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CHARCOAL PRODUCTION AND MARKETING

IN GUJARAT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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Foreword

Promotion of improved systems of production, distribution and utilization of wood energy for household and industrial purposes is one of the major objectives of the Regional Wood Energy Development Programme in Asia.

Charcoal, an age old refined from of wood fuel, still remains an important energy source for domestic cooking and a wide range of industrial and processing applications such as manufacturing of activated carbon and calcium carbide, reduction of iron ore in the steel industry, black smithies, cloth ironing, heavy-clay soil conditioner, orchid planting medium, etc.

Despite its versatility, charcoal production is often not encouraged due to a wide belief that charcoal making would contribute to deforestation or would be a less efficient source of energy than fuelwood. While unsustainable practices do exist, experiences in many countries also show the contrary, where charcoal making does promote tree production and a wiser use of tree resources, in addition to income generation and employment for local people. Examples that may be referred to are: charcoal production from plantations for the steel industry in Brazil; some 20 year (sustainable) practice in natural mangrove forest management for charcoal making in Southern Thailand and Peninsular Malaysia; over 40 year practice of small farmers in the Rhizophora cultivation for charcoal and pole production (upper part of the Gulf of Thailand) in which some of them today still survive the onslaught of a pervasive prawn culture industry. Other notable examples are: charcoal production systems from wastewood in sawmill and from rubber tree replanting programmes in many south east Asian countries and the production of coconut-shell charcoal (eg. Philippines, Indonesia, Sri Lanka, South India and Thailand), carbonized sawdust briquettes industry etc. Charcoal and its derived products, have also become an increasingly important, commodity in the international trade.

In India, old records show that charcoal production has been quite important in the past but later it apparently was marginalized due to a general scarcity of fuelwood and in some cases replaced by coal substitution. Lately however, there has been an upsurge in charcoal demand for industrial application, notably from calcium carbide and activated carbon manufacturers.

Considering the potential fuelwood supplies from social forestry programmes and wasteland development in India, an excellent opportunity exists to meet such a demand surge from modern industries in addition to the many traditional applications. However, due to a lack of understanding coupled with very limited data presently available on how charcoal production and marketing systems operate, it is very difficult, if not possible, for the development planner to make an appropriate assessment, let alone, attempting an intervention on charcoal for sustainable development.

This first pilot study, conducted by Professors P.M. Shingi and S.P. Seetharaman of the Indian Institute of Management, Center for Management in Agriculture, Ahmedabad has revealed many interesting features of charcoal production, trade and marketing. They include its contribution to wasteland development and to employment and income generation of people in both the rural and ruban areas. The study also highlights the legal and administrative difficulties encountered by farmers and traders, especially in relation to tree harvesting, charcoal processing and transport, all requiring separate permits from the local authorities.

This project wishes to express its sincere thanks to the authors for their very significant contribution to our understanding of the problems and potential of the charcoal sector in Gujarat. I also wish to thank Dr. Aroon Chomcharn, Wood Energy Conversion Specialist of this project who provided supervision and assisted in technical editing and to Ms. Pimpa Molkul and Panpicha Issawasopon who provided editorial support and text lay out.

It is hoped that this report will be useful, especially for the forestry, energy, rural industry and rural development planners in their quest for sustainable development in rural areas. Any comment and feed back from the readers will be highly appreciated.

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Chief Technical Adviser

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1. DEVELOPMENT BACKGROUND AND JUSTIFICATION

1.1 Background

Gujarat is one of the leading states in India in promoting and propagating non-conventional and renewable energy sources and conserving non-renewable sources of energy. The Gujarat Energy Development Agency (GEDA) was constituted to undertake projects such as (a) obtaining electricity from wind energy; (b) growing energy plantations; (c) developing smokeless biofuel burning stoves; (d) demonstrating biogas plants; (e) implementing the solar cooker programme; (f) promoting integrated rural energy centres; and (g) promoting energy conservation in agriculture, food processing, and marine-based industries. The Seventh Five Year Plan of Gujarat has made a provision of Rs. 94 million to assist these efforts.

Simultaneously, the importance of forests and social forestry has been recognized for improving the supply of wood-based energy. The state has only 9.5% of its geographical area under forests. This works out to only 0.05 hectares of forests per capita which is alarmingly low. Besides, almost one-third of the forest area is sparsely vegetated. The community forestry programme, undertaken by the Social Forestry Wing of the State Forest Department, has been actively undertaking energy plantations on various types of land. To conserve the existing state owned forests, the government has imposed a moratorium on the cutting of forests since 1987-88. As a result, the by-products of around 1.2 million trees are not available annually. This has increased the importance of farm forestry and community forestry to meet fuelwood and other needs. The response of farmers in adopting farm forestry essentially depends on the marketing potential of farm forest products outputs.

Along with Eucalyptus, *Prosopis juliflora* is becoming a popular species in Gujarat as part of farm forestry. Charcoal is one of the by-products of *Prosopis juliflora*, which is being grown in larger areas of drought affected regions of the State. The Prosopis-based farm forestry programme has good potential in Gujarat not only for meeting energy needs, but also to support the wastelands development programme. This study therefore, was undertaken to understand the current practices and trends in charcoal production and marketing and to identify policy implications for developing renewable sources of energy. The Asarva market in Ahmedabad is the oldest and a unique charcoal market in the country and as a result, Gujarat was selected as the study area. The findings, however, would be applicable also to other states having sizable wastelands.

1.2 Objectives of Study

In India, a considerable quantity of charcoal is used in urban areas for applications ranging from services (food vending, laundry, etc.) and industrial processing to domestic cooking. Unfortunately, field information on various aspects of charcoal production, distribution and consumption is almost non-existent. In order to promote development and proper intervention regarding charcoal and direct links with social forestry and wastelands development programmes, collection of firsthand information on charcoal markets and marketing practices would be useful. This study was undertaken with the view of sharing regional experiences on charcoal production between countries participating in the FAO Regional Wood Energy Development Programme in Asia.

The objectives of this study were:

1) To analyze the use, consumption, and distribution patterns of charcoal in an urban area of Ahmedabad,
2) To identify the sources of production and flow to urban centres,
3) To assess the nature and characteristics of the charcoal marketing system, and
4) To identify policy gaps to strengthen the planning and implementation potential of forestry, energy, and rural industry sub-sectors by developing the charcoal programme, if relevant, in support of social forestry and wastelands development activities.

1.3 Survey Method

Starting from the consumption pattern of charcoal, the study looked at the production sub-system, charcoal processing, marketing, and the policy environment. In the absence of previous studies of this kind, detailed statistics on various aspects of charcoal production and trade were gathered to provide a benchmark for future comparisons and analysis. The survey obtained information:

1) **from official records**, whereby a review on charcoal production and movement through the Ahmedabad market was made. All the movements of charcoal arriving at and despatched from Ahmedabad were analyzed to identify context-specific locations of production and consumption. When a truck carrying charcoal entered or left the Ahmedabad market, it was recorded in the register of the forest chowky (inspection booth) in the market itself. These registers provided adequate data for a relatively accurate assessment of the business transactions for the years 1986/87 through 1989/90. The forest chowky did not exist prior to this period. Records of 11,622 truck movements were studied (see detail later in chapter 4, table 4.1).

2) **from the user**, whereby different types of users in Ahmedabad and outside Ahmedabad were studied and charcoal application practices and trends were assessed selectively. Aspects such as present consumption levels, alternative fuels or raw materials, prices, user-supplier/seller arrangements, credit facilities, charcoal using devices, criteria used for charcoal selection, grade preference, transportation and storage practices, and sources of supply were studied to gain insights into the consumption patterns from the user's angle.

3) **from a short study** of the Vadgam Cooperative Farm Forestry and Charcoal Making Programme. This was done to understand production techniques, labour inputs, charcoal prices, income generation potential, wood species used, and constraints.

A survey was conducted primarily in Ahmedabad to trace the distribution channels and patterns of consumption. Trade aspects included types of distributors/sellers, nature and scale of operation, sources of supply, cost of procurement, mode of delivery, marketing arrangements, and market trends. The study also identified major demand centres for charcoal and changes that were taking place there. Based on information so obtained, the study also aimed at assessing the value added potential of charcoal and its attractiveness to rural people for possible participation in small scale charcoal producing enterprises through farm forestry and wasteland development programmes. And finally efforts were made to assess the future potential for charcoal development. The study also identified research and information gaps for policy prescriptions.

2. CHARCOAL AND ITS CONSUMERS

2.1 General Quality Preferences

Charcoal is made from ligno-cellulosics materials such as wood and other woody biomass wastes through a process called "carbonization". Wood is heated in a closed entity with very limited air (oxygen) to decompose it into a variety of substances, the important one being charcoal. Charcoal is a black porous solid substance consisting mainly of elemental carbon (FAO, 1985). Foley (1986) reports that charcoal can be made from organic materials such as wood, straw, coconut shells, rice husks, and bones. Wood, however, is the most common and best yielding raw material. He points out that charcoal made out of hardwoods yield a dense charcoal which burns cleanly and slowly. Charcoal made from softwoods tends to be light and porous, burns too quickly and is thus prone to breakage during transport. Properties such as fixed carbon, volatile matter, moisture and ash contents decide the suitability of charcoal for different purposes. For example, charcoal for industrial or metallurgical use should have a fixed carbon content of 85-90%. Charcoal with fixed carbon content of 65-75% and volatile matter of 20-30% is usually used for cooking, and general applications (Foley, 1986).

2.2 Local Use in Ahmedabad

Although this study provides information on charcoal use in Ahmedabad, given the nature of charcoal use, there is every reason to believe that the pattern in other places would be, by and large, very similar. The extent of use would probably vary depending on the availability of supply and substitutes. The usage is as follows:

Figure 2.1: Fresh Charcoal Bags Ready for the Market

2.2.1 Laundry units

A large number of laundry units in Ahmedabad use charcoal for ironing clothes. Most families wash clothes at home and get them ironed by small laundry units located near their residences. People in general are very dress conscious and invariably wear neatly ironed clothes. Most of the laundry units use charcoal in their irons.

Figure 2.2: Laundry Service Using Traditional Charcoal-Heated Iron

Irons come in two sizes; Number 18 and Number 20, and around Rs. 235 and Rs. 260 respectively. Once filled with charcoal and ignited, a Number 18 iron can be operated for about 45 minutes. A Number 20 iron, can be operated for about an hour. Depending on the skill of the worker, about 20 clothes of mixed type can be ironed in an hour. One fill requires about 500 grams of charcoal. An eight-hour working day requires around 3 kg. of charcoal, allowing sufficient time for breaks and attending to customers.

Laundrymen prefer wood-based charcoal over hard coal which not only produces smoke and smell, but is also difficult to ignite and may extinguish with the slightest movement. Since the iron has to be moved over crumpled clothes, hard coal creates operational problems. The alternative is an electric iron. Laundrymen also prefer it. However, most laundry units are operated without registration or proper authorization. Thus they are liable to be evicted without notice. Therefore, they cannot think of obtaining an electricity connection to operate an electric iron. Secondly, obtaining a power connection is not easy. Laundrymen, therefore, compromise with charcoal. They feel that the operating cost of an electric iron would be marginally higher than that of a charcoal using iron. Price and quality of charcoal, however, have been problems and often discourage them from using charcoal. Poor quality charcoal gives off sparks which sometimes damage valuable clothes.

Laundrymen conservatively estimate 2 kg. (instead of 3 kg.) as a reasonable daily amount charcoal for a full day's operation because the workload is not heavy on all days in a year. Assuming that these units work for about 300 days in a year, annual consumption of charcoal for a laundry unit comes to around 600 kg.

It is difficult to estimate the total number of laundry units in Ahmedabad as they are scattered all over the city and generally operate from small and temporary sheds. It is also difficult to obtain the precise number of laundrymen who use charcoal operated irons. A rough estimate is that around 1000 units in Ahmedabad use charcoal for ironing jobs. The annual consumption of laundrymen, therefore, would be about 600 MT (1000 units x 300 days x 2 kg.) or about 75 truckloads.

Charcoal-based laundry units generally do not store charcoal in large quantities partly because of lack of space and partly because of cash flow problems. Laundrymen prefer to buy charcoal on alternate days. Their experience shows that there is no price advantage in buying one bag of 40 kg. charcoal which would last about 20 days compared with buying 5 kg. of charcoal every day because the two rates do not vary a great deal. There is an advantage in buying small quantities of charcoal because the laundrymen can be choosy.

The method of procuring loose charcoal is interesting. A person collects orders from individual laundry units in the morning, buys the preferred grade of charcoal, and delivers it within an hour. He collects Rs. 2 as a service charge per unit per trip. He knows the requirements of laundrymen and buys charcoal from a reliable depot. Not all charcoal depots allow consumers to select charcoal. Some laundrymen do not mind buying ungraded charcoal at a lower price as the leftover, chips and fines, can be used by their womenfolk for cooking.

2.2.2 Badami (Almond-like) charcoal briquette

Charcoal traders in Ahmedabad estimate that about one-fourth of a bag of charcoal contains fines and chips. Charcoal fines are converted to Badami coal briquettes, which offer the advantage of burning slowly. Making Badami charcoal briquettes is rather simple. Charcoal fines and chips are mixed with yellow clay and sawdust in the ratio of 80:10:10. The mixture is kept moist overnight and fed into an extruder operated by an electric motor. In one cycle, the extruder makes about 10-15 cylindrically shaped pieces which are about 2 inches in length. These pieces are sun-dried for about 8 to 9 hours. The machine operates for about 3 hours every day and produces a daily output of 1,500 kg. The factor limiting production is the availability of open space for drying.

Generally production is carried out in batches. Each batch produces stocks which could last for about 15 days. Production is stopped during the rainy season. Demand for this charcoal is more during winter months. Badami charcoal is sold at Rs. 16 for 20 kg.

Badami charcoal is popular among lower middle class households. One kg of Badami charcoal can keep the stove burning for about an hour. This is enough for cooking one meal for a family of five persons. Cost of charcoal is less than a rupee/family/meal. As more and more families switch over to kerosene and LPG for fuel, demand for Badami charcoal has declined. Ten years ago, 6-7 units were manufacturing Badami coal in Ahmedabad. Today not more than two units are in operation. Small tea shops and streetcorner eating places use Badami coal in small quantities.

Figure 2.3: Briquette Made from Charcoal Fines, and a Press Mold

2.2.3 Lead extracting

Lead extraction is another small scale unorganized industry which uses charcoal as fuel. Substitutes for charcoal are not suitable given the nature of processing. Owners of kilns (bhatti) purchase discarded automobile batteries and smelt them to extract lead. Diesel operated blowers constantly fan the burning charcoal to keep the temperature high. The work is done by four labourers who work together in a group, mostly at night, for a shift of 4-5 hours. There are about 30 kilns in Ahmedabad. Very few kilns run two shifts. Initial processing of the discarded batteries requires about 6 bags (240 kg.) of charcoal. A second processing of the initially processed material requires another 4 bags (160 kg.) of charcoal. Taking the average daily consumption / kiln as 5 bags, and assuming 300 operating days, annual consumption for this sector works out to about 45,000 bags or 1,800 metric. Processed lead is generally sold in small lots.

