Plant Archives Vol. 18, Special Issue (ICAAAS-2018), 2018 pp. 148-152 *ISSN 0972-5210*

PROSPECTS OF SUGARCANE FARMING WITH ITS FUTURE STRATEGIES TO ENHANCE PRODUCTIVITY AND INCOME OF FARMERS : AN ECOFRIENDLY NEED FOR SUSTAINABLE AGRICULTURE IN SUBTROPICAL REGIONS

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Abstract

India is the second largest producer of sugarcane (18.18%) and sugar (15.81%) and top most consumer of the sugar in the world. The northern states having subtropical climate particularly Uttar Pradesh plays important role in improving national sugarcane productivity is obvious. Now days stagnation in sugarcane crop yield (72.37 t/ha) and sugar recovery (10.61%) in U.P. with decline in the factor productivity have raised a question during green revolution period. In order to maintain sugarcane crop sustainability with conserving natural resources like soil, water, air etc., applied researches are being conducted in different disciplines. Crop rotations, integrated nutrient management strategies and green cane harvesting have been resulted to increase irrigation and drainage efficiency, improvement in organic matter, its better effect on soil properties and sugarcane nutrition.

The sustainable sugarcane and sugar production is yet another viable, feasible, economical and environmentally sound approach based on the principle of "more with less" in agriculture. This also improves the productivity of water, land, labour, cane and sugar production with improving economic status of cane growers in the country. Strategies for achieving these objectives involves usage of less seeds, less water and optimum utilization of fertilizers, land with organics and biofertilizers. Recent technologies have revolutionized Agriculture and Environment and also hold the promise of developing sustainable agriculture, reducing environmental pollution and generation of sustainable bio - fuels with far reaching benefits for the society at large. A new modified trench method of cane planting with wider spacing (120 -150 cm) by raising plantlets through space Transplanting method (STP) is an part of management strategies have been conducted at research farm of U.P. Council of Sugarcane Research, Shahjahanpur, U.P. Resulted that application of 10t/ha FYM/ Compost + recommended NPK fertilizers on soil test basis + biofertilizers (*Azotobacter*+ P.S.B) @ 10 kg/ha each recorded significantly better cane yield (113t/ha). Soil health and physico – chemical parameters have also improved by this treatment as compare to the treatment in which only recommended NPK fertilizers were applied through inorganics.

Key words : Sustainable sugarcane agriculture, productivity, ecofriendly, subtropical regions, natural resources, biofertilizers.

Introduction

In the present day scenario of climate change/ variability and its effect on global warming, human and animal health and welfare, its is imperative that industrial and agricultural developments should be in a way to protect the sustainability of the environment. Agriculture uses about a third of the world's land surface and depends directly on the wider environment for its existence and sustainability. Sunlight, water, macro and micro nutrients and a diversity of plant animals and microbes all plays fundamental roles in agricultural production. The environmental impact of agriculture involves a variety of factors, such as soil, water, air, animal, people , plants, green house gasses and the food itself. Some of the environmental issues that are related to agriculture are climate change, deforestation, genetic engineering, irrigation problems, pollutants, soil degradation and waste management. Excessive use of fertilizers and non bio -

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degradable chemicals pesticides change the chemistry of soil and kills usefull microbes which damage the natural ecosystem/habitat (Mahendra Pal Yadav, 2018).

Green revolution has been the major success story of India. Agriculture has been a source of livelihood for more than two thirds of our population. Agriculture in India is not merely a business enterprise; it is more a way of life. The recent policy of liberalization and globalization has opened up new avenues for agriculture modernization. There has been paradigm shift in the way agriculture is being practiced in the last few years and the Indian farmer is gearing up himself to face the challenges of globalization. In order to create awareness of sustainable agriculture and their impact on livelihood, supporting and driving innovations, accelerate the knowledge of farmers, stimulation of agricultural development such type of conferences will provide a positive ambient and will be useful in spreading the information and knowledge of new technologies for sustainable agricultural growth (Kumar, 2018).

For the improvement of sugarcane in North India a sugarcane Research Station was established at Shahjahanpur in 1912 named U.P. Council of Sugarcane Research with simultaneous establishment of sugarcane Breeding centre at Coimbatore (Tamil Nadu) for South India. In Northern region as well as in India Sugarcane is a major commercial crop that sustains sugar industry the second largest next to cotton and textiles industries. India occupies better position in the world in area and production after Brazil but the cane yield/ ha is generally lower than several other countries like Peru, Australia, Brazil etc. Uttar Pradesh ranks first in the country with regards to cane area and also in sugar production in the country. Therefore the northern states role in improving national sugar productivity is obvious.

Sugarcane scenario at a glance

Worldwide sugarcane is main source of sugar. Sugarcane and sugarbeet are grown for sugar globally. In the whole world, 80% sugar is grown in 123 countries on an about 24 million ha land but the largest area in Brazil (10-44 million ha). In India, sugarcane grown in about 5 million ha land with the average productivity (71 t/ha). In India, Uttar Pradesh ranks first in area (2.19 million ha) and also in sugar production (about 86 lakh tonnes) but productivity of U.P. is 72.37 t/ha (2016-17). The sugar recovery of the nation is about 10.50% but in U.P. is about 10-61 percent (2016-17). The highest cane productivity is in Tamil Nadu (105t/ha) due to favourable climate condition for sugarcane growth and sugar recovery.

