
1	P/H/R	ICS-101	Fine	Below 22mm	5.0 – 7.0	4%	15	11304 (40200)	11304 (40200)	11304 (40200)	H	11304 (40200)	11304 (40200)
2	P/H/R (SG)	ICS-201	Fine	Below 22mm	5.0 – 7.0	4.5%	15	11445 (40700)	11445 (40700)	11445 (40700)		11445 (40700)	11445 (40700)
3	GUJ	ICS-102	Fine	22mm	4.0 – 6.0	13%	20	9139 (32500)	9139 (32500)	9139 (32500)		9195 (32700)	9195 (32700)
4	KAR	ICS-103	Fine	23mm	4.0 – 5.5	4.5%	21	10489 (37300)	10489 (37300)	10489 (37300)	O	10545 (37500)	10545 (37500)
5	M/M (P)	ICS-104	Fine	24mm	4.0 – 5.5	4%	23	11051 (39300)	11051 (39300)	11051 (39300)		11107 (39500)	11107 (39500)
6	P/H/R (SG)	ICS-202	Fine	27mm	3.5 – 4.9	4.5%	26	11417 (40600)	11417 (40600)	11417 (40600)	L	11473 (40800)	11473 (40800)
7	M/M(P)/ SA/TL	ICS-105	Fine	26mm	3.0 – 3.4	4%	25	10686 (38000)	10686 (38000)	10686 (38000)		10742 (38200)	10742 (38200)
8	P/H/R	ICS-105	Fine	27mm	3.5 – 4.9	4%	26	11557 (41100)	11557 (41100)	11557 (41100)		11614 (41300)	11614 (41300)
9	M/M(P)/ SA/TL/G	ICS-105	Fine	27mm	3.0 – 3.4	4%	26	10854 (38600)	10854 (38600)	10854 (38600)	I	10911 (38800)	10911 (38800)
10	M/M(P)/ SA/TL	ICS-105	Fine	27mm	3.5 – 4.9	3.5%	26	11276 (40100)	11276 (40100)	11276 (40100)		11332 (40300)	11332 (40300)
11	P/H/R	ICS-105	Fine	28mm	3.5 – 4.9	4%	27	11614 (41300)	11614 (41300)	11614 (41300)	D	11670 (41500)	11670 (41500)
12	M/M(P)/ SA/TL	ICS-105	Fine	28mm	3.5 – 4.9	3.5%	27	11585 (41200)	11585 (41200)	11585 (41200)		11642 (41400)	11642 (41400)
13	GUJ	ICS-105	Fine	28mm	3.5 – 4.9	3.5%	27	11473 (40800)	11473 (40800)	11473 (40800)		11529 (41000)	11529 (41000)
14	M/M(P)/ SA/TL/K	ICS-105	Fine	29mm	3.5 – 4.9	3.5%	28	11810 (42000)	11810 (42000)	11810 (42000)	A	11895 (42300)	11895 (42300)
15	GUJ	ICS-105	Fine	29mm	3.5 – 4.9	3.5%	28	11670 (41500)	11670 (41500)	11698 (41600)		11782 (41900)	11782 (41900)
16	M/M(P)/SA/ TL/K/O	ICS-105	Fine	30mm	3.5 – 4.9	3%	29	12063 (42900)	12063 (42900)	12063 (42900)	Y	12148 (43200)	12148 (43200)
17	M/M(P)/SA/ TL/K /TN/O	ICS-105	Fine	31mm	3.5 – 4.9	3%	30	12345 (43900)	12345 (43900)	12345 (43900)		12429 (44200)	12429 (44200)
18	SA/TL/K/ TN/O	ICS-106	Fine	32mm	3.5 – 4.9	3%	31	12710 (45200)	12710 (45200)	12710 (45200)		12795 (45500)	12795 (45500)
19	M/M(P)/ K/TN	ICS-107	Fine	34mm	3.0 - 3.8	3.5%	33	15157 (53900)	15157 (53900)	15185 (54000)		15241 (54200)	15241 (54200)

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