Since lead processing units are located on the outskirts of the city, transport costs are high and average about Rs. 3.75 a bag. Bags are weighed twice, the first weighing being done just before despatch from the market and the second immediately after arrival. Each weighing costs Rs. 6.00 / cart load. This ensures that charcoal bags are not tampered with by cart drivers who give small quantities of charcoal to roadside tea-makers and hoteliers in exchange for food or hot drinks. The lead extractors are not very quality conscious. In fact, some portion of fines is believe to help obtain good quality output. The traders generally supply ungraded charcoal.

2.2.4 Metal processing

There are not many metal processing units in Ahmedabad. However, a few manganese processing units use sizable quantities of charcoal. Metallic ore is mixed in alternate layers with charcoal and heated in a furnace to extract the metal. Daily consumption of charcoal varies from

60 to 70 bags, and is used mainly for heating the raw material for further processing. Charcoal users in this industry are particular about the quality of charcoal. Impurities are perceived to affect the output. Charcoal is screened and cleaned upon arrival. The price is fixed on a 100 MT basis. This means that once a price is negotiated, it is valid till the supply of 100 MT is completed. At least one truckload of charcoal is supplied every week. Price includes delivery at the factory gate. Ruling prices are Rs. 70-72/20 kg., including all expenses.

2.2.5 Dhania dal (coriander seeds) processing

Dhania dal or coriander seeds are taken after meals, snacks, or tea as a mouth freshener. The moist seeds are put in an electrically operated mill to separate the husk and split the seed. The seeds are roasted and marketed. Medium sized charcoal stoves are used for roasting. Two electrically powered blades rotate at slow speed to roast the dal uniformly without burning it.

Figure 2.4: Roasting of Dhania Dal with Charcoal Stove

A unit of eight stoves working for six hours consumes roughly two bags of charcoal. Production is seasonal and the units generally operate for 180 to 200 days in a year. About seven units operate in Ahmedabad. The number of stoves in each unit varies from 6-16. Depending on the quality of charcoal, it takes about 45 minutes to one hour for roasting 12 kg. of dal. But the users are not quality conscious. Ungraded charcoal is generally supplied and accepted without any resistance. It is possible to use gas or kerosene for roasting operations. However, most of the workers are scared of the accidents that could result from using these fuels. Hard coal is not used because it gives out intense heat and burns the roasting pans.

2.2.6 Agarbatti (incense) manufacturing

Next to Karnataka, Ahmedabad is emerging as a large incense manufacturing centre, giving employment to around 300,000 middle to lower middle class housewives.

There are two types of incense sticks: oil-based and water-based. The oil-based incense, known as Darbar Agarbatti is generally slow-burning and one stick could last up to 45 minutes. One kilogram of this incense normally requires 200 to 250 grams of finely ground charcoal dust. The water-based incense stick, on the other hand, burns for 20 minutes and consumes about 500 grams of charcoal dust / kilogram of incense. The price of oil-based incense sticks ranges from Rs. 19-125 / kg., and that of water-based sticks from Rs. 15-200 / kg., depending on the fragrance.

There are 60 varieties of oil-based incense and nearly 500 varieties of water-based sticks. Sticks are about eight inches in length; certain varieties could go up to 24 inches. Charcoal dust is used to keep the fire going. Therefore, charcoal dust must be of extremely good quality and foreign matter must not exceed one per cent. Hard coal dust is not used in incense manufacturing because the sticks do not burn properly.

Ahmedabad has about sixty units manufacturing incense sticks and production ranges from 100-3,000 kg./day, averaging around 500 kg./unit. A person could roll up to 8,000 sticks a day earning between Rs. 25-30. While the low to medium quality incense manufacturers procure charcoal fines locally, the high quality and large scale manufacturers get it from Tamil Nadu, as well as from the local market.

2.2.7 Food vendors

Roadside catering units are another important group of charcoal users. Though their number is not very large, they are concentrated in those areas where business is brisk. Most units use charcoal as a fuel. Kerosene is as expensive as charcoal; however, charcoal provides uniform and prolonged heat, which is essential for preparing several food items. A kerosene stove either burns the vegetables or leaves some portion half-cooked. Some of the units have switched over to gas (although, this is not permitted), and they have to pay 25-50% more for a cylinder. Hard coal takes long time to ignite. Since the business is not continuous and service has to be quick, charcoal is preferred.

As a general practice, the stove is ready by 5 pm. Each stove requires around 2-2.5 kg. of charcoal. As the business picks up, more and more charcoal is added to keep the fire burning. The stove door is kept closed when the business is slack to save on fuel. Vendors operate till midnight and, depending on the business and hours of operation, require 5-10 kg. of charcoal for a stove.

Vendors generally buy one bag of charcoal which lasts about a week. The charcoal depot owner takes orders in the evening and delivers charcoal next morning by cycle rickshaw. Vendors have to bear transport charges of Rs. 3 a bag. Generally, charcoal is sold ungraded but marginally cleaned with sieves.

The charcoal consumption figures for vendors in the Law Garden area, one of the famous snack centres of Ahmedabad, are given in Table 2.1. Consumption is more on Saturday and Sunday, but per day figures are the average for a normal week.

Figure 2.5: Preparing Snack on Charcoal Fired Stove

Table 2.1 : Vendor's Consumption of Charcoal at the Law Garden

Vendor	Food Item	No. of Stoves/Bhatti	Charcoal Use (kg/day)
A	Pav-Bhaji	3	30
B	Pav-Bhaji	2	20
C	Dosa & Pav-Bhaji	2	35
D	Pav-Bhaji	1	5
E	Tandoor	1	20
F	Tandoor	1	20
G	Tandoor	1	20
H	Dosa & Pav-Bhaji	2	12
I	Pav-Bhaji	2	5
J	Pav-Bhaji	1	10
K	Pav-Bhaji	2	10
L	Pav-Bhaji	1	10
			5
		Total daily use	202

Other important snack centres are Manek Chowk, Memnagar, and Bhatta. These centres consume approximately 800 kg of charcoal in a day. There are about 350 vendors who consume 3-4 kg. of charcoal a day scattered in different parts of the city. About 90 % of the small vendors use charcoal.

Assuming these five major centers consume an average of 192 kg. of charcoal/day and operate 35 days/year, estimated consumption would be about 350 MT/year. For another 350 vendors in other parts of the city, consumption could be similarly estimated at about 330 MT/year.

Figure 2.6: A Road-Side Food and Tea Shop Using Charcoal

2.2.8 Hostels

The Blind School of Ahmedabad, which has been rendering highly praiseworthy service, runs a hostel where about 230 residents take meals. The school uses charcoal as fuel for cooking. It also uses hard coal which gives heat for about 3-4 hours. The ratio of charcoal to hard coal is 5:1. The hostel is closed for about two months in an academic year. The share of charcoal consumption for different items of food is estimated as follows:

Roti	:	30 %	Vegetables	:	20 %
Rice	:	10 %	Tea	:	7.5%
Curry	:	20 %	Milk	:	12.5%

The School prefers charcoal to wood because a) consumption of wood tends to be more wasteful, and therefore more expensive; (b) fuelwood blackens cooking utensils, requiring more labour for cleaning; and (c) fuelwood gives off smoke.

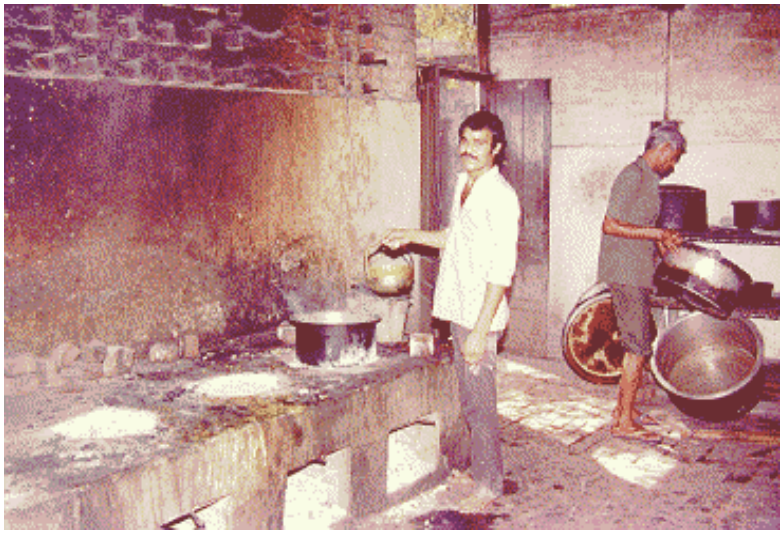


Figure 2.7: Preparing Meal with Charcoal Stoves at the Blind School

Charcoal is supplied by a retailer who has been serving the school for several years. The School does not purchase its requirements from the wholesale market because of the small quantity required. Once every two months the retailer visits the School to determine its requirements. Transport, loading, and unloading costs are extra (see table 2.2).

Table 2.2 : Charcoal Purchases for the Blind School

Date of Purchase	No. of Bags	Rate Rs. /20 kg. bag	Transport Cost (Rs.)	Total kg.	Ave. Consump. kg./day
Jun 16,1990	70	60	350	3,210	(Rains)28
Nov 6,1990	73	70	330	3,452	(Winter)40
Jan 31,1991	115	80	575	4,418	(Summer)26
Aug 17,1991	96	82	400	3,900	45
Dec 9,1991	92	85	460	3,660	33
			17 months total	18,640	

The School does not screen or weigh the material on its arrival. The kitchen staff screen the material manually. Fines are sold at Rs. 14 a bag to self-employed women who make fuel-balls for domestic use by mixing fines with cowdung. Annual consumption for this school is an estimated 15 MT.

Visits to the University hostels in the city, however, give an altogether different picture. None of these hostels ever uses, or is even thinking of using, charcoal for cooking. It is generally believed that charcoal is more expensive. Charcoal is also not considered suitable for cooking purpose because it cannot provide heat continuously for a sufficiently long period of time. Hence, hard coal and fuelwood are used in combination.

Fuelwood is used for igniting the hard coal and cooking food items like rice, curry, and vegetables. Hard coal is mostly used for making chapaties (unleavened bread). For two standard meals for about 250 diners, a mess generally requires 1,500 kg. of coal, at Rs.4,500, and 2,000 kg. of fuelwood, at Rs.1,500 / month. According to the mess staff, the price of hard coal has gone up from Rs.800 to Rs.1,500/500 kg. in the last 2-3 years. Kerosene or gas is not considered as alternate fuel.

2.3 Use Outside Ahmedabad

2.3.1 Calcium carbonate industry

Calcium carbonate is used as a filler in toothpaste, medicines, PVC pipes, leather goods, rubber products, and even specialized clothes. Searsole Chemicals Limited (SCL), Dehra Dun, which manufactures calcium carbonate, has been using charcoal to make producer gas, which is used for calcining the limestone. In 1990, after a great deal of debate, it decided to discontinue the use of charcoal because charcoal prices were increasing steadily as follows:

Year	Price Rs/MT	Increase rate from base year, %
1981	1,400	-
1983	1,700	21.4
1985	2,200	57.1
1987	2,900	107.1
1989	3,200	128.6
1991	3,500	150.0

Obviously, the operations became unviable because calcium carbonate is not a high value product. Calcium carbonate's price ranged from Rs. 5-6/kg. SCL was not a major user of charcoal compared to other industries, which use charcoal as raw material for chemical processing. Therefore, SRL did not have a price advantage over a bulk-purchaser which normally would get a lower price.

SCL started using charcoal in the early eighties as a substitute for pearl coke, which was then available as a by-product from steel plants. Later, the steel plants started putting pearl coke to captive use.

SCL needed around 15 rail wagons of charcoal every month; each wagon carrying 18 MT. Though a wagon was rated for 24-25 MT, due to the size, weight, and packing of charcoal, the wagon could never reach that carrying capacity. Transport charges, however, had to be paid on the basis of rated tonnage, which increased the cost of charcoal.

Unlike major users of charcoal who floated tenders for charcoal, SCL had to place orders with dealers for its requirements. This was partly because of the small quantity it required.

Furthermore, the calcium carbonate industry was not highly sensitive to the quality and grade of charcoal which was the case with other major users. SCL was more concerned with the calorific value of charcoal. The calcium carbonate industry still considers charcoal as an excellent fuel, but regards it as expensive at present rates.

There are about eight medium sized units manufacturing calcium carbonate, each with an annual installed capacity of around 35,000 MT, i.e., 100 MT/day. Another 8 to 10 units are in the small sector with a production capacity of 15 MT a day. Most of these units are located in the north. Production is estimated at around 200,000 MT. Since one ton of calcium carbonate requires approximately 0.4 MT of charcoal, the industry as a whole has potential to use about 80,000 MT of charcoal, annually. In the total cost of production, the share of charcoal is sizable, around 25%. With SCL having discontinued the use of charcoal, other manufacturers are also likely to follow suit.

2.3.2 Calcium carbide industry

Uttar Pradesh Carbide and Chemicals Limited (UPCCL), located in Dehra Dun, uses about 1,000 MT of charcoal / month to extract carbon from charcoal making calcium carbide. The process is as follows: limestone is burnt to obtain calcium oxide. Calcium oxide is then fused with glowing charcoal carbon at very high temperatures to obtain calcium carbide. The carbide, after it has solidified, is sold as a material for use. The processors converted it into gas, which was used in metal welding and cutting operations. Like UPCCL, there are another five major carbide plants and a few small manufacturers in the country.

Though the ratio of calcium oxide and charcoal in the making of calcium carbide is 1:1, some other good grade carbon raw materials, e.g. anthracite coal and/or petroleum coke are also used to the extent of about 30%, along with charcoal carbon. This means that the charcoal requirement in production is only about 70%.

The installed capacity of carbide manufacturing in the country is estimated at 150,000 MT/annum. At this level, charcoal requirements work out to 8,750 MT/month or 105,000 MT/annum. However, actual production varies from 50-60% of the installed capacity because this industry also heavily depends on electricity. Power failures are the most common cause for production shut-downs. Therefore, it is assumed that the current use of charcoal in the carbide industry is about 5,250 MT/month or 63,000 MT/annum (80% by big units and 20% by smaller units).

UPCCL has been obtaining its charcoal supplies from Gujarat and Tamil Nadu. Alhough Gujarat has been a good supplier so far, supplies went down in 1990-91. Therefore, UPCCL obtained supplies from Tamil Nadu. UPCCL feels that the quality of charcoal it got from Tamil Nadu is better than that from Gujarat suppliers. Besides, Gujarat alone could not meet its entire requirements.

The carbide industry is highly quality conscious. Charcoal on arrival at the factory is tested for fixed carbon, ash, and volatile matter, as well as moisture contents. Charcoal which does meet these requirements is either rejected or bought at a reduced price. The final price paid is determined after the test reports are available. The industry is not very sure which tree species gives them the preferred quality of charcoal. Presently, it is a seller's market for charcoal and therefore less choice can be exercised by the industry.

In 1991, UPCCL was buying charcoal at Rs. 3,100/metric ton, which was about 10 % more than what it paid in 1990. One month's inventory is usually maintained. UPCCL recently floated a tender for the supply of charcoal. It does not depend on one supplier. The suppliers are paid partly at the time of delivery, with the balance paid on an agreed date. For the carbide industry, charcoal is an important raw material. If charcoal is not available indigenously, high grade imported coal, such as that from Australia, has to be substituted.

The installed capacity of a big plant is about 21,000 MT/year. The smaller units operate at 3-5 MT/day. The market price of calcium carbide is about Rs.13,000/ton. Assuming a yearly minimum production of 80,000 MT, the turnover is Rs. 1,040 million. The units require about 60,000 MT of charcoal valued at Rs.1,550 million. In the production cost outlay, therefore, charcoal accounts for about 18%. The carbide industry is highly power intensive and electricity consumption itself accounts about 50% of the total production cost. Even the limestone cost fluctuates about 8%. This signifies the importance of charcoal and electrical power for the carbide industry.

Table 2.3 : Charcoal Despatches to Dehra Dun from Asarva Market

Month	1987-88		1988-89	
	Bags	MT	Bags	MT
April	14,467	578.7	8,306	332.2
May	1,894	75.8	9,830	393.2
June	1,600	64.0	4,220	168.8
July	390	15.6	1,390	55.6
August	0	0.0	565	22.6
September	2,655	106.2	613	24.5
October	2,035	81.4	260	10.4
November	2,315	92.6	4,907	196.3
December	2,325	93.0	6,480	259.2
January	15,204	608.2	8,510	340.4
February	10,097	403.9	12,320	492.8
March	5,150	206.0	26,959	1,078.4
12 months total	**58,132**	**2,325.3**	**84,360**	**3,374.4**

Note: 1 bag = 40 kg.

2.4 Impressions

In this chapter, different types of charcoal users both in and outside Ahmedabad, with the exception of domestic users and textile processors, were investigated. In the household sector, higher income groups still use some charcoal for special cooking. It is rather difficult to estimate the consumption level of this sector. A large number of textile processing units also used charcoal as a fuel, but as its price kept increasing, they switched over to other cheaper fuels.

The users differed in their preferences for the quality of charcoal. Charcoal users, like briquette makers, lead extractors, coriander seed processors, food vendors, and student hostels were not quality conscious. They accepted ungraded charcoal. On the other hand, metal processors, incense manufacturers, and the carbide industry were highly sensitive to quality and

rejected material which did not meet the standards specified by them. They were also willing to pay more for quality. Laundrymen and the calcium carbonate industry were somewhat quality conscious. Table 2.4 summarizes the quality preference and consumption level for different users, both inside and outside Ahmedabad.

Table 2.4: User Quality Preferences and Estimated Annual Consumption
(for Gujarat charcoal used inside and outside Ahmedabad)

Use Category	Quality Consciousness	Preferences and Uses	Estimated Consumption MT
Laundry (1)	Somewhat conscious	Chips and fines not liked, impurities give sparks and damage clothes	600
Briquette Makers (local)	Not conscious	Use mostly the leftover charcoal fines	-
Lead Extractors (local)	Not conscious	Fines, chips, and good quality charcoal are all mixed in the furnace	100
Metal Processing (local)	Highly conscious	Impurities affect the output	2,000
Coriander Seeds Processing (local)	Not conscious	Used only for heating	70
Incense Manufacturers (local)	Highly conscious	No more than 1% of dust particles is tolerated, otherwise the incense would not burn properly	10
Food Vendors (local)	Not conscious	Small quantity mostly used for heating	700
Hostels (local)	Not conscious	Small quantity mostly used for heating	15
Calcium* Carbonate Industry	Somewhat conscious	Concerned with calorific value	3,200
Calcium Carbide* Industry	Highly conscious	Used for chemical processing	63,000

* National estimates

Ability to influence market mechanisms also differed with the type of consumers. The small consumers had very little or no control over markets. Moderate and bulk consumers, on the other hand, could influence the market to some extent and looked for dependable supply, quality, type of intermediaries, storage and credit facilities. The user survey indicated that all charcole in the Ahmedabad market was used for domestic, commercial, institutional, small-scale industrial users, and the large scale chemical industries purchased charcoal in Ahmedabad market. Although charcoal remained the same product, end users varied widely from illiterates to the most sophisticated. Similarly, the use of charcoal also varied from very simple use such as cooking, to the most complex use such as chemical processing.

3. PRODUCTION SUB-SYSTEM

3.1 Production Districts

In the last chapter, a brief profile of the local charcoal users and other markets served by Ahmedabad was presented. Charcoal sold at, or despatched from, Ahmedabad is mostly produced in Gujarat. Only about three per cent of the charcoal that arrives in the market comes from other states.

Of the 19 districts in Gujarat, four districts alone accounted for 90% of the charcoal supplied to the Ahmedabad market during 1986/87 and 1989/90 (see map 3.1 and figures 3.1 & 3.2). Of these four districts, Surendranagar (33 %) and Bhavnagar (33 %) supply the maximum, followed by Banaskantha (18 %), and Jamnagar (6 %). All the four districts belong to the low rainfall region of Saurashtra. Charcoal is produced in the relatively drier and risky crop production regions (see map 3.2). Charcoal is made out of *Prosopis juliflora* as the main specie(s). The monthly supply of charcoal from Gujarat and other places between 1986/87 to 1989/90, is shown in Annexures 3.1 to 3.5.

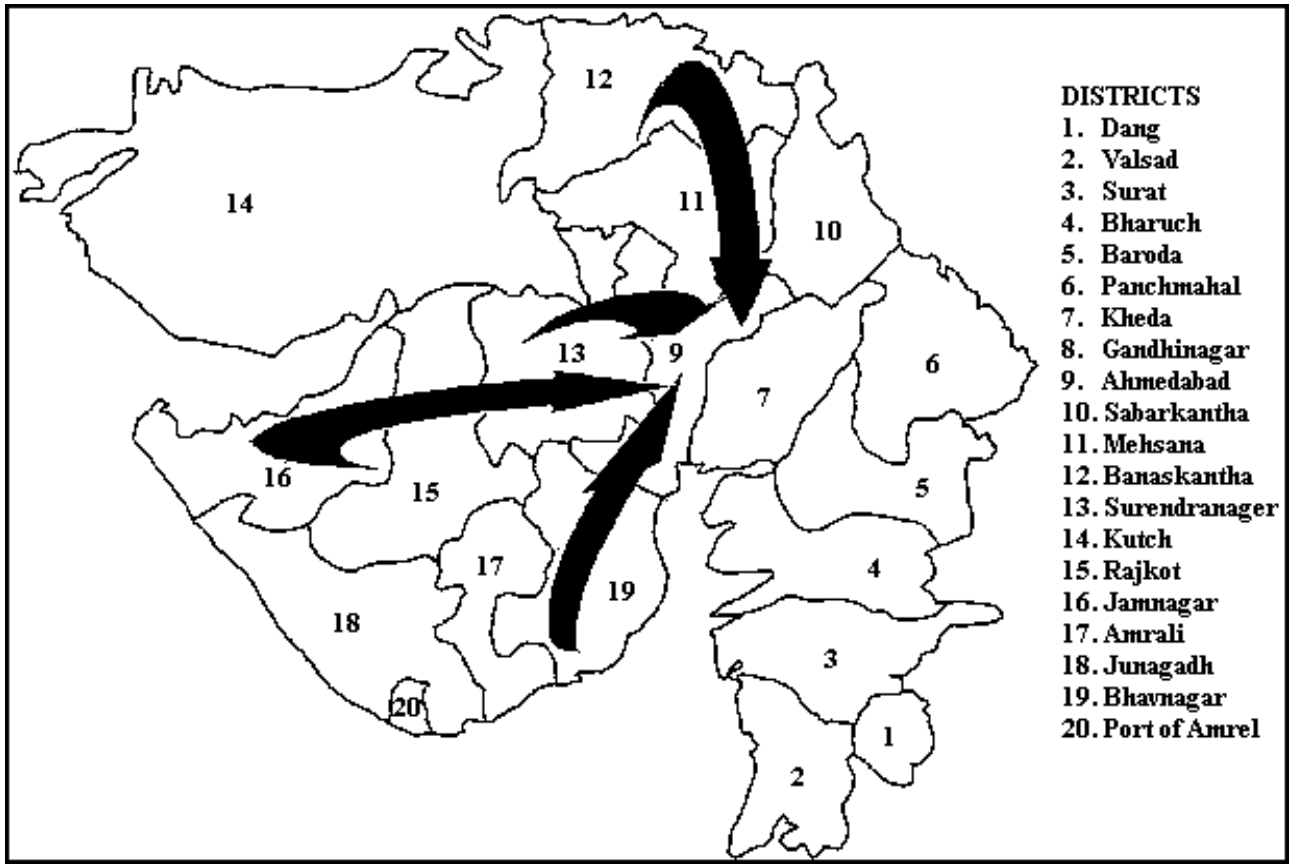
3.2 Supply Pattern of Major Districts

District-wise supply patterns vary from one year to another. The four year trend, from table 3.1, shows that Surendranagar and Banaskantha, starting from a low supply, have grown in recent years. Supplies from Bhavnagar district were the highest in 1986/87, but have come down since 1988/89. Supplies from Jamnagar were low in 1986/87, increased during 1987/88, and have declined steadily. It is difficult to identify the reasons for these trends however. Both physical and administrative reasons could probably explain such trends.

Table 3.1: Arrival of Charcoal at Ahmedabad Market During 1986/87 - 1989/90 (No. of Bags of 40 kg.)

Place of Origin	1986-87	1987-88	1988-89	1989-90	Total	Annual Average	Per cent
Districts of Gujarat							
Ahmedabad	8,929	1,658	17,400	6,800	34,787	8,697	1
Baroda	220	0	0	0	220	55	0
Bharuch	27,190	0	360	6,995	34,545	8,636	1
Bhavnagar	201,673	318,813	162,609	108,779	791,874	197,969	33
Banaskantha	20,571	6,207	72,491	327,454	426,723	106,681	18
Dang	3,473	0	0	0	3,473	868	0
Gandhinagar	6,494	1,577	19,746	12,918	40,735	10,184	2
Jamnagar	17,440	109,730	9,103	1,620	137,893	34,473	6
Junagadh	0	0	2,000	0	2,000	500	0
Kheda	810	3,367	0	0	4,177	1,044	0
Kutch	3,900	0	3,173	1,191	8,264	2,066	0
Mehsana	3,130	8,670	3,620	2,190	17,610	4,403	1
Panchmahal	0	740	613	155	1,508	377	0
Rajkot	4,975	21,110	8,905	200	35,190	8,798	1
Surat	4,705	2,253	2,470	0	9,428	2,357	0
Sabarkantha	400	0	0	0	400	100	0
Surendranagar	117,938	118,957	336,964	222,230	796,089	199,022	33
Valsad	2,929	0	0	0	2,929	732	0
Other States							
Maharashtra	6,015	3,622	16,416	7,860	33,913	8,478	1
Tamil Nadu	0	0	0	791	791	198	0
Karnataka	0	660	680	322	1,662	416	0
TOTAL	430,792	597,364	656,550	699,505	2,384,211	596,053	100

Map 3.1: Areas Supplying Charcoal to Ahmedabad Market in Gujarat



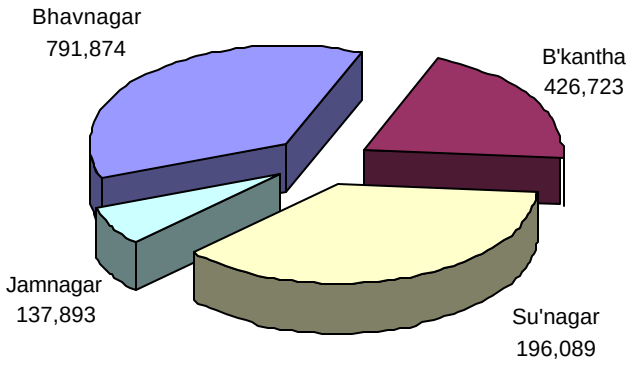


Figure 3.1: Combined Charcoal Supply Strengh of Major Districts from 1986-87 to 1989-90

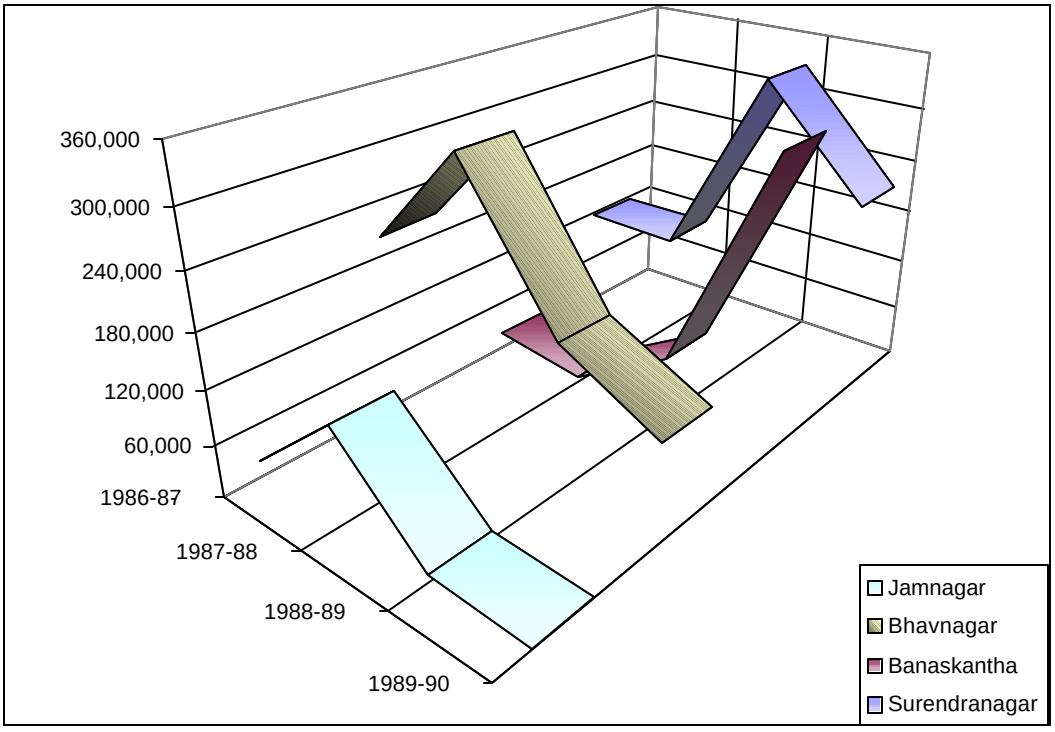
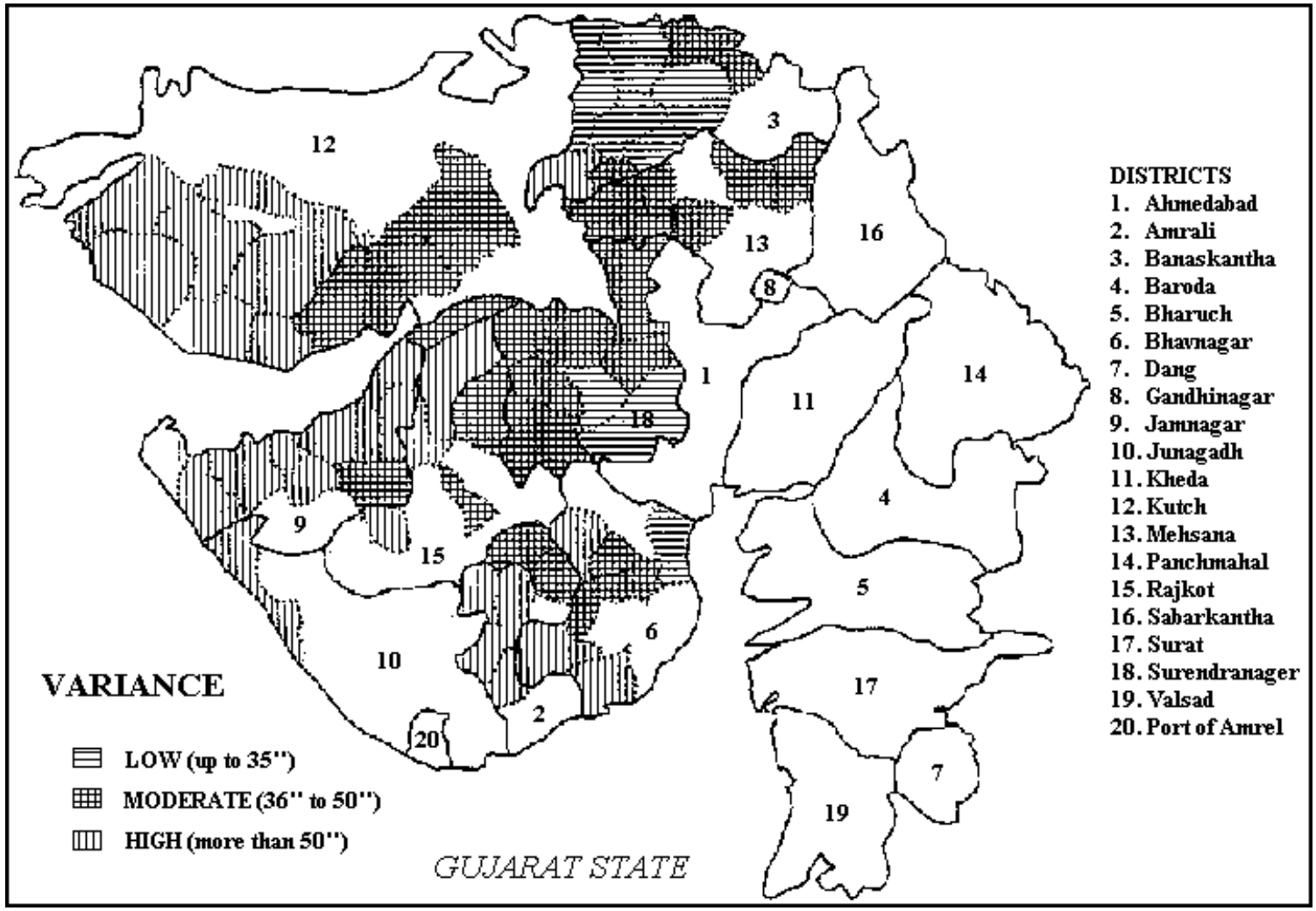


Figure 3.2: Charcoal Supply Pattern of Major Districts (1986-87 to 1989-90)

Map 3.2: Low Rainfall Regions of Gujarat



3.3 Surendranagar : A Case Study

Surendranagar district is one of the major suppliers of charcoal to Ahmedabad. The district has hills in the north-east, small elevations in the south-west, a flat and saline track in the north, and low lying areas in the east. (see map 3.3) The soils of Halvad, Dhrangdhra, Wadhwan, Lakhtar, and Dasada Talukas (revenue sub-divisions of the district) are alkaline. Most of the big rivers of the Saurashtra region originate in this district. As shown in table 3.2 below, seven categories of wastelands are found in Surendranagar district:

Table 3.2 : Categories of Wastelands in Surendranagar

Category	Wasteland area in sq. km.	% of total Geographical area
Upland with or without scrubs	1,514	14.44
Salinity-alkalinity affected land	710	6.77
Barren rocky wasteland	214	2.04
Waterlogged land	82	0.78
Degraded forest land	56	0.53
Gullied, ravinous land	35	0.34
Degraded pastures	3	0.02
Total	2,614	24.92

Source : Space Application Centre, ISRO, Ahmedabad, 1988.

About one-fourth of the geographical area of Surendranagar district, therefore, is wasteland. In fact, uplands with or without the scrubs category, which is a relatively flat area, mainly grows *Prosopis juliflora* that supports charcoal making.

The district receives about 500 mm of rainfall, which is low (see table 3.3). Variations in annual rainfall from the normal rainfall are also on the negative side. Droughts are quite common. Major crops include jowar, bajra (pearl millet), and pulses. There are no natural forests in the district and only grasslands are under the control of the forest department.

Table 3.3 : Arrival of Charcoal From Surendranagar District by Taluka in 1989-90

Taluka	Total Charcoal Supplied	% Supplied	Normal Rainfall (mm)	Variation
Halvad	52,924	23.98	586.3	42
Dhrangdhra	56,034	25.39	523.4	44
Dasada	53,660	24.31	432.5	42
Chotila	4,180	1.89	563.2	43
Limbdi	11,820	5.36	527.9	35
Lakhtar	872	0.40	516.9	42
Muli	10,780	4.89	539.8	44
Sayla	0	0.00	490.7	38
Wadhwan	775	0.35	507.0	28
Not identified	29,605	13.41		

To find the agro-climatic profile of the talukas producing and supplying charcoal, data on all the villages which supplied charcoal during 1986-90 were analyzed and aggregated at the taluka level. Nearly three quarters of the production during 1987-90 was concentrated in three talukas, namely, Dhrangadhra (25 %), Halvad (24 %), and Dasada (24%).

Villages supplying sizable quantities of charcoal were then identified to see their pattern of geographic distribution. Most of the charcoal supplying villages were located adjacent to the desert, the Little Rann of Kutch (see map 3.3). Arrivals of charcoal by village during 1989-90 are shown in Annexure 3.5.

3.4 Charcoal and Wastelands

The data, thus, point out that low rainfall districts of Gujarat account for almost 90% of the charcoal supplied in the state. The incidence of wastelands is also high in this region. The charcoal which is supplied to Ahmedabad market is mainly made of *Prosopis juliflora*. Discussions with traders and officials indicate that charcoal manufacturing provides much needed employment during the drought years. This observation therefore needs further exploration.

3.5 *Prosopis juliflora*

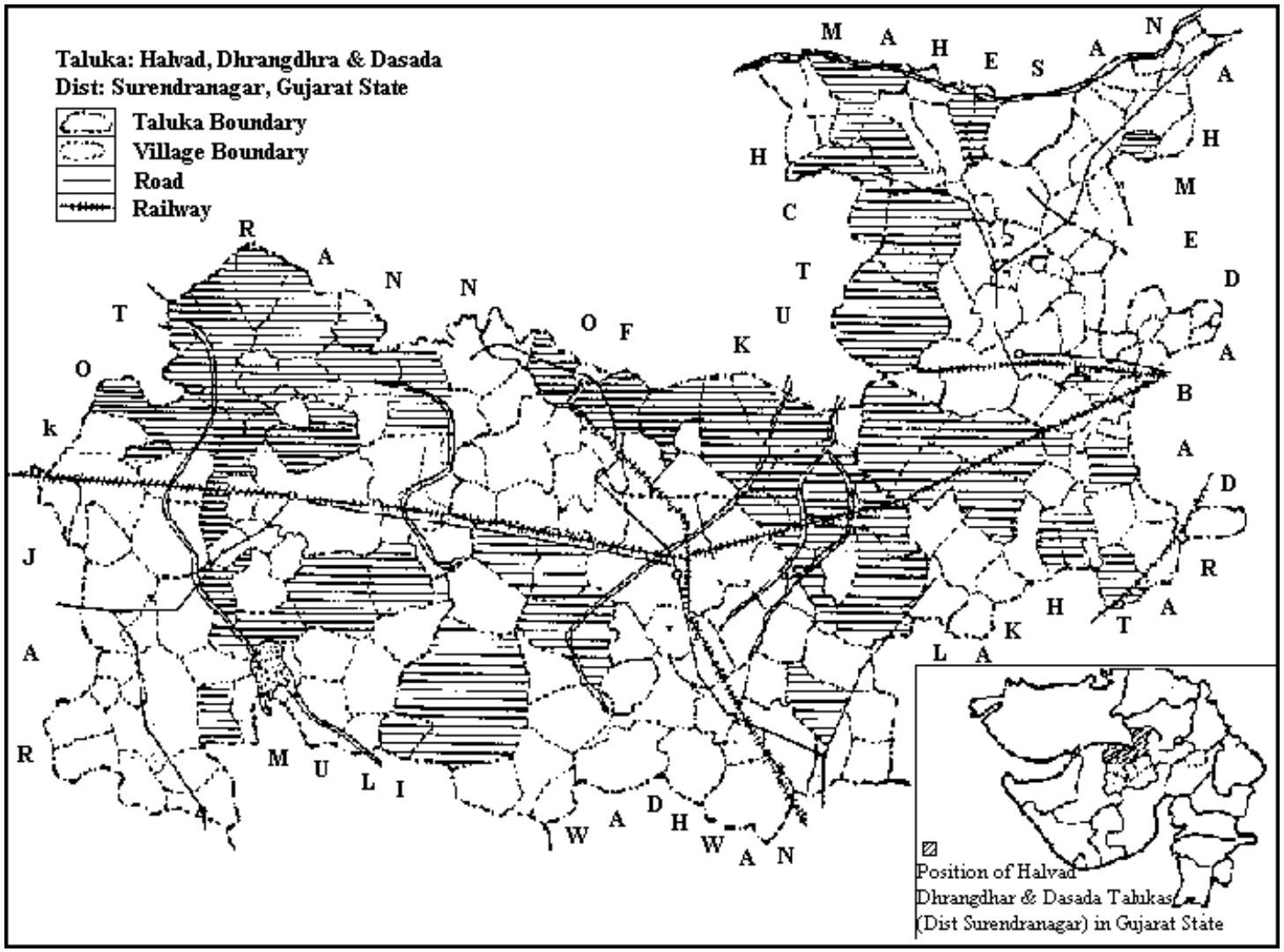
To assess the profitability of planting *Prosopis juliflora*, a major tree species used for charcoal making, the experience of the Behavioral Science Centre (BSC) in Vadgam village of the Bhal area is documented here. BSC was specifically chosen for three reasons. First, documented evidence on cultivating *Prosopis juliflora* in problematic soils was readily available. Second, data were available on costs, returns, and marketing of *prosopis juliflora* as fuelwood and charcoal. Third, the institution was willing to share the data and its experiences. (see also FAO/RAPA Community Forestry Paper).

3.5.1 Behavioural Science Centre (BSC) and Bhal Cooperatives

During 1978-79, BSC carried out a survey of 128 farmers from eight villages on the salinity affected Bhal area of Cambay (also known as Khambhat). The survey found that indebtedness was acute; the per capita income of the selected households was Rs. 700/year, while their expenditures were about Rs. 950.

Indebtedness was associated with low agricultural productivity, unemployment, social customs, and poor health. It was from these findings that the Vadgam project, set up to work with scheduled caste households, was born. The project aimed at increasing the productivity of identified members by providing them with capital, managerial skills, proper technology and eventually making them self-reliant.

Map 3.3: Villages Supplying Charcoal to Ahmedabad Market



The organizers soon realized that "technically agriculture was problematic and socially it was not an answer". The answer, therefore, was sought in growing trees in the wastelands that were to be made available within the village. *Prosopis juliflora* (locally known as vilayati or gando baval) grew well even in the worst of the Bhal lands. This species, as a result, attracted the attention of the organizers.

Available literature indicated that, even on a conservative note, *Prosopis juliflora* promised yields of about 13 MT an acre at Rs. 100/MT by way of fuel. Assuming that 182 acres of available land could be obtained from the government, each plot of 35 acres was expected to give a gross income of Rs. 45,500, or a net income of Rs. 26,400, at the end of five years.

Figure 3.3: Raising Prosopis juliflora on the Wastelands in Gujarat

As most of the expenditure was envisaged to be in the form of wages to members participating in the plantation activity, the project was expected to serve the purpose of providing much needed employment and income. Keeping this in view, BSC persuaded the schedule caste people of Vadgam to form a cooperative and helped it obtaining the wastelands near the village on long lease. This was the first cooperative to be established in the Bhal region in 1979. Since then, eleven more cooperatives have been formed, as shown in table 3.4.

All these cooperatives were federated under an apex body. The Vadgam, Pandad, Golana, Gudel, Vainej, and Rohini Cooperatives were the first to promote the Federation. They provided technical know-how on plantation and also on charcoal production and marketing activities to the member societies.

Table 3.4 : Bhal Cooperative Societies

Name of Cooperative	Members	Year of Formation	Affore-station	Land (old)	Land (new)
1. Vadgam	67	1979	Yes	182	50
2. Pandad	115	1982	Yes	578	0
3. Golana	108	1982	Yes	147	0
4. Gudel	46	1982	Yes	85	22
5. Valli	17	1984	Yes	34	0
6. Vainej	42	1984	Yes	83	0
7. Mitli	67	1985	Yes	140	0
8. Rohini	40	1987	Yes	50	0
9. Tansa	28	1987	Yes	67	0
10.Varasada	116	1988	No	0	0
11.Indranaj	72	1988	No	0	0
12.Golana(H)	22	1989	Yes	44	0
Total	740			1410	72

Source: Annual Report of BSC, 1988-89.

3.5.2 Techno-economics of Prosopis juliflora

During the year 1979/80, transplanting was carried out in five plots. Results in the first year showed that survival rates varied from 26-67% and better lands showed more promising results (see table 3.5 below). Total expenses of planting 73 acres were Rs. 48,466.

Since a lower rate of survival meant higher cost of plantation, BSC decided to adopt a more scientific approach to surveying, soil testing, land levelling, data collection, analysis, etc.

Table 3.5 : Survival Rate of Prosopis Planting in 1979/80

Plot	Acres	Saplings	Survivals	Survival(%)
1	4.7	1420	440	30.9
2	10.0	3040	1158	38.0
3	25.0	7525	1975	26.2
4	10.5	3170	2138	67.4
5	22.2	6660	2025	30.4
Total	72.6	21815	7736	35.51

The low survival rate mainly resulted from: (a) low hydraulic conductivity leading to either waterlogging in low lying areas or excessive runoff; (b) shattered soil structure preventing adequate moisture holding capacity and (c) salt deposits in the root zone, creating physiological drought. Different technologies for raising plantations were systematically tried with varying degrees of success which are summarized in table 3.6. Lack of adequate moisture was identified as a critical factor affecting the growth of *Prosopis juliflora*. Bunding, drainage facilities,

water harvesting, moisture conservation and a close watch over young plants during moisture stress conditions raised the survival rates from 35 to 55%.

Table 3.6 : Experiences with Plantation Techniques

Technology Attempted	Source of Technology	Year	Result	Present Status
Chemical amendments to reclaim for agriculture	G.A.U., Anand	1979	Total failure	Abandoned
Forestry with *P. juliflora* using standard techniques	Forest Department	1980	35 % survival rate	Abandoned
Screw Auger Technique to afforest saline land	CSSRI Karnal	1982	Total failure in low lying area; no significant advantage in upland area	Abandoned
Bunding and leaching with rain water	Local	1980	Beneficial	In use since 1980
Rain water harvesting through pits	Based on micro catchment water harvesting system	1982	Beneficial survival rates 80 %	In use since 1982 except in high water table areas
Bunds for planting; gutters for water harvesting	Fusion of outside and local knowledge	1984	Found most suitable for establishment as well as subsequent growth	In use only since 1986
Use of Gypsum to tackle alkalinity	CSSRI, Karnal	1982	Suitable	Used in patches

Source: A.R. Pastakia, Behavioural Science Centre, Ahmedabad, 1988

The period from 1985 to 1987 was one of trial for the Bhal societies. However, by the end of this period, 494 out of total 1159 acres of wastelands owned by six societies were planted with *Prosopis juliflora*.

3.5.3 Prosopis for fuelwood vs. charcoal

It is interesting to note that at one stage Mr. A.R. Pastakia and his colleagues, who had taken pains to develop the whole concept, were not sure that charcoal offered a higher value addition than revenue generated through sale of Prosopis as fuelwood. In fact, it was felt that the sale of fuelwood could be as remunerative as charcoal itself. Therefore, for almost one year fuelwood selling was carried out to gain some lessons. Sale of fuelwood as a product eventually had to be discontinued for technical and economic reasons.

Efforts were made to convince boarding schools in nearby areas to purchase Prosopis fuelwood. Of the 20-25 schools in the area, 5-6 schools showed interest and willingness to use Prosopis fuelwood. Many unanticipated problems surfaced after the sale. First, the shelf-life of the fuelwood was approximately six months. The minimum order quantity required was one truck load of fuelwood to contain transportation cost within acceptable limits. A truck load of

fuelwood for a boarding school meant a supply for the whole year. Obviously, the losses in storage were considerable. The project authorities thought of sending a small quantity by tractor trolley. But the cost of transportation by tractor was considerably higher. This was, therefore, abandoned. Dipping the stumps of fuelwood in a wood preservative like boran compound to prolong the storage life was also considered. But the stump ends had to be dipped twice to protect them from wood boring insects, and the labour cost of this operation was quite high.

The second problem was that the variable size of fuelwood did not suit the requirements of the users. Kitchens preferred to have thicker piece fuelwood.

Third, the thorns on Prosopis fuelwood created serious problems for the users. Attempts were made to acquire thornless varieties but without success. The thornless variety was not perfected, and thorns reappeared every alternate year. Tissue culture was another alternative considered but could not be explored as the needed material could not be obtained. The experiment, therefore, had to be discontinued after a year.

Against this background, the charcoal option emerged, since it could be processed and stored in one operation while fuelwood was too messy to handle. Charcoal reduced the bulk by as much as 40-50%. The administrative workload with charcoal was also considerably lower. Every time a truck of fuelwood had to be loaded, many administrative formalities, such as obtaining permission of the forest department to transport the load, had to be completed. Charcoal, on the other hand, could be sent by taking permission for the lot as a whole. In the case of fuelwood, meeting commitments was becoming difficult since trucks and permits to transport fuelwood were not available as and when required. Charcoal did not face such problems. By holding stocks, charcoal could be sold when prices were high. Prosopis fuelwood rarely has this advantage and even deteriorate with time.

3.5.4 Economics of Prosopis fuelwood and the charcoal trade

3.5.4.1 Contributions from fuelwood marketing

As some trees were already standing in the plantation area, BSC decided to carry out experiments to work out the costs and benefits from selling Prosopis as a fuelwood and as a charcoal product. Khambat (Cambay), the nearest market and Ahmedabad were chosen as the market for fuelwood. In 1980, fuelwood prices ranged from Rs. 2.50-2.75/20 kg. at Cambay, to Rs. 4.00 in Ahmedabad. On an average, 300 trees were expected to be harvested / acre and one tree was expected to give 40 kg., as a conservative yield. The estimated cost and contribution were as shown in table 3.7.

Table 3.7 : Per Acre Cost and Contribution from Fuelwood, 1980

	Cambay (Rs.)	Ahmedabad (Rs.)
1. Cutting Expense @ Rs. 1 / tree for 300 trees	300	300
2. Transport Expense	300	900
3. Income (300 trees * 40 kg.) Rate: Cambay=Rs. 2.50/20 kg., Ahmedabad=Rs. 4.00/20 kg.	1500	2400
4. Contribution / acre 3-(1+2)	900	1200
5. Contribution / 20 kg. of wood	1.50	2.00

In the second marketing test of fuelwood in 1982/83, additional valuable market information was obtained. (see table 3.8).

Table 3.8 : Results of Marketing Fuelwood at Nadiad (90 Trees)

Expenditure (Rs.)		Income (Rs.)	
Cutting	355.00	8,940 kg. @ Rs., 4.00/20 kg.	1,788.00
Loading & Unloading	90.00	Less Commission	- 89.40
Transport	360.00	Less Dalali	- 10.00
Other	21.00		
Total	826.00	Amount Realized	1,688.60
Contribution (Income - Expenditure)		862.60	
Contribution / 20 kg. of wood		1.83	

Source: Annual Report of BSC, 1982-83

Yield of fuelwood / tree worked out to be actually 99.3 kg. The harvesting cost worked out to be Rs. 4.00, compared to Rs. 1.00, as in the earlier case. The contribution realized / 20 kg. of fuelwood was Rs. 1.83. In brief, the marketing of Prosopis as a fuelwood gave the farmers a contribution of Rs. 0.09 / kg. only. The idea of going for charcoal as alternative to fuelwood was therefore accepted in Golana Village during 1984.

3.5.4.2 Contributions from charcoal marketing

In 1984, when the Society had more quantities of Prosopis, it decided to carry out marketing tests to find out the economics of marketing charcoal. The Society harvested 1,006.50 quintals of Prosopis, converted it into charcoal, and sold it in truckloads at two different markets to find out the cost and contributions. Details appear in figure 3.4 and tables 3.9-3.11.

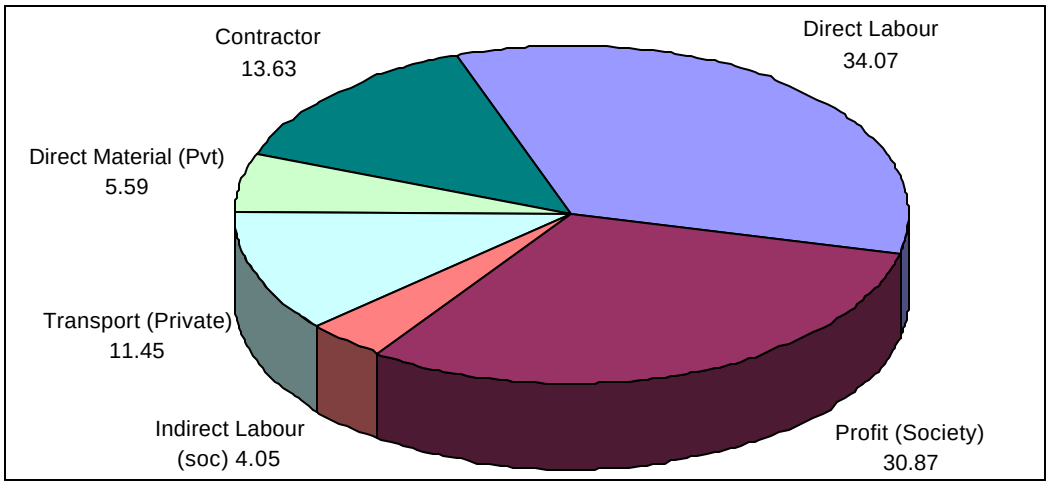


Figure 3.4: Price Composition in Charcoal Production in percent (BSC experience 1984)

It was estimated by the Society that to obtain one kg. of charcoal, 3.75 kg. of wood was required, i.e. a yield of 27%. Thus, to obtain 20 kg. of charcoal, 75 kg. of wood was required. The contribution / 20 kg. of charcoal was Rs. 7.80 (see table 3.11). In other words, the contribution of 75 kg of wood converted into charcoal was Rs. 7.80. Therefore, the contribution of 20 kg. of wood sold as charcoal was Rs. 2.08. As shown earlier in Table 3.8, 20 kg. of wood sold as fuelwood fetched a contribution of only Rs. 1.83. Therefore, the additional contribution by selling wood as charcoal was 14% higher. Selling Prosopis as charcoal also offered more convenience than selling it as fuelwood.

Table 3.9: Manufacturing and Selling Expense (for 268.40 quintals)

Items of Expense	(Rs.)	
Charcoal Conversion Cost	19,365.55	
Gunny Bags	2,129.80	
Watch & Ward	650.00	
Supervision	84.00	
A. Charcoal Manufacturing Expense		**22,229.35**
Transport Cost from Site to Village	2,815.45	
Transport Cost from Village to Market	1,785.60	
Weighing Charge	69.00	
Octroi & Association Charge	136.30	
Administrative Expense	375.50	
B. Selling Expense		**5,181.85**
C. Total Expense (A+B)		**27,411.20**

Note: 1 quintal = 100 kg.

Table 3.10: Marketing Test Results

Income Statement	Truck one	Truck two	Truck three	Truck four	Total
1. Market	Ahmedabad	Ahmedabad	Ahmedabad	Cambay	
2. Total Weight (mds)	317.25	342.75	324.00	358.00	11342.00
3. Weight Deductions (mds)	7.50	8.85	8.10	10.00	34.45
4. Net Weight (mds)	309.75	333.90	315.90	348.00	1307.55
5. Price (Rs./mds)	28.50	29.00	30.00	29.50	
6. Value (Rs.)	8,827.77	9,683.10	9,477.00	10,266.00	38,253.87
7. Cash Discount (Rs.)	87.27	95.89	93.82	103.00	379.98
8. Gross Income (Rs.)	8,740.50	9,587.21	9,383.10	10,163.00	37,873.89

Note: mds = 20 kg.

Table 3.11: Summary of Contribution from Charcoal Marketing

Gross income from charcoal marketing (Rs.)	37,873.89
Expenditure on charcoal production and selling (Rs.)	27,411.20
Contribution (Rs.)	10,462.69
Contribution, Rs/maund of 20 kg. (10,462.69/1,342.00 mds)	7.80

Figure 3.5: Preparing Stem-Wood of Prosopis for Charcoal Making

Figure 3.6: Mound Shape Piling of Prosopis Fuelwood for Charcoal Making (by earth mound method)

Investment cost for bringing one acre of wasteland under Prosopis cultivation as / BSC records was Rs. 4,695 as shown in table 3.12.

Table 3.12: Per Acre Cost of Cultivation of Prosopis

Items	Rs.	Per cent
1. Lease amount	Nil	-
2. Investment on Land		
a. Infrastructure	2,141	45.60
b. Investment on Plantations	1,805	38.45
3. Investment on Human Resource Development*	749	15.95
4. Investment / Acre of Plantation	4,695	100.00

* This item was intentionally listed to show the members and management of the cooperatives what the cultivation of Prosopis would cost them.

If the life of the Prosopis plantation is assumed, at a conservative level, to be 30 years, with 8 harvesting cycles, the amount to be recovered in each harvesting cycle would be Rs. 4,695/8 = 587. An acre of plantation with 300 trees in the Bhal region gives about 30,000 kg. of wood / harvesting cycle at the rate of 100 kg. of wood / tree. This wood sold as fuelwood would give Rs. 2,745 / harvesting cycle, based on the calculated contribution of Rs. 1.83 / 20 kg. of wood (table 3.8). Similarly, this wood sold as charcoal would fetch Rs. 3,120 / harvesting cycle at the rate of Rs. 2.08 / 20 kg. of wood. The overall economics shows that it is more favorable to use the wastelands for Prosopis based charcoal production. Further, as earlier discussed in chapter 2, the actual price of charcoal was as high at Rs. 3-3.5/kg., while the price for test marketing in table 3.10 registered only about Rs. 1.5/kg.

3.6 Marketing

As stated earlier, the major market for charcoal was at Ahmedabad. BSC identified an agent in Ahmedabad to sell the charcoal produced by the cooperatives. BSC and the agent agreed that charcoal would be given to the agent as and when produced, at a fixed rate for the entire season. BSC expected price fluctuations in different seasons and was not keen on taking a risk on this account. BSC therefore, bargained for an average rate after taking the fluctuations into account. In its opinion, the risk was transferred to the agent. A truckload of charcoal would go to the market, the agent would receive it, grade it, and make payment. BSC was able to bargain a fair deal as it was supplying large quantities of good quality charcoal in bulk. The premium BSC obtained for quality, was almost Rs. 2 / 20 kg. The agent was willing to give a premium because the material obtained was by and large clean and unadulterated. Some traders sprinkled water over charcoal before despatching it to market, which made the charcoal unusally moist. Such a practice was not adopted by the cooperatives.

The agent preferred to get the material graded on the production site itself to reduce the element of speculation on quality. But the society did not think that such a practice would be beneficial because grading created not only a mess at the site, but also disposing of the rejected material was a problem.

Whenever there was delay in getting administrative clearances, the society sold the material to a local commission agent who would in turn deliver it to Ahmedabad. The local agent was willing to work to obtain clearances, which BSC was not able to obtain in convenient time. The prices offered by local agents were lower than the negotiated price by about Rs. 2 for 20 kg. The members did not mind this as long as they faced no difficulty selling their charcoal.

It was also felt that if the societies were to undertake grading at the site themselves, it would be much better for them to resort to market segmentation and get directly involved in independent marketing.

3.7 Impressions

Frequently, questions are asked as to what was the / acre cost and returns from Prosopis plantation and charcoal making. Based on the data and insights provided by BSC's Bhal plantations, the economics has been worked out. It is necessary to underline that this cost and return pattern should not be taken as valid for Prosopis cultivation in all sites.

Production varies a great deal from one site to another within the same geographical location. One cannot accurately predict the level of productivity given many uncertainties. For instance, an isolated patch of 2-3 acres is more prone to damage by wind than a block plantation of about 100 acres. But for obtaining the benefits of scale, it would appear that people need to pool their land resources, so that costs can be reduced. In the context of wastelands, an ecological unit could not be divided into acreages. For instance, one or two individuals going for field bunds would not be able to stop the sea's ingress. The concept of shelterbelts was also very important to protect plantations and the investment. Wind coming from the sea, laden with salt, could do damage to the plantations. Harvesting was, therefore, carried out from the inside of plantations leaving the shelterbelts. Otherwise, the survival rate of the second coppice would come down to 40-50%, from the ideally possible 90%.

The blessing in disguise in Gujarat is that it does not have the tree patta scheme by which land is parcelled and allocated to selected beneficiaries. Instead, revenue wastelands are given on a long term lease to different types of collectivities. The lease amount varied from different places and different sites depending on the original status of land, annual removals expected, and lease duration. Because of these variations, the cost and benefit are not easily generalizable on a / acre basis. Village to village variations on many factors can also be very high. The benefit-cost ratio would therefore differ from one site to another.

Pandad village offered a good example. The village had close to 575 acres of wasteland. A vehicle was needed if one wanted to travel from one end of the site to the other. There was a great deal of pressure from the members to initiate some work on this plot of land. A survey indicated that for the most part, the land was useless. Forty per cent of the area was inundated by water and therefore considered outright reject. Nonetheless, about 200 acres were identified as having some potential. These 200 acres were further classified as A, B, and C categories. Only 30 acres could attain the A grade.

A cost-benefit analysis was carried out for these 30 acres over a longer time frame, and it was realized that returns from these 30 acres alone could cover the entire cost of plantations on other categories of land, even though the attrition rate on those lands was likely to be very high.

Two impressions can be drawn from the BSC experiment. Using appropriate technology, it is possible to cultivate *Prosopis juliflora* on wastelands. It is more profitable and practical to make charcoal, which has a good market, rather than sell the tree as fuelwood. In fact, it is financially profitable to bring wastelands under Prosopis cultivation because there is a good demand for charcoal. Prosopis is a nitrogen fixing tree and its leaves can also be used for fodder.

3.8 Summary

The case studies reveal that : (a) charcoal production based on *Prosopis juliflora*, a species that generally concentrates in low rainfall and high risk ecological regions (where agriculture is not a major supporter of the household economy), is economically viable; (b) charcoal making has the potential to generate gainful employment in a region where it is most needed; (c) the supply pattern of charcoal varies greatly but could be stabilized and improved with organizational innovations like that of BSC; (d) charcoal making is most suited to areas having sizable wastelands; (e) there is a need to promote the application of science and technology in Prosopis cultivation in problematic soils and in charcoal making practices; (f) the economics of prosopis-based charcoal production is more favourable than that of marketing prosopis fuelwood; and (g) the marketing of charcoal is not difficult because the industrial demand is expanding. This opportunity, therefore, should be taken to support the production systems.

4. MARKETING OF CHARCOAL

4.1 Charcoal Arrival in Ahmedabad

Arrivals of charcoal in the Ahmedabad market increased from 2,364 to 3,264 truckloads between 1986/87 and 1989/90 -- a growth rate of 9.4%/annum (table 4.1 and figure 4.1). The monthly despatch pattern showed that despatches were low during the rainy months from June to September (see diagram 4.1). Of course, the despatch pattern was closely linked with the pattern (figure 4.2 and 4.3).

Table 4.1: Number of Trucks Arriving at Ahmedabad Market, monthly

Month	1986-87	1987-88	1988-89	1989-90
April	95	344	310	322
May	161	261	472	423
June	134	331	446	465
July	53	178	285	148
August	122	10	89	150
Septembe	117	290	25	100
r	148	166	88	245
October	163	267	125	192
November	312	274	252	233
December	351	251	322	352
January	366	177	318	352
February	342	329	384	282
March				
Total	2,364	2,878	3,116	3,264

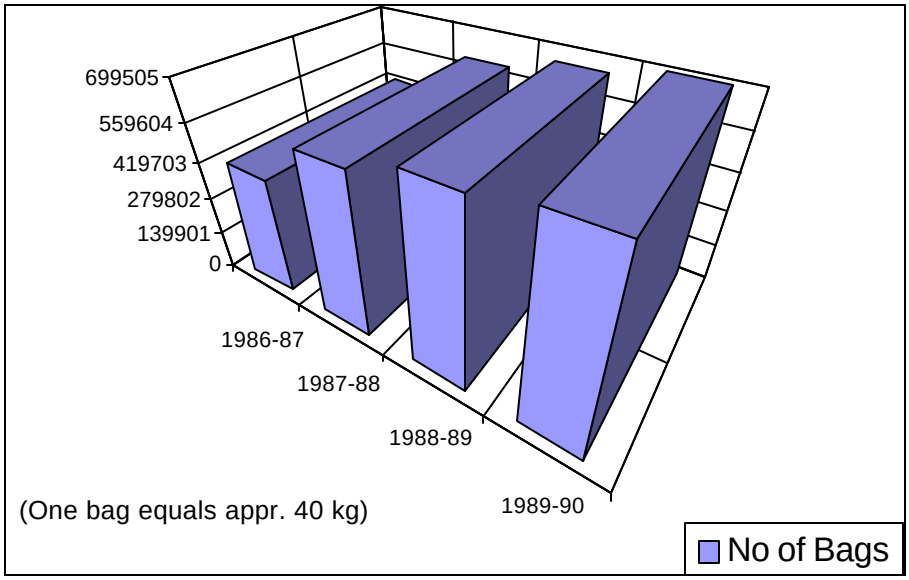
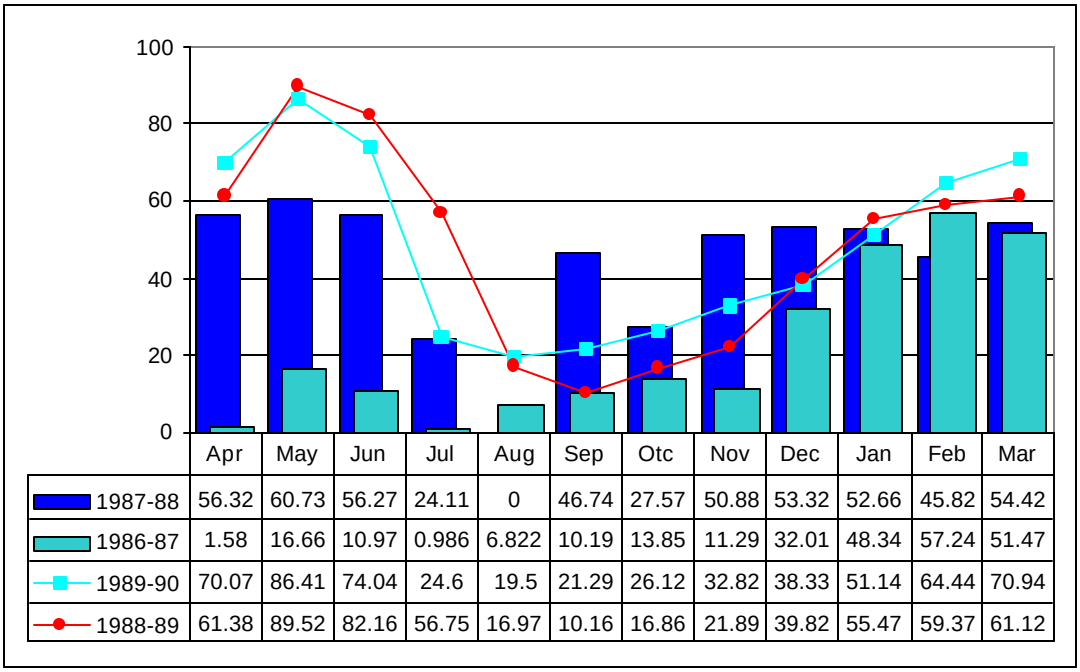


Figure 4.1: Charcoal Arrival at Ahmedabad



	Apr	May	Jun	Jul	Aug	Sep	Otc	Nov	Dec	Jan	Feb	Mar
1987-88	56.32	60.73	56.27	24.11	0	46.74	27.57	50.88	53.32	52.66	45.82	54.42
1986-87	1.58	16.66	10.97	0.986	6.822	10.19	13.85	11.29	32.01	48.34	57.24	51.47
1989-90	70.07	86.41	74.04	24.6	19.5	21.29	26.12	32.82	38.33	51.14	64.44	70.94
1988-89	61.38	89.52	82.16	56.75	16.97	10.16	16.86	21.89	39.82	55.47	59.37	61.12

Figure 4.2: Charcoal Despatch from Ahmedabad

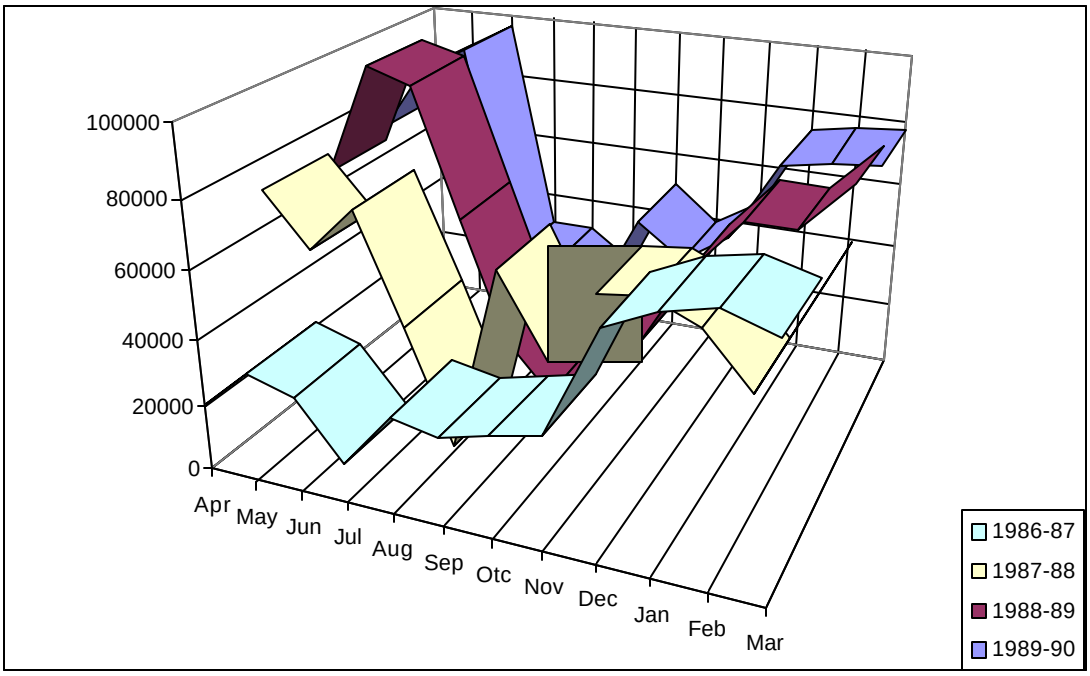


Figure 4.3: Pattern of Charcoal Arrival at Ahmedabad

4.2 Asarva Market

The Asarva market in Ahmedabad is the wholesale market for charcoal in Gujarat. Not many markets of this kind exist in the country. The market's inception date is not known but it is believed to be a century old. About 134 charcoal traders were members of the 35 year old Charcoal Traders Association of Ahmedabad. The number of dealers and retailers operating in the market was high in those days when the demand for charcoal was high. As charcoal was coming from other states like Madhya Pradesh and Maharashtra, the market developed closer to railway lines and roads. The membership, however, has declined over time and at present only about 30 members are active. New entrants to the charcoal business are negligible. The Asarva market is well known for its cash transactions and charcoal producers prefer to bring charcoal here from long distances because of this feature.

Active traders in the Asarva market are declining for many reasons. Firstly, the arrival of charcoal over the years has become stagnant. Secondly, with the growth of the industrial sector, charcoal is used more as an industrial fuel and/or raw material, and its price has been increasing. This has also affected the domestic cooking market, which depends on a large number of wholesalers-cum-retailers and small retailers. Declining business has forced marginal traders to look for other business opportunities. Thirdly, the quantity required by each trader rose because buyers want supplies in large quantities. Small to medium sized traders, therefore, have not met the new challenge. There have been progressive changes in the function performed by the trade. For example credit is being provided to buyers, who are mostly outsiders. Prices for charcoal in the market are determined on the basis of quality. Most industrial buyers subject the charcoal to chemical analysis and market prices are decided on the basis of quality reports. The market has become more quality conscious.

Figure 4.4: Charcoal Cleaning After Arrival at Asarva Market

4.3 Trader's Economics

To remain in the charcoal business, a trader expects an income of at least Rs. 5000 a month. The number of trucksloads he needs to sell in a month to achieve this income vary from 8 to 10 depending on the quality of the charcoal. By and large, a trader expects four out of ten trucks to be of poor quality. This lowers his margin. About 5 truckloads of clean charcoal (about 40 M. tons) a month give a trader sufficient income to break even. A trader with a monthly turnover of 125-150 truckloads is regarded as big. There are very few big traders in the market. A trader having a monthly turnover of about 10 to 15 truckloads is considered small or marginal. These small traders are more prone to quit the market.

4.4 Standard Deductions on Supplies

Ten truckloads of charcoal arrived at Asarva in the last week of December 1991. A truckload carried approximately 8 MT or 200 bags of charcoal. The price ranged from Rs. 2,600 to 3,100/MT (December 1991) depending on quality. Deductions as shown in Table 4.2, were made by the traders before making payment to suppliers.

Figure 4.5: (Rejected) Fines After Cleaning, Collected by the Workers

Figure 4.6: Adulterated Material Coming with Charcoal Bags Delivered

Table 4.2 : Standard Deductions on Delivery (per truckload)

1. Truck weighing charge	: Rs. 10
2. Unloading charge	: Rs. 70
3. Association charge	: Rs. 30
4. Charge for fresh jute bags as replacement for damaged jute bags (average 20 bags/truck) @ Rs. 0.50 for filling	: Rs. 80
5. 1% discount for cash payment	: Rs. 208
Total	: Rs. 398

4.5 Preparatory Expenses of Traders

A trader deducted anywhere between Rs. 390-430/truck, depending on the quantity of charcoal carried. A bearer's cheque was given to the supplier and the trader usually helped the supplier to cash it. While entering the market, the supplier was expected to submit his transit pass to the forest chowky in the market. The trader was expected to obtain a fresh transit pass. The expenses the trader had to incur are indicated in table 4.3.

Table 4.3: Preparatory Expenses of Traders for Marketing Charcoal (per truckload)

1. Screening and refilling charge @Rs. 1/bag for 200 bags	Rs. 200
2. Weighing and noting down weight	Rs. 15
3. Brown string to fasten bags	Rs. 45
4. Top dressing of bags with good quality charcoal pieces	Rs. 5
5. Bag filling charge for leftover charcoal power, grains, and chips @Rs. 0.25/bag for 20 bags/truck	Rs. 5
6. Stitching charge for torn bags	Rs. 10
7. Weighing charge for powder etc	Rs. 6
8. Cost of bags for powder etc	Rs. 25
9. Cost of one bag of unburnt wood to be given free to a group of 12 labourers doing screening	Rs. 65
10 Cost of one bag of unburnt wood to be given free to a group of 5 labourers filling bags	Rs. 65
Total	Rs. 441

Figure 4.7: Repairing of Torn-Bags Before Refilling with Clean Charcoal

Figure 4.8: A Bag After Refilling and Top Dressing with Best Quality Charcoal Sticks (to impress customers)

4.6 Costing

To arrive at the cost of 20 kg. of charcoal, data from one trader for one truckload were compiled as shown in Table 4.4.

Table 4.4: Cost of Charcoal to a Trader

1. Gross weight on arrival including weight of gunny bags	8,700
2. Deductions for weight of gunny bags @ 1 kg./bag	- 250
3. Loss of charcoal in preparatory cleaning	- 1,950
4. Net weight of charcoal recovered	6,500
Cost of charcoal (in Rs.)	
5. Amount paid for (8,700-250=8,450 kg.) @ Rs. 2.40/kg.	20,280
6. Cleaning expenses/truck load	441
7. Expenses sub-total	20,721
8. Recovery from the rejects including fines	1,586
9. Net expenses	19,135
10. Cost/maund of 20 kg. (Rs. 19,135/6,500 kg.X 20 kg.)	58.80

The gross weight of charcoal received was calculated after deducting the weight of gunny bags. To meet the quality needs of consumers, sieving was done. Generally, about 25% of content was rejected after sieving. However, the rejects comprising chips, fines, and unburnt wood were also sold in the market at lower prices. To arrive at the cost for good charcoal, the amount recovered from the sale of rejects was taken into consideration. In the above case, the cost/20 kg. of charcoal came to approximately Rs. 59. The trader would not sell the charcoal below this price. The actual selling price, however, varied from one consumer to another depending on whether the sale was on cash or credit. In the case of a cash transaction, the price would be 2% above the cost price (around Rs. 60 in this case). In the case of credit sale (say for four months), the price would be around 18% above the cost price (around Rs. 70 in this case).

Figure 4.9: Weighing of Cleaned Charcoal Bags Before Shipment

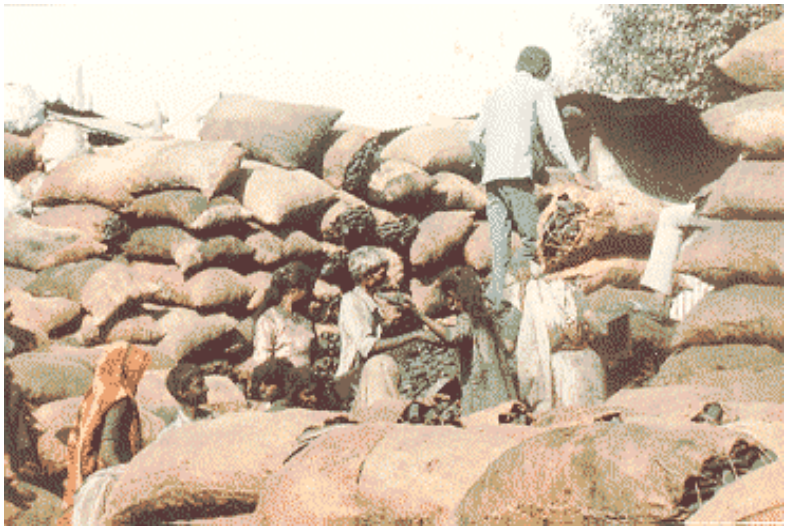


Figure 4.10: Cleaned Charcoal Bags in a Sale Storage

4.7 Quality Control

Charcoal traders were concerned about the quality of charcoal arriving in the market. Dust, chips, and adulterated material comprised around 20-25%. The Traders Association suggested that the trader and the supplier of charcoal should each select two bags of charcoal of their choice from a truck. These four bags would then be graded in each other's presence and payment would be made according to the assessed quality. This decision, however, could not be implemented in practice. When the demand was high, some traders preferred to buy without checking the quality. This obviously affected the market in general. Lack of quality control means incurring the cost of transporting 20-25% of almost useless/rejected material over long distances.

4.8 Storage Space

The Asarva market had storage space for about 100 truckloads. In terms of quantity, this could range from 800 to 1000 MT of charcoal. About eight traders owned most of the storage space. The storage space owned/trader ranged from 5 to 20 truckloads. Generally traders, who had access to large storage space, supplied charcoal on a large scale to clients outside Ahmedabad. At the same time, some persons who owned storage space were not involved in charcoal trading at all; instead they rented their premises to charcoal traders.

Table 4.4 : Storage Space Owned at Asarva Market for Charcoal

Trader	Appro.Space	Renting Space	Financing	Trading
A	10 trucks	Yes	No	Yes
B	5 trucks	Yes	No	No
C	7 trucks	Yes	No	Yes
D	20 trucks	Yes	Yes	Yes
E	15 trucks	Yes	Yes	Yes
F	10 trucks	Yes	No	Yes
G	7 trucks	Yes	No	Yes
H	20 trucks	Yes	No	No

4.9 Financing

Some traders not only dealt in charcoal, but also made financing available to other traders dealing in charcoal. Such financing was available to traders or their agents from 3-4 financier-traders. The financier would purchase the truck containing charcoal on instructions from the trader. The buyer-trader was free to unload this charcoal anywhere he wished. However, if charcoal was unloaded at the storage space of the financier, then the usual rent of Rs 100 a truckload was not charged to him. The credit extended was for one month and the interest amount charged was Rs. 10 a quintal (i.e. interest of about 3.3%/month). The financiers made cash payments to the suppliers of charcoal.

Figure 4.11: Filling of Cleaned Charcoal in Gunny Bags

Figure 4.12: A Leftover After Bagging is Normally Given to the Workers

4.10 Industry Contractor's Agent

Concerned about the poor quality of charcoal supplies and rising prices, agents of industrial contractors/suppliers stationed their representatives in the Asarva market during the season to keep track of the material purchased. These agents opened temporary bank accounts for their immediate transactions. As charcoal did not have uniform standards, the representatives of contractors personally supervised purchases and made payments.

4.11 Risks by the Commission Agent

Some traders also acted as commission agents of the industrial raw material contractors. These commission agents faced considerable risks as they generally dispatched charcoal on credit. Often there were delays in payments. Sometimes, the quality control norms were applied very strictly by the industrial units, and a sizable quantity of charcoal was rejected. Quite frequently, charcoal producers adulterated the charcoal with material which the one-inch sieves could not detect. As a result, the commission agents suffered losses.

4.12 Producer's Agent

During 1991, the Asarva market witnessed the birth of a new market functionary. A commission agent started working on behalf of the suppliers and/or producers of charcoal. The agent belonged to the market itself and had a great deal of internal information about the functioning of the market as well as the requirements of different traders, their timings, quality preferences, profit margins, and the destinations to which they sent the product. He started exercising control in determining or influencing the prices to some extent. He worked for only a limited number of suppliers. If his client's charcoal was not sold on the day of its arrival, or was offered a low price, he would unload the material in his storage space and let the supplier go with part payment. Whenever prices improved, because of non-arrivals or urgent requirements, he sold the material and made payment of the balance owing. Thus, a weakness which prevailed in the market was removed. The commission agent charged Rs. 4 a quintal (about 1.3% of the sale value) as commission from the suppliers and guaranteed full payment within six days.

4.13 Transportation

Charcoal was transported to consumers in Ahmedabad, by bullock or camel-driven cart. The mode of transportation from the Asarva market to places within Ahmedabad was determined by the carrying capacity of bullock or camel-drawn carts. A bullock-drawn (two-wheeled) cart carried a load of 16 bags of about 40 kg. each (6.4 quintals). A two-bullock or a camel (four-wheeled) cart, on the other hand, carried 48 bags. The cost of transport depended on the location and distance involved, and ranged between Rs 35-80 a trip.

Of the 15 carts operating in the market, around ten were single bullock driven. Camel carts charged still higher rates although they were relatively faster and capable of carrying heavier loads. Cart owners employed labourers to deliver charcoal bags. The labourers were paid a remuneration

of Rs. 800-900 a month. Charcoal merchants normally had a long lasting relationship with cart owners. Transport costs were charged to the buyer of charcoal.

Figure 4.13: Delivery of Charcoal to Customer in Ahmedabad by a Bullock Cart

Figure 4.14: Truck for Charcoal Despatch to Customer Outside Ahmedabad

To outside markets, charcoal was dispatched by trucks. As stated earlier, these trucks had to obtain transit passes from the forest chowky.

4.14 Wholesale Price

Unlike agricultural commodity markets, where auctions took place, prices of charcoal were determined through negotiation. The forest chowky at Asarva did not maintain daily price records of charcoal. The Traders Association also did not compile nor make available the ruling prices to members. It was, therefore, difficult to get authentic daily prices of charcoal. One trader agreed to provide some information from his records for the period 1983-84 to 1990-91. According to him, this was the best price of the months during that period (see figure 4.15). While it is difficult to observe relationships from these figures, some upward trends can be observed. It can be seen that the price of charcoal kept on rising steadily during this period. From Rs. 22/maund in 1980-81, it went up to Rs. 60 during 1990-91. In most of the years, the price was depressed during the months of June to September. The trend showed that starting from November, the prices tended to increase until January-February and then tapered off once again.

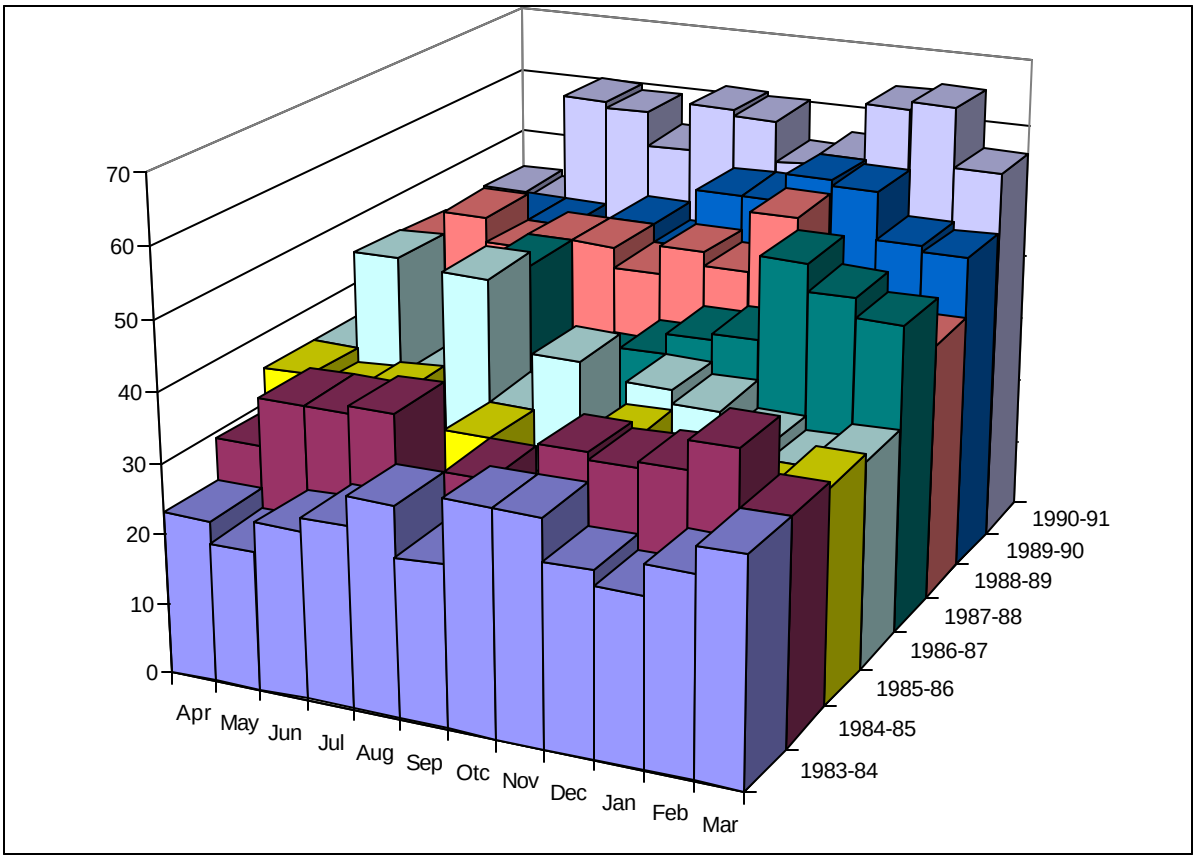


Figure 4.15: Wholesale Price of Charcoal in Ahmedabad, 1983-84 to 1990-91

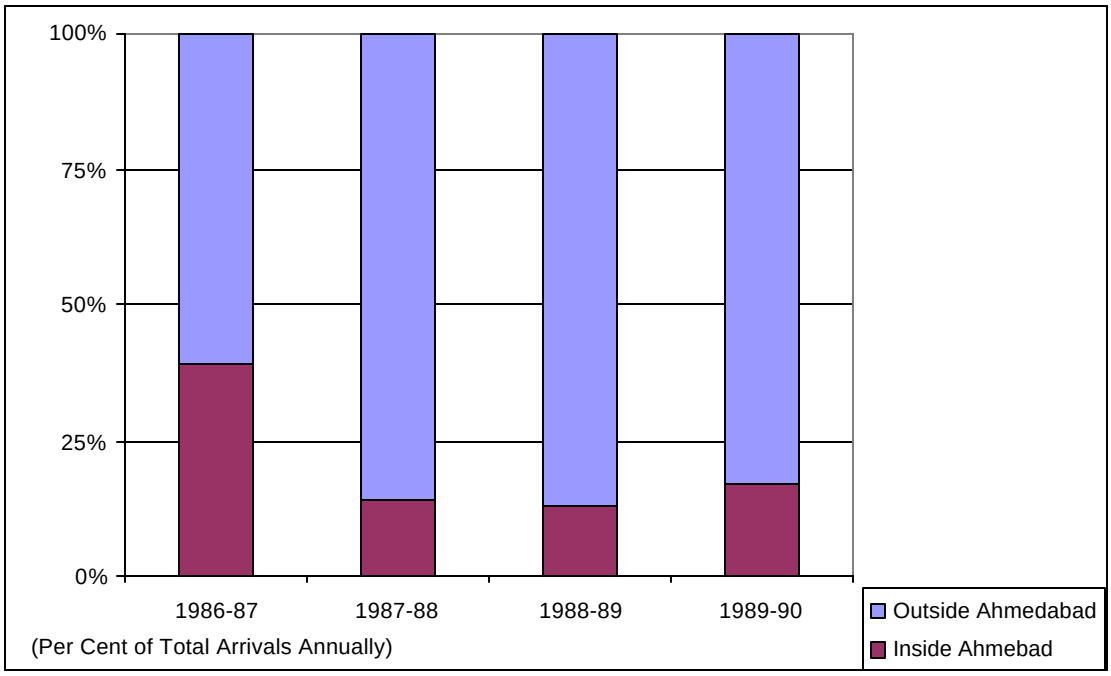


Figure 4.16: Consumption Share of Charcoal Supplied by Asarva Market 1980-87 to 1989-90

4.15 Destinations of Charcoal

4.15.1 Within Ahmedabad

Destinations for charcoal can be classified as within and outside Ahmedabad. During the period 1986-87 to 1989-90 shown in table 4.6, annual charcoal consumption in Ahmedabad city ranged from a low of 84,760 bags (3,390 MT) to a high of 169,386 bags (6,675 MT), in the years 1987-88 and 1986-87, respectively.

Table 4.6: Estimated Local Consumption in Ahmedabad

(in No. of Bags of 40 kg.)

Year	Total Arrivals	Total Despatches	Local Consumption	
1986-87	430,792	261,406	169,386	39 %
1987-88	597,364	512,602	84,762	14 %
1988-89	656,550	571,465	85,085	13 %
1989-90	699,505	579,678	119,827	17 %

The year 1986-87 was probably exceptional; charcoal consumption in the city dropped from 39% of the total arrivals in Ahmedabad market to 14%, even though the arrivals were showing an upward trend. Since then, the consumption level stabilized at 14-17% (see Diagram 4.2). Details on the charcoal users in Ahmedabad city were already provided earlier in chapter 2 section 2.2.

4.15.2 Outside Ahmedabad

It was surprising to note that charcoal from the Ahmedabad market was despatched to a large number of destinations in the country through trucks. Data for the period 1986-87 to 1989-90 indicated that charcoal destinations covered around 182 towns outside Ahmedabad. Most of these destinations were in the north and north-west states of India. Of these 182 destinations, only 32 destinations could be classified as highly regular because charcoal was dispatched to these destinations in all the four reference years. Another 31 towns received charcoal from Ahmedabad in three out of four reference years, and these towns were classified as fairly regular destinations. The remaining 112 destinations purchased charcoal from Ahmedabad occasionally (twice in four years), or rarely (once in four years) as shown in figure 4.17. Names of these destinations, years, and the quantities supplied are given in Annexures 4.1 to 4.4. It is hoped this information will prove useful as a benchmark for the future follow-up studies. Since the terms of reference for this study covered only the Ahmedabad market, no information could be collected on the purposes for which different towns purchased charcoal from Ahmedabad. It would be interesting to capture a profile of the buyers outside Ahmedabad for systematic marketing of charcoal. It was surprising to note that none of the Ahmedabad traders had precise knowledge regarding which, and to how many destinations the charcoal from their market was going.

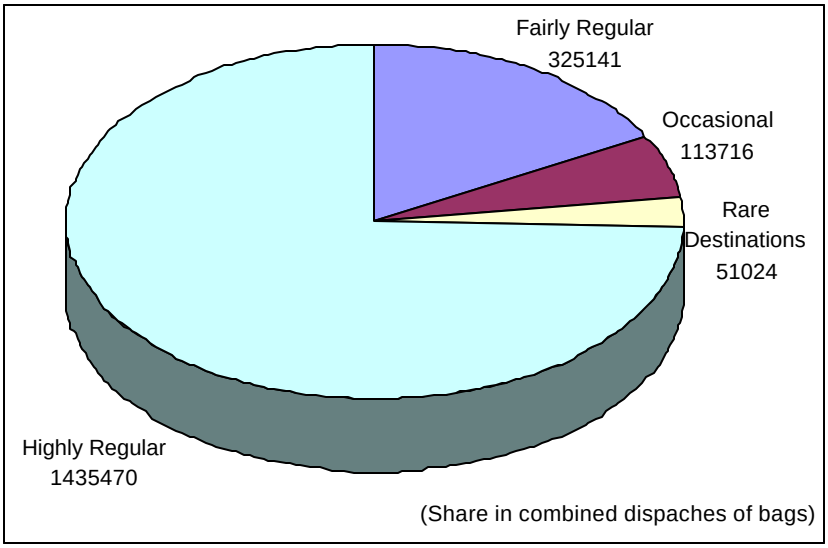
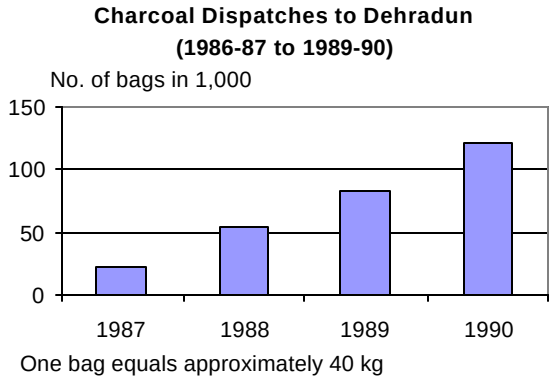


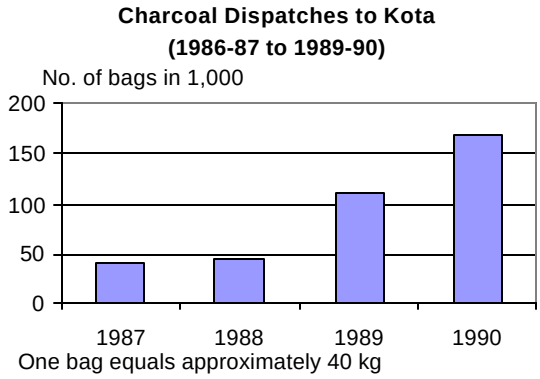
Figure 4.17: Type of Destinations and Share of Charcoal As Despatched from Asarva Market from 1986-87 to 1989-90

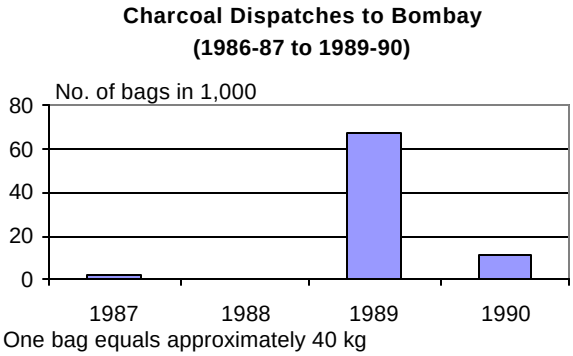
Analyses for selected towns on the basis of the data available however had shown that none of these towns consumed as much quantity as was consumed in Ahmedabad city itself. However, some cities like Kota in Rajasthan and Dehradun in Uttar Pradesh were catching up. In fact, their consumption during 1989-90 surpassed that of Ahmedabad. The consumption of charcoal in these

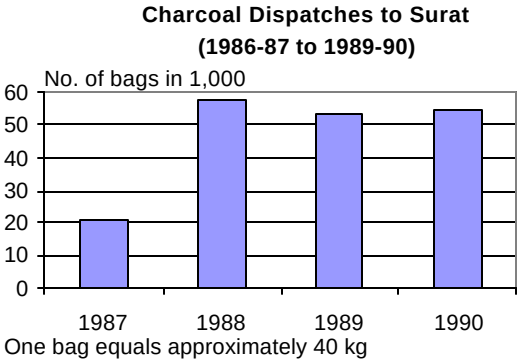
towns had been increasing steadily (see figure 4.18) because of the presence of industrial units using charcoal for chemical processing.

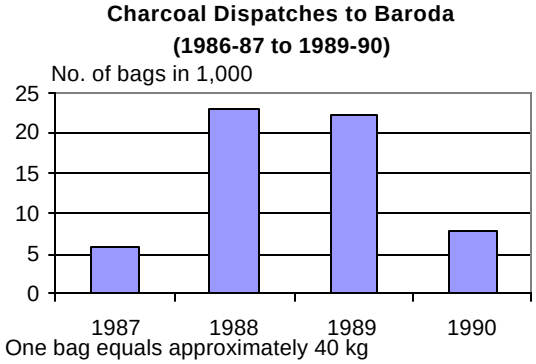
Figure 4.18: Charcoal Despatches from Asarva Market to Various Destinations

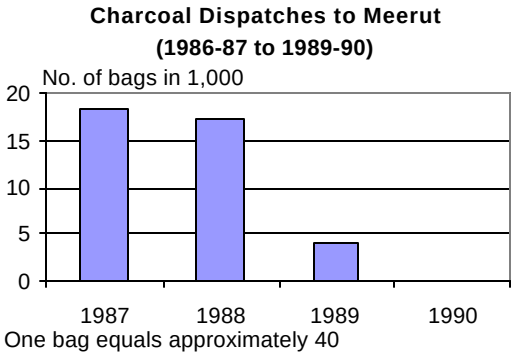












Other centres were Surat, Saharanpur, Delhi, Meerut, and Baroda. But different trends were visible for these places during the reference years. In Surat, for example, consumption was becoming stabilized. In Bombay and Meerut it was falling sharply. In Baroda, it was showing cyclical fluctuations. One needs to study the reasons for such variations further. One observation could be that in those places, where charcoal was used for industrial fuel, demand had been going down because of the rising prices of charcoal. This encouraged substitution with cheaper fuels. It should be noted that coal prices had also doubled in the past 3 years (see section 2.2).

4.16 Change in Marketing Practice

The trend shows that changes are taking place in the charcoal market behaviour. Urban demand for household cooking is declining and will probably continue to decline both because of availability of other sources of energy and rising prices of charcoal. In the initial period, charcoal arrived at the Asarva market from several places, and was also sold to a large number of small consumers. A trader's function was to bring the produce from the producer to the customer. Given the size of domestic users, the number of intermediaries in the charcoal trade was also large. The movement was from wholesalers to sub-wholesalers to retailers. As new users entered the market, a new category of traders called commission agents emerged, who bought material on behalf of industries consuming charcoal. The industrial buyers were few and were located at distant places. Their needs and quality standards were less ambiguous. As a result many members were withdrawing from the scene as retailing was becoming unviable. Credit sales were becoming increasingly common. However, as shifts were taking place in the consumer segment, the market structure was not changing. Today, the acute need is to pay attention to the new type of consumers who are not only bulk purchasers, but also expect efficient responses.

Charcoal traders still function as traders in primary commodities rather than as vendors or suppliers of industrial raw material. Functions like sourcing the raw material, pooling it, grading it, and directly dispatching it without even a physical transit, through the Ahmedabad market are possible and economically more preferable. But this is not yet happening and the market place and its operation still continue to be as they were a few decades ago. The trading community still follows old management styles. A high degree of professionalism and quality consciousness will have to emerge to maintain the original edge and the image it previously enjoyed. It is still considered to be the only market place where traders honour cash transactions giving much appreciated security to the producers of charcoal. Producers from other states prefer to sell their produce in the Ahmedabad market only for this reason.

Nonetheless, competition from southern states, particularly Tamil Nadu, is increasing because the producers, in spite of longer distances, are able to supply good quality charcoal in sufficient quantity at lower prices. Unfortunately, fierce competition among the Asarva merchants to corner the share of existing business has not allowed the southern competitors to come out with a comprehensive and well thought out strategy to boost charcoal production, implement quality standards, and serve efficiently the already developed distant markets. Transporting charcoal over long distances which at the end of the journey, is likely to be rejected is not a sound business proposition. Among the trading community, this realization has yet to emerge. In short, charcoal markets are showing promise, but charcoal marketing continues to be governed by traditional practices.

5. CONCLUSIONS AND DEVELOPMENT PERSPECTIVE

5.1 Setting

Gujarat state in India is one of the states committed to the development of non-conventional and renewable sources of energy. Recognizing the need to improve the supply of wood-based energy to rural areas, the state forest department had launched farm forestry and community forestry programmes on a massive scale. Response of the farmers to the farm forestry programme is influenced by the marketing potential of the farm outputs. Charcoal being one such output, this study was undertaken to learn about the current practices and trends in charcoal production, marketing, and the policy environment from the point of view of developing a charcoal programme to support social forestry and wastelands development activities. Although charcoal has been used in India for centuries for a variety of applications, not much information is readily available. This study, therefore, not only provides an opportunity for sharing experience, but also serves as a benchmark for future studies in India.

Beginning with the consumption pattern of charcoal, the study looked at the production sub-system, charcoal processing, marketing, and the policy environment. A review of official records, a survey of different types of users, a village case study, and interviews with the traders were carried out to obtain information and insights on various aspects of charcoal production and marketing.

The study revealed that in Ahmedabad city itself charcoal continued to be used by laundry units, charcoal briquette manufacturers, lead extractors, metal processing units, coriander seeds processors, incense manufacturers, food vendors, and hostels. Traditional uses of charcoal for domestic cooking and textile processing have drastically declined because of the rising price of charcoal. Outside Ahmedabad, the calcium carbonate and calcium carbide industries consume sizable quantities of charcoal.

Preferences for the quality of charcoal, however, differed among the users. Metal processors, incense manufacturers, and carbide units were very concerned about quality and exercised quality controls. Others, with the exception of the laundry and calcium carbonate units, were not quality conscious and used whatever charcoal was available. The size of operation influenced the market mechanism. While small consumers had little control over the market, bulk consumers looked for services such as information, dependable supply, quality, storage and credit facilities.

It was interesting to note that about 90% of charcoal which was routed through Ahmedabad market actually came from only four districts of Gujarat. All these four districts fell into the low rainfall region of Western Gujarat. The trend also indicated that charcoal was produced in relatively drier regions with irregular rainfall. Supply patterns from these districts were also not regular. Informal discussions with the trade revealed that charcoal manufacturing provided much needed employment during stress years.

A case study in Vadgam village on cultivating *Prosopis juliflora* in problematic soils showed that it was economically more favourable to use wastelands for Prosopis - based charcoal production. Marketing of Prosopis as fuelwood was less beneficial than selling it as charcoal. A well developed market in Ahmedabad for charcoal facilitