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RETROSPECT AND PROSPECT OF NATURAL BIO - DIVERSITY CONSERVATION IN INDIA WITH SPECIAL THEME TO SUSTAINABLE SUGARCANE AGRICULTURE

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Abstract: *Life was originated 3,500 million years ago and it is composed of 27 lifeless molecules but how the lifeless molecules interact to maintain the life? No one knows, means for science it is yet to be discovered. Owing to encompassing large tract, diverse climate and varieties of ecosystems the natural bio-diversity of India's quite rich. It comprises about 56,700 floral and over 96,400 known animal species out of estimated 1.8 million species in the world. The country has thus been duly considered as one of the 12 mega bio- diversity zones of the world with its North East region and Western ghats, which are in rich endemic species, have been termed as bio-diversity hot spots. Since in addition to food, the bio –diversity provides most basic needs of mankind, it is desirable to conserve them by formulating appropriate rules and legislations and by maintaining conducive environment for their perpetual existence. In addition to various conservation measures prevailing in the country we ought to emphasize the importance of education, research, moistoring and awareness more elaborately and effectively. There is an urgent need to identify areas of gaps even in the regime of research and management in Indian agriculture. Asia accounts for about two – thirds of hungry and malnourished people in the world and within Asia, South Asia which includes India, Pakistan and Bangladesh accounts for about 34.3%, which in absolute numbers are 276.4 million people. Agriculture is the main stay of Indian economy. Agriculture and allied sciences contributes nearly 22 percent of Gross Domestic Products (GDP) of India, while about 65-70 percent of the population is dependent on agriculture for their livelihood. The agricultural output however, depends on monsoon as nearly 60 percent of area sown is dependent on rainfall as a main source of irrigation. In the light of these crucial facts and also with the growing population and developments particularly sustainable agriculture in the mainstream functioning of human subsistence becomes all the more imperative. The goal of sustainable agriculture including sugarcane is to meet society's food, sugar and textile needs in the present without compromising the ability of future generations to meet their own needs.*

Key words: *Natural bio- diversity, sustainable agriculture, sugarcane, livelihood, sugar and textile.*

Introduction: With an ever growing population and other emerging challenges leading to increased sugar, food and textile demand, Indian sugar and cotton industry needs to consistently strive towards augmenting its sugarcane, sugar and others food production. Sugarcane (*Saccharum spp.* hybrid) is the prime source of sugar in India. It occupies a pre – eminent position in the Indian Agricultural scenario on accounts of its wider adoption in agro – climatic conditions in the country. It has a significant role in national economy and provides raw materials to sugar and over 25 other industries. The Indian sugar industry is successfully meeting the domestic sugar demand. Ethanol production and co – generation of electricity in sugarcane factories are other utilities that enhance the importance of sugarcane in national economy. Besides the sugar factories and other industries based on by – products, sugarcane also supports rural and cottage industry of gur (jaggery) and khandsari which together produce about 7-10 million tons of sweeteners. Due to its multi – purpose uses in different industries, the demand is increasing for the increased production of sugarcane and its sustainability in the country (Pathak *et. al.*, 2017).

Alleviating hunger with enhanced sustainable sugarcane, food and textile production: With all the advances in agricultural technology millions of people even today go hungry to bed in the world and need our attention and help them. Hunger is caused

by the want or scarcity of food in a country or by lack of money to buy food by the poor people. In many countries both these occur simultaneously, because when food is in short supply, the prices also rise making it more difficult for the poor to procure it. Hunger leads to malnutrition and under nutrition and protein – energy malnutrition (PEM) are of foremast importance (Prasad, 2013).

Most (98.2%) of the world's under nourished people are in developing countries of the world in Asia, Africa, Latin America and the carribbeans (Table 1). Asia account for about two – thirds (66.5%) of malnourished people in the world and within Asia, South Asia (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka) accounts for about 34.9%, which in absolute numbers are 276.4 million people.

