Can Co-ops Become Energy Producers Too?

Challenges and Prospects for Efficient Co-generation in India's Co-operative Sugar Sector

by

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Abstract

Electricity supply in India has not kept pace with rapid urbanization and is projected to be in even greater shortfall in the coming decades. India's sugar sector – one of the largest in the world – could provide approximately 5,000 MW of power through high efficiency bagasse cogeneration with export of surplus power to the grid network. From the perspective of the sugar sector, diversification into energy production holds the key to survival due to a crash in the price of commodity foods the world over.

My project focuses on Maharashtra, a large sugar producing state in India where almost all sugar is produced by cooperatives – farmer-owned entities that serve important social functions in the countryside. It evaluates the particular financial, institutional, and political characteristics of cooperative sugar mills that have prevented them from becoming electricity producers. It finds that domestic renewable energy programs and international projects have not as yet taken into account the financial circumstances of cooperative mills. Some recommendations include introducing alternative financing mechanisms; augmenting interaction and learning among cooperatives; and regulatory policies conducive to renewable power generation. In addition, it finds that if cooperative sugar in India is to emerge as a viable and independent energy producer, systemic changes in the sugar sector as a whole will have to be made.

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TABLE OF CONTENTS

List of Tables and Figures

List of Abbreviations

BOOT – Build, Own, Operate, Transfer
ESCO – Energy Service Company
ESMAP – Energy Sector Management Assistance Program of the World Bank
GDP – Gross Domestic Product
GEF – Global Environmental Facility
GHG – greenhouse gas
IPPs – Independent Power Producers
IREDA – Indian Renewable Energy Development Agency
ISMA – Indian Sugar Mill Association, an association of private mills
MNES – Ministry of Non-Conventional Energy Sources
MoP – Ministry of Power
MSEB – Maharashtra State Electricity Board (the state electric utility)
MW – megawatt, a unit of power
MWh – megawatt-hour, a unit of energy
NFCSF – National Federation of Cooperative Sugar Factories
Rs. – Rupees. USD1 = Rs 46 approximately
SDF – Sugar Development Fund
SMP – Statutory Minimum Price (factory gate price of cane given to farmers by sugar mills)
SERC – State Electricity Regulatory Commission
TCD – (metric) tons of sugarcane crushed per day
UNDP – United Nations Development Agency
USAID – United States Agency for International Development
WADE – World Alliance for Decentralized Energy

I. Project overview

"It is the experience the world over that any sugar factory cannot survive by producing merely sugar."
—S Patil, President of the National Federation of Cooperative Sugar of India, 1991 (Patil 8:1991)

While urban India charges steadily ahead with a booming information technology industry and a competitive outsourcing business, six hundred million people (60% of the total population) in the country continue to rely on agriculture for their livelihoods. Rapid economic expansion through liberalization – an average GDP growth rate of 6% was registered over the past decade – has largely left rural India behind (UNDP 2005). Moreover, economic growth has not been accompanied by an expansion of basic infrastructure services such as power and water, a problem that is anticipated to worsen with increased urbanization. The power sector alone in India is severely financially constrained and in need of approximately 100,000 MW of capacity addition (or twice its current capacity) to meet anticipated demand by 2012 (MoP 2003a).

Efficient electricity production from *bagasse* – the fibrous residue left over after processing sugarcane – can make important regional contributions to India's electricity supply at zero net carbon dioxide emissions. As a means of meeting their on-site needs, sugar mills all around the world currently burn bagasse in boilers to produce both steam and power (a process known as cogeneration or combined heat and power).[1] A few mills around the world are also able to export surplus power to the grid via more efficient, high temperature and pressure boilers. For instance, Mauritius, an island country with very little fossil fuel reserves, meets 8% of its electricity demand through sugarcane waste alone (Deepchand 2001).

Globally the sugar sector, like other commodity sectors, is facing unfavorable conditions due to a pronounced, and continuing decline in prices. A 2004 report by the United Nations Food and Agricultural Organization (FAO) on the state of world agricultural commodity markets notes that since the mid-1990s, world sugar prices have been on the decline due to oversupply of the market (FAO 2004). In such a depressed market situation, both developed sugar-exporting countries (e.g. Australia and the European Union) and developing sugar-exporting countries (e.g. Mauritius and Brazil) have recognized the importance of diversifying sugarcane into other products (Milford, 2003; Filho and Badr, 2004).[2] This means that sugar

[1] In the literature, the term "bagasse cogeneration" refers to high-efficiency cogeneration (i.e. power export to the grid via the use of high temperature and pressure boilers) and not to the low efficiency cogeneration that most mills the world over carry out for on-site needs. Thus, this paper will follow the convention found in the literature.

[2] It is important to note here that 19 sugar exporting countries of Africa, the Caribbean and Pacific (known as the ACP group) that depend almost entirely on sugar export for national income (e.g. Jamaica, Mauritius, and Guyana) are especially concerned about the removal of preferential access to European markets from 2007 onwards under the WTO regime. Experts and policy makers from

mills do not only refine the harvested cane into table sugar, but from it, also produce alcohol, molasses, and black liquor.[3] The bagasse waste is also used as raw material for particleboard (used in construction); pulp for the newspaper and paper industries; and, as described above, fuel for electricity production. Even for countries that do not export significant quantities of sugar, such as India, diversifying sugar production provides an opportunity for the industry – and the millions of farmers it employs – to insulate itself from adverse domestic market conditions and fluctuating production cycles. Revenues from electricity sales as a percent of total revenues in India range from 10-20% depending on equipment purchased (Chandrakumar 2004).[4] Some experts in India suggest that diversification in the sugar industry has become imperative for survival, without which revenues from sugar alone would be insufficient to break even (Tyagarajan 2004, Padmanaban 2004).

India is a sugar giant. In 2004, it was the second largest producer of sugar in the world behind Brazil, with a majority of production destined for domestic markets (FAO 2003 *in* WADE 2004). Approximately 60% of India's sugar sector is owned and run by farmers through cooperatives, a situation that is unique to the country, and results from historical reasons, while private sugar mills in India are the second largest producer. Sugar production by cooperatives in India is greater than the combined production of Australia and China – two of the top-ten sugar producers in the world (FAO 2003 *in* WADE 2004). Sugar cooperatives provide key socio-economic functions in the countryside, such as the establishment of schools and hospitals and the construction of paved roads. They are also a powerful political lobby. Typically, a cooperative has the membership of 10,000-15,000 farmers and distributes all profits earned from sugar sales to its members in the form of a sugarcane price. A cooperative leader or patron may also contest in state and national elections and therefore uses the cane price to garner votes from other members.

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these countries have been particularly vocal about the need to diversify the sugar industry (e.g. Deepchand 2001, Clark 2005).

[3] Ethanol is produced from anaerobic fermentation of sugarcane juice and is a chemical used in many industries. Some countries such as Brazil also produce ethanol as a substitute for gasoline for transportation. Molasses is a dark syrup produced after boiling down juice from sugarcane. It is used in the food industry and for animal feed. Black liquor, also known as alkaline spent liquor, is another byproduct of the sugar industry and can be used as a source of energy (DOE 2005).

[4] This figure is in line with Deepchand's estimate for Mauritius, where bagasse power represents 22% of total proceeds from sugar (Deepchand 2002).

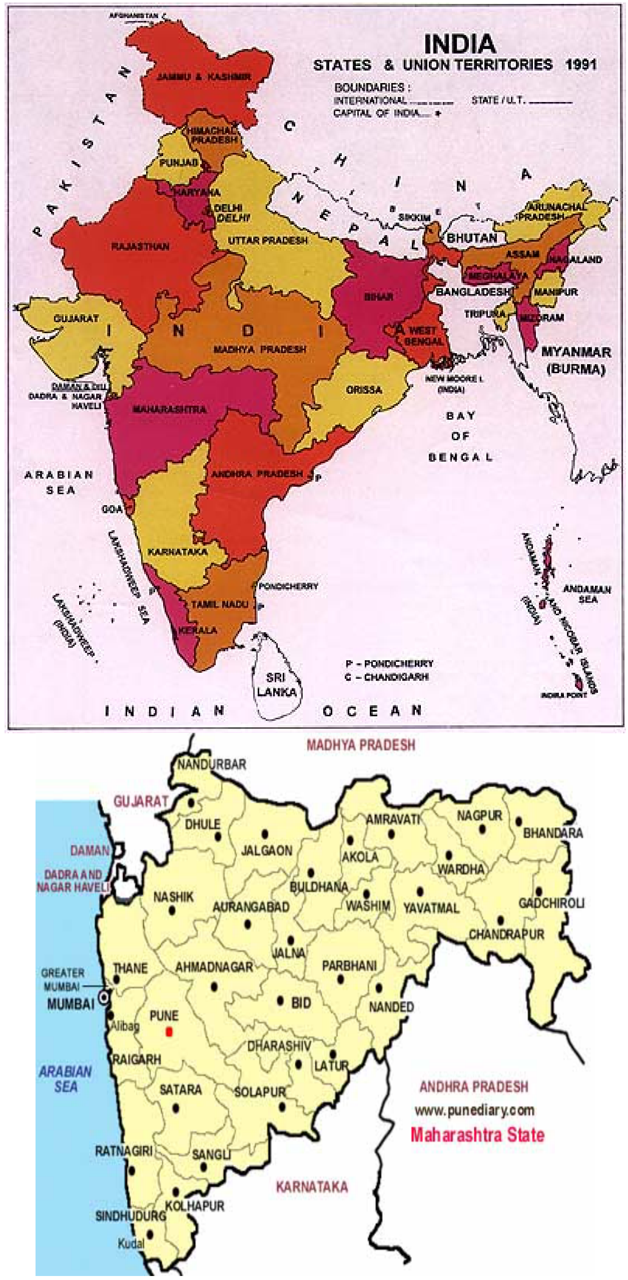

Figure 1a and 1b: Maps of India and Maharashtra. Fieldwork was carried out in the districts of Pune, Satara and Sangli (south-west of the state).

Cooperative sugar factories, however, have not kept pace with rapid changes and diversification trends in the industry (Godbole 2000, Tuteja Committee 2004). Unlike their private counterparts, many continue to use outdated and inefficient equipment and have not upgraded their boilers in order to produce surplus power for the grid (Gollakota and Sobhanbabu 2002). Many also face bankruptcy and rely on government support to bail them out (Godbole 2000, Deulgaonkar 2004, Bavadam 2005, Baviskar 2004). The sheer size of the cooperative sugar sector in

India and its role in rural development, make this lack of financial performance and absence of product diversification of particular concern.

This project probes the challenges and prospects for bagasse cogeneration in the cooperative sugar sector, with a geographic focus on the cooperative-heavy state of Maharashtra in India **(Figure 1a and 1b)**. Maharashtra is the second largest producer of sugar in India after Uttar Pradesh in the North, with 99% of its sugar produced by cooperatives (Gollakota and Sobhanbabu 2002). The paper is based on the premise that diversifying the cooperative sugar sector into electricity production is one important way in which to make the cooperative sector more financially viable, while also produce cleaner power for India. Given that sugar mills employ a significant proportion of the rural population, additional remuneration has indirect positive social and economic benefits. The four main national and global benefits of bagasse cogeneration can be summarized as follows:

i) Power from bagasse produces no net carbon emissions since the carbon dioxide that is taken up during photosynthesis is released when bagasse is combusted.
ii) India's electricity grid is facing a chronic supply deficit; additional generating capacity from bagasse cogeneration can make a significant difference at the state-level (10% of Maharashtra current installed capacity could come from bagasse cogeneration), and contribute approximately 5% on a country-wide scale (Deo 2003, Golkotta and Sobhanbabu 2002).
iii) Additional revenue for the sugar mill can have positive spill-over effects, such as investment in infrastructure and social services in the surrounding rural areas (Golkotta and Sobhanbabu 2002).
iv) Decentralized sources of electricity supply have a number of efficiency benefits, such as reduction in transmission and distribution losses and improvement in local power quality (Sobhanbabu 2004).

Research Questions & Methods

Given the need for increased electricity supply, the potential for the cooperative sector to meet some of this need, the overall financial and social benefits of a better performing cooperative sugar sector, and the apparent success of certain private mills in India in undertaking bagasse cogeneration, this project asks the following questions:

Why has the cooperative sugar sector not been able to evolve into electricity producers like the private sector in India?

What institutional, financial, and capacity building strategies might be deployed to increase electricity generation in the cooperative sugar sector?

The research is focused in the state of Mahrashtra for reasons given above. It also included private sugar mills in the southern state of Tamil Nadu for comparison purposes. Interviews were conducted in the field with engineers and directors at sugar mills, non-governmental organizations (NGOs) focusing on renewable energy and power sector policy in India, international development agencies, and government officials at the Ministry of Non-Conventional Energy Sources (MNES). In total, eight representatives from cooperative sugar factories in Maharashtra were interviewed, five from private sugar factories, and approximately 15 people from international donor agencies, NGOs, and the government.

A case study on Jawahar Cooperative Sugar Factory, the first cooperative to install bagasse cogeneration in the state was also conducted. Other methods such as data collection were from statistical yearbooks on approximately 500 sugar mills in India. An extensive literature review, including a media survey (i.e. newspaper and magazine article), of the cooperative sugar sector and experiences with bagasse cogeneration in India and around the world was also carried out.

This rest of the paper is divided in to five chapters. Chapter II provides the context of the Indian power sector (both fossil fuel generation and renewable power generation), and overviews the relevant policy-making bodies. Chapter III discusses the sugar sector and state of affairs today. Chapter IV tries to understand why cooperative participation in bagasse-based grid power projects has been so low. Chapters V and VI set out existing and potential policy directions, and provide recommendations for increased cooperative sugar power projects.

II. Crisis and Change in the Indian Power Sector: Scope for Renewables?

The Indian electricity sector has undergone profound change since independence in 1947. Whereas it was once entirely state-run, the sector now has private sector participation in generation, distribution, and trading, reflecting broader macroeconomic trends of liberalization since the early 1990s. As recent as 2003, the Indian government passed a new reforms-enabling legislation, the Electricity Act 2003, replacing all previous legislation in the sector. The new Act basically aims to introduce greater competition in the sector while also making the electricity regulator more accountable. It provides substantial flexibility for individual states to design their own reform strategy. The Act is also the first electricity legislation in India to make specific mention about renewable energy, a fact that has led to a number of interesting questions posed by experts. The purpose of this section is to provide an overview of power production in India, the major institutions responsible for producing power and overseeing renewable energy policy, and the implications of various restructuring developments for grid connected renewable power.

Conventional Power Production

India has an installed electricity generation capacity of 112,000 MW which is about 10% that of the U.S. (EIA 2003). Approximately 70% of India's electricity comes from coal as shown in **Figure 2**.