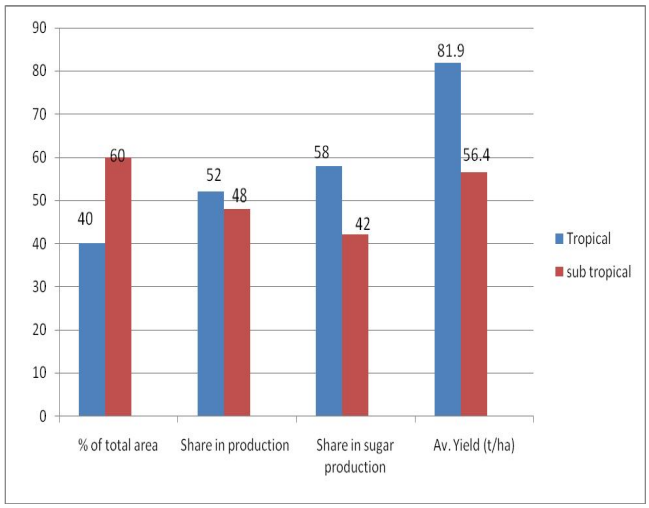

Fig. 1 : Comprarision of tropical and subtropical region.

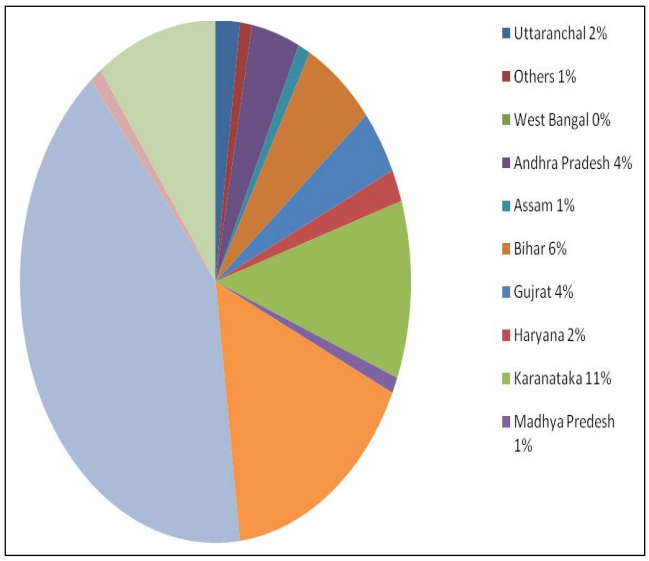

Fig. 2 : State wise distribution of additional output of sugarcane.

Sugarcane in India is cultivated broadly with two district agro–climate regions known as tropical and subtropical region. The tropical region includes southern states while subtropical comprising the northern states like U.P., Bihar, Punjab, Haryana, M.P., Rajasthan, Assam etc.

Constraints for sugarcane yield gaps and sugar production in northern subtropical region

Number of constraints in sugarcane production influences its successful cultivation. These are resource, site – specific technology, climate, socio – economic and environmental constraints which hamper the cane productivity and sugar production to rise above a certain level. These constraints in two major climate zones: Tropical and subtropical zones are as follows:

• Environmental constraints

Table 1 : Top five states in sugarcane area, production and yield in 2016-17.

Rank	Area wise		Production wise		Yield wise	
	State	(Lakh ha)	State	(mt)	State	(t/ha)
1	U. P.	21.90	U. P.	133.70	Tamil Nadu	105.00
2	Maharashtra	9.87	Maharashtra	75.09	Maharashtra	80.90
3	Karnataka	4.00	Karnataka	34.20	Karnataka	90.30
4	Tamil Nadu	2.63	Tamil Nadu	27.62	U.P	72.37
5	Bihar	2.58	Bihar	14.24	Bihar	65.40

Source: Cooperative Sugar (2017)

Table 2 : Growing population and estimated sugarcane consumption in India upto 2050.

Year	Population in millions	Sugar consumption (m. tons)		
		@ 20kg per capita per year	@ 30kg per capita per year	@ 40kg per capita per year
2010	1180	23.60	35.40	47.20
2030	1470	29.40	44.10	58.82
2050	1757	35.10	52.71	70.28

Table 3 : Top five states in sugarcane area, production and yield in 2017.

Rank	Area wise		Production wise		Yield wise	
	Country	Area(m ha)	Country	(mt)	Country	(t/ha)
1	Brazil	10.44	Brazil	737.16	Peru	133.72
2	India	5.10	India	362.33	Ethiopia	119.57
3	China	1.75	China	126.00	Egypt	115.33
4	Thailand	1.35	Thailand	104.00	Senegal	114.10
5	Pakistan	1.17	Pakistan	67.46	Malavi Senegal	107.41

- Biotic and abiotic constraints
- Small size of the sugar cane farm
- Varietal constraints
- Poor ratoon crop stands
- Delayed planting
- Socio – economic constraints
- Marketing and post – harvest constraints
- Cyclicality in cane production
- Declining soil health and depleting water resources.
- High cost of sugarcane production.

