RESEARCH AND TECHNOLOGY TRANSFER STRATEGIES FOR THE NEXT DECADE—AN INDIAN EXAMPLE

By

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Abstract

Globalisation is driving unprecedented, radical internal and external reforms in sugar industries across the world. In addition to this, five major emerging or intensifying forces with extraordinary implications will shape sugarcane farming and the sugar industry in future–demographic, economical, socio-political, environmental and technological. This paper first addresses the growth and status of the sugar industry and impact of these emerging forces in shaping future Indian sugarcane farming. Emerging complexities and diversities in farming structure and process demand a new and more complex model of research and technology transfer. Consolidation of the best technologies for maximum exploitation, identification of technology diffusion and adoption gaps, and introduction of new technologies and innovative practices throughout the farming chain will continue to play a vital role in sugarcane productivity improvements. Demographic changes, socioeconomic status of farmers and prices for competing crops will demand sugar companies provide, in addition to competitive cane price, targeted delivery of diverse services to farmers to ensure a sustainable cane supply. Introduction of new sustainability standards and the need for certification from consumers will drive sugar companies to integrate the entire value chain from farmer to consumer through various forms of cooperation, relationship and partnership. These emerging realities will open up untapped potentials and utilise opportunities throughout the value chain to create a new research and technology transfer architecture and competitive landscape for the sugar industry in India

Introduction

Sugarcane, sugar beet and sugar are politically regulated agricultural crops and a commodity. However, during the past two decades, liberalisation and globalisation has been driving internal and external reforms in the sugar industry.

Sugar production has more than doubled since the 1960s and the production share from cane has increased to 78%. Regional composition of production, consumption and exports/imports has shifted considerably. Brazil, India, the European Union and China are the largest sugar producers with roughly 55% of world production. These are followed by USA, Thailand, Pakistan and Australia with 15% of production during 2007–2008. Eight of these countries are also among the top sugar consumers, representing 55% of global consumption. Historically, sugarcane research has also been concentrated in these countries.

Factors that determine the fundamentals of success and failure in sugarcane research, farming and sugar businesses have also changed. New innovative players, especially Brazil, have demonstrated their ability to adopt these changes quickly and have dominated the world market. However, multiple utilities of sugarcane as a feedstock for production of sugar, electricity, alcohol, biofuels, bio-polymers and bio-pharmaceuticals are creating a new competitive landscape. These result in increased complexities and diversities in farming structure and process, and demand a new and more complex model of research and technology transfer. Further demographic, economical, socio-political, environmental and technological changes demand consolidation, innovation, and integration across the entire value chain.

Changing landscape

Demographic shift

Along with continued population growth, the world population is experiencing unprecedented demographic changes. People are living longer and increasing numbers are moving from villages to cities in search of a better life. United Nation’s revised estimates on population growth indicate the world population will reach 7.5 billion in 2020 (UN, 2001). All of this growth will occur in Africa, Asia and Latin America, the major cane growing areas of the world. In contrast, in the developed world, the area of major beet growers (Europe, Japan and North America), populations will either decline or remain the same. This means that the demand-supply situation of sugar will move towards the Asian, South East Asian and African countries. Presently, India is the largest consumer of sugar representing 15% of world consumption, even with its lower per capita consumption than the world average (18 kg/22 kg). A projected population of 1.3 billion in 2020 with its large working population (60% in the age group 15–64 years) and emerging young generation (36% younger than 15 years) with wide choices and life styles will push per capita sugar consumption beyond world averages.

Economic growth

Globalisation and the information technology revolution are creating dramatic changes in the economic growth pattern of the developing countries. The World Bank Global Economic Prospects (2009) forecast that the average annual growth rate over the next decade will be highest in China followed by India, Brazil and South East Asia and African countries. This will generate demand for diverse foods. These demands are expected to have a significant impact on the type of sugar consumption among the new generation elites. As a consequence, Brazil, India and China are becoming new centres of forces shaping world sugar production, consumption and trade. A nationwide survey conducted in 2007 also confirmed that there was a shift in consumption pattern of sugar from domestic to industrial use (beverages, confectionery, preserved food, etc.). Of the total sugar sold in the free market, 61% accounted for industrial and the balance of 39% for household use (KPMG, 2007).

Socio-political situation

Sugar is produced in more than 100 countries. However, sugar trade is limited to 30% of the production with long-term agreements. Various socio-political policies continue to influence sugar prices and increase volatility. WTO agreements are expected to liberate the sugar trade from some of these distortions. The major beneficiaries of these sugar reforms will be least-cost-of-production countries with potential to expand production. However, countries such as Brazil, Thailand, India, Pakistan and South Africa, where the domestic market prices are lower than the average world traded price, will face pressure from domestic consumers and political lobbies will continue to constrain price.

There is a need for production to keep pace with sugar consumption. Only Brazil has the capacity to expand the area under sugarcane; another 9 million hectares without affecting their food crops (UNICA, 2008). The Brazilian industry is expanding to capitalise on these opportunities along with its pro-alcohol flex-fuel program. Countries such as Brazil, Australia and South Africa are more advantaged than others, because of the size of their farms, the structure of operations, and their integrated value chains.

India, with 17.5% of global population but only 2.4% of the world's arable land, can not further increase its area under sugarcane without replacing other food crops. Between 1960 and 2003, the number of agricultural holdings doubled (51–101 million), while the area operated declined from 133 to 108 million hectares. This has led to a sharp decline in the average size of holding (2.63 ha to 1.06 ha) leading to an increase in the number of marginal farmers (22.6 to 39.1%; marginal means <1 ha (GOI, 2007; NSSO, 2005). Increasing marginalisation leads to insecurity, increasing costs, inadequate returns, and difficulties in accessing credit. The consequence is exploitative informal credit and resulting pervasive indebtedness (Assadi 1998; Posani 2009).

Hence, India's farming costs continue to lag behind over the present low-cost producers. There is a growing view that most smallholders do not have a viable future, and agricultural development should focus on larger, commercially oriented farms that can be successfully integrated with technological breakthroughs and linked with emerging markets. The scale of operation is a significant factor in reducing costs as shown in Australian sugarcane farming system studies (Hanlon, 1996; Wegener, 2000). Further, greater integration of harvesting and transport operations would remove inefficiencies and better utilisation of capital leading to substantial gains for global competition. However, India provides a different picture of inverse relationships or lack of relationship in farm size and productivity (Sen, 1964; Dipak, 1965; Ashok, 1985; Mahesh, 2000).

Despite different farm size and technologies, in India small farm holdings have advantages that enable them to dominate. Small farms have lower labour-related transaction costs and more family workers per hectare, each motivated to work and supervise hired workers. Hence, small farms have an advantage in early stages of developing countries through low capital for unskilled workers. These advantages are slowly disappearing in India because of economic growth and labour scarcity through migration of workers to towns and non-farm jobs. Labour cost of cane cultivation has been increasing over the last few years.

Sugarcane being a highly labour-intensive crop, farmers divert to less labour-intensive crops, evident from the recent decrease in the area growing sugarcane. The only available alternative is to mechanise the farming operations. With millions of small and marginal land holdings, large-scale mechanisation poses many challenges compared to countries such as Brazil, Australia, Africa and Latin America where farm sizes are large. Large farms have lower capital and land-related transaction costs, allowing owners to more readily finance equipment that they can use over many hectares. Further efficiency, adaptability and manoeuvrability of these large machines in small farmer holdings are still under question.

With increasing wealth and the IT revolution in India, many farmers are sending their children for education in cities–they then take up jobs in cities or abroad. The wealthy, salaried middle class with decreasing loyalties to agriculture and the village still owns a large part of the rural land (Lindberg, 1995; Gupta, 2005). In rural societies, the identities of villager and farmer and how they relate to village are changing. Managing, sustaining and improving productivity of these absentee landlords offers new opportunities and challenges for innovation. This requires a new pragmatic approach with deep insight to customer's minds to reduce the drudgery associated with farming and offer benefits to customers.

Environmental issues

Sugarcane cropping systems that use intensive land, water and other inputs continue to raise concerns about environmental issues and sustainability of farming (WWF, 2003). Globally, irrigated agriculture accounts for almost 70% of water withdrawn for human use. Ground water withdrawals exceeding natural recharge rates of aquifers are leading to the lowering of water tables, salinisation and land subsidence in many parts of the world. There is not enough additional water resources that can be diverted for increased sugarcane production. In countries such as India, the current water development and management system is not sustainable. India has a highly seasonal pattern of rainfall with 50% of precipitation falling in just 15 days and over 90% of river flows acquired in just 4 months. India’s dams can store only 200 cubic metres of water per person constituting 30 days of rainfall compared to 900 days in the major river basins (World Bank, 2005; IPCC, 2008).

Over the last two decades, 84% of the total addition to net irrigated area came from exploitation of ground water and only 16% come from canals. By 2020, India will need about 29% more water for agriculture, whereas water availability for agriculture is likely to be reduced by 12%.

In 2007, the Intergovernmental Panel on Climate Change (IPCC, 2007) confirmed that climate change is accelerating and, if the present trend continues, average global temperature will rise by 6^{o}C in the long term. A compounding fact is that there is likely to be rapid de-glaciations in the Himalayas, resulting in a substantial impact on the river flows in India. Further, an Indian model of climate change suggests a decrease in the number of rainy days and an increase in extreme precipitation.

This means that the water requirements of sugarcane need to be minimised through finding ways to improve productivity of the crop per drop of water. Irrigation technologies such as furrow, border and flood irrigation need to be replaced by sprinkler and drip irrigation to increase water use efficiency.

Technological changes

Sugarcane is among the plant kingdom's most efficient converter of sunlight into chemical energy that is stored in sugars, fibre and straw. These three products can yield 7192.92 MJ from one tonne of cane–equivalent to 1.2 barrels of oil (Oliverio and Riberio, 2006). Over the last 30 years, Brazil has developed a successful ethanol industry.

Presently, 37 countries mandate for blending ethanol as a fuel component, either directly or blending with gasoline or fuel. Another important aspect of the sugarcane biomass source is the significant generation of electricity using bagasse, which reduces carbon dioxide emissions.

With integration of biotechnological and bioprocess engineering, the sugarcane biomass has been tailored to produce a wide range of products similar to petroleum refiners, the so-called ‘Carbohydrate Economy’ (Allen *et al*., 1997; Rogers *et al*., 2001; Edye *et al.*, 2007; Gravitis, 2007).

At the farm level, improved productivity per unit area is critical. In response to concerns about the sustainability of ‘Green Revolution’ technologies and their ability to manage the environmental interface, many are advocating agro-ecological and sustainable agriculture approaches, based on ecological principles of farming (REAP, 2003; Suttivan, 2003). By contrast, advocates of biotechnology argue that biotechnology can help to overcome limitations and offer major yield benefits.

Although these two approaches represent themselves in opposition to one another, both approaches have been integrated successfully in small farms in India with respect to Bt-cotton. These ecological methods include technologies for land preparation, water conservation, soil health and balanced nutrition, farm management, integrated pest and disease management in a sustainable way.

Conventional sugarcane breeding continues to be the major source of varieties. Complexities of breeding, a narrow source of germplasm and diverse requirements of industry resulted in recent biotechnological interventions in the sugarcane genome (Fitzgerald and Bonnett, 2007). However, their commercial applications have so far been limited to field trials. Advances in biotechnological manipulations, integrated with ecological principles, will play a significant role in future sugarcane productivity improvements.

Sugar: Indian scenario

The sugar industry in India is the second largest agro-industry with more than 516 sugar mills operating in 18 states, and it plays a significant role in socio-economic development in rural areas (KPMG, 2007 and MoCFA, 2007). About 249 factories are in the co-operative sector and the balance is in the private or public sector. About 50 million sugarcane farmers and a large number of agricultural labourers are involved in sugarcane cultivation and ancillary activities, constituting 12% of the rural population. In addition, the industry provides employment to about 2 million skilled/semi-skilled workers mostly from rural areas.

Sugarcane growing areas of India may be broadly classified into three regions based on agro-climatic conditions, yield of cane and sugar content (Table 1).

Table 1—Classification of sugarcane regions of India.