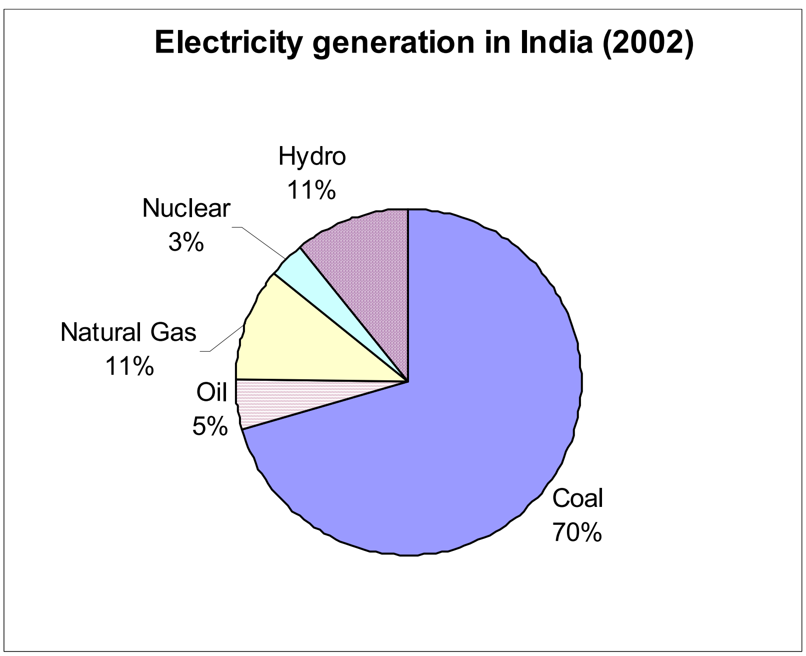

Figure 2. Source: IEA 2002.

Industry is the largest electricity consumer, followed by the agricultural and residential sectors **(Figure 3)**. India's power sector continues to face a considerable demand-supply gap as well as poor quality of supply (low voltage and grid instability). Peak shortage in power is estimated in the range of 13% (MoP 2003a) and commercial transmission and distribution (T&D) losses in some states (e.g. Maharashtra) amount to around 40% of total electricity generated centrally (World Bank 2002).

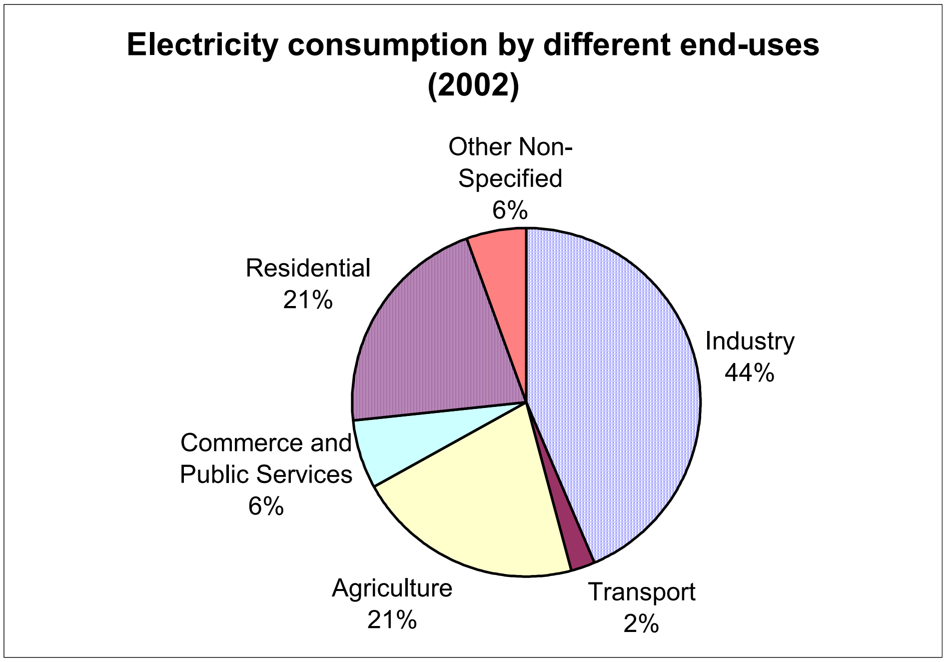

Figure 3. IEA 2002.

Electricity access is also markedly different between rural and urban areas. According to the latest Census of India (2001), 56.5% of rural households and 12.4% of urban households lack access to electricity (GoI 2001). High initial connection charges and the techno-economic infeasibility of extending the grid in certain areas are some of the reasons why access is so low in rural areas.

Institutional structure and evolution of the power sector

Dubash and Rajan (2002) and Kale (2004) outline four major eras of India's electricity sector: 1) pre-1991 state ownership, 2) the 1991 independent power producer (IPP) policy and its failure, 3) the World Bank-led reform policy followed first in Orissa, and 4) the period starting after 1998 when major electricity reform policies were formulated and are currently being implemented across the country. For much of post-independence history, the electricity industry has been publicly owned and run by state employees on a socialist development agenda. In India's constitution, electricity is listed as a "concurrent" subject, meaning that both state and central governments are involved in designing and implementing policy. This has spawned a complex institutional structure with various policy-making bodies existing at both the national and state levels (Kale 2004). At the national level, the Ministry of Power is mainly involved in designing power policies in line with budgetary and demand projections of the Planning Commission. State electricity boards (SEBs), once vertically integrated electric utilities[5], are mainly responsible for implementing policy at the state level.

No discussion of India's electricity sector proceeds without mention of the political economy issues that have so profoundly shaped its evolution. From the late 1970s onwards, populist politics practiced by various states declared subsidized or even free electricity to farmers as a means of garnering electoral votes. However, states did not always compensate SEBs for the loss of revenues from agricultural consumers (Dubash and Rajan 2002). By the mid-1990s, the World Bank estimated that SEBs paid an annual subsidy of approximately $5 billion to agricultural and residential users (World Bank 1999 *in* Dubash and Rajan 2002). High T&D losses due to theft by industrial and other consumers exacerbated the financial distress of SEBs. In 2000-2001, total commercial losses by SEBs rose to $18 billion, or 25% of the states' gross fiscal deficits (Planning Commission 2002 *in* Kale 2004).

The extent of SEB bankruptcy has been more severe in certain states. For example, with an installed capacity of approximately 10,000 MW, 13 million connections, and a staff of 108,000, the Maharashtra State Electricity Board (MSEB) is by far the largest electric utility in India (World Bank 2002). However, given the large percentage of sugarcane farmers in Maharasthra, subsidized power for a water-hungry crop such as sugarcane was particularly damaging to the utility's financial resources (Prayas 2001). Added to this were the financial perils resulting from Enron's natural gas power project in Maharashtra, a project that was shrouded in secrecy and financial mismanagement , from the beginning, (Dubash and Rajan 2002).[6]

Starting from the early 1990s, the paradigm of state monopoly in the electricity sector was overturned, first by inviting independent power producers into the generation sector, and then through the World Bank-supported reform of Orissa's electricity sector in the mid-1990s. Although a lengthy discussion of reforms is beyond the scope of this paper, I provide a synopsis of the major events that have shaped electricity reform next

Power sector reforms

To restore efficiency and financial health in the sector, state-level market-oriented electricity sector reforms have been underway since the early 1990s. After a failed attempt in the early 1990s to invite private participation in electricity generation, various states in India have begun to follow a largely common pattern of reforms, spearheaded by the World Bank-supported Orissa model in the mid-nineties. State-

[5] This means that one state-owned company manages the generation, transmission and distribution stages of electricity production.

[6] For a detailed discussion of the Enron "fiasco" as it has come to be known, please see Dubash and Rajan (2002) and Prayas (2001).

level reforms since Orissa's experience have generally followed a pattern of i) unbundling state utilities into three separate companies of generation, transmission, and distribution and commercializing them, ii) private sector participation in generation and distribution, iii) restructuring tariffs and subsidies to certain classes of consumers mentioned above, and iv) the establishment of an independent state electricity regulatory commission (SERC).

In 2003, in an attempt to formalize various state-led initiatives, the central government passed the Electricity Act 2003, replacing all previous legislation in the sector. The stated objectives of the Act are "competition, protection of consumers' interests, and power for all areas (MoP 2003b)." Major provisions include facilitating private investment; eliminating licensing requirements for generation, particularly stand-alone generation in rural areas; introducing open access to T&D; and mandating the creation of a SERC in every state.

States across India have adopted these elements of reform at different paces. Maharashtra, for instance, has established a regulatory commission, and issued two tariff orders aiming to reduce subsidies to consumers that have traditionally been undercharged, and charge lower tariffs to consumers that have traditionally been overcharged (e.g. industry) (Deo 2003). It has also played one important role in the context of bagasse cogeneration. In 2002, MERC issued a second tariff order for the purchase of electricity from co-generation projects based on non-fossil fuels. The elements of this tariff order are described in detail below.

The process of reforms provides ample opportunity for scrutiny and evaluation by experts (e.g. see Prayas 2001, Reddy 2001, Sankar 2002, Dubash and Rajan 2002, Phadke and Rajan 2003, Kale 2004 for detailed analyses). A number of these studies point to the lack of attention paid to social and environmental dimensions of electricity during the reforms process, and stress the importance of incorporating these considerations. For instance, Dubash and Rajan say "While reforms may yet indirectly lead to both social and environmental gains through the construction of a better functioning sector, there has been little attempt…to ensure this outcome (2002: 68)." Similarly, Phadke and Rajan argue that "…issues related to protecting the environment, extending access to the poor…need to be addressed up-front in order for the reforms to be in the broader public interest (2003: 3062)". Reddy (2001) takes this argument further by insisting that a transition to renewable non-fossil fuel sources must also incorporated into the reforms agenda, citing the examples of the UK Non-Fossil Fuel Obligation (NFFO) and the U.S. Renewables Portfolio Standard (RPS). What scope does renewable energy have in India's context, given current trends? The next section provides some insight into this question.

Renewable Power Production

In a situation of high T&D losses, supply shortage, lack of access in rural areas, and abundance of natural resources, the case for distributed power is compelling.

The government's goal of renewable power is two-fold: to increase the non fossil fuel generation capacity of the grid, and to serve rural areas through small-scale off-grid systems (MNES 2004). India possesses a large potential for distributed power from renewable sources: around 80,000 MW of generation potential from wind, small hydro, biomass, waste, and solar energy, of which only 5,000 MW has been achieved.

Table 1: Cumulative Achievements of Renewable Power Programs in India

Source/Technologies	Potential (MW)	Cumulative Physical Achievements (MW) (up to 3/31/2004)
Wind Power	45,000	2,483
Small Hydro Power (up to 25 MW)	15,000	1,603
Biomass Power (not including bagasse cogeneration)	16,000	234
Bagasse Cogeneration	3,500 – 5000	379
Biomass Gasification	Not estimated	58
Solar Photovoltaics	20 MW/km^2	2.5
Energy Recovery from Urban & Industrial Wastes	1,700	41
Total	**81,200**	**4,800**

Source: MNES 2004

The rationale for bagasse-based power

As seen from **Table 1**, India possesses significant biomass power and bagasse cogeneration potential. The process of producing heat and electricity from the fibrous waste (bagasse) left over after processing sugarcane is known as bagasse cogeneration (see **Appendix A** for more detail about the technology). Sugar mills require both power and process heat for their operations, and typically use the bagasse for meeting on-site electricity and heat needs. Historically, there has been little incentive to burn the bagasse efficiently – in fact the chief motivation for bagasse cogeneration has been bagasse disposal. Thus mills typically use low-pressure (20 kg/cm^2) and low temperature (300^{o}C) boilers for their steam and power requirements.

However, in recent times, a number of factors have increased the desirability of more efficient boiler configurations (temperatures in the range of 490-520^{o}C and pressures in the range of 60-80kg/cm^2) that produce more steam and electricity for a given amount of bagasse (Gollakota and Sobhanbabu 2002). The bagasse saved can be sold to paper mills (bagasse is a raw material for pulp), as well as other industries interested in firing their boilers with biomass. With electricity price hikes, energy efficiency has also become more desirable as well. But perhaps the most attractive reason for burning bagasse efficiently is the opportunity to export surplus power to the grid and earn additional revenues from electricity sales, thereby avoiding the adverse effects of a cyclical (boom and bust) sugar market (Gollakota and Sobhanbabu 2002).

Institutional structure and renewable energy policy

Two main government bodies at the national level – the Ministry of Non-conventional Energy Sources (MNES) and the Indian Renewable Energy Development Agency (IREDA) – are responsible for promoting renewable energy in India. Each works through regional offices and state renewable energy agencies. MNES chiefly administers wind, solar (thermal and power), waste-to-energy and a range of biomass energy programs in both rural and urban areas. Its activities cover policy-making, research and demonstration programs, and implementing fiscal and financial incentives (MNES 2004).[7]

IREDA, the corporate financing arm of MNES, was established in 1987 to address the barriers of high initial cost and risk perceptions associated with renewable energy technologies. It was designed to provide support as the market for a technology is being developed, and to withdraw support as the technology becomes financially competitive. IREDA provides concessional loans for renewable power projects with the interest rate varying according to the financial viability of the project (from 0-15%)[8] and according to the category of user (lower rates are provided to geographically disadvantaged regions and peoples) (MNES 2004). IREDA receives loans from a variety of international sources such as the World Bank, Asian Development Bank, Germany's aid agencies, and the Dutch Government (IREDA 2005).

Pursuant to the renewable energy policy guidelines issued by the Ministry, states in India have different promotional policies pertaining to wheeling and banking of power, third party sale[9], and renewable power purchase tariffs. Fourteen states have so far announced such policies (Gupta 2000). Most states have issued wheeling charges of 2-5% of the total cost of energy wheeled, banking periods of between 6-12 months, and renewable energy buy-back tariffs of $0.049/kWh starting 1994-95 with 5% escalation in tariff per year (CII 2005). Sale of renewable energy to a third-party (i.e. other than the electric utility) has also been allowed in some states.

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[7] These incentives include up to 100% depreciation of the asset in the first year of installation of the project; exemption from excise duty and sales tax; and concessional customs duty on the import of certain equipment used for producing renewable power (MNES 2004).

[8] For instance, today, the interest rate offered by IREDA for wind power developers is on par with market interest rates (Hasan and Vipradas 2004)

[9] Wheeling refers to the trading of electricity over the system. Since electrons cannot be directed per se, it refers to the process in which electricity is fed into the network at one end by a transmitting utility (e.g. a renewable energy producer), and an equivalent amount is removed at the other end by the receiving utility (e.g. a retail consumer or the state utility). Banking refers to the drawing of electricity from the grid at a later date by the energy producer. Lower wheeling charges and longer banking periods are favorable. Third-party sales refer to the sale of electricity to a non-utility party (e.g. an industry).

How Is Renewable Energy Being Affected By Reforms?

A number of questions arise at the intersection of the recent power sector reforms and the country's renewable energy capacity.[10] Policy design in the renewable energy field in India has traditionally been isolated from mainstream power sector decision-making. For instance, apart from large hydropower, renewable energy is not explicitly recognized in the planning processes and budget allocations of the Ministry of Power. Moreover, until the Electricity Act 2003, the regulator was not obliged to promote renewable energy. Today, the regulator faces the task of requiring utilities to increase their renewable energy contributions – a task that is challenging given that renewable energy is comparatively more expensive to purchase than conventional power (see below for a comparison of tariffs), and that utilities are cash-strapped. Under the new reforms scenario, the role of the regulator becomes particularly crucial as described next.

The Electricity Act 2003 and renewable energy

Unlike any other mainstream power sector legislation before it, the new Electricity Act 2003 specifically mentions renewable energy by stating:

> "The Central Government shall…prepare the National Electricity Policy (including tariff policy) in consultation with the State Governments…based on the optimal utilization of resources including conservation thereof and the *use of renewable sources of energy* (MoP 2003b, emphasis added)".

