DURING the past decade, Indian government agencies such as the Khadi and Village Industries Board and private voluntary groups have promoted gobar gas plants as an important component of their rural development strategy. Indian planners consider this to be a technology which, if disseminated widely enough, has the potential to deliver major benefits and improve rural living conditions. The advantages cited can conveniently be listed under four heads:

Benefits of Gobar Gas

Simplicity and Utility: The basic process of gobar gas generation is relatively simple and does not require very sophisticated equipment or knowhow. Once the unit is constructed it uses primarily local resources (raw materials and labour) and creates products that are extremely useful in the village (fertiliser and fuel). The methane gas produced can be used for a variety of purposes: cooking, lighting, and driving machinery such as water pumps.

Optimal Allocation of Resources: Villagers frequently collect and dry animal dung and organic plant wastes for use as fuel (as in cooking). It is estimated that 30 per cent of the country’s fuel needs are met by burning cattle-dung and another 34 per cent by burning agricultural residues. Not only is this procedure an inefficient way of generating heat; it also uses up valuable nutrients that could have been applied to the soil. The denudation of forests and stripping of hill-sides causes further problems. In contrast, although the process of gobar-gas generation reduces the volume of organic wastes by 20 per cent, the gas produced gives 120 per cent of the heat that would be generated by burning the cow-dung. The wastes can then be used as fertiliser; moreover, some proponents claim that their nitrogen and phosphorus content is enhanced, thus producing a better soil additive.

On the national level the increased use of dung for fertiliser and decreased deforestation that should result from widespread adoption of gobar gas technology would be a clear benefit.

Improved Health: The various types of waste which today litter and fester in the lanes and houses of villages will be collected, rendered innocuous and used for manure. Flies and other insects thrive on this matter today and reach epidemic proportions in some seasons causing many health problems. This nuisance should be considerably reduced as standards of hygiene rise with the sanitary disposal of wastes.

The majority of houses in rural India do not have facilities for disposal of human waste. Generally, people go to designated fields adjacent to the village to relieve themselves. Excrement can thus be carried around by human feet or on the hooves of pigs and cattle that graze in these fields and consume it and thus contaminate food or water. In fact, sometimes these areas are close to sources of water and through seepage, human excrement can contaminate drinking water. Gobar gas plants with attached toilets would facilitate the sanitary disposal of human waste.

Health benefits would also accrue in the home. In most rural households, cooking is presently done on wood or dung burning clay stoves that do not have chimneys. Inevitably, during cooking, kitchens fill with smoke and village women frequently have eye problems as a result. Often the kitchen is the only room of the one room house and so smoke affects the health of not only the housewife but all the family. The clean burning gas provided by the gobar gas plant would change this and result in healthier living quarters for the rural family.

Savings to Villagers: One energy source used in villages is kerosene, but this has become scarce and expensive in the wake of rising petroleum prices. Gobar gas would be a suitable alternative. Since it burns cleanly, unlike cakes of dung, housewives would realise considerable savings in the time they currently spend cleaning soot-stained cooking utensils. Furthermore, the replacement cost of pots is significant for the very poorest families, who own a total of only three or four.

It might be noted here that ways have been suggested of collecting animal urine which is currently largely wasted, and adding it to the gas plant. Since even the small marginal farmers in India have to buy urea and phosphate-nitrogen fertilisers, gobar gas plants would help to reduce the need for such major cash purchases from the city and increase farmer savings.

Critique

Not all of the advantages that have been claimed for gobar gas technology bear up under scrutiny. For instance, consider the gobar gas plant design.
that has received the most exposure and promotion in India. It consists of the following components:

1. A trough for mixing up the dung-water slurry and a pipe leading this slurry by gravity to the bottom of the digester well.

2. A digester well, lined and finished so as to be impervious, constructed to a size and capacity that is designed and specified by a specialist.