Region	State	Average yield t /ha	Average sugar recovery (%)	Average crushing days	Temperature Min (^{0}C)	Temperature Max (^{0}C)
Sub Tropical-North	Bihar	42.91	9.13	93.00	7.7	41.5
	Uttar Pradesh	57.57	9.62	134.42	3.6	42.6
	Uttaranchal	57.95	9.54	131.00	2.1	42.1
	Punjab	60.21	9.60	107.85	4.6	43.6
	Haryana	60.54	10.00	136.28	4.1	43.3
Sub Tropical-Central	Gujarat	72.08	10.70	154.14	11.1	40.9
	Maharashtra	72.77	11.46	116.71	10.9	42.8
	Karnataka	83.74	10.56	141.85	14.4	41.5
Tropical-South	Orissa	59.01	9.33	72.42	11.5	41.2
	Andhra Pradesh	76.64	10.16	123.85	13.6	41.0
	Tamil Nadu	100.25	9.59	185.85	18.5	37.5

Source: Sugar data from Cooperative Sugar Journal, published by Indian Sugar Mills Association
Temperature data from www.indiawaterportal.org
Values are average of 2001–02 to 2006–07

Sugarcane supply to mill is dependent on the cane production from a large number of small farmers within a 15–20 km radius (average holding less than one hectare). Crop cycle (plant and ratoon) is limited to two or three years because of extreme climatic conditions, compared to six to seven year cycles in other countries. The value chain of the sugar industry has significant regional variations in its profitability to farmers and millers (KPMG, 2007; ISMA, 2009). In India, the sugar industry is beginning to diversify to an integrated complex with co-generation of power and alcohol for industrial and fuel uses.

Sugar is a controlled commodity in India under the Essential Commodities Act of 1955 and is regulated across the value chain. The heavy regulations in the sector artificially impact on demand-supply forces, resulting in market imbalance. Due to a realisation of these problems, since 1993 the regulations have been progressively eased out. However, central and state governments still have control over the sugar value chain, through mandatory and state advisory cane price (SMP and SAP), mill capacity expansion, geographical area of operation, by-product utilisation and movements, levy and sugar release mechanisms and exports and various forms of taxes at central and state level.

Cyclical sugarcane and sugar production

Since independence, the land area under cane cultivation, cane production, productivity and sugar production has increased dramatically (Figures 1 and 2).

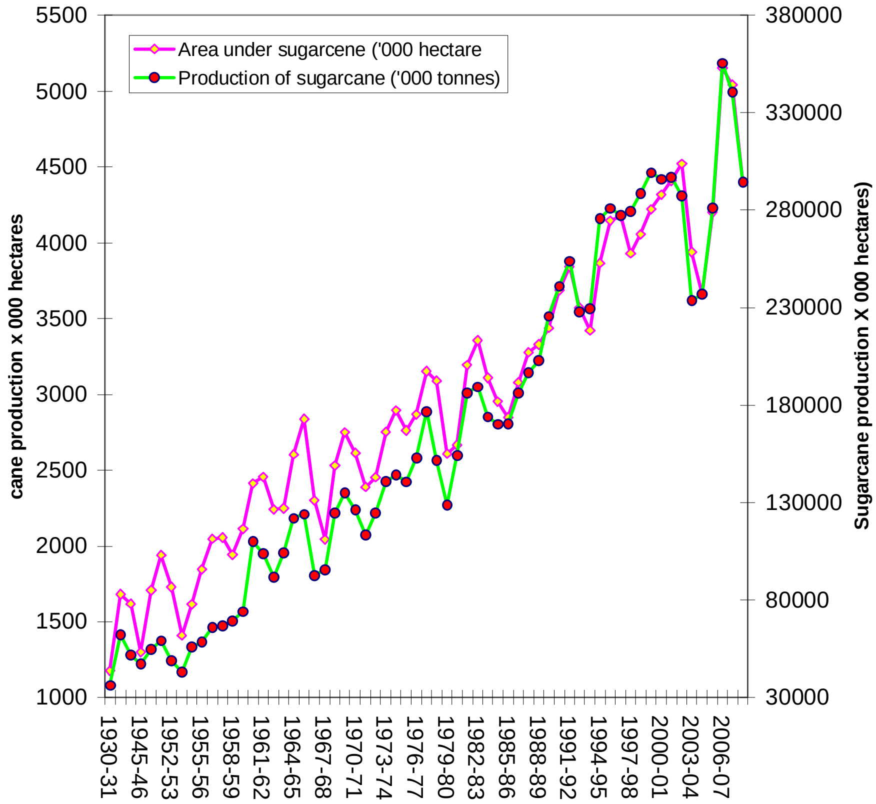

Fig. 1—Cane area and sugarcane production, India.

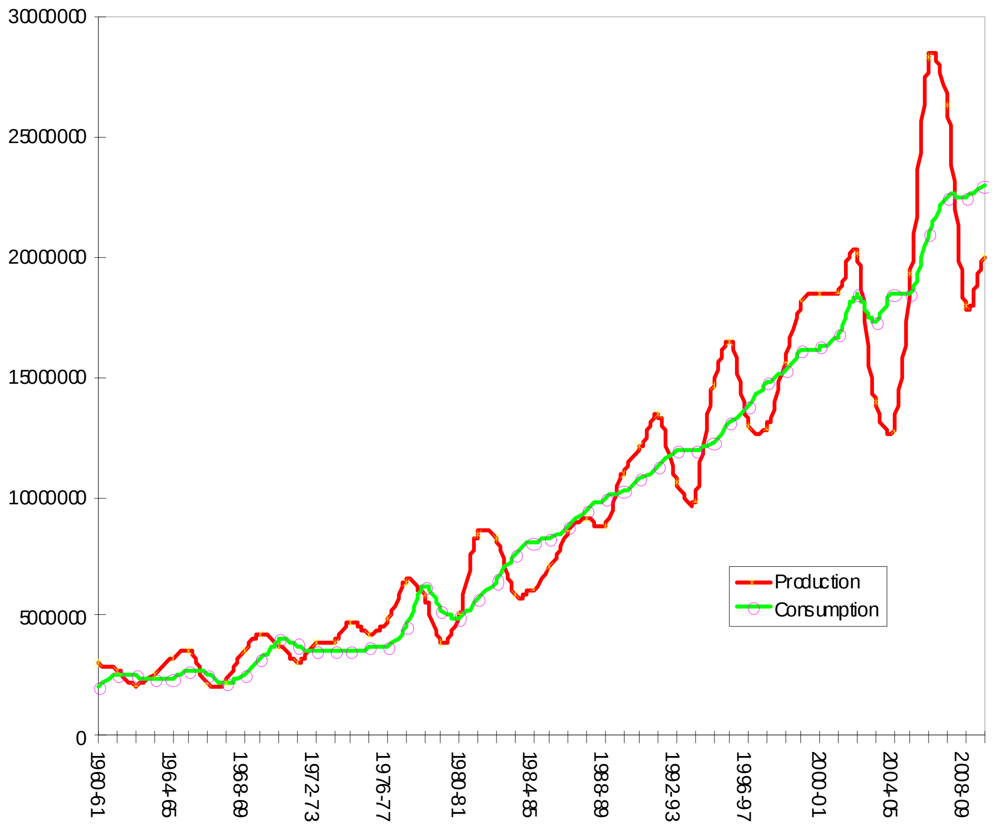

Fig. 2—Sugar production and consumption—growing trends.

Irrespective of increased growth in area and productivity, production of sugarcane and sugar fluctuate considerably from year to year in India (Figure 1). This volatility is influenced by natural and man-made factors (KPMG, 2007; Gopinathan and Sudakaran, 2009).

Natural factors include distribution of rainfall, climatic conditions of flood and droughts, pests and diseases. Man-made factors are primarily government policies regarding sugarcane price, release mechanism, taxes and export and import controls.

In the past, these cycles arose every 4 to 5 years (Figure 3). In recent years, these deficit/surplus gaps are becoming wider irrespective of stock positions and various control regimes. India started its biofuel initiative in 2003.

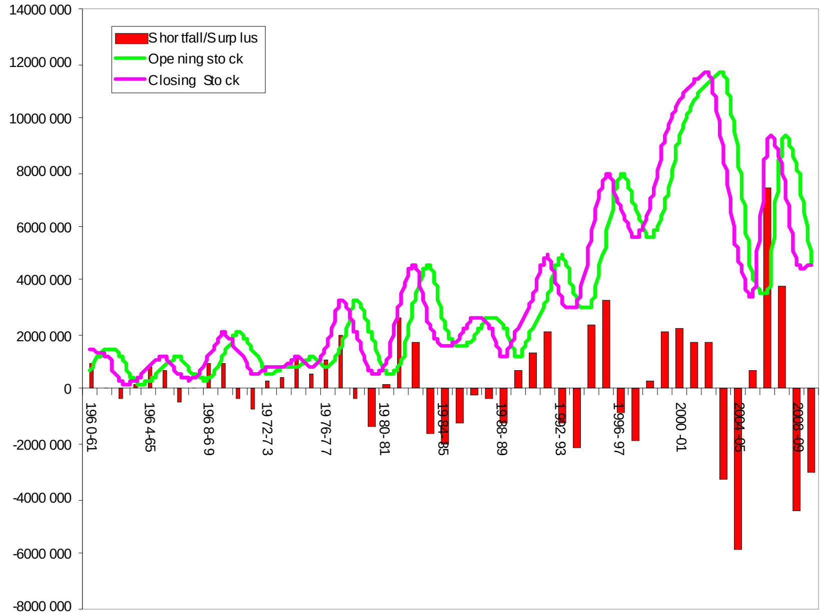

Fig. 3—Periodic cyclicality of Indian sugar production.

This initiative differs from the rest of the world in its choice of raw material for biofuel production: molasses for bio-ethanol (Gopinathan and Sudakaran, 2009). Cyclicality of sugar, molasses and ethanol production and restrictive policies, availability of molasses, and fluctuating price hampered the fuel ethanol program.

Strategic options

Various authors have projected the demand supply requirements of sugar for the next decade (Table 2). Most projected a wide gap between demand and supply. It is evident from the factors that increased production can be brought only through productivity improvements per unit area.

Table 2—Projected demand supply–sugar based–food, fuel and power.

Reports	Year	Demand millions	Supply millions	Gap millions
Sugar				
Surabhi, M, 2008.	2021	55 tonnes	26.6 tonnes	- 28.4 tonnes
KPMG, 2007	2017	28.5 tonnes	25 .0 tonnes	–3.5 tonnes
Vision 2025 SBA	2025	44.1 tonnes	32.3 tonnes	–11.9 tonnes
Alcohol–Ethanol E10				
KPMG, 2007	2017	3961 litres	3013 litres	–948 litres
Co–generation potential				
KPMG, 2007	2017	9700MW of power	48 million carbon credit	

The vision 2025 document of the Sugarcane Breeding Institute (ICAR, 2007) envisages at least the average yield of the sugarcane to be increased (105 tonnes per hectare from the present 67.5) to meet the sugarcane production of 450 million tonnes from 4.3 million hectares in 2020 (Table 2). This is going to be a challenging task.

Yield levels in cane and sugar has plateaued for the last 10 years (Figures 4 and 5) and shows wide variability between three agro-climatic regions and cyclicality year after year (Figure 6).

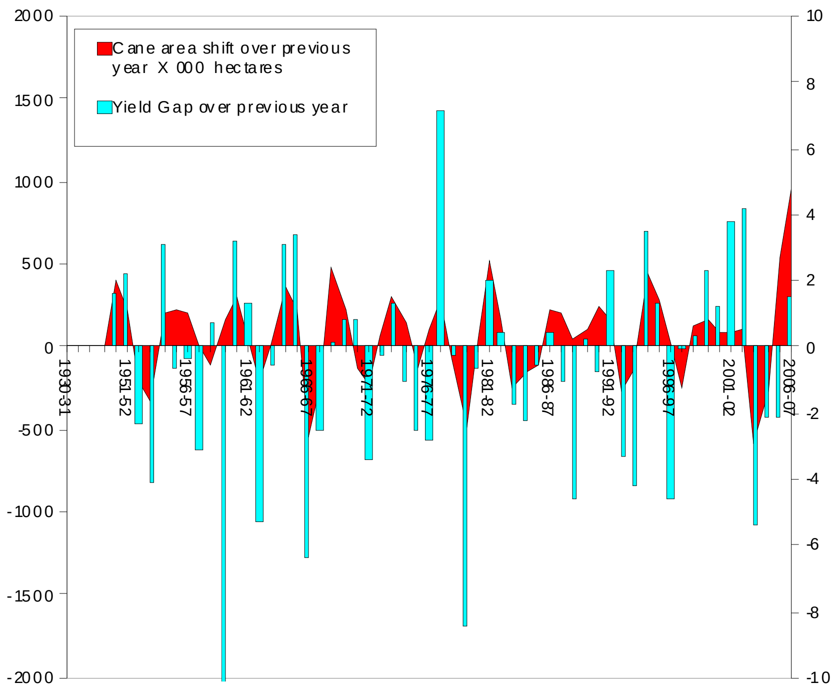

Fig. 4—Cane area shift and yield gaps year after year.