Section 86 states that the function of regulatory commissions is to:

> "promote co–generation and generation of electricity through renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any persons, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee."[11]

In analyzing the role of the regulator vis-à-vis renewable energy under the reforms scenario in India, Hasan and Vipradas (2004) highlight three major concerns:

i) A reasonable share of renewable energy in the portfolio of energy procurement

[10] The future of renewables under power sector reform has been the subject of much research in recent times. It is noteworthy that experience from around the world has shown that increased competition in electricity also increased interest in cogeneration and distributed power in order to reduce transmission and distribution losses (e.g. bagasse power in Mauritius and cogeneration in Europe) (Martinot 2002).

[11] The Act further states that stand-alone systems (including those based on renewable energy) will be permitted for rural areas, and that a policy for local distribution will be formulated at the state level. However, institutional arrangements for an expanded rural power supply based on renewable energy are yet to be worked out in sufficient detail. Sugar cooperatives as local power distributors could provide a novel and potentially feasible solution for the lack of electricity in rural areas, although this solution is not without its problems. I discuss this further in Chapter 4.

ii) The power purchase price for procuring renewable energy
iii) Issues related to grid interconnection

Each of these concerns raises additional questions. To start with, what should be considered a "reasonable share" of renewable energy in the power procurement portfolio? Hasan and Vipradas (2004) state that the potential of the renewable resource and the economic feasibility of exploiting the resource should both determine this optimal share.

Similarly, determining the power purchase price for renewable energy is complicated by a number of issues. For instance, which price-setting mechanism should be used: A marginal price approach in which renewable energy is priced at the cost of purchase of electricity from the marginal plant – i.e. the one that is lowest in the merit order stack? Or a preferential feed-in tariff that takes into account the additional social and environmental benefits arising from renewable energy generation? As described above, the MNES provided guidelines for renewable power to be purchased at a rate of \$0.049/kWh in the base year 1995 with a 5% escalation in each year. In 2002, this tariff amounted to \$0.067/kWh. This tariff was determined by the avoided cost of power generation keeping in mind the prevailing cost of generation of an independent power project at the time when MNES issued the policy guidelines (Hasan and Vipradas 2004).

Following these guidelines, MERC issued a tariff order in 2002 as follows:

> "The Tariff for the purchase of electricity by the MSEB from the co-generation project based on any non-fossil fuel (such as bagasse, biomass, biogas, agriculture waste such as rice husk, groundnut shells etc.) shall be Rs. 3.05/kWh (or approximately \$0.067/kWh, as per MNES's guidelines for year by year escalation) for the first year of operation of the co-generation project and the tariff shall be escalated at the rate of 2% per annum on compounded basis (MERC 2002)".

The tariff order is valid for co-generation projects commissioned before the end of the tenth five-year plan (2002-2007), i.e. 31st March 2007. However, the order has faced resistance by the Maharashtran utility (Deo 2003). MSEB has argued that it does not strictly "need" the cogenerated power, and that it should be compensated through a government subsidy for having to pay the comparatively higher renewable energy buy-back tariff, versus one that would have been paid to conventional generators (\$0.058/kWh) (Deo 2003).

Finally, grid interconnection issues for renewable energy are also important for the regulator. For instance, the regulator must decide who should bear the cost of installing the evacuation facility up to the nearest sub-station. Should it be the responsibility of the renewable energy project developer or the utility to construct and finance a renewable energy switchyard? Similarly, who should bear the cost of extending the grid up to the renewable energy facility? These arrangements are likely to be worked out on a project-to-project basis.

The impacts of reforms on renewable energy are likely to be mixed, and it may be still too early to come to any definitive conclusions. This section has laid out a number of questions posed by experts, particularly concerning the role of the electricity regulator in promoting renewable energy. The electricity regulator now has greater responsibility to deal with issues concerning renewable energy procurement, pricing, and grid interconnection.

In the bagasse cogeneration sphere, Maharashtra's regulatory commission has been proactive in issuing a buy-back tariff. However, instability and the cancellation of renewable energy buy-back tariffs have also been experienced in certain states, leading to the lack of confidence in utilities by many sugar mills in India (Sobhanbabu 2004), including some cooperatives as described in Chapter IV.

While understanding India's complex electricity sector and reform policies is essential to understanding the challenges and prospects faced by sugar mills in undertaking bagasse cogeneration, equally important is insight into India's sugar sector. I devote the next chapter to India's colossal and diverse sugar sector. Reviewing the numerous policies and players that characterize this sector will provide context for why bagasse cogeneration is fraught with multiple challenges.

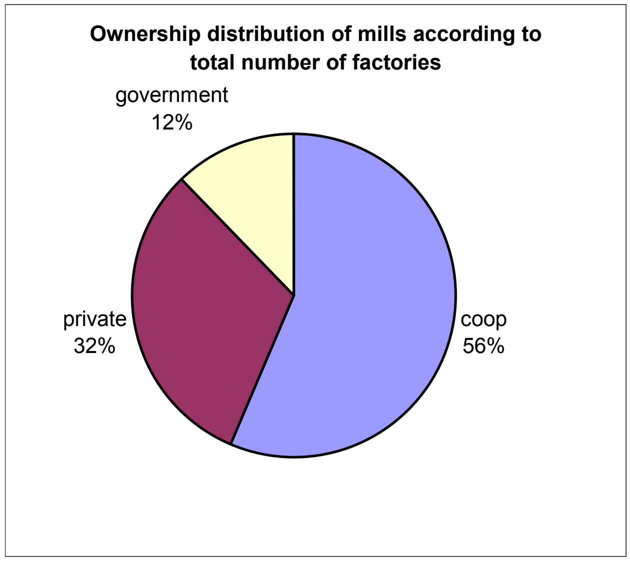
III. The sugar sector roller coaster and the anomaly of cooperatives

Structure of the industry

India and Brazil compete with for the title of the largest producer of cane sugar in the world.[12] In 2002-03, India produced 22 million tons of cane sugar, or 15% of total global production (Tuteja Committee 2004).[13] Fourty-five million farmers and their families and an additional 0.5 million workers are involved in sugar cultivation and harvesting (about 8% of India's rural population) (Tuteja Committee 2004).

India's sugar sector is incredibly heterogeneous. Mill size ranges from 500-10,000 tonnes crushed per day (TCD), with an average capacity of 3,300 TCD (Tuteja Committee 2004). Crushing seasons vary from state to state, depending on rainfall and soil characteristics, as do sugar recovery rates.[14] Moreover, unlike in Brazil where the plantation system for cultivating and processing sugar prevails (i.e. a few large agricultural companies employ thousands of laborers to cultivate and harvest sugar on their land), in India, the cooperative sugar makes up over 60% of the market, followed by the private and public (government owned) sectors. This is both in terms of number of factories **(Figure 4a)** and sugarcane crushing capacity **(Figure 4b)**.

[12] Cane sugar is more common in tropical climates whereas beet sugar is common in temperate climates such as Europe and the U.S. Including both cane and beet sugar production, India surpasses all other countries but Brazil.
[13] Although India is a large sugar producer, it is not a large sugar exporter. Most of the sugar produced is consumed internally. Moreover, sugar productivity is low in India compared with the rest of the world: 2.4 tons sugar per acre planted as compared to 5-6 tons per acre in other parts of the world (World Bank 2004). As such, India does not have a competitive position in terms of world sugar and has much scope for improvement.
[14] Sugar recovery rate refers to the amount of refined sugar produced from a given amount of cane crushed in the mill. It is a measure of technical efficiency.



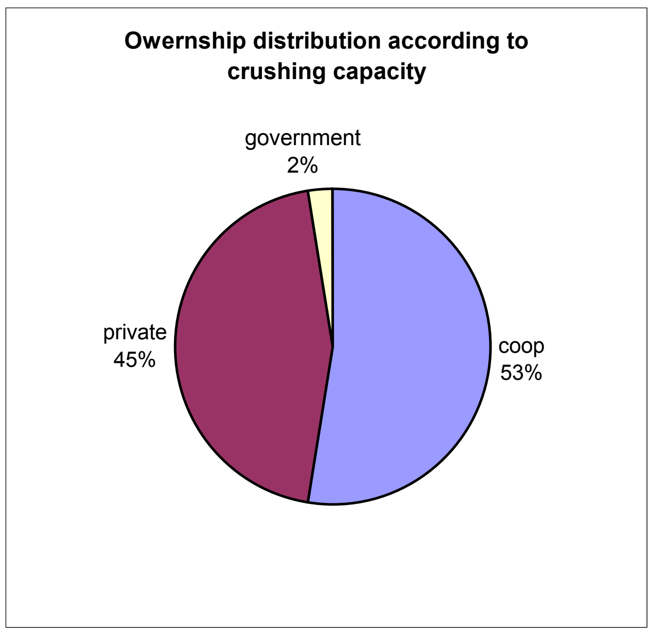
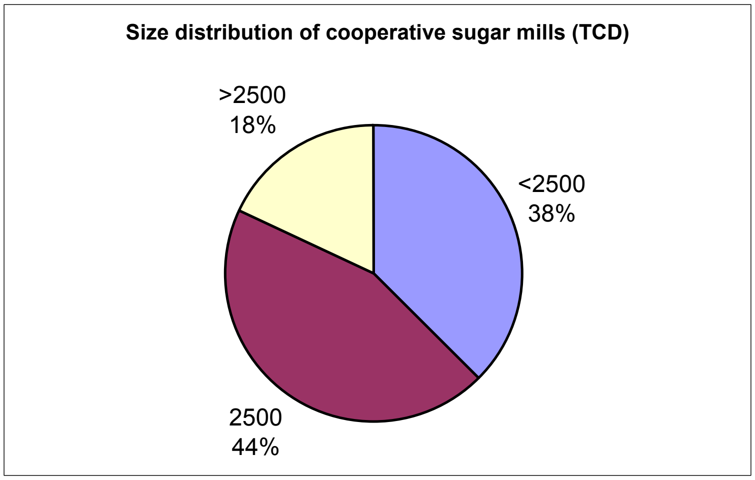


Figure 4a and 4b. Source: Gollakota and Sobhanbabu 2002, STAI 2004

Another important characteristic about the structure of the industry is the size distribution of mills. For historical reasons, cooperative mills are smaller in size than private mils **(**see **Figure 5a and 5b)**. The average size of cooperative sugar mills in India is around 2,400 TCD, as compared to 3,750 TCD for private mills (STAI 2004). Recognizing that larger mills are more technically efficient, the central government issued a mandate that only factories of above 2,500 TCD would get new licenses. The government also provided additional incentives for mills that undertook expansion projects (i.e. for those mills that wanted to expand from 1,250 TCD to 2,500 TCD and beyond). However, a number of mills established between 1950-1980 are smaller in size and use outdated technology.



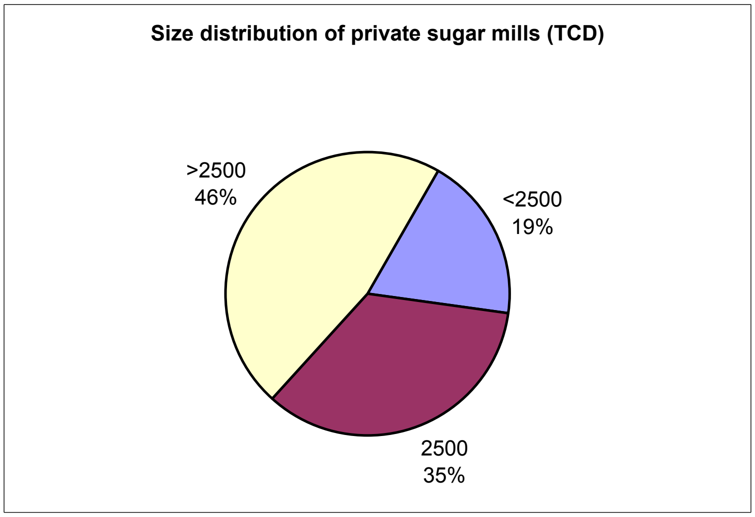
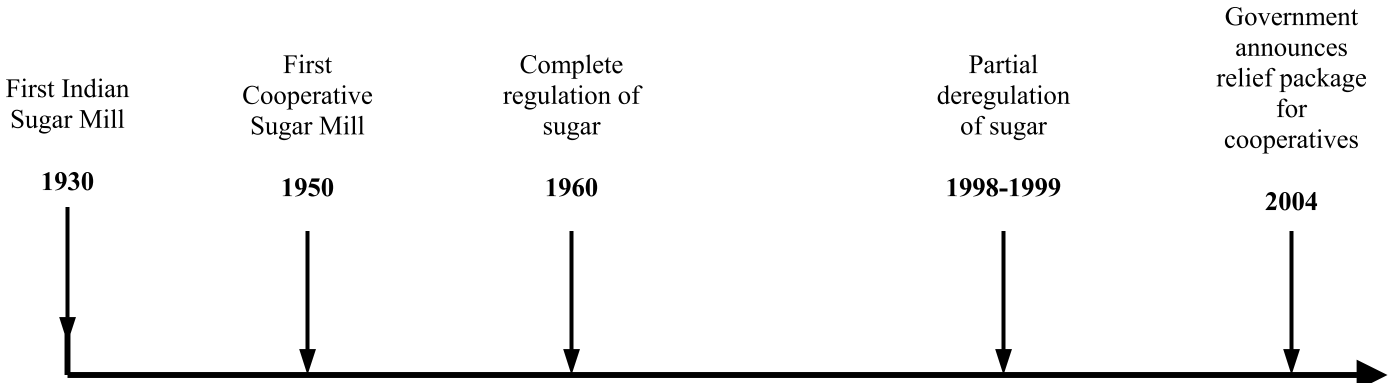


Figure 5a and 5b. Source: Compiled from STAI 2003.

For electricity generation from bagasse to be economically viable, mills should crush at least 2,500 tons of cane per day, which means that many cooperatives being typically smaller must increase the capacity of their mills before installing cogeneration. The size distribution of cooperatives requiring additional investment to increase capacity presents a high equity requirement for power projects as seen in the next chapter.

Regulatory policies

To add to this heterogeneity, sugar is a highly protected commodity in India (as in other parts of the world), characterized by an extensive and complex web of controls, pricing mechanisms, taxation, subsidies, quotas, and rationing policies. Throughout its history, sugar has been completely regulated, partially deregulated and completely deregulated depending on the industry situation (ISMA 2003) **(**see **Figure 6)**.



29	Number of mills	506
1,176	Cultivated area (thousand hectares)	4,500
36	Annual cane production (million tonnes)	295
110	Average crushing season (days/year)	180
0.12	Annual sugar production (million tons)	20

Figure 6: Timeline of sugar sector. Source: WADE 2004 and ISMA 2003.

The ostensible purpose for government regulation is three fold: i) to keep the price of sugar affordable for urban consumers, ii) to set a minimum price of cane for farmers, and iii) to protect sugar mills from the vagaries of weather and fluctuating prices (Baru 1990). At present, a system of partial decontrol is in place wherein the government mandates that 10% of sugar – known as "levy sugar" – must be sold to fair-price shops, while the rest can enter the market as "free sale sugar". However, both free sale sugar and levy sugar are subject to monthly quotas decided by the government in the form of per mill quantities of sugar allowed to be released into the market. The rationale behind the quota is to ensure that sugar is available throughout the year at reasonable prices to consumers. The problem with the quota mechanism is that certain factories manage to bypass the system by getting permission from the Courts to release additional sugar, thus depressing the market price (Tuteja Committee 2004).

Another problem with partial deregulation is that the price at which the government sets levy sugar is often below the factory's cost of production (Tuteja Committee 2004). The cost of production is in turn influenced by the statutory minimum (cane) price (SMP) that is the minimum price that the factory must pay farmers per ton of cane purchased. As per my interviews with sugar mills, the difference between the price of "levy sugar" and cost of production can sometimes amount to a loss of $120/ton (Ravindran, 2004).

Sugar production cycles

To complicate matters more, nature plays a major role in determining sugar production with rainfall, disease outbreak, and pests being decisive factors. Sugar production typically follows a four to five-year cycle with consecutive years of low production following high production (known as a "trough and valley" or "boom and bust" production cycle). Since 1996, sugar production has been steadily approaching a trough **(Figure 7)**. Since the price of free-sale sugar normally takes a few years to adjust to the production cycle, from 2000 prices steadily declined until 2003 **(Figure 8)**.

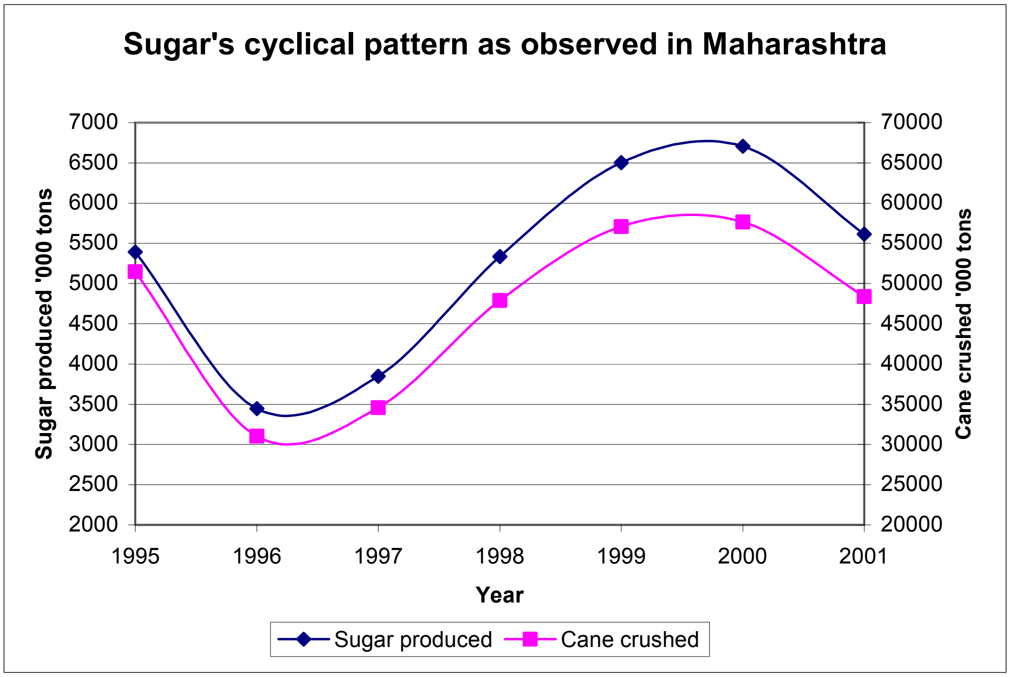


Figure 7. Source: ISMA 2003.

Figure 8. Source: Compiled from ISMA 2003 and MCAFPD 2005.

Although not shown in **Figure 7** (exact production figures were not available for recent years), increases in production have been followed by a sharp decrease in production in 2003-04 on account of drought and pest infestation in certain major sugar producing states (Tuteja Committee 2005). Now the sugar industry is facing a different situation from above. Instead of over-production being a problem, the loss in harvested sugarcane has led to low capacity utilization of the mill. This situation is equally detrimental as the situation of surplus production. The Tuteja Committee for the Revitalization of Sugar report (2004) estimates that as many as 100 factories are unlikely to operate in 2004-05 because of non-availability of cane. The overall result has been one of low cash realizations and a serious financial crunch for the sugar industry for both private and cooperative mills.

Cooperative mills are particularly badly hit by the current market situation

However, in such a dire market situation, private sugar mills such as Thiru Arooran Sugars and EID Parry's in Tamil Nadu, were able to fall back on their electricity sales and other by-product industries to cover the revenue shortfall (Tyagarajan 2004), as well as other by-product industries. As mentioned, revenue from electricity sales can comprise up to 20% of revenue received from sugar sales. One private mill in the south was quoted as saying "We have gone from being sugar mills that also produce power to power producers that also produce sugar (Tyagarajan 2004)."

Private mills that have not as yet installed bagasse cogeneration are also badly hit, and have become bankrupt in recent times. But by far, the worst sufferers are cooperatives. Cooperatives maintain a low capital base since they distribute their profits to cane growers as explained above. Although they are able to collect additional contributions for their members for social projects (by lowering the cane price provided to members), this is done only for social investments (such as schools and hospitals). Therefore, in the conditions described, the financial reserves of cooperatives drop dangerously low, and many fall in to the red. If they are so financially weak, why do cooperatives still persist in India? Why not liquidate them all together, or privatize them? Cooperatives have a long history in India and have played an important role in the countryside of Maharashtra for many decades. In the next section, I detail the evolution of cooperatives in order to understand why this drastic move has not been taken to date. I also highlight that this situation has not always been the case: early studies by Attwood (1989) and Baviskar (1980) show that many were financially competitive and technically innovative.

History of the Cooperative Movement

What exactly does a cooperative entail?

Early cooperatives have their roots in the Rochdale Equitable Pioneers Society, a small group of weavers in the UK who, in 1844, set out the Rochdale Principles that form the basis of the cooperative movement today. These original principles include open and voluntary membership, democratic governance, the distribution of surplus in proportion to trade, education of members, and autonomy and independence. In theory, each cooperative member has a vote in deciding how the institution is run. Cooperatives were formed to provide more equitable benefits to all concerned, particularly for the marginalized producer. Cooperatives today continue to be active in various parts of the world, including the U.S. and Europe.

In the agricultural arena, cooperatives transcend the strict dichotomy between "collectivistic" and "individualistic" forms of ownership, and between "laissez-faire" and "planning" market mechanisms, involving some combination of state intervention, a free market, private ownership of land, and collective ownership of capital (Worsley 1971).

Why does India have a cooperative sugar sector?

Sugar cooperatives in India share essential features with most other agricultural cooperatives in the developed and developing world. In the cooperative system, individual landowning farmers (between 10,000-50,000 farmers belong to a single cooperative) are also shareholders in the sugar factory. Farmers deliver cane to the factory during the crushing season, and theoretically have a say in the functioning of the cooperative as well through their vote. Revenue earned from sugar sales are redistributed to farmer-members in the form of a sugarcane price.

For setting up a new mill or for a technical upgrade, cooperatives are normally expected to contribute 10% of the capital cost or approximately $1 million of the total $10 million it costs to set up a new mill. The government is then expected to provide the remaining equity and stand financial guarantor to cooperative loans. The Sugar Development Fund (SDF) is also an important vehicle through which cooperatives can receive equity support.

At first glance, it may seem surprising that such a decentralized system, involving thousands of individual landowning farmers, each holding a stake in a vertically integrated cooperative, dominates in India. Whereas the plantation system is technically more efficient, the cooperative system suffers from poorer coordination (Attwood 1992). This is because timing for harvesting sugarcane is crucial – with sucrose content maximized at peak maturity. As a result, coordination between harvesting and crushing is key, as is an adequate supply of raw material for the factory. The nature of the crop is hence most amenable to a form of centralized plantation-based organization that is able to coordinate between field and factory in a timely manner (Attwood 1992). Cooperative sugar factories, on the other hand, have less control over the behavior of individual farmers. Why, unlike countries of Latin America and the Caribbean, does the plantation system not dominate in India? What are the exceptional features of India and its peasants that have allowed such a striking anomaly to emerge and endure?

The reasons are rooted in colonial and post-independence history. Unlike colonial expansion in the New World, British policy did not involve expropriating large amounts of land from the Indian peasantry to cultivate sugar (Attwood 1992).

Following independence in 1947, India's first Prime Minister, Jawarahal Nehru, adopted a socialist-type planning methodology devoted to land reform and state-sponsored rural development projects. The Nehru government strongly endorsed the cooperative movement in Maharasthra, led by outspoken socialist economists like D R Gadgil and powerful peasant leaders of the Maratha[15] class like Vithalrao Vikhe Patil. Nehru was particularly supportive of the cooperative movement because many of its founders were partook in India's independence struggle (Baviskar 1980). The first cooperative factor was set up in Pravara, in Maharashtra in 1950-1951. For a discussion on this early experience, please see **Appendix B**.

Over the next three decades, 90 cooperatives were established in the state, producing 30 per cent of India's white sugar in 1990 (Attwood 1992). Today Maharashtra has more cooperative factories (140 in total) than any other state (Gollakota and Sobhanbabu 2002). This growth can also be attributed to the government's sugar factory licensing policy, which was directed towards the west and the south where it was thought that the agro-climatic conditions were better for growing cane (Baviskar 1980). In Maharashtra, the sugar cooperative provided a launch pad for aspiring political leadership by the Maratha class, as we shall see later (Attwood 1992).

Cooperatives then versus cooperatives now: What the literature says

Social science research on the cooperative sugar movement in Mahrashtra conducted in the period 1960-1980 portrays cooperatives in a favorable light, both in terms of what they achieved for their members, as well as their economic and technical successes (Baviskar 1980, Attwood 1989, Attwood 1992). In his analysis, Baviskar concludes "The success of…sugar cooperatives in Maharashtra leads to the inescapable conclusion that cooperatives are the best form of organization for the agricultural processing industry in India…sugarcane growers in Maharashtra have demonstrated that they can manage the industry as efficiently as private entrepreneurs, if not better (1980: 194)." Similarly, Atwood says "The cooperative sugar factories in Maharashtra state have been remarkably successful – economically, socially and politically…on average they outperform most other cooperatives and are more efficient than private sugar factories (1989: 1)."

Both Attwood and Baviskar provide remarkable examples of early cooperative sugar factories that i) serve invaluable social functions in the countryside, ii) repay loans taken from the government before the loan moratorium, and very relevantly for this study, ii) *undertake "risky and expensive" diversification projects into by-product industries* (Attwood 1989: 19, emphasis added). Contrast these descriptions with recent analyses of the cooperative sector:

[15] Indian society is highly hierarchical, characterized by a number of upper, medium, and lower level castes and classes. The Marathas, defined as a middle level social class, are the majority in Maharashtra, and also dominate the political arena in rural areas.

> "Cooperative societies have limited creditworthiness; their decision-making process is controlled and slow, and they lack professional management and in-house capacity (Gollakota and Sobhanbabu 2002: 8)"
>
> "Maharashtra's sugar cooperatives, which have played a key role in the state's economy and politics for more than 50 years, are on a downward trend thanks to corruption, mismanagement and undemocratic functioning (Bavadam 2005)."
>
> "Political patronage has been the main reason why the economics were ignored and the Government does not mind regularly providing a few crores[16] in its budget to back the guarantees to the loans raised for the sugar cooperatives (Vijapurkar 2003)".

The first quote is provided as a rationale for why cooperative sugar factories have not installed bagasse cogeneration, while the second comes from a recent article in the prominent Indian newsmagazine *Frontline.* Cooperative decline has been the subject of many such recent media pieces (e.g. see Bunsha 2001, Bavadam 2005, Deulgaonkar 2003). Baviskar himself has, subsequent to his 1980 position, lamented the fall of the "Golden Age of Cooperation" (1960-1980) due to the emergence of a black market in sugar; a change in political leadership at the national level and the quality of leadership at the cooperative level; and the rise of "dynastic rule" via cooperative leaders installing their sons and nephews in positions of control (Baviskar 2004). For instance, Baviskar points to increased corruption in cooperative mills (e.g. unaccounted for use of funds by cooperative leaders). Although corruption did occur in the early days as well, it was much more restricted, and has now gotten out of control (Baviskar 2004). Moreover many cooperative leaders nowadays are far more concerned with allying themselves with political parties in power. As a result, cooperatives are used as vote banks by aspiring politicians. As Baviskar says, "While the old leaders acquired political power to strengthen the co-operatives under their control, the new leaders capture co-operatives to acquire political power (2004: 12)."

It can be said that by now, a general consensus has emerged in the literature backed by recent facts and figures. This consensus is perhaps best summarized by the following quote: "[Sugar] cooperatives have grown under protection and now they are like an overgrown baby in an incubator (Naiknavare 2005 *quoted in* Bavadam 2005)". The "protection" referred to is the hefty subsidies and relief packages provided by the government. The World Bank estimates that over the past decade, the government has provided share capital worth $160 million to cooperative factories. Against a return on equity due to the state government of $150 million, only 8% has actually been received (World Bank 2002). In addition, since 2002, the state government of Maharashtra has announced more than $800 million in relief packages for the cooperative sugar sector (Jog 2004, Baviskar 2004). These

[16] 1 crore = 10 million

enormous financial favors place additional burden on the state exchequer, and reinforce negative public perception about cooperatives.

To summarize, there has been a pronounced shift in the perception of sugar cooperatives from the early years following their establishment. This is due to a number of reasons. First, cooperative debts have increased to unsustainable levels over the last few decades. This has been exacerbated by deteriorating market conditions for sugar as well as the inappropriate government sugarcane pricing mechanism. Second, scholars have remarked that there has been a perceptible change in the quality of leadership in cooperatives as compared to the early founder-leaders. Both these aspects – financial and management-related – are in turn chiefly responsible for the low participation of cooperatives in bagasse cogeneration projects. However, what this general perception has failed to recognize is that this deteriorating situation *is not common to all cooperatives*: there are a small but not insignificant number that are run extremely efficiently (e.g. see **Appendix B** for a case study on Hutatma Sugar Cooperative) and financially sound, as will be seen in the next chapter.

IV. Sugar Cooperatives as Power Producers: What are the Challenges?

Experience With Energy Production: A State-Wise Comparison

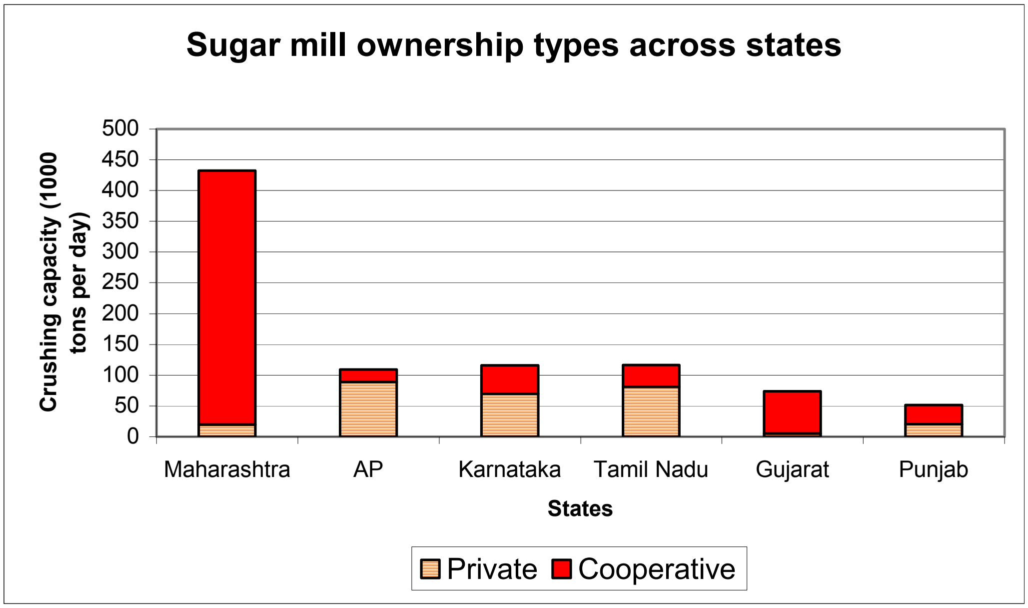
A state-wise comparison of market structure (i.e. cooperatives, private, and government sectors) with the amount of cogeneration installed is revealing **(**see **Figures 8a and 8b)**. Sugar mills are distributed throughout India, with the vast majority in nine states (Uttar Pradesh, Bihar, Punjab and Haryana in the north; Maharashtra and Gujarat in the west; and Andhra Pradesh, Tamil Nadu and Karnataka in the south). Of these, five (Maharashtra, Uttar Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu) have over 75% of sugar mills in the country (Gollakota and Sobhanbabu 2002).

As mentioned, although Maharashtra has one of the largest bagasse cogeneration potentials in India, it is the state that has achieved the least amount of cogeneration capacity.[17] Maharasthra is also the state with the greatest proportion and absolute number of cooperatives. The correlation is clear in this case: states with a greater proportion of private sector mills (e.g. Tamil Nadu and Karnataka in the south) have had much greater success with installing efficient cogeneration units.[18]

The net result is a profound disparity not only in the amounts of cogeneration installed in the private sugar sector versus the cooperative sector, but also in their financial performance. Why, compared to the private mills of the south, has the cooperative sector in Maharashtra not been able to transition into power producers? Two types of analysis reveal why cooperative participation has been low. The first is an investigation into the peculiar traits of cooperatives that have thus far hindered them from transforming into energy producers. The second is an analysis of the impacts of various government policies and international programs targeting bagasse cogeneration on cooperative mills.

[17] The numbers in the graph reflect only those cooperative mills that have come on-line. In addition to these, there are a handful of cooperative mills that are in the implementation stage of bagasse cogeneration, such as Terna SSK and Vikhe Patil SSK (MEDA 2004).

[18] Two states – Uttar Pradesh and Bihar – are anomalous in that they have a significant number of private mills, but also have achieved low cogeneration capacity. This has been attributed to the overall poor progress in infrastructure development and high incidence of corruption in these states (Sobhanbabu 2005).



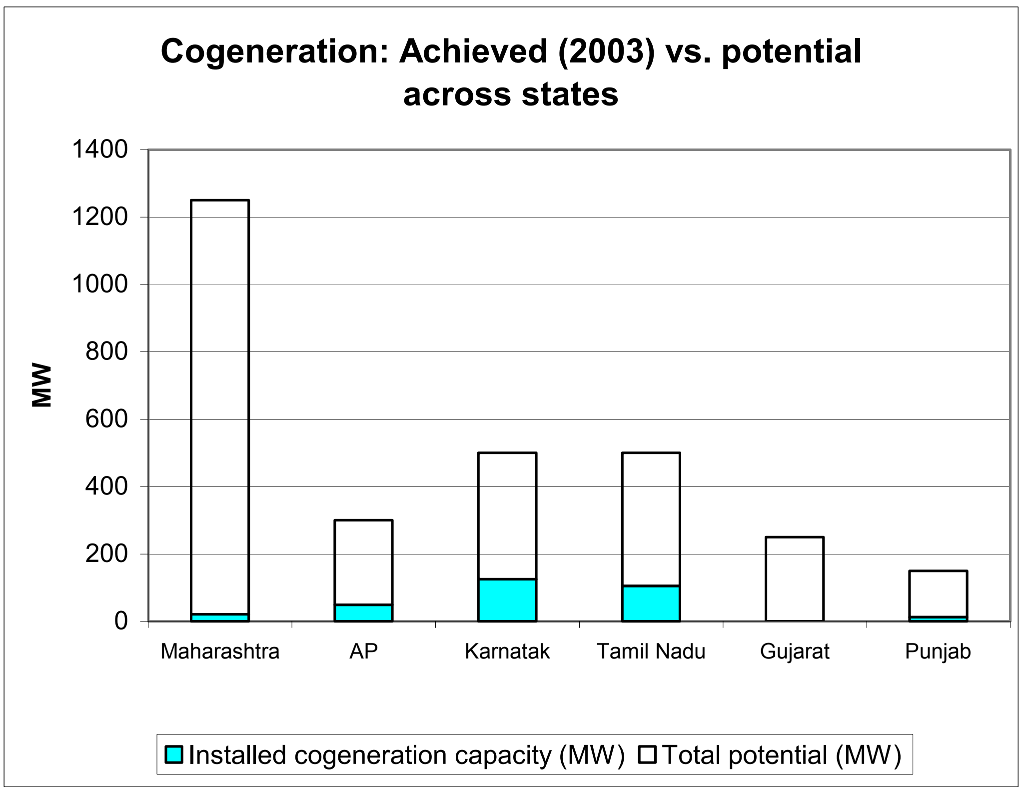


Figure 9a and 9b. Source: Gollakota and Sobhanbabu 2002.

Reasons For Low Participation From The Cooperative End

Cooperatives lack financial equity

In the last chapter, I introduced growing negative perception about cooperatives due to poor financial performance, deteriorating management, and internal corruption. I also mentioned towards the end of the last chapter that this situation is not indicative of all sugar cooperatives. Some cooperatives are financially sound are therefore possible candidates for bagasse cogeneration. How many of the entire sector in Maharasthra possible candidates? Of the 140 functional cooperatives in Maharashtra, 39% are bankrupt **(**see **Figure 10)**. A significant proportion are near bankruptcy while 13% of all cooperatives are making a profit.

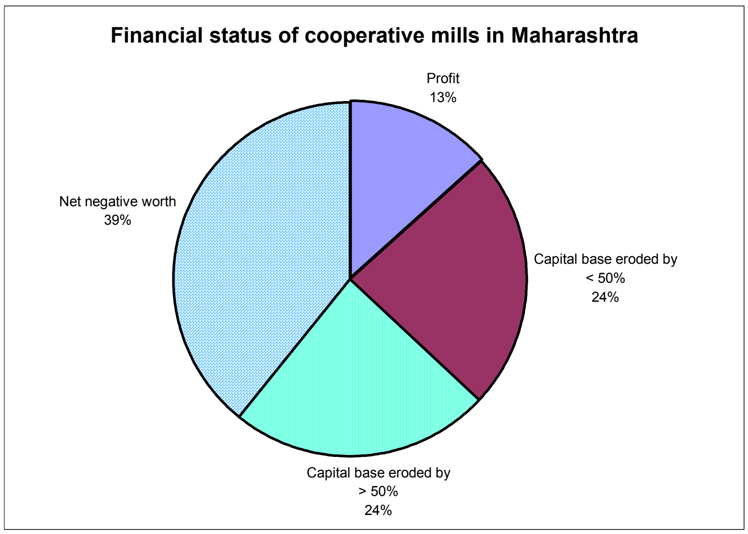


Figure 10. Source: Srinivasan 2004

The fact remains that *even* these 13% face a fundamental barrier to bagasse cogeneration: the lack of financial equity for cogeneration projects. Cooperatives are required to put in 10-15% of the total project cost in the form of equity, while the rest is covered by the Sugar Development Fund (SDF) and state government. However, cogeneration projects are expensive: they can cost up to $20 million, while other by-product industries such as ethanol can cost 100 times less, or only $0.2 million (Bhosale 2004). What makes cogeneration projects so much more expensive is the investment needed for increasing the capacity of the mill (as seen in the previous chapter), mill technology upgrades, especially energy conservation retrofits. In order to maximize the use of steam for electricity generation, it is crucial to electrify the mill drives, thus ensuring more power for the same amount of bagasse and steam. One of the first requirements is thus an energy audit to identify areas for energy conservation. An audit would identify measures such as changing the mill drives from conventional steam drives to electric drives, and retrofitting the cane juicing machinery, evaporation, crystallizers, centrifuges, etc. to make them more efficient. These measures can be expensive. Since most cooperative mills have outdated technology, a considerable amount of investment must be made (Sidhaye 2005). Additional investments range from $1-4 million depending on the size of the plant, while payback period ranges from 15 to 30 months (Gollakota and Sobhanbabu 2002). These measures combined with the actual cost of the boiler, turbogenerator, and power evacuation equipment results in a large upfront equity contribution that cooperatives are unable to meet.

Cooperatives also have limited creditworthiness, which make financial institutions reluctant to finance them. This expresses itself in state guarantee and collateral requirements by banks (UNDP 2005) that, again, cooperatives are unable to meet. Although interest rates have been falling in general in India, sugar mills are not able to avail of these lower rates, since from the perspective of financial institutions, it is not attractive to finance the sugar industry due to the adverse sugar market scenario mentioned above, and because cooperatives are perceived as particularly risky to finance.

Cooperatives lack the professional capacity to manage energy projects

There are two main aspects to the lack of professional capacity in many cooperatives: i) the lack of power project management expertise and absorptive capacity for power projects, and ii) the institutional and political nature of decision-making within cooperatives. The claim that many cooperatives lack the capacity to manage energy projects has been made by Golakotta and Sobhanbabu (2002), as well by a number of experts interviewed. The assumption is that power projects require a higher level of engineering and management expertise as compared to other by-product projects, which many cooperative leaders lack. Due to the policy of giving a seat on the board of management to poor and lower class farmers, there may be limited capacity to make decisions concerning the design, development, and management of grid- connected power projects. Sugar mills must also have the capacity to deal with the state electricity utility in order to negotiate the terms of a power purchase agreement. These skills are in need of further development for the majority of cooperatives. This is in stark contrast to private sugar mills where engineers and financial managers are hired from the top engineering colleges in India that have access to state-of-the-art computing facilities and other infrastructure.

The second aspect is the political nature of cooperative decision-making. Cooperatives operate on so-called democratic principles, with the board of directors rotating seats every five years. Because of this rotating tenure system, cooperatives typically do not have a consistent set of priorities or long-term goals. Since decisions are usually taken with the consent of all members, major decisions are typically protracted.

Furthermore, what can be said of most cooperatives is that their leaders are – or seek to be – politically prominent figures (Baviskar 2004). The desire for political visibility suggests that leaders will seek short-term investments that are also seen to confer direct benefits to members of the cooperatives. An expensive and potentially lengthy project such as bagasse cogeneration is therefore not looked upon favorably by a director that seeks visibility during his tenure. As a case in point, when a financially viable cooperative mill was asked why cogeneration had not been implemented, one engineer responded that the board “would take too long to approve something like that…plus, the entire project cannot be completed within the tenure of one set of directors (Shirole 2004)”.

One cooperative, Jawahar, was able to overcome these hurdles when their board took a firm decision to upgrade the mill’s crushing capacity, retrofit it with energy conservation measures, and finally to install high temperature and pressure boilers. In this case, credit “should go entirely to the progressive management, who has the vision to…run it as a business rather than a charity (Sobhanbabu, 2002)”.

In summary, cooperative sugar factories have a number of financial, managerial, and political characteristics that are unique to their institutional set-ups. These characteristics not only make cooperatives financially vulnerable, but also slow to take decisions and therefore fundamentally resistant to change. Unless a given board of directors takes a keen interest in promoting energy efficiency, and has the vision and support from other members to do so, it is unlikely that the decision to install cogeneration will be made. Unfortunately, these weaknesses have not been sufficiently addressed to date by public policy efforts to promote cogeneration. Programs supporting bagasse cogeneration have not considered the specific circumstances of cooperatives. An analysis of past programs and policies is the substance of the next section.

Why Haven’t Past Efforts To Support Bagasse Cogeneration Helped The Cooperative Sector?

Past government programs did not target the financial circumstances of cooperatives

As a flip side to the lack of financial equity problem, government programs have also not taken into account the special financial circumstances of cooperatives. As seen from **Figure 11**, since the early 1990s, a number of government programs promoting biomass power – of which bagasse cogeneration was an important component – have been undertaken. The Indian Renewable Energy Development Agency (IREDA) and Ministry for Non-Conventional Energy Sources (MNES) were involved at the national level. However, most of the fiscal and financial incentives provided by the government have been availed of by the private sector with only one cooperative mill currently participating. This is the case despite efforts by the MNES to set up demonstration projects in the cooperative sector and provide additional financial support to cooperative mills. A review of the last decade of promotional efforts reveals that the approaches used were largely inappropriate.

In 1993-1994, the National Program on Biomass Power and Bagasse Cogeneration sponsored by MNES was launched. The demonstration portion of the program provided a capital grant of approximately \$150,000/MW of exportable surplus capacity (with a total upper limit of \$1.3 million) and a soft loan at an interest rate of 9% to cooperative mills (this is 2-5% percentage points lower than market interest rates). However, the demonstration program also necessitated financial involvement from respective state governments equivalent to \$54,000/MW, which state governments were reluctant to do because of the financial risk associated with cooperatives. This is one reason why despite these financial incentives, by 1997-98, no cooperative mill had come forward (i.e. a vicious cycle is in motion here). The various schemes MNES implemented in the 1990s assumed that cooperatives would be able to avail of financing from local banks. However, even with the interest subsidy provided by MNES, banks still required difficult loan conditions on cooperatives (in the form of collateral; security, or funds secured up to 200%; guarantees, etc) because as described above, many cooperatives are not creditworthy (UNDP 2005).

Figure 11 also shows that no progress was made in the cooperative sector even under a second phase known as the "Program Partnership" carried out from 1998-2000. In this phase, the Ministry continued to promote bagasse cogeneration, and also tried to reach out to cooperatives. This phase involved a new scheme for interest subsidies; for instance, the interest subsidy was revised in 1999 and now operates indirectly through lending institutions. Interest rate subsidies for financing higher-pressure boilers of 1% (40 kg/cm^2), 2% (60 kg/cm^2) and 3% (80 kg/cm^2) are now provided by these institutions. An additional 2% interest subsidy was extended to cooperative mills in each boiler pressure category (UNDP 2005). The capital subsidy was also revised to \$77,000-87,000/MW. However, this still was not sufficient, as the required equity contribution from most cooperatives surpassed their financial means. Moreover, cooperatives could not meet the requirements of the financing institutions and the problem described above continued to persist.

In sum, these two major programs implemented in the 1990s by MNES assumed that cooperatives would be able to avail of financing from local banks when in fact banks mandated conditions that cooperatives simply could not meet (UNDP 2005).

States utilities have been reluctant to buy bagasse power

Another crucial factor that influences the appeal of high efficiency cogeneration is state electricity policy. In 1994, MNES issued guidelines to state electric utilities to purchase power from local generators at avoided costs, plus a 50% contribution to grid connection costs (WADE 2004), based on which several states independently announced policies for electricity purchase from bagasse cogenerators. As mentioned, the tariff prescribed was \$0.049/kWh for 1994-1995 with a 5% compounding escalation per year thereafter, making it \$0.067/kWh in 2002. MNES also issued guidelines for wheeling and banking of power from distributed generators.

As stated earlier, the Indian power sector is seeing widespread changes in its structure. State-level electricity regulatory commissions have formulated policies for buying electric power from bagasse. However, the reform process has caused previously signed contracts to be over-ridden, slowed down the implementation of these contracts and several states have reneged on their power purchase agreements in some states. Many sugar mill owners report that SEBs have historically not been creditworthy, which makes project developers cautious about implementing large bagasse cogeneration plants. Cooperatives, being much more risk averse, are even more suspicious of SEBs and are more adversely affected by fluctuating SEB policies.

The tariff guidelines for cogenerated power issued by the MERC, for instance, faced considerable resistance by the state utility on the grounds that they did not strictly "need" the power from sugar mills. They insisted on compensation by the government for the higher they were being required either through government subsidy or 100% fuel cost pass-through in the tariff (Deo 2004). Because of this initial resistance on the part of MSEB, the first cooperative bagasse cogeneration project was delayed (Sidhaye 2004). Unfortunately, this delay had the effect of dissuading other cooperatives to install bagasse cogeneration since they believed that they would not be guaranteed a buyer for the electricity they generated.

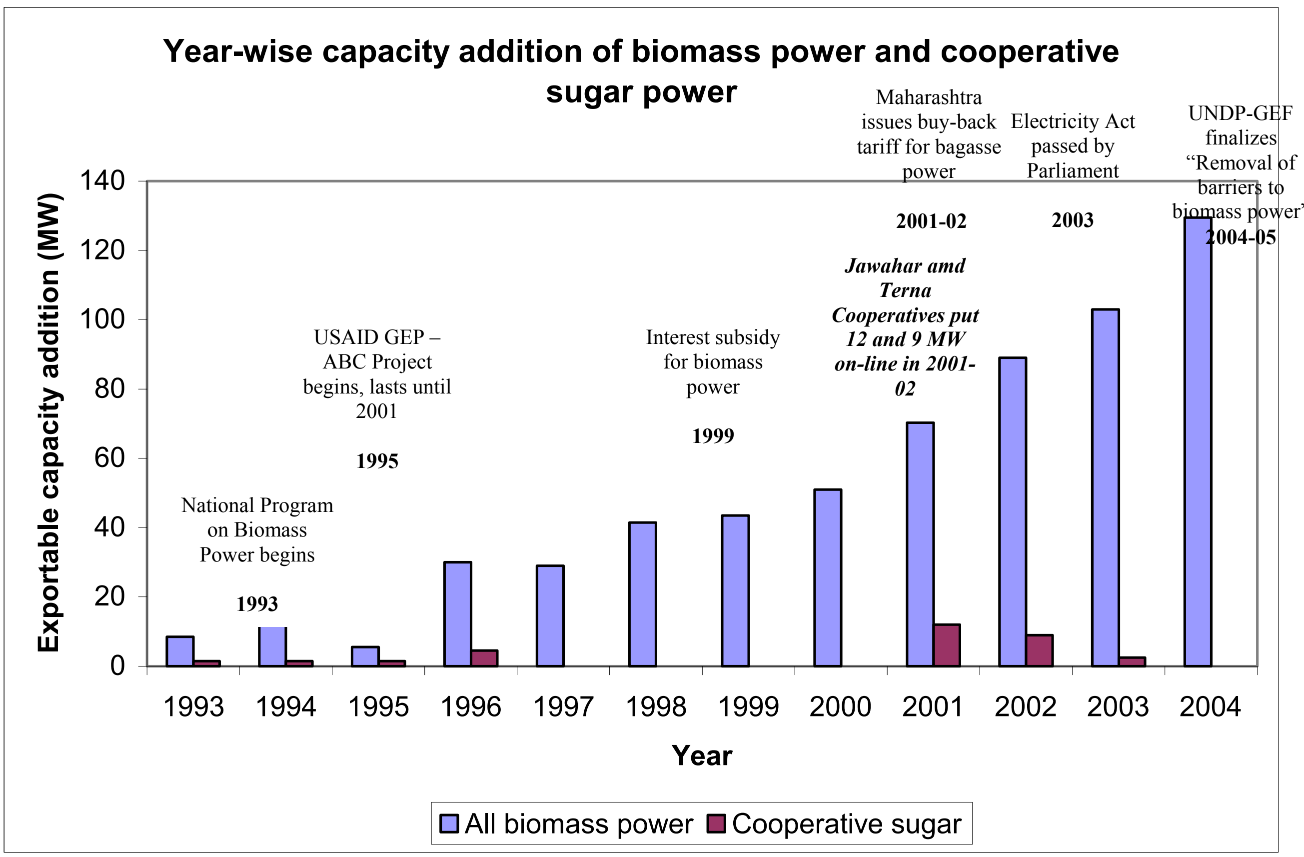


Figure 11. Source: Compiled from MNES 2004 and MEDA 2004.

Problems with international financing

Another source of support for bagasse cogeneration programs is from the national agency IREDA and its associated state focal agencies. The World Bank, Asian Development Bank and KfW (German aid agency) have each provided lines of credit for lending for biomass power and other renewable energy projects. However one of the chief criticisms of these funds is that under each line of credit, specific procurement procedures are defined by the bilateral or multilateral agency and have to be followed for each project. These are often inflexible and difficult to meet by the project proponent. As per interviews, IREDA receives loans from international agencies at high interest rates. These high rates then translate into high on-lending rates by IREDA for renewable energy projects (Reddy 2004). Even private sector mills have difficulty with some of IREDA's financing terms and high interest rates, suggesting that the cooperative mills, with much poorer credit histories, face even greater difficulty.

A second major source of international funding for bagasse cogeneration has been the the United States Agency for International Development (USAID). Complementing the Indian government's efforts through the 1990s, USAID carried out an important initiative from 1994-2003 called the Greenhouse Gas Pollution Project (GEP) with a special component for bagasse cogeneration (the Alternative Bagasse Cogeneration or ABC component). This project built on prior work by the USAID in the late 1980s in which a series of feasibility studies assessing the potential for bagasse cogeneration were carried out. The primary objective of the GEP-ABC project was to demonstrate high pressure and multifuel boiler configurations in Indian sugar mills and to reduce CO_2 emissions per kilowatt hour of electricity generation by encouraging the use of alternative biomass fuels during the off- season[19] instead of coal (Smouse et al. 1998).

Given this goal, the requirements for mills participating in the USAID project were stringent. Firstly, USAID required that mills operate for 270 days using only biomass fuels. It also required that mills were financially sound, and operated through a commercial bank, the Industrial Development Bank of India. If mills qualified, they received grant assistance of $1 million per project (or 10-20% of the project cost). In order to elicit participation by sugar mills, USAID issued a request for proposals inviting mills to apply for the grant assistance.

Not one cooperative mill came forth during the call for proposals (Tandon 2004). Around 300 mills applied, from which 9 large private mills were finally selected. The problem lies with the stringency of the stipulations. As we know already, cooperatives are generally a) not able to meet the requirements of commercial banks, and b) cooperative factories typically receive less cane and therefore have less bagasse and biomass to burn for as many as 270 days. This is because they are

[19] The "off-season" is a six-month duration (April-September) during which sugarcane is growing in the field. The season is referred to as the harvesting time (October-March).

located in closer proximity to one another causing more competition between mills for cane, thus resulting in less overall availability of bagasse.

Another major problem was that the knowledge transfer component of the USAID project (e.g. newsletters such as *Cane Cogen India*, other publications, workshops, etc) did not sufficiently reach out to cooperatives. For instance, one problem may have been that the published materials were predominantly in English, whereas most cooperative leaders are not educated in English. Many of the study tours (e.g. to Mauritius) also required a hefty participation fees that cooperatives could not pay (Sidhaye 2004).

To summarize, we have seen how major government and international support for high efficiency sugar mill cogeneration has not been able to elicit the participation of cooperative mills. The above findings point to the common deficiency in all programs to date; that is, special financial concessions and barrier removal efforts have not been made for cooperatives. The National Program on Biomass Power and Bagasse Cogeneration's provision of interest subsidies to cooperatives did not produce the intended effect because it was not able to remove a fundamental barrier – i.e. cooperatives are not able to get the loan in the first place due to conditions imposed by banks. The reluctance of utilities to buy bagasse power has also sent negative signals to cooperatives, causing them to have a lack of confidence in the potential buyer for cogenerated electricity. Finally, the net effect of international programs has also been an exclusion of cooperatives because of their financial and operational requirements, and because the knowledge transfer activities were chiefly targeted private mills.

Despite these odds, Jawahar Cooperative Sugar Factory put 12 MW of high efficiency cogeneration on-line in 2003. How did Jawahar manage this? The next section details the success story of one cooperative mill.

Against The Odds: The Jawahar Success Story

Jawahar Cooperative Sugar Factory, located in Kolhapur district of southern Maharashtra, was established in 1981 as a 1,000 TCD cooperative factory and later upgraded to 2,500 TCD in 1990 in order to take advantage of the government expansion incentive scheme mentioned earlier. Jawahar has the advantage of favorable location: Kolhapur is a well-irrigated area due to a number of dams. Over a period of 10 years, Jawahar also launched a series of cane development and yield enhancement programs, encouraging farmers in the area to plant sugarcane. The cooperative wanted to always be assured of a supply of cane.

In 1993, Jawahar installed a 1.5 MW cogeneration unit and began exporting power to the Maharashtra State Electricity Board in 1994. With its 1.5 MW unit, Jawahar was exporting around 3,500-4,500 MWh to the state utility. In 1995, members of the board of management voted unanimously to increase Jawahar's crushing capacity from 2,500 TCD to 5,000 TCD, and to install high pressure boilers and two 12 MW turbines imported from Brazil. Simultaneously, energy conservation measures were undertaken in the mill, such as changing the steam mill drives to electrical drives and a new juice evaporation scheme that provided greater steam savings. Expansion and efficiency improvements amounted to $19 million, while the cogeneration unit amounted to $280,000 per MW installed.

Jawahar signed a power purchase agreement with MSEB in 2002, however, due to delays on the utility end, the cooperative could not export power immediately and had to wait until the end of 2003 to begin selling power to the grid. When asked what caused the delays, Jawahar responded that since they were the first grid-connected cogeneration project in Maharashtra, the utility demonstrated some initial reluctance to buy their power (Sidhaye 2004). Following a public hearing by the electricity regulatory commission of Maharashtra in 2003, however, permission was granted to the cooperative to begin exporting power to the grid. This experience provides some hope of the pro-activeness of the newly established regulatory commissions.

Jawahar's managers believe that there are three main factors that go a long way towards establishing any new project: creation of equity, consistent government policies, and the present setup of the mill, all of which will in turn determine the amount of retrofitting that must be carried out (Sidhaye 2005). When asked about the reasons for their success vis-à-vis cogeneration, Jawahar responded that contributions from their growers were essential, without which they would not have had the capital base to install more efficient equipment.[20]

Secondly, unlike other mills, Jawahar has relied comparatively less on government subsidy contributions for their day-to-day operations. Whereas the *modus operandi* for many cooperative mills has become that the government subsidizes them for more than 50% of their total expenditures, Jawahar demonstrated that this does not have to be the case. **Figure 11** shows that the ratio of subsidy contribution to Jawahar's overall expenditure over a period of 10 years has been less than 50% in every year. The lesson that can be learned is that an energy-producing cooperative is first and foremost one that is autonomous – both in a financial and governance sense, as revealed by the Jawahar case study. The only substantial subsidy contribution came during 2000-01, when the cogeneration unit was being built. For the cogeneration unit, Jawahar contributed 15% in equity while the rest was financed by loans and a government contribution.

There are other important lessons to be learned from the Jawahar cogeneration success story. First, it is important that the mill be located in a good sugarcane growing region, so that the raw material is abundant. Second, Jawahar seem to have had strong, forward-thinking leadership that was in agreement about the need to upgrade their facilities while implementing cogeneration. This decision also did not

[20] Cooperatives routinely take contributions from their members to finance schools, hospitals, etc. This means that they reduce the price of cane paid to the farmer so that they can retain funds for investments.

drag out unlike what was feared at other mills. Third, once the cogeneration unit was set up and there were delays from the utility end, the newly established electricity regulatory commission MERC was clearly on the side of the cooperative. Such experiences should allay the fears of sugar mills that feel that they will be treated unjustly by utilities. This is one positive outcome of electricity reforms in which regulatory commissions are forcing utilities to become more accountable.

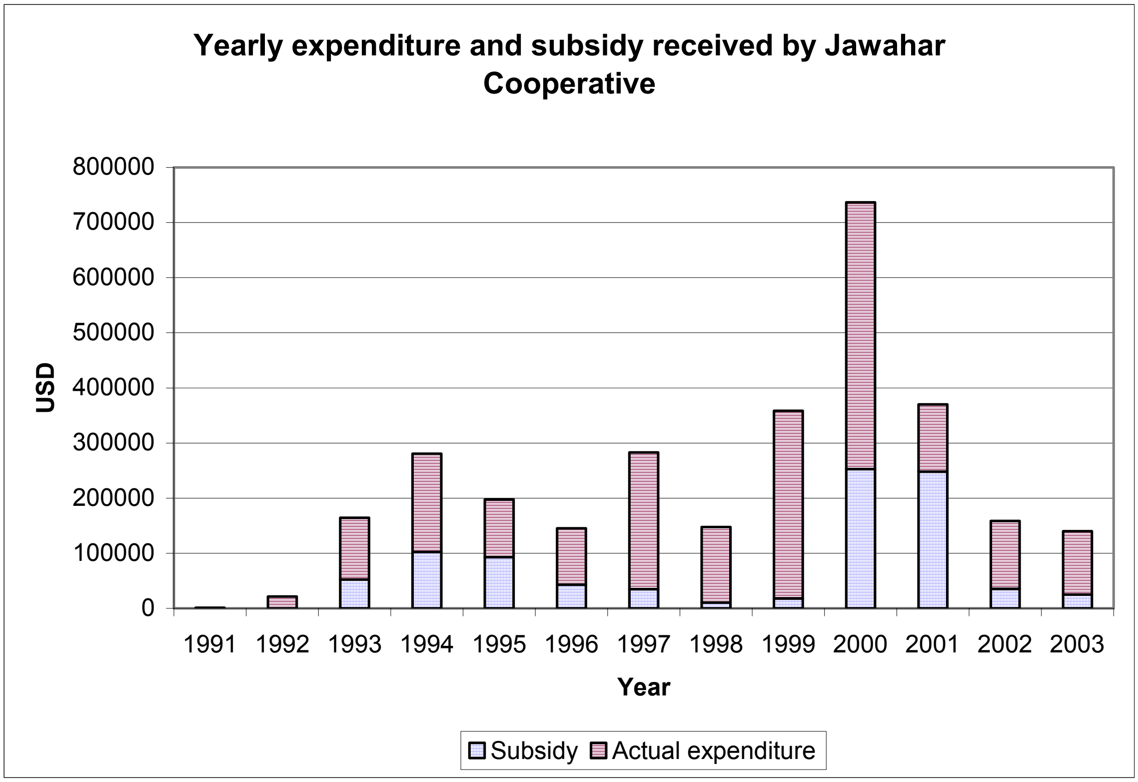


Figure 12. Source: Jawahar 2002.

Discussion & Summary

Like Jawahar, a few other cooperative mills in Maharashtra (e.g. Terna SSK) have also installed cogeneration and a handful more are in the implementation stage (MEDA 2004). These few cooperatives do not fall into the majority category that have received excessive government support and are poorly run. It is therefore important not to lump all cooperatives into one category – a pattern that much of the literature and media has fallen in to. In fact, it is crucial that if further progress is to be made on the cogeneration front, the problems of cooperatives are assessed more systematically and with greater sophistication; merely denigrating cooperatives as intractable problems in the sugar sector will not solve many of the deeper systemic problems, nor will it bring about greater cogeneration.

This chapter has shown that there are financial and managerial problems at the cooperative end, as well as failures at the policy and program level that have led to cooperatives not evolving into power producers. At the cooperative end, a fundamental barrier is the financial equity requirements for cogeneration projects. Even those mills that are comparatively more financially sound face difficulty in meeting the equity and bank requirements.

At the policy and program level, a decade or more of domestic programs have also not been designed keeping cooperative circumstances in mind, and have thus not encouraged appropriate financing mechanism for cooperatives to set up cogeneration projects. In the next chapter, I will point to emerging ways of overcoming the equity issue. State utility policies are also crucial, and cooperatives must feel assured of a buyer for their power before making the investment.

At the international aid level, multilateral and bilateral agencies seek project proponents that are a commercially attractive proposition from the start. This is why, for instance, USAID's GEP-ABC program did not have any impact on the cooperative sector.

There are lessons to be learned from the Jawahar Cooperative story, such as the importance of strong leadership with a long-term vision. It also reveals the close relationship between cooperative management and financial performance. However, perhaps what is most significant about this story is that cooperative power projects *are* possible, given the right circumstances and determination. It is therefore imperative that cooperatives stop being seen as somewhat intractable "barriers" in the sugar and bagasse cogeneration sectors. In the final chapter, I layout the various recommendations that have emerged from prominent policy making bodies and provide my own insights as to what can be done about a seemingly intractable problem.

V. Policy directions and recommendations

A Summary Of The Problem

This paper has attempted to understand why India's cooperative sugar sector has not as yet seized an important and potentially lucrative opportunity to become an electricity producer. Since power generated from bagasse, a renewable fuel, is environmentally preferable to coal, the case for increasing the cogeneration capacity in cooperative sugar mills is compelling. Bagasse power can also make much needed contributions (around 10%) to state electricity grids like Maharashtra's.

Explanations for the lack of cooperative participation in power projects are deep-rooted and systemic. If you are a cooperative and your first business is sugar production, becoming an electricity producer requires a substantial reserve of up-front capital that you currently don't have since you distribute your profits to your farmer-members. It requires the funds and technical knowledge to retrofit your existing operations and undertake energy conservation measures in your mill. It requires the will and persistence of a transparent and forward-thinking management, one that is not excessively preoccupied with political endeavors. Above all, even if you were to amass the equity for a power project through contributions from other members, you need clear policy signals from the electric utility to which you intend to sell your power. You therefore seek a power purchase tariff and secure contract that will make the investment worthwhile.

Each of these factors is in turn influenced by conditions that are not always in your control. For instance, an irrational pricing structure for sugarcane and huge carryover stocks makes the cost of production greater than your revenue from selling sugar. This is one reason why your mill has been in loss for the past few years. Prolonged drought, pest and disease attacks in the next year will mean that your mill's capacity for crushing raw cane is largely underutilized. Thus you are hit from two sides: low market prices for sugar and low supply of sugarcane. Under these conditions, you do not have the funds to make large investments. Moreover, if you hear news that in certain states, state electric utilities have reneged on their power purchase agreements with sugar factories, you are suspicious and fearful of making any new investments in efficient power generation equipment. Thus you continue at status quo, spiraling into greater debt, but somewhat complacent because in the past, the state government has always bailed you out.

With very few exceptions, this, in a nutshell, is the worsening condition of sugar cooperatives in Maharashtra. Financial insolvency in the cooperative sugar sector is in part reflective of a broader trend in agriculture – that is, low prices and an oversupplied market. But it is also due to a crisis in management, increasing corruption, and excessive financial dependency on the state government. It can be said that financial insolvency is a problem that befalls a majority of cooperatives.

For these cooperatives, bagasse power projects are unlikely to become a reality in the near future. In their cases, the government needs to determine whether it is worth keeping them alive at all, or whether to take more drastic measures of liquidation and privatization.

However, there are a number of cooperatives that are potential candidates for bagasse cogeneration since they are better off financially. Since even for many of the financially solvent cooperatives, equity requirements are still posing a barrier, it is imperative that alternative funding mechanisms be looked at and promoted.

On another level, if India is serious about renewable energy and its target of increasing rural electricity access, the Electricity Act 2003 needs to be implemented at a state level, allowing for renewable energy buy-back tariffs and state-mandated renewable portfolio standards. As provided for in the new Act, opportunities for sugar cooperatives acting as rural electricity franchisees could be explored further.

Finally, there is much to be shared *between sugar* cooperatives – after all they have common motivations and a common history. However, there is insubstantial effort to increase interaction between cooperatives to allow them to share experiences regarding cogeneration and other by-product diversification initiatives. Since cooperatives do not really compete with each other, I believe there is no reason for not increasing this sort of beneficial interaction.

In this chapter, I develop a taxonomy of recommendations for the cooperative sugar sector based on the identified challenges. I have divided challenges into three principal types: financial, institutional/management-related and regulatory (summarized in **Table 2**).

Table 2: Summary Of Major Challenges Cooperative Sugar Factories Face In Installing Bagasse Cogeneration

Type of Challenge	Description	Recommendation
Financial	-Financial reserves low because of fluctuating market; sugar pricing; and earlier mistakes made in setting up mills in close proximity to one another -Lack of financial equity for mill efficiency upgrades and for upgrading cogeneration equipment -Banks reluctant to lend to cooperatives	-Encourage BOOT and ESCO contracts for cogeneration -For sugar sector as a whole, encourage deregulation of sugar; establishment of a futures market; and cost-benefit analyses to determine which mills are worth keeping alive
Institutional/ management-related	-Board of Management takes a long time to make a decision -Low absorptive capacity for power generation technology and familiarity with power projects -Corruption and excessive dependency on government bailouts in some mills	-Educational and training programs -Greater role for cooperative federations -Limit government bailout packages
Regulatory	-Renewable energy buy-back tariffs not consistent across states; sends wrong signals, leads to lack of confidence by sugar mills	-Increased role for regulator to ensure contribution of renewable energy and power purchase tariff

The recommendations I discuss are based on suggestions put forth by the Tuteja Committee for the Revitalization of the Sugar Industry, the United Nations Development Program (UNDP), the World Bank, and others, and provide some of my own based on my understanding of the needs of the sector. I start with some of the broader changes that have been recommended for the sugar sector and treatment of cooperatives, since these will ultimately determine their financial position.
If cooperative sugar is to emerge from the brinks of complete bankruptcy and regain its reputation of a democratic and effectively governed institution, broad-based changes will need to take place in India's sugar sector policies, and appropriate steps will need to be taken to address the root of insolvency in the cooperative sector.

Addressing Financial Challenges

ESCO financing through BOOT approach

As explained, financially solvent cooperatives also face the problem of lack of financial equity for power projects. One alternative is for private sector-cooperative partnerships to be established on a build, own, operate, transfer (BOOT) model. In this case, a private energy service company (ESCO) would take on the risk of the cooperative power project and finance it in part, while entering into a contractual arrangement with the cooperative mill for supply of bagasse. Revenue from electricity sales would be shared on some basis between the private party and cooperative. After a certain number of years, the private party would transfer the assets back to the cooperative. The BOOT model has been investigated for some smaller private mills, but not as yet for cooperatives. Under the BOOT system, cooperatives would only have to putdown $300,000 of equity, while the rest can be raised on the market by private bidders. This is ten times less the amount cooperatives would have to contribute if they set up the project themselves (Damle 2004).

Contingent financing

As this paper was being written, other financing mechanisms for bagasse power projects in the cooperative sector have been proposed in the recently released UNDP project document titled "Removal of Barriers to Biomass Power" (UNDP 2005). This project aims to promote investments through a flexible framework using contingent financing, or financing with variable discount rates for different risks over time. Although it is far too early to examine the effects of the UNDP project on the cooperative sector, the financing schemes proposed are as follows:

i) **Subordinate debt financing**, which carries lower interest rate and is payable after the repayment of the principle loan. Sometimes, payment of interest is also deferred. The maximum amount of support to any given cooperative would be 10% of the capital cost of the power project.
ii) **Guarantees**, also limited to a maximum of 10% of the project cost; and
iii) **Venture/seed capital**, also limited to a maximum of 10% of the project cost, which would seek venture capital in specific investment categories involving cooperative bagasse power projects.

UNDP anticipates that approximate 50 cooperatives will be selected, each having exportable capacity of 10 MW (UNDP 2005).

The above two proposed financing mechanisms are directly related to increasing cogeneration among financially viable sugar mills. For a more detailed discussion on ways to address the financial challenges of the sugar sector as a whole, please turn to **Appendix C**.

Addressing Institutional & Management Challenges

Promoting bagasse cogeneneration through cooperative federations

Sugar cooperatives, owned largely by small and medium planters, are organized in State Federations, which, in turn, are coordinated by the National Federation of Cooperative Sugar Factories (NFCSF). NFCSF is very active in representing the interest of its members at the national level, in the provision of technical assistance to sugar cooperatives, and in the publication of periodicals concerned with the sugar sector. In addition, the cooperative movement has set up a research and training school for sugar technologists, now known as Vasantdada Sugar Institute near Pune (Maharashtra). NFCSF is financed by way of contributions from its members. This shows that they do have some organizational and technical capabilities when it comes to improving their sugar cultivation prospects. It would be advantageous for the NFCSF to become more involved in promoting bagasse cogeneration projects in the cooperative sugar sector.

Training and capacity building

When it comes to diversification into electricity generation, cooperative have a number of training and capacity building needs. It is not so much their lack of knowledge regarding the technology as it is the regulatory and economic issues that surround the technology. These can be summarized as: i) training on how to formulate PPAs, ii) training on how to operate as a local distributor, if this opportunity arises, and iii) managerial and leadership capacity building. One of the means through which to address the last need is through greater interaction among cooperatives. For instance, other sugar cooperatives would greatly benefit from understanding the factors that led to Jawahar's success. The NFCSF could also be involved in disseminating this information.

Addressing Regulatory Challenges

Consistent policy on renewable energy buy-back tariff

The importance of a stable buy-back tariff for bagasse power cannot be overstated. One of the main reasons why Jawahar came on-line was the announcement of a tariff policy by the Maharashtra state utility. Currently around India, other sugar mills are facing difficulty because of certain states reneging on earlier formulated tariff policies. It is frustrating for sugar mills to be faced with an inconsistent tariff policy, especially when they are relying on revenue from electricity sales to recoup their investment. This is particularly important for cooperatives that tend to have less confident in state utilities, and be more risk averse.

New provisions in the Electricity Act 2003

A new provision in the Electricity Act 2003 provides room for a possible renewable energy portfolio standard (RPS), currently open to interpretation by utilities and regulators. According to the new Act, "the Central Government shall prepare the National Electricity Policy in consultation with the State Government for the development of the power system based on optimal utilization of resources…including renewable sources of energy (MoP 2003b)." Hence states are free to decide on the proportion of renewable power in the grid. As of yet, there has been no announcement by regulators to this effect. Should such a policy be announced in Maharashtra, it would certainly ensure a buyer for bagasse power, and thus reduce some of the risk associated with such projects.

A second provision in the Act concerns the role of cooperatives in rural electrification. The government currently has plans to scale up electricity access to rural areas through distributed technologies and appropriate institutional arrangements based on cooperatives, community-based organizations, and users' associations. These goals are embodied in the Electricity Act 2003 as well as the Rural Electricity Supply Technology mission, a policy initiative announced in the same year combining the efforts of MNES and Ministry of Power. Instead of encouraging cooperative sugar factories to produce power for urban areas, from an equity standpoint, it makes more sense for cooperative to play an increased role in rural electrification. After all, members are farmers who have an enormous stake in continuous and reliable power supply.

In principle, sugar cooperatives could also become rural electricity cooperatives, managing local distribution, being responsible for the collection of tariffs, etc. In practice, however, the technical difficulties are considerable.[21] The benefits of this system are a) since the farmers around the sugar mill are also owners in the cooperative, we can expect minimal commercial losses, and b) low T&D losses. The problems with this system is that the current power tariff to farmers is very low, hence for the cooperative mill to be a financially viable electricity cooperative, a suitable regulatory and financial framework has to be worked out. With the Electricity Act 2003 entering into force, there is potential for cooperatives to operate as mini utilities or small distributing companies (Dadhich 2005).

[21] It is technically possible for power generated by a sugar cooperative to be fed to a local rural mini-grid. The mini-grid could either be stand-alone, or could interface with the main grid after building the requisite infrastructure. The main consideration for establishing a mini-grid is the costs involved. If the mini-grid is interfaced with the main grid, then when the external grid goes down, the bagasse plant could reconnect to the now isolated local grid. The exact procedure for this will determine on the relative magnitude of the plant and local loads. When the main grid comes back up, then the bagasse plant would have to be synchronized again with the main grid which would require competent technology and operators.

VI. Conclusion

In many ways, bagasse cogeneration for India can be viewed as a no-regrets energy option. Not only does it have the benefits of decentralized power generation and adding much needed generating capacity to the grid, it is also capable of providing additional revenue to a key agricultural sector – the cooperative sugar sector – that employs many small and medium farmers in India. Additional revenue from electricity sales also has the potential of buffering cooperatives from an adverse sugar market situation. However, there are a number of financial, managerial, and regulatory needs which must be addressed in order to increase the installment of efficient cogeneration in cooperative sugar mills.

Of all the policy directions and recommendations presented in this paper, those that can be implemented immediately and with minimal incremental cost pertain to i) ESCO financing on a BOOT basis, and ii) capacity building through the promotion of increased interaction between cooperative mills. Many decentralized energy projects have already been implemented on a BOOT basis and it is a question of replicating these in the cooperative sector. Moreover, a National Federation for Cooperative Sugar Factories whose task is to serve as a focal point for all cooperatives in the country already exists. The Federation's activities in the energy sphere, however, could be augmented. For instance, it could assist in publicizing the experience of Jawahar, a cooperative that has now started exporting power to the Maharashtra's grid network.

In the longer term, however, there is no doubt that the government of India has an enormous task ahead of it to sort out the fiscal and financial mess of the sugar sector. Respective state governments can no longer afford to bear the fiscal burden of non-performing sugar entities. In order to make their operations more viable and less risky, there is a need to rationalize the pricing and release mechanisms, and move towards a futures market in sugar. Other long-term approaches should also consider establishing sugar cooperatives as rural electricity franchisees in order to increase access in rural areas.

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Appendix A: How bagasse cogeneration works

When sugar is crushed and processed, a fibrous residue known as bagasse is left behind. Bagasse is 50% moisture and has a gross calorific value of around 2,270 kcal/kg. All mills burn their bagasse to produce steam and power for their on-site needs. However, when bagasse is burned at high temperature and pressure, more power is generated for the same quantity of bagasse used. As shown in **Figure A-1**, the technology used is the conventional steam Rankine cycle design with recovery of steam for mill operations.

Since the sugar industry operates in seasons (off-season and season are both approximately six months), boilers are normally multi-fuel, meaning that they can accommodate a range of fuels when bagasse is not available, including coal and other forms of biomass. During the season, because of the higher demand for steam to run the mill, less power is exported than during the off-season. Turbo-generators are generally of two types: back pressure or extraction-cum-condensing.

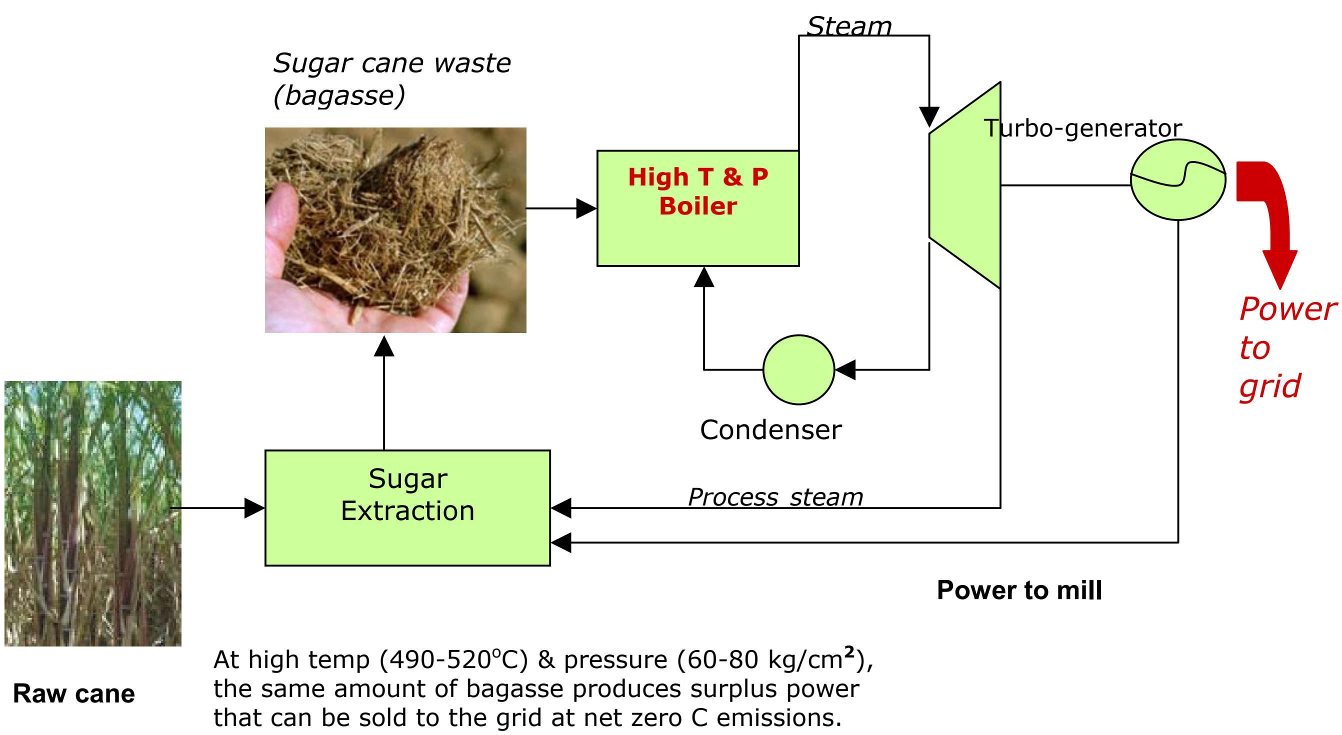

Figure A-1: Bagasse cogeneration technology

Table A-1. Data for a typical 2,500 TCD mill. Source: Gollkotta and Sobhanbabu 2002

Mill crushing capacity	2,500 tonnes per day
Exportable capacity: season and off-season	10 and 15 MW
Temperature and pressure configuration of boiler	495^0C, 67kg/cm^2
Type of turbo-generator	Condensing-cum-extraction
Energy exports (season and off-season)	92 million kWh
Total project cost ($/MW)	$625,000
Cooperative equity contribution	10-15%
Government contribution/loan	85-90%
Cost of generation	$0.06/kWh
Pay back period	4 years
Internal Rate of Return	21.03%

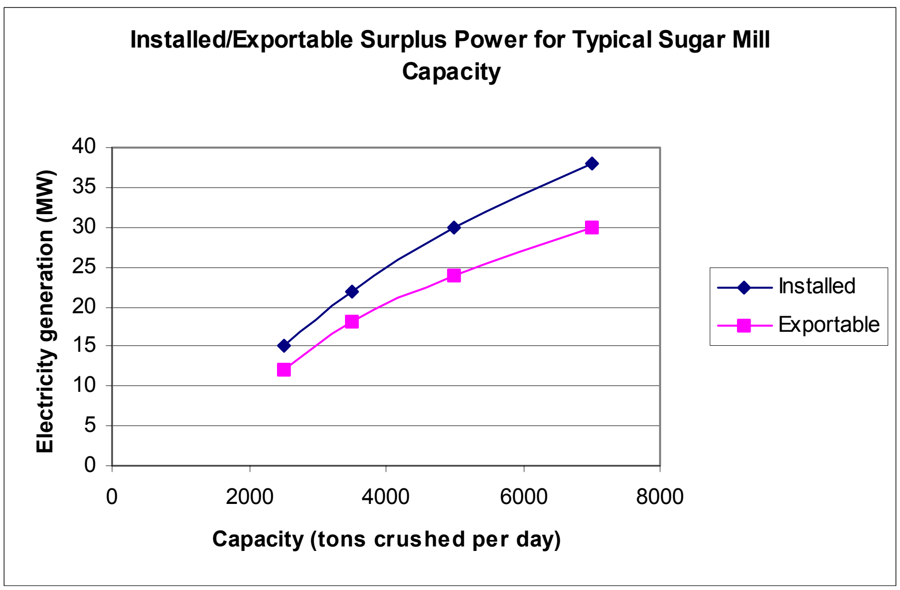

Figure A-2. Source: Gollakota and Sobhanbabu 2002.

Appendix B: The Pravara and Hutatma Sugar Cooperative Experiences

Pravara: The First Cooperative

Intent on demonstrating the virtues of a socialist agricultural system and protecting farmers from exploitation by middle men and money lenders, Patil and Gadgil set up the first cooperative sugar factory at Pravara, in Maharashtra in 1950-51. Together, Patil and Gadgil rallied sugarcane growers into supporting cooperative factories on the grounds that they would: i) provide stability in the price of sugar, ii) persuade the government to release additional supplies of water from the canals for cultivating cane, and iii) improve the ability of indigenous farmers to take advantage of the sugar industry through mutual cooperation which, until then, had accrued to the urban capitalists and non-indigenous farmers (Baviskar 1980).

The Pravara Cooperative Sugar Factory was hailed as a model of success soon after it was established (Baviskar 1980). It was financed through a combination of share capital from farmers, the Bombay State Cooperative Bank, and short-term loans from the State Bank. In his writings on cooperation, Gadgil attributes much of this success to the dedication of the cooperative's leaders and the loyalty of the members (Attwood 1992). The first sugar cooperative at Pravara proved its success at raising capital, procuring cane, and producing sugar, and provided the impetus for all-out state sanction.

Pravara was soon followed by another cooperative factory in nearby Kopergaon, founded by G R Autade, a leader who had played an instrumental role in strengthening the cooperative credit society in his own village (Baviskar 1980).
In 1954, the Government of Bombay announced a policy favoring licensing of all new mills in the cooperative sector. It also imposed a ceiling of six acres for cane cultivation on canal-irrigated lands, but exempted cooperative members from this ceiling, allowing them to cultivate up to 25 acres of cane (Baviskar 1980).
The state government also provided financial support to early cooperative endeavors. However, it has been stated that one reason for the success and replication of sugar cooperatives is that the impetus for cooperative formation came from the peasants themselves, and not from the government. It was a true grassroots movement that was subsequently encouraged by the state, unlike the case of ujamaa in Tanzania which was a cooperative agriculture strategy developed and imposed by the state in the 60s. Since *ujamaa* was externally imposed and did not in fact emanate from the desires of peasants, the government found it difficult to convince peasants to adopt the system. Fundamentally, *ujamaa* could not be reconciled with the pre-existing modes of peasant production and networks of social institutions (Hyden 1980).

The Hutatma model of cooperative governance

> *Who says you need an MBA to run a company successfully? You don't even have to pass high school*
> –Dionne Bunsha for the Hindu Newspaper (a national daily) referring to the Hutatma Sugar Cooperative

The Hutatma cooperative in Sangli District, Maharashtra, is one of the most efficient, environmentally sound cooperatives in the area, although it has not installed cogeneration as of yet. The factory boasts the highest cane recovery rate, the most equitable distribution of benefits and employment profile (women and low-caste members are routinely recruited on the management board), and sound financial performance. During the last 18 years, the factory has received several national awards for being the most technically efficient. Its recovery rate (amount of sugar recovered from cane) is the highest in the country. Payments to farmers are also prompt. The cooperative also has money to spare for rural development. Part of its surplus goes towards a college and hostel for girls. Many of the villages that are part of the cooperative have paved roads due to the cooperative's investment in rural infrastructure. Cooperative diaries and banks have also come up in the area, and the factory is also funding lift irrigation schemes for farmers. What is the secret of Hutatma? It is not the typical bankrupt or financially weak cooperative, nor is it one that is patronized by politicians. The factory was founded by Naganath Nayakawadi, a freedom fighter and social activist with vision and strong leadership skills. One former director responds to the question of political interference "They [politicians] know there is no scope for corruption here, so they leave us alone…All of us support different political parties. But when we come for a meeting, we leave our politics outside the door. It should not interfere with issues of our livelihood (Bunshaw 2004)."

When asked why the cooperative hadn't installed efficient cogeneration equipment yet, Nayakawadi responded that it is just a matter of time – they are currently waiting for the prices in the industry to pick up again (Personal communication, 2004).

Appendix C: Improving the overall situation of the sugar market

Financial relief packages for the sugar sector

The most obvious way for cooperatives to emerge from debt is for the government to provide financial relief packages. A number of financial relief packages have been announced for the sugar sector, and the cooperative sugar sector in particular whose patron, Sharad Pawar, is the current Minister for Food and Agriculture. In 2004, Pawar, announced a lowering of interest rates from the Sugar Development Fund (SDF) for loans taken by potentially viable, loss-making sugar mills (Parsai 2004). The SDF has also been instructed to lend at concessional rates for bagasse cogeneration and other by-product utilizing industries (Tuteja Committee 2004).

Other financial recommendations, although they have not as yet been implemented, include the 1) conversion of outstanding state government loans into equity, 2) infusion of additional equity by the state government and members of the cooperative, and 3) rescheduling outstanding loans of cooperatives by banks and financial institutions. In late 2004 following an order by the Supreme Court, cooperatives in Maharashtra received a major income tax relief worth approximately $540 million (Jog 2004).

These financial supports, implemented and under discussion, from the state and central government have obviously been well received by the industry. However, there are strong voices of dissent from the media and policy watchdogs who claim that it is not worthwhile to try and rescue sugar cooperatives. A World Bank report strongly urges the Government of Maharashtra to consider liquidating cooperatives that are not revivable and to halt any support to new or existing cooperatives. It concludes "It is true that some of the successful sugar co-operative mills…have helped rural areas socially, economically, industrially, and educationally. But it has come at a high cost to the state exchequer and it remains to be seen whether the benefits have outweighed the costs (World Bank 2001)."

As seen in the case of Jawahar, a successful cooperative is one that has remained relatively autonomous from the government. The subsidies received by Jawahar over the past have been substantially lower than that received by other cooperative mills. It is this autonomy and self-sufficiency that I believe has made it possible for Jawahar to diversify its business activities into power production. Therefore, my overall recommendation in the financial sphere would be for the state and central government to gradually withdraw support and to avoid making large equity commitments.

Deregulation of sugar and establishment of a futures market

As mentioned, a complex web of pricing and release mechanisms characterize the sugar sector. Decades of regulation, however, seem to have failed in "getting the price right" – by which I broadly mean both the SMP which must be paid to the farmer (which is inflating a mill's cost of production), and the quotas allowed to each mill. The Tuteja Committee Report (2005) hints that the government is moving towards establishing a futures/forward trading market in sugar, which already exists in the industrialized world. A futures market would represent an essential hedging tool for producers, as well as trade houses, refiners and dealers. If provided adequate training to engage in forward trading, cooperatives would be better to better hedge the risks of a crash in the sugar market. In order for a futures market in sugar to work successfully, however, sugar will have to be decontrolled completely (i.e. there would not be a differentiation between levy and free sale sugar – all sugar would be sold on the open market). However, this is a decision that is potentially politically risky to any party in power.

Rationalization of sugarcane pricing and sugar release
Instead of drastically cutting financial support to cooperatives, it would be a worthwhile endeavor to reconsider the pricing mechanism of sugar cane and sugar. A number of requests have been made by the sugar industry to establish a more rational methodology by which to determine the SMP, which many feel is currently too high. The rationale for the SMP is that the cane grower is assured of a minimum price to meet his cost of cultivation for the sugarcane. The problem is when the price of sugar cane is too high, and that of sugar is too low, which leads to a negative profit margin. Being vertically integrated, cooperatives face an ironic situation in which their grower members are enthusiastic about higher cane prices but are then also harmed by low sugar prices. It would therefore be in the best interest of cooperatives if cane prices were set taking into account the market price of sugar, and if periodic sugar releases on to the market took into account the potentially depressing effect on sugar prices.

Cost-benefit analyses for setting up new mills and establishing inter-mill distance
In the state of Maharashtra, the government grants licenses only to new cooperative sugar mills, but does so without adequate assessment of a) the geographic location of the mill and whether there is enough water for sustainable sugarcane harvesting, and b) the location of adjacent mills. The obvious problem with having too short a distance between adjacent mills is that each mill is not able to procure the amount of sugarcane it needs to operate at full capacity. The Tuteja Committee determined that a minimum radial distance of 25 km should be maintained between mills for mill sizes in the 5000 TCD range (Tuteja Committee 2004).

The above policy directions are about restoring financial health in the cooperative sugar sector. In general, they propose a relief package for still-viable but currently loss-making mills, a policy of liquidation and no further assistance for those mills that are beyond help, and a rationalization in the cane pricing and geographic placement of new cooperative mills. For mills that fall in these categories, the most pressing need at present is to restore financial solvency where possible. Installing a bagasse cogeneration unit is neither a priority nor a possibility for these mills, and is unlikely to be in the near future.