3. A metal dome cover that is set so that its rim is in a masonry collar inside the well. When the well is filled with slurry the dome forms an air-tight enclosure to the well. As gas is generated in and expelled from the dome, the dome moves up and its weight is designed to pressure the gas to the required degree.

4. The gas is conveyed out by means of a hose that is attached to the top of the dome. For efficient delivery of gas it is best to use it within a ten to twenty foot radius of the gas plant since problems of pressure drop, condensation and breakage of pipe increase as the pipe length increases.

It is quite clear that not only are most of the components of the gobar gas plant produced outside the village economy but the skills required to manage, repair and maintain it must be introduced from outside. The labour for construction of the plant can be largely supplied by local people such as the owner himself, his family, local masons and day labourers as long as there is careful technical guidance and supervision from the gobar gas plant specialist. Gobar gas plants require bricks, cement, cast iron dome, piping, etc. which must be acquired from outside the village. Case studies of plants constructed in other regions of India show delays of over one year due to bottlenecks in delivery of these materials. Thus the technology becomes difficult to deliver in the face of scarcity of raw material resources.

Some researchers have questioned the connection between deforestation and the use of vegetable matter for fuel. They note that what many families burn are the stalks from their crops or small bushes that are grown as fencing and for fuel. Three- and leaf-cutting are carried out mainly for house construction or for the feeding of animals; thus, they argue, deforestation will not be affected by the installation of gobar gas plants.

The argument that savings result from the adoption of gobar gas can also be criticised. Farmers who do not currently buy their fuel will realise no savings by investing a gas plant. Furthermore, savings of time and money in the kitchen are not perceived as important by the man, and it is he who makes decisions concerning family investments.

Still another factor, however, frustrates the realisation of the benefits of gobar gas technology. Despite the great interest in the gobar gas plants and their active promotion by the state and Central government, they have not received widespread acceptance in the villages. A study of gobar gas plants in Gujarat by the Indian Institute of Management indicated that adoption rates were low and most adopters (76 per cent) were larger farmers who owned more than 10 acres. Even the few adopters who had less land were not the really marginal or landless farmers whom the proponents of this technology claim to want to include. This finding is corroborated by more casual observations in Maharashtra. Generally there is widespread curiosity about the technology but few adopters. As in Gujarat, the majority of gobar gas plant owners tend to be the more affluent farmers. The Gujarat study further noted that the rate of adoption of the gobar gas plants had been decreasing particularly in the low status groups and there was fear that if this trend persisted only the well-to-do in each village would benefit from the technology.

If the majority of villagers do not use the gobar gas plant some of the social benefits that are claimed to accrue from it and for which the technology is being actively propagated — such as reduced deforestation and generally improved sanitation and health — cannot in fact be actualised. If the gobar gas technology is to improve rural conditions in any dramatic way a more widespread adoption which benefits the small and marginal as well as the affluent farmers is essential at the village level.

A cost-benefits study on the economics of village level gobar gas plants done at the Gokhale Institute indicates that under existing technology, a gobar gas plant of a size requiring three or four cattle to provide the necessary dung is economically profitable but any plant smaller than that is not. This is partly because the larger capacity gas plants operate more effectively, since it is easier to maintain them in the temperature range of between 25 and 35 degrees Centigrade which is desirable for methane generation. This technical limitation immediately precludes small farmers and landless villagers who generally own only one or two cattle apiece from adopting, unless they co-operate with each other and share a medium sized gas-plant between three or four families or unless larger sized communal plants are built.

Based on the review of the literature on the subject and discussions of the problems of gobar gas adoption with researchers, it appears that although there is substantial room for technical improvements and refinements of various aspects of the plant, they do not constitute the critical bottleneck to successful and more widespread adoption. Gobar gas plants of the type presently available have been constructed and successfully used by individuals over a number of years. A reduction in the price of installing a plant; a radically new plant design that operates efficiently on dung from only one animal, or on only human waste of a small family; some such innovation would naturally make adoption of the technology more attractive to a greater number of families. Even as it stands today, however, investments in gobar gas plants should be more attractive to a greater number of rural, farming families than are currently coming forward to adopt it. In addition, co-operative gas plants could bring the technology to within reach of even larger numbers of smaller farmers and agricultural labourers. Why then are villagers not adopting gobar gas in significant numbers?

**The Village Perspective**

In an attempt to gain insight into the factors that were important and contributed to non-adoption of gobar gas plants at the village level, a number of interviews were carried out by the author in "Sugao" village, a small predominantly peasant farming community in the Deccan region of Maharashtra.

Sugao has been extensively studied in detail since 1937 by various researchers at the Gokhale Institute of Politics and Economics in Poona and by this author. As a result of power structure, the social hierarchy and relationships, the distribution of wealth, particularly in terms of land holding, the centres of moral leadership, and the opinion makers in the village are identified, familiar and well understood. In addition, the author has lived in the village for varying periods of time, spanning more than one and a half years in 1976-77 and as a result, people in Sugao feel at ease and give factual information fairly readily. As
a result of the long connection with Sugao the overall process of change in the areas of economic activity, social relations, and political awareness has been monitored and studied in detail. This provides a rich contextual background within which to study the specific problem of non-adoptions of gobar gas plants.

Many men as well as a few women from various social strata living in the village expressed their views. Interviews were carried out with large landowners who are the accepted leaders and spokesmen for the village, with middle and small farmers, with some high school teachers, and with some of the lower caste day-labourers.

In 1976 it was clear that a number of Sugao farmers, particularly the larger farmers, had heard of gobar gas plants and were aware of the financial subsidy, low-interest loan and technical know-how package that the Khadi and Village Industries Board were offering to adopters. There were, however, no adopters. In 1979 there was more widespread curiosity and knowledge about gobar gas plants but still not a single family had invested in one.

Space Constraints: When larger farmers, the acknowledged leaders and trend-setters in adoption of new things, were queried they displayed a fairly clear awareness of the gas technology. Some had even visited other villages to observe installed plants. They all indicated that they had given some thought to investing in a plant for themselves but all but two of them, who had built new houses on the periphery of the village, discussed the serious space constraint on its construction around their home.

Sugao, like most villages in the Deccan region of Maharashtra, is a nuclear clustered village located in the middle of its agricultural land. Village housing is fairly dense and narrow lanes and alleys give access to the centrally located housing. In this configuration it is rare for a farmer to own and be able to spare the minimum 30 or 40 square feet of land, within a 20 foot radius of the kitchen, required to build the gas plant on. Even in discussions with smaller farmers about the possibility of co-operatively building a gas plant between four or five of them, these problems of land scarcity surfaced. Additionally, in a co-operative situation none of the members would want to give up housing land that they owned individually for a co-operative gas-plant because they feared that all the other members would acquire easement rights over this area. For a technology that seems tentative and exploratory, as gobar gas still does to villagers, these farmers were not interested in jeopardizing their ownership of even a scrap of individually-owned house site land.

This chronic space problem is fairly typical for many areas of Maharashtra. Traditionally, in the state, village settlements are nucleated and clustered in form and with time result in tightly packed housing on the limited village site. In a clustered village, such as Sugao, the technical development of a fixed-dome gas plant that has no movable parts and can be buried underground, under the floor of adjacent cattle sheds or a room, would possibly make the plant a more attractive investment. Versions of such a design are in use in China and are being developed in India. This 'Janata' model consists of a digester-well covered with a fixed brick porous dome and an inlet and outlet. Because the dome does not move, less maintenance and care is required in its operation. Despite a few current problems with the rate of generation of gas, the Janata units are cheaper and could be valued more for the superior quality of organic manure they produce.

Another space requirement is for the storage of the digested slurry. In an ideal low maintenance set-up, the effluent is led into pits where it dries out to be used as manure at strategic periods in the agricultural cycle. Compost material added to this is converted quickly to a rich organic manure. In a space restricted situation, however, arrangements have to be made to catch the output and carry it to compost pits on the periphery of the village which makes for an additional chore in the crowded day of the cultivators.

The gobar gas plants work more efficiently at gas generation if night soil is added to the digester. In order to facilitate this, some type of toilet, primitive though it might be, has to be constructed and hooked up to the plant. Most villagers do not like the idea of a toilet so close to home. They are afraid it will smell as well as require too much maintenance and (most importantly) space and money. All these factors become even more of a problem in a co-operatively owned plant.

Water Constraints: Solving the space problem could certainly make the gobar gas plant more attractive to larger farmers, and perhaps even to smaller farmers thinking of a co-operatively owned and run plant. There is, however, still another resource constraint that is a factor in non-adoption: the scarcity of water.

Sugao has been fortunate to obtain some twelve years ago a government financed piped water scheme to distribute water to common taps scattered through the village. Water is turned on for a couple of hours in the morning and has to be stored for use during the day. The village was not involved in construction of the water scheme; it came as a 'free gift' through political connections. Right from the beginning the scheme did not deliver sufficient water to the furthest end of the village and a new, improved scheme that has been partially constructed floundered when the contractor embezzled the funds. Villagers have become disgruntled and rather than maintaining and making the best of the scheme they have started to break into the pipes and create impromptu tapping points, which have no siphons to stop the flow of water when not in use thus resulting in even more wastage. Altercations every morning at each tap are common.

For the proper operation of the gobar gas plant, cow dung and water in a ratio of 4:5 by volume are mixed into a slurry to be fed into the digester. In the water scarcity situation existing in Sugao it will be a major chore for someone to obtain, every day, the necessary buckets of water to keep the plant going. In a communally owned plant this chore will probably be even more resented. As one village woman exclaimed, "It's a fight to get enough water to drink for everyone, who is going to waste a battle to get more for this gas-plant?"

Social Factors: The history of co-operative ventures in Sugao has not been encouraging. A foodgrain and cloth co-operative, a jointly owned flour mill, and a weavers' co-operative to obtain credit, raw materials and markets have been started, have functioned sporadically for a couple of years and then have failed, often due to defaults and outright corruption. The failure of co-operative ventures has left participating members saddled with debts and idle equipment. Villagers, with good reason, do not believe in each other's capacity to maintain agreements over long periods of time. Because of this even blood related families and members of a former joint family are reluctant to consider any joint ventures such a
collective gas plant. The history of feuds in the village has also bred mistrust and pitted family groups and castes against each other.

In the scarce resources economy of Sugao individual families are concerned about how their contribution of waste to a community plant would be measured and what share of gas and manure they would get from it. In successful pilot projects of community gas plants these problems have been solved in the following ways:

Each family's contribution of waste is weighed and noted each day. Gas is released for set hours every day during meal cooking times and families can use as much they want at this time. This time-rationing system is introduced rather than individual meters because at present with the available technology these meters are very expensive. Perhaps a technical breakthrough here to reduce cost would be useful.

It was reported by those who have worked on such community plants that people are not happy with this distribution of benefits. They think of the gas as the major benefit from the gobar gas plant. The enhanced quality of slurry, which larger contributors of dung get proportionally more of, is not immediately apparent since it is stored in compost heaps and applied at periodic intervals. Thus farmers perceive this system of distribution of gas as inequitable and there is less incentive to collect cow dung from longer distances in the outlying fields. The result is a corresponding reduction in the amount of dung supplied to community plants.

An additional cost and maintenance problem is the piping to each household. As distance between plant and kitchen increases, maintaining the gas pressure becomes a problem. Some families whose houses are further from the plant may at times get less gas than they need for cooking. This will inevitably cause disputes. From past experience, villagers are sceptical that careful accounts of everyone's contributions will be maintained and a fair distribution of the product will be ensured in a co-operative gas plant. Someone has to be designated to keep these records who is trustworthy, literate and able to spare the time. On a volunteer basis such a person is on a volunteer basis such a person is needed to keep track of everyone's contributions.

**Toilets and User Preferences:** If toilets are built and hooked up to a gobar gas plant, whether as individual units, small groups or large community ones, the amount of water each individual uses to clean himself has to be strictly controlled. Excessive use of water dilutes the slurry in the digester and impedes the process of gas generation. Villagers are not used to squatting over toilets and have to be taught to do that they do not foul up the surrounding plinth. If water is unavailable it is a custom at present to use small stones or foliage to clean oneself, and villagers have to be taught not to do this in the new toilets, as these items would just block up the toilets. The whole process of social education has to be done slowly and with regard to people's inhibitions and feelings. Older people will resist the idea of having to wait in line at times to use the toilet facility. Women may not like to give up the few minutes of social time they enjoy when they go to the fields to relieve themselves and linger to chat with other women there. This is one of the few occasions in the day that young women can discreetly escape the watchful eyes of their in-laws or parents. The design and introduction of toilets, if they are to be used successfully by the villagers, will have to recognise and be sensitive to such social realities.

In other areas of India villagers have resisted the idea of using night soil as manure on their land and even the idea of cooking over a gas that is generated from a slurry that contains human excreta. In Sugao, however, none of the many villagers questioned voiced any reservations about this. Someone in fact described how green and good the crops had been in a neighbouring village where such manure had been used.

**Villagers' Perceptions of Benefits:** Although a number of studies were underway or being completed on the cost benefits of such gobar gas plants, the evidence is not conclusive and opinions differ on what benefits accrue in reality. In any case, the decision to adopt or not to adopt a technology, either at the individual villager's or the community level, does not appear to be heavily informed by such criteria. The villager's perceptions of benefits and the values he attaches to them differ from the specialist's. A gas plant meeting the needs for lighting and cooking in a household is not considered a high priority item, especially since the major beneficiaries are women, a group that has little decision making power in the village. However if the energy from the plant is used to run a flour mill or threshing or to pump water for a tubewell, then it is considered a major benefit and improvement.

Similarly, if the village has enough land and grows plants and bushes so that he buys little wood for fuel, then he does not value very highly the fact that a gobar gas plant provides him with fuel for cooking. Another case in differing perceptions is that of the usefulness of threshing machines. If a farmer owns bullocks he will continue to thresh his grain in the traditional way under the feet of the bullocks rather than take the crop to the mechanical thresher for whose use he has to pay.

Presently most of the energy needs of the villagers are in fact being met in one way or another. A gobar gas plant is perceived as providing facilities and improvements that are more qualitative in nature. Besides, they appear to be more useful to women than men and therefore are discounted when men make decisions about investments.

In addition if only one element of improvement technology, such as gobar gas, is introduced into a system that remains essentially the same in organisation and production, the impact is only at the margins. To be fully integrated a more comprehensive, evolutionary transformation of the total structure is necessary. The change inducing agent has to be much wider based and cognizant of all of the constraints that operate against adoption and assimilation of new ways.

**Overcoming Constraints**

The constraints outlined above are not insurmountable. If there is little space around houses, plants can be installed underground or at the periphery of the village near the fields that villagers currently use for relieving themselves. If distance prevents the piping of gas to households, the gas can be used for some community purpose such as street lightings or a small scale industry. Installation of gobar gas plants can be delayed until bottlenecks are overcome and an adequate water supply is assured. Villagers can change their toilet habits. But if villagers see no clear advantages to this technology, they are unlikely to invest in individual plants. If, in addition, they are suspicious of co-operative ventures,
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it will be a long time before gobar gas technology appears in Sugao.

It would seem that the initiative for installing a gobar gas facility must come from some outside agency. Such an agency could construct a larger-sized communal facilities on the outskirts of the village. Once a system of toilets, a gas-plant, and soak pits were constructed, they could be supervised by salaried individuals who would ensure that the system was kept clean and operational.

Nevertheless, the organisational solution of hiring people to maintain such a facility becomes dubious when assessed in terms of social goals. Starting with Mahatma Gandhi’s “bhagini mukti” programmes to free the scavenger-castes from the socially untouchability their work brought upon them, the effort in development planning has been to eradicate caste distinctions and discriminations, especially those of untouchability. The technical, organisational solution suggested for community gas plants would in fact create a new, scavenger class, albeit a paid and salaried one. Besides this basically moral question is an economic one: whether small or medium gas plants could generate enough income to eventually pay for the services of such individuals and whether the plants would eventually pay for their maintenance.

When questioned about the possibility of introducing gobar gas units to Sugao one of the respected village leaders, who was noted for his foresight and concern about village affairs, insisted upon digesting from this topic. He proceeded to talk about and finally to show a new introduction to Sugao’s very rudimentary waste, drainage and sanitation system. Three of the large farm families in Sugao whose houses were located on the edge of the village had bought special toilet pans and begun construction of day pit toilets that were developed by a Gandhian organisation as valuable devices for collecting and converting human waste to fertiliser. These toilets are very simple in design and relatively inexpensive. They work on the premise that night soil when covered and left to decompose for some time converts to valuable manure. Despite their simplicity and ease of construction the three toilets that were started in Sugao were incomplete because they needed a small amount of cement to form the channel joining the toilet pans to the soil pit. Cement being in short supply had been un-available to these Sugao families for six months. The larger quantity of cement needed for a gobar gas plant would have constituted an even greater constraint.

Referring to these pit toilets and to his observation of trench toilets provided at centres of large religious festivities which he had attended, the village leader suggested an approach to improving the physical plant and living conditions in Sugao. He suggested that funds be raised to hire a few people to dig pit trench toilets in the existing fields where people presently relieve themselves. Some low, temporary partitions, made of cheap mats, could be installed for privacy and a few paving slabs could be placed as footpads to squat on. People could be taught to use the trench toilets and to cover over the excrement with the heaped up soil from the trench cutting. When full, the trenches would be covered by soil for a few months, new trenches would be dug, the partitions moved, and the fertiliser created could either be sold or applied to commonly owned village grazing lands that are so barren today.

One more proposal that he made was that drainage and paving material could be bought and supplied to the village. The villagers would organise themselves in groups to slope and level the streets and alleys round their houses, dig out the drainage ditches and pave them to facilitate the removal of waste water from the village itself. The present sloping of streets and alleys has evolved over many centuries and functions reasonably well. The hard surfacing, however, would considerably improve the functioning of the system.

With these two very simple technological introductions and a change in the social practices, the general cleanliness and living conditions of Sugao could be enhanced. The improvements would not achieve everything that widespread use of gobar gas could, but some gains would be made and the village would learn from successful completion of an immediately useful co-operative effort. This might lead to increased trust and a propensity to venture upon innovations and changes requiring more complex social reorganisation. It illustrates the importance of striking a balance between choosing and modifying a technology so that it fits into the social organisation of village India and in the process of introducing the new technology attempting to incrementally modify the existing social relationships.

The willingness of Sugao’s neo-buddhists to take risks and co-operate has been increased by their success in organising a collective lift irrigation scheme. A similar growth of social confidence could equally occur in the village as a whole around other successful actions that would benefit the whole community; for instance, the scheme suggested by the Sugao leader for improving waste disposal. The evolution of social organisational capacity can result from introducing more basic and simple technology that delivers some benefits and creates a social environment receptive to
reorganising in ways that are essential for the widespread adoption and assimilation of other far-fetched reaching technology, such as gobar gas, that may be more transforming of society in the long run.