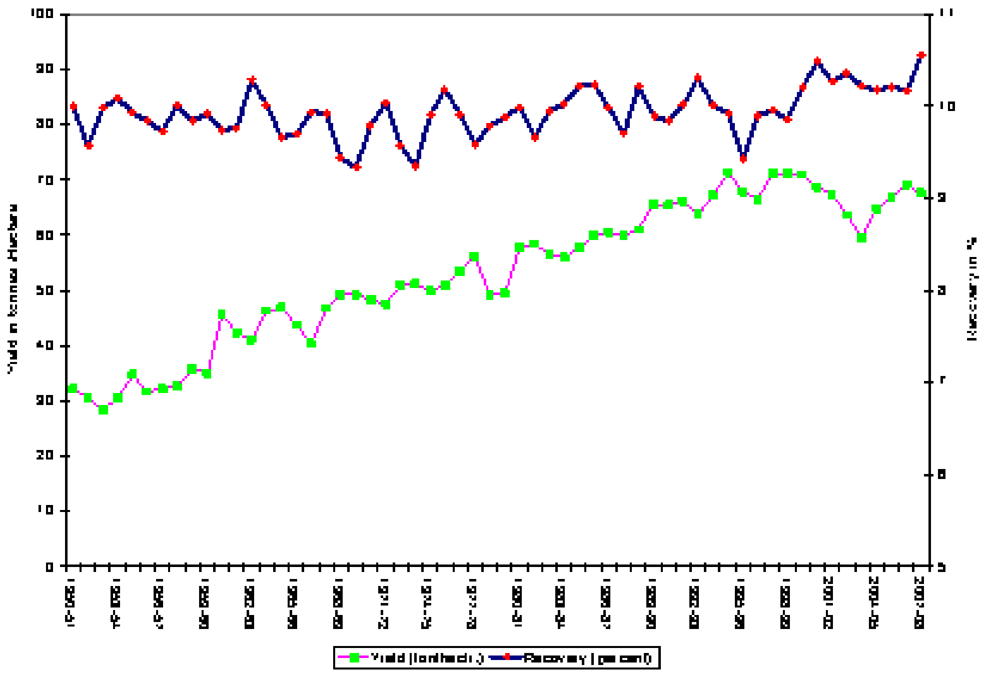

Fig. 5—Cane yield and recovery, Plateau Trend.

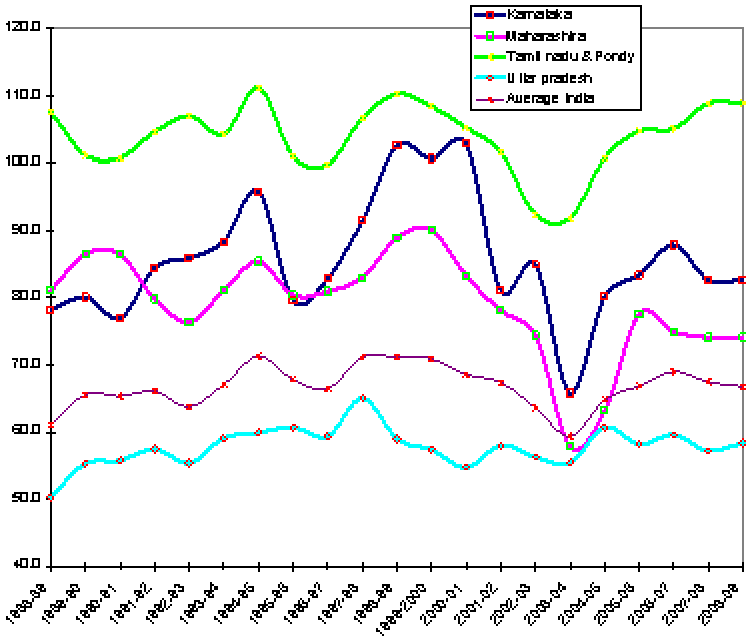

Fig. 6—State-wise average yeild of cane.

Even within the 15–20 km radius of a supply area representing 20 000 farmers, yield levels can range from 1–10 to 100 tonnes per hectare (Figure 7). Such wide variations within the farm and among farms and year after year has been attributed to complex agro-ecological conditions, access and adoption of technologies, cash and credit availability, timing of application of inputs, management of biotic and abiotic stresses, availability of power and labour, and willingness to manage risks. Heavy investments in inputs, infrastructure, and technology added with credit and weather risks and declining profitability can lead to pervasive indebtedness of small farmers. Technologies themselves are not sufficient to bring sustainability and profitability to farming in these situations.

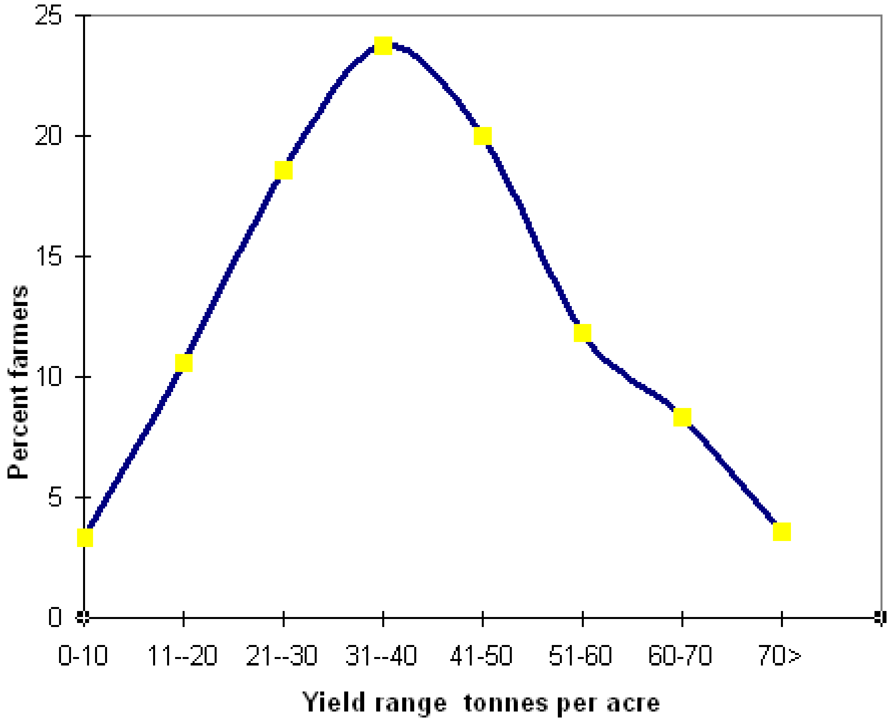

Fig. 7—Percentage of farmers in various yield categories.

There is an urgent need to evolve strategies and feasible alternatives for creating a viable future for the small farmers. Scientists need to re-orient and adapt to understand the management issues of farming, considering the bio-physical and socio-economic components. There is a need to consider the farmer beyond the passive receiver of technologies and information to a ‘partner’ in the entire value-chain.

Various interlocking arrangements, such as contract, network and leased farming, can create highly integrated backward and forward linkages converting small farmers as entrepreneurs in their own backyards. There is a need for a concerted effort by governments, millers, research institutions and non-governmental organisations to create a more equitable, economic environment for these small farmers to compete in a global context.

This includes targeted customer-oriented agricultural research and extension at local, state and national level, tenure security, efficient land management, assured market-linked competitive price, micro-credit facilities, risk management policies and technology/knowledge access with hassle-free farming.

In addition to this, government needs to continue investment with increased allocations in basic infrastructure such as roads, irrigation, communication, health, and strategic research and extension with long-term objectives.

Parry way: a strategic initiative

This calls for a different approach to the dissemination of agricultural research technology for sugarcane production in India by the millers. The conventional pipeline approach to agricultural research and extension has its serious limitations to meet the broad-based sustainable agriculture with complex demands of environmental, economic and diverse aspirational level of farmers.

An innovative integrated approach practised by Parry (*Parry way*) from cane registration to delivering payment on-line to the farmer at his doorstep using research, information technology, extension, development of Farm Process, out-sourcing (FPO) at village level in co-operation with financial institutions, and net working with National and State Research Institutions and Government establishments is depicted as a conceptual framework in Figure 8.

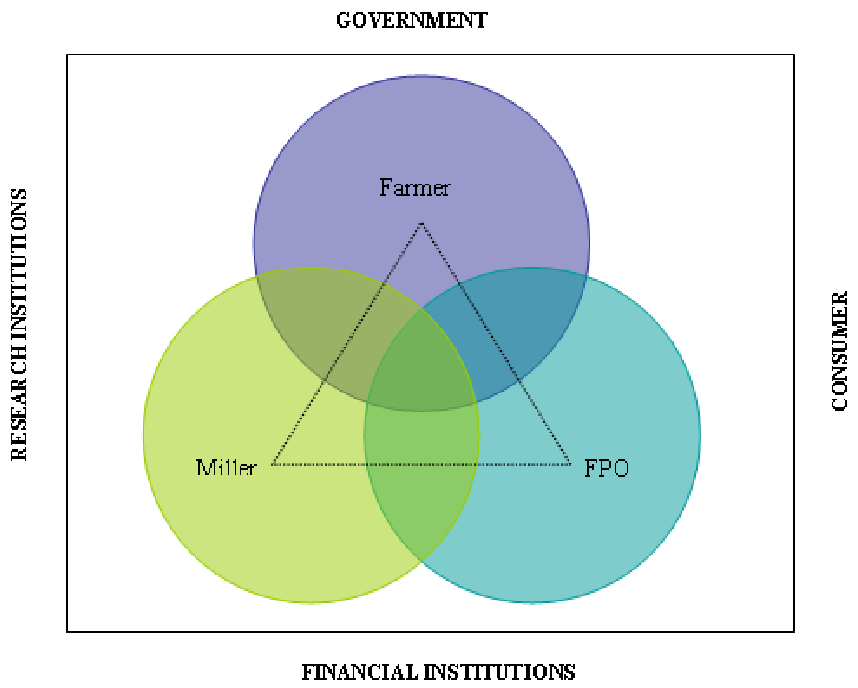

Fig. 8—Farmer relationship: conceptual framework—Parry Way.

The approach emphasises that innovation is a systemic process and can emerge from any source, complex interactions and the knowledge sources throughout the value chain—farmer to consumer. The conceptual framework envisages a millers' partnership with farmers in an interdependent way to ensure their aspirations are met through mutual dialogue and service rendered to facilitate hassle-free farming.

On registration of his land for cane, the grower is offers by the miller credit or advance and infrastructure loan either directly or through banks to facilitate easy cash flow.

Extension/Operation staff provide crop advice, farming calendars, soil analysis reports, fertiliser recommendations and suitable varieties. Farm Process Outsource (FPO) centres were developed within the village by selecting entrepreneur farmers and providing technical and financial support.

These FPO centres at village level deliver services at farmers' door-steps by a mobile call or a request from land preparation to harvesting including the supply of inputs. On successful completion of each activity, millers make the payments to FPO and deduct the same from the farmer's cane proceeds, enabling cash flow of the FPO.

Agricultural extension staff reduce the risk of farming operations through insurance, survey, monitoring and controlling crops from pests and diseases. Operation staff organise harvesting, transport of cane to factory and payments on time (within 14 days). In-house research staff continue to develop Parry varieties and technologies and also out-source suitable varieties and technologies from National or State institutions.

Traditional on-farm demonstrations, print media, and TV, combined with modern on-line kiosks, are used for communication and information sharing. Traditional class rooms, on farm training and feed back sessions, are an integral part of farmer training offered throughout the year. Information and communication technologies, integrated with geographic information, financial and cane management systems offer reliable and crop-specific information and knowledge flow on-line, accessible through kiosks, internet or mobile phones (Figure 9).

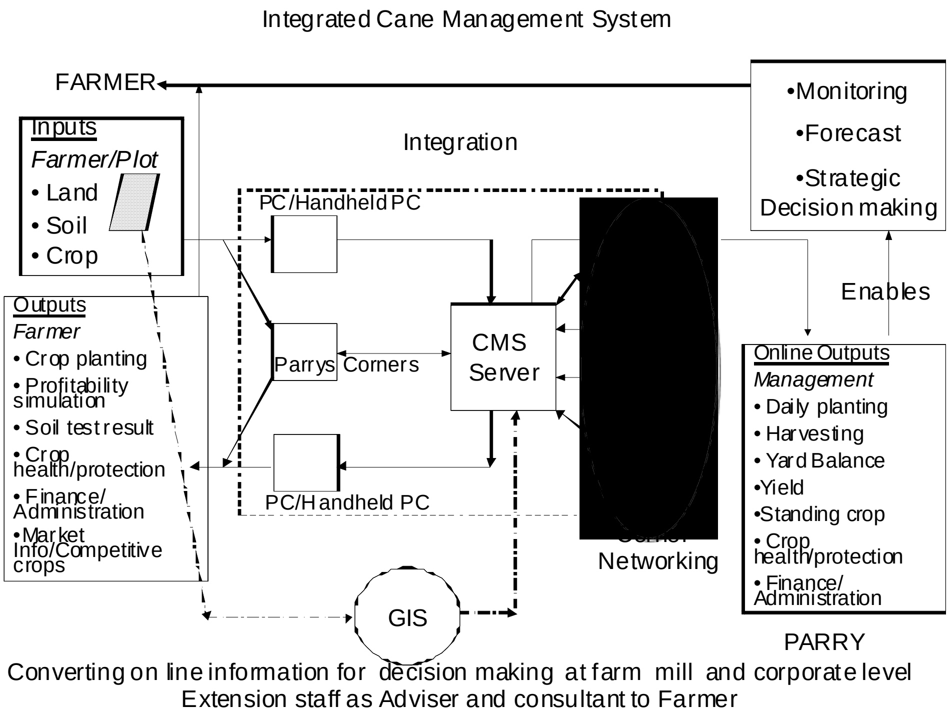

Fig. 8—Integrated to-and-fro information flow: farmer–miller.

Such information flow throughout the value chain enables traceability of agriculture even to small farms and also facilitates sustainability certification standards.

Open communications and access to information continue to build trust and relationships among the partners and create new avenues of opportunities for extracting value throughout the chain on a sustainable and profitable way for all stakeholders.

Beyond the convenience of farming, working together through an integrated professional culture, the farmer and FPO develop a sense of pride and ownership within himself and in his village.

Such relationships and respect can play a reversal role in rural-to-urban migration in the long term by attracting and retaining youth in farming and thus making farming intellectually stimulating, financially rewarding and a respectable profession.

REFERENCES

Allen, C.J., Mackay, M.M., Aylward, J.H. and Campbell, J.A. (1997). New technologies for sugar milling and by-product modification, In: Keating, B.A. and Wilson, J.R. (eds), Intensive Sugarcane Production: Meeting the Challenges Beyond 2000, CAB Int., Wallingford, UK, 1997, 267–286.

Ashok, R. (1983). Indian Agriculture Economics–Myths and Reality, Allied Publishers, Pvt. Ltd.

Assadi, M. (1998). Farmers' Suicides: Signs of Distress in the Rural Economy, Economic and Political Weekly, 33(14): 1562–1571.

Dipak, M. (1965). Size of Farm and Productivity: A Problem of Indian Peasant Agriculture, Economica, Vol. 32, May.

Edye, L., Hobson, P.H., Kent, G., Steindl, R. and Dunn, K. (2007). Maximising the revenue from Sugarcane through whole of biomass utilisation strategies. In: Jones, K. (2007). (eds). Research and Development Strategies to advance the Australian Sugarcane Industry. SRDC Technical Report 1/2007. 131–158.

Fitzgerald, P. and Bonnett, G. (2007). Research strategies for future farming systems: GM Sugarcane. In: Jones, K. (2007). (Eds). Research and Development Strategies to advance the Australian Sugarcane Industry. SRDC Technical Report 1/2007.94–115.

Gopinathan, M.C. and Sudhakaran, R. (2009). Biofuels: Opportunities and challenges in India. *In vitro* Cell. Dev. Biol.–Plant, 45: 350–371.

Government of India (GOI). (2007). Report of the Expert Group on Agricultural indebtedness, New Delhi: Ministry of Finance.

Gravitis, J. (2007). A biochemical approach to attributing value to Bio-diversity–The concept of zero emission biorefinery. http://www.unu.edu/zef/publications_e/intro_to_biorefinery.pdf

Gupta, D. (2005). Whither the Indian Village: Culture and Agriculture in Rural India**,** Economic and Political Weekly, 40(8): 751–758.

Hanlon, D. (1996). Management is key to making more money. Australian Canegrower. 24 June, 1996. p. 25.

ICAR (2007), SBI Perspective Plan Vision 2025, Sugarcane Breeding Institute, Coimbatore, Tamil Nadu.

IPCC (International Panel on Climate Change) (2007). Climate change 2007 synthesis report. http://www.ipcc.ch/ipccreports/ar4-syr.htm;2007

IPCC (International Panel on Climate Change) (2008). Climate change and water. Technical report, IPCC working group II; 2008. http://www.ipcc.ch/ipccreports/tp-climate-change-water.htm

ISMA (2009) (Indian Sugar Mills Association) Hand book of sugar statistics. Indian Sugar Mills Association, New Delhi.

KPMG (2007). The Indian Sugar Industry: Sector Roadmap 2017. KPMG International India.

Lindberg, S. (1995). 'New farmers' Movements in India as Structural Response and Collective Identity Formation: The cases of Shetkari Sanghatana and the BKU' in Brass, T., ed. New farmers' Movements in India, London: Frank Cass.

Mahesh, R. (2000). Farm Size–Productivity Relationship: Some evidence from Kerala. KIED Working paper 2. http://www.kied.org

MoCFA. (2007). (Ministry of Consumer Affairs, Food and Public Distribution).Annual Report. http://fcamin.nic.in/dfpd

NSSO. (2005). National Sample Survey organisation**.** Situation Assessment Survey of Farmers: Indebtedness of Farmer Households, NSSO 59th Round, Report 498, New Delhi: NSSO, Ministry of Statistics and Programme Implementation, Government of India.

Oliverio, J. L and Riberio, J. E. (2006). Cogeneration in Brazilian Sugar and Bioethanol mills: Past, Present & Challenges. International Sugar Journal, 16: (1287): 17–26.

Posani, B. (2009). Crisis in the Countryside: Farmer Suicides and the Political Economy of Agrarian Distress in India. Development Destin Studies institute. Working paper Series. No. 09–95.

REAP (2003). Introduction to ecological farming. http://www.reapcanada.com.online-library/intdev/introduction.pdf

Rogers, R.D., Spear, S.K., Swatloski, R.P., Reichert, W.M., Godshall, M.A., Johnson, T.P. and Moens, L. (2001). Non-Sugar products from sugarcane for the new millennium : Green Pathways to a carbohydrate economy?. Proc. Sugar Industry Technol., Vol. 60, 2001.

Sen, A.K. (1964). Size of Holdings and Productivity. The Economic Weekly, Annual No. February.

Surabhi , M. (2008). Demand–supply trends and projections of food in India. Working paper No.209. Indian Council for Research on International Economic Relationship.

Suttivan, P. (2003). Applying the principles of sustainable farming. http://www.attra.org/attra-pub/PDF/Transition.pdf

U.N. (2001). World Population Prospects–The 2000 revision 28 February 2001. http://www.un.org/spamish/esa/population/wpp2000h.pdf

UNICA. (2008). Sugar Industry Brazil. http://english.unica.com.br/mutlimedia/publicacao

Wegener, M.K. (2000). Opportunities to improve economic performance on sugarcane farm. In: Keating, B.A. and Wilson, J.R. (eds). Intensive Sugarcane Production: Meeting the Challenges Beyond 2000, 343–360.CAB Int., Wallingford, UK.

World Bank (2005). India's Water Economy: Bracing for a Turbulent Future. http://www.worldbank.org.in

World Bank (2009). Prospects for Global Economy. http://www.worldbank.org.in

WWF (2003).Thirsty crop report, Agricultural water use and river basin conservation. Rob de Noof, WWF. http://assets.panda.org/downloads/agwaterusefinalreport.pdf

STRATEGIES DE TRANSFERT EN RECHERCHE ET TECHNOLOGIE POUR LA PROCHAINE DECENNIE–UN EXAMPLE INDIEN

Par

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Résumé

LA GLOBALISATION est entrain de conduire à des réformes radicales externes et internes sans précédent dans les industries sucrières à travers le monde. Ajouté à cela, 5 forces émergeantes, qui montent en puissance, vont redessiner la production de canne à sucre et l'industrie sucrière dans le futur, avec des implications extraordinaires sur le plan démographique, économique, sociopolitique, environnemental et technologique. Cet article dresse tout d'abord un tableau de la croissance et du statut de l'industrie sucrière et l'impact des forces émergeantes sur le remodelage des systèmes de production agricoles. La complexité et la diversité émergeante des exploitations agricoles requièrent la mise en place d'un modèle de recherche et de transfert de technologie nouveau et plus complexe. La consolidation des meilleurs systèmes pour l'exploitation, l'identification de la diffusion optimale des technologies et des problèmes d'adoption, ainsi que l'introduction de nouvelles technologies et pratiques innovantes dans la chaîne agricole va continuer de jouer un rôle primordial dans l'amélioration de la productivité. Les changements démographiques, le statut socioéconomique des planteurs et les prix relatifs à la compétitivité des cultures vont demander aux compagnies sucrières de fournir, en plus d'un prix compétitif de la canne, la livraison de divers services aux planteurs pour assurer un approvisionnement durable des cannes aux usines. L'introduction de nouveaux standards pour la durabilité et le besoin de certification pour les consommateurs conduira les compagnies sucrières à intégrer l'ensemble de la chaîne de valeur du planteur au consommateur au travers de divers formes de coopération, de relations et de partenariats. Ces réalités émergeantes vont débloquer des potentiels inexploitées et opportunités inutilisées à travers la chaîne de valeur pour créer une nouvelle architecture de recherche et de transfert de technologie et un paysage compétitif pour l'industrie sucrière en Inde.

ESTRATEGIAS PARA LA TRANSFERENCIA DE INVESTIGACIÓN Y TECNOLOGÍA PARA LA PRÓXIMA DÉCADA–UN EJEMPLO DE LA INDIA

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Resumen

LA GLOBALIZACIÓN está impulsando reformas internas y externas radicales y sin precedentes en las industrias de azúcar alrededor del mundo. Además de esto, cinco fuerzas principales emergentes o intensas, con grandes implicaciones extraordinarias - demográficas, económicas, sociopolíticas, ambientales y tecnológicas- moldearán el cultivo de caña de azúcar y la industria azucarera en el futuro. En primer lugar, este documento aborda el crecimiento y el estado de la industria azucarera y el impacto de estas fuerzas emergentes en el moldeamiento del futuro agrícola de la caña de azúcar. Complejidades y diversidades emergentes en la estructura y el proceso de explotación agrícola exigen un modelo nuevo y más complejo de investigación y transferencia de tecnología. La consolidación de las mejores tecnologías para la explotación máxima, la identificación de las lagunas de difusión y adopción de tecnología, y la introducción de nuevas tecnologías y prácticas innovadoras a lo largo de toda la cadena de agricultura van a seguir desempeñando un papel fundamental en la mejora de productividad de la caña de azúcar. Los cambios demográficos, el estado socioeconómico de los agricultores, y los precios de los cultivos competidores exigirán a las empresas de azúcar ofrecer, además de precios competitivos de caña, entrega especifica de diversos servicios a los agricultores para asegurar un suministro sostenible de la caña. Introducción de nuevos estándares de sostenibilidad y la necesidad de certificación por parte de los consumidores conducirá a las empresas de azúcar a integrar la cadena de todo valor desde el agricultor hasta el consumidor, mediante diversas formas de cooperación, relación y asociación. Estas realidades emergentes abrirán potenciales sin explotar y oportunidades sin utilizar a lo largo de la cadena de valor para crear una nueva arquitectura de transferencia de investigación y tecnología y un panorama competitivo para la industria del azúcar en la India.