Strategies to enhance sugarcane productivity and profitability

The ways and mean for achieving cane yield beyond 100 t/ha would be as follows:

- Revival of the seed cane programme
- Ensuring availability of quality seed cane
- Varietal planning and replacement of old and rejected varieties
- Improving productivity of ratoon canes
- Reducing cost of cane cultivation by improving (1) Integrated nutrient management technology (2) Water use efficiency through micro- irrigation 3. Land use efficiency through companion cropping (4) Insect pests and diseases control by integrated pest management (IPM) and integrated disease management (IDM) technologies (5) Mechanized sugarcane farming.
- Encouraging intercropping in sugarcane

Discussion with some experimental results

An experiment were conducted during 2014-15 and 2015-16 at Research Farm of UPCSR, Shahjahanpur (U.P.), India. The result shewed significantly higher number of shoots (174990/ha) millable canes (222920/ha) and B:C ratio (2.66) in treatment application of FYM@ 10 t/ha + soil test based recommended dose of inorganic fertilizers for NPK + biofertilizers (*Azotobacter* + PSB) @ 10 kg/ha each (Yadav *et al*., 2018). Ranwa and Singh (1999) have also recorded that germination and CCS percent were not affected significantly due to integration

Table 4 : Trends in sugarcane area, production, productivity and sugar recovery of U.P. (2006 to 2016).

Year	Sugarcane area (mha)	Sugarcane Production (mt)	Cane productivity (t/ha)	Sugar production (mt)	Sugar recovery (%)
2006-07	2.25	133.95 58.20	8.48	9.47	
2007-08	2.18	124.67 59.60	7.32	9.79	
2008-09	2.08	109.05 57.20	4.06	8.94	
2009-2010	1.98	117.14 52.30	5.18	9.13	
2010-2011	2.13	120.55 59.30	5.89	9.14	
2011-2012	2.16	128.82 56.70	6.97	9.07	
2012-2013	2.11	132.43 59.60	7.49	9.18	
2013-2014	2.23	134.69 59.90	6.49	9.25	
2014-2015	2.14	133.06 60.50	7.10	9.54	
2015-2016	2.18	145.39 66.46	6.84	10.61	
2016-2017	2.19	133.70 72.37	8.75	10.61	

Source: crop. Sugar. Vol.48 No. 8, April 2017

Table 5 : Total cane holding and average size of sugarcane farms in India.

State	Holdings			Average cane area per farm (ha)			
	Total (million)	Share %	% to total holdings	Marginal (<1ha)	Small (1-2 ha)	Large (>10 ha)	Over all
Maharashtra	1.01	16.90	8.38	0.33	0.66	2.49	0.62
Uttar Pradesh	3.03	50.60	14.00	0.34	0.81	7.40	0.72
All India	5.99	100.00	5.07	0.36	0.77	3.53	0.77

of organic and inorganic sources as well as biofertilizers. The substitution of N requirement to 50% by FYM has given yield levels nearly similar to those obtained with complete fertilization. Manuring recommended under inter – cropping systems is as per the individual crop requirement *i.e.*, the total quantity of fertilizers nutrients applied is equal to the full requirement of sugarcane (Palaniappan and Siddeswaran, 1995).

Studies on long term effect of cropping and manuring in "AICRP" on sugarcane clearly indicated that the role of balanced NPK fertilizers in increasing soil organic matter over unfertilized soil (Annual Report, 1999-2000). The results of Nambiar (1995) and Swaroop (1998) also indicated that the soil organic carbon was increased with application of NPK + FYM continuously for 20 years compared to initial status of soil.

Sugar production vision 2030

With for achieving high cane productivity along with sustainability and contributing to the nation's food and energy needs, the industry explores all available option to realize this vision. The population in the present is set to reach 1.5 billion by 2030 at the present compound growth rate of 1.6% per annum. The projected requirement of sugar for domestic consumption in 2030 will 36 mt which will be about 50% higher than the present production. To achieve this target, the sugarcane production should be about 500 mt from the current 350 mt for which the production has to be increased by 7-8 mt annually. The increased production has to be achieved from the existing cane area through improved productivity (> 100 t/ha) and sugar recovery (> 11%). Since, further expansion in cane area is not feasible. The energy demand in India is estimated to grow by 200% or more Nambiar (1995) and Swaroop (1998) also predicted that the soil organic carbon was increased with the application of NPK+ FYM continuously for 20 years compared to initial status of soil.

Conclusion

Soils of the intensively cultivated areas and climatic conditions of northern region of India sugarcane and sugar production needs more special attention. Maintaining soil health, rising water table, mechanization in cultivation, INM IPM and IDM, better ratoon management, intercropping and improved agronomic practices with improved varieties etc are of great importance to achieve the target getting more income.

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