Social readiness to absorb and assimilate a new technology is an important criterion for assessing whether a technology is an ‘appropriate’ one for any particular context. It must be given equal importance when considering the possible application of a particular technology in a specific context. A technology is only fully ‘appropriate’ when there exists a fit between it and the organisational capability to receive it in the social system in which it is introduced. In addition to technical efficiency it must also be judged from this perspective and from the point of view of its ability to shape and change the social environment in ways that will facilitate incremental steps towards transforming rural life.

Notes

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1 Gobar gas is generated when organic matter such as animal, human and plant waste is mixed with a given proportion of water (4:5 ratio) to form a slurry. This is fed into an enclosed, impervious container called a digester and allowed to decompose. Methane gas, along with carbon dioxide, (in a proportion of 55 per cent to 45 per cent with traces of hydrogen sulphide) is generated by anaerobic bacterial action. This gas is collected in a dome placed over the digester and when it reaches the necessary pressure it can be released and burned to provide energy for a variety of uses. An overview of the evolution of the technology is given in S K Subramanian, “Bio Gas Systems in Asia”, Management Development Institute, New Delhi, 1977.
3 Although the KVIC consistently makes the claim that the nitrogen content of the fertiliser is enhanced not all of the literature pertaining to gobar gas plants supports this. For example, see Ramesh Bhatia, ‘Economic Appraisal of Bio-gas Units in India’ Economic and Political Weekly, Special Number, August 1977.
7 In his paper, “Energy Alternatives for Irrigation Pumping: Some Results for Small Farms in North Bihar”, Ramesh Bhatia states that the gobar gas research centre at Ajitmal in Etawah district of Uttar Pradesh has developed a gobar gas plant based on the Chinese design. There were 45 such plants in operation in the area in 1978. Their advantage is that the capital cost is 40 per cent lower than the conventional plants: local masons can do the work of constructing it, and maintenance costs are reduced since the steel dome which required periodic painting is eliminated. These plants can be constructed under the ground beneath a cowshed or other area near the kitchen.  Scientifically measured comparative techno-economic parameters of the two types of plants are not yet available. Also some problems of choking up of the plant due to incorrect mixing and over-adding of slurry have been encountered.
8 Maharashtra Gandhi Smarak Nidhi, Kothrud, Poona.

Cost of Protecting India’s Sugar Industry

Susmita Rakshit

There is no indication that, even after all these years of protection, the sugar industry is on its way to self-sustaining growth. The resources costs of protection have been enormous both absolutely and relatively, even neglecting the huge cost to the economy arising out of faulty location sustained through a system of zonal pricing and restrictions on movement of sugar. The worst sufferer has been the consumer of sugar who has had to bear the lion’s share of this cost.

I

WHEN goods can move freely between countries and all markets are perfectly competitive, the amounts in which the goods will be produced in a country depend on the country’s ‘comparative advantages’ in producing different goods. Such a pattern of production maximises the value of the national product at international prices. The consumers, on the other hand, have the opportunity of maximising their utilities by equating the marginal rates of consumer substitution between goods with the ratios of their prices in the international free market. The amounts chosen to be consumed can thus diverge widely from the amounts produced in the country.

This system is interrupted if a tariff is imposed on the import of a particular commodity into the country. There is consequently a loss to society both through inefficient allocation of resources and distortion in the pattern of consumption. Hence the loss, that is the ‘cost of protection’, can be divided into two parts: the ‘production cost’ and the ‘consumption cost’ of protection. In order to measure these costs in the context of a particular industry the following partial equilibrium analysis can be used.1 In figure (1) let SS be the domestic supply curve of an importable commodity and DD the compensated demand curve through the free-trade consumption point ‘P’. Protection raised the home market price from Ft to Fp, domestic production increases by amount bc, the resource cost of production (including normal profit) in excess of the internationally accepted value of the amount produced increases by amount abc — called the ‘production cost of protection’ — and domestic con-