The only way to alleviate hunger and PEM is by producing more and better quality food. Cereals rank number one in food, sugarcane rank number one in sugar among cash crops and in South and East – Asia, rice and wheat supply and will continue to supply 50% or more of calorie needs of human as compared to only 30-33% in industrialized countries. During the triennium 2005-07, developing countries accounted for 79.4% population and it is estimated to further increase to 84.2% in 2050. Food and others availability for its will, however depend upon several factors including regional availability, purchasing power of the people and government support to the poor. Thus, poverty will continue to be a major barrier to the access of food, especially in developing countries. With the increasing urbanization and industrialization and the extra – land needed for housing, schools, hospitals, roads, railways, airports etc. the cultivable land is going to decrease in future; the tragedy is that these amenities take away some very fertile land. It is estimated that take away some very fertile land. It is estimated that atleast the cultivable land in world will increase from 1592 million hectares (Mha) during the triennium 2005 – 07 to 1661 Mha in 2050, a more 4.3% increase (Prasad *et. al*, 2016).

Table 1: Spread of under – nourishment in the world (2012-14)

Regions	Million people	% of total
World	805.30	100.00
Developed regions	14.60	1.80
Developing regions	790.70	98.20
Africa	226.70	28.70
Asia	525.60	66.50
East Asia	161.20	20.40
South – East Asia	63.50	8.00
South Asia	276.40	34.90
Latin America and Carribbean	37.00	4.70
Oceania	1.40	0.20
	Source: FAO (2015)	

Following have been and will continue to be major ways to achieve sustainable production of sugarcane, sugar and food simultaneously with conservation of natural biodiversities.

High yielding hybrids and varieties of crop: The first and foremost is better and higher crop hybrids/ varieties including genetically modified (GM) plants. The development and promotion of semi – dwarf rice hybrid and varieties by the International Rice Research Institute, Philippines (Dalrymple, 1978) increased rice production in the world. Again Green Revolution in India was brought about by the introduction of high yielding wheat varieties from CIMMYT, Mexico (Swaminathan, 2013). Similarly development of improved varieties of sugarcane (Table 2) for higher cane yield and sugar recovery recommended for the respective regions in all over India.

Table 2: Sugarcane varieties (Zone wise) recommended for cultivation in India

Zone	Recommended varieties
Peninsular zone	Co 85004, Co 86032, Co 87025, Co 87044, Co 8371, CoM 7714 (Krishna), CoM 88121, Co 0238, Co SnK 05103, Co Snk 05104 etc.
East Coast zone	Co 86249, CoC 01061, Co Or 03151, Co 06030
North West Zone	CoS 91230, Co Pant 90223, CoH 92201, CoS 95255, CoS 96268, Co Pant 97222, CoJ 89, CoS 96275, Co 0118, Co 0238, Co 0239, CoH 128, Co 05011, CoPk 05191, Co 05009
North Central & North Eastern znne	Co 87263, CoS 08272, CoS 08279, CoS 12232, Bo 128, CoSe 95422, CoSe 96436, CoLk 94184, CoSe 01421, CoP 2061 etc.
	Source: Souvenir: AGM of AICRP (S): 2017

Improved Agronomic practices and technology: In sugarcane, planting techniques (Table -3) and integrated nutrient management (INM), integrated weed management (IWM), integrated pest management (IPM) and mechanization impart key role in sustaining higher number of millable canes and therapy sugarcane yield. An experiment conducted at research farm of U.P. Council of Sugarcane Research, Shahjahanpur, U.P., India under the funding of All India Co – ordinated Research project (AICRP) on sugarcane revealed that Application of 10t FYM/ Compost + recommended NPK on soil test basis through inorganic fertilizers + bio fertilizers (P.S.B+ *Azotobactor)* @ 10 kg/ha each gave significantly better plant and subsequent ratoon yields (Yadav et. al., 2018)

Table 3: Comparative profitability of various sugarcane planting methods

S.No.	Planting techniques	Yield (t/ha)	Benefit – cost ratio
1	Conventional planting	75	1.40
2	Double row planting	92	1.44
3	STP	81	1.29
4	Furrow and Trench planting	76	1.44
5	Trench planting	126	2.15
6	Ring – pit planting	148	1.83
	Source: Souvenir: AGM AICRP (s),2017		

There are great scope exists to improve sugarcane productivity by increasing number of millable canes per unit area. Yadav et. al., (2016) have been reported that one budded setts of sugarcane treated with cow dung + cow uring + water in the ratio of 1: 2: 5 gave significantly higher germination of cane, millable canes and cane yield than treatment in which two or three budded setts were treated with any fungicide.

An effective integrated method of weed management involving cultural and chemical methods has been evolved. It comprises of one hoeing after first irrigation and application of Atrazine @ 2.0 kg ai/ha after second irrigation. It is effective in checking weed growth (WCE 97-100%) and increases cane yield and saves 50% cost as compared to manual hoeing. Metribuzine 1.0 kg ai/ha, or Ametryn 2. Kg ai/ha or Atrazine 2.0 kg ai/ha as pre – emergence application followed by 2, 4-D @ 1.0 kg ai/ha at 60 days after planting (DAP) and one hoeing at 90 DAP has been recommended for effective and economic weed management in sugarcane (Shukla and Sharma,2017).

Due to non – availability of manpower in sufficient number during peak planting time, planting of cane usually gets delayed. Under this situation mechanization of the cane planting operations and several labour saving devices have been designed and developed at the Indian Institute of Sugarcane Research (IISR), Lucknow, (U.P.).

Mulching for improving resource use efficiency in crops: Recently, many studies at IISR, Lucknow, U.P.C.S.R, Shahjahanpur and S.B.I. Coimbatore (TN) aptly demonstrated that the use of crop residues like cane trash, wheat and paddy trashes/ straws mulch along with bio – agents like organo decomposer @ 10 kg /ha was found effective in economizing water use, weed control, improving soil physico – chemical properties and enhancing crop yields including sugarcane ratoon crop yield. Trash mulching is recommended in U.P., Bihar and Punjab to conserve soil moisture and to economize irrigation water.

Recent major technological research advances in sugarcane crop

1. Uttar Pradesh has achieved 1st rank in sugar production (8.75 million tonnes in 2016-17) because of research and development efforts made by collaboration of IISR, Lucknow, UPCSR, Shahjahanpur and S.B.I, Coimbatore. It has also increased UP state average cane yield (72.3t/ha in 2016-17) and mean sugar recovery level upto 10.61%.
2. Developed and wide adaptation of high sugared early maturing varieties in sugarcane cultivating zones viz., Co 86032(70%) in Peninsular zone, Co 0238 (50%) in North Western zones and central zone and CoLk 94184 (28%), Bo 91 (20%) and Co 6907 (20%) in North Central and North Eastern zone of the country. Replacement of old/ local varieties are must.
3. Sugarcane planting methods viz., Trench method, Furrow Irrigated Raised Bed (FIRB) method, ring/pit methods are being widely adopted and recommended for sustainable sugarcane production.
4. Water management approaches viz., drip irrigation, alternate furrow irrigation with cane trash mulching are recommended to achieve higher cane yields in plant and ratoon crop both with economized application of irrigation/water.
5. INM approaches viz., application of well decomposed FYM/ Compost @ 10-15 t/ha or composted pressmud @ 5 t/ha, application of bio fertilizers viz., Phosphorus Solubilizing Bactoria (P.S.B.), *Azotobacter, azospirillum,* Ankush @ 10 kg/ha each Cfu 10^7in two equal splits at 30 and 60 days after planting.
6. Drought and flood management through drought and flood tolerant sugarcane varieties.
7. Crop diversification approaches like pulses and vegetables etc. are recommended for additional income generation for sugarcane growers.
8. Weed management approaches in sugarcane viz., three manual hoeing or integrated application of pre- emergence herbicide Atrazine @ 2.0 kg ai /ha+ 2,4-D @ 1.0 kg ai /ha at 60 DAP and one hoeing at 90 DAP is recommended.
9. Mechanization of sugarcane cultivation viz., Trench planter, ratoon management device (RMD), Plant residue shedder and sugarcane detrasher is recommended to reduce cost of production and improving farmer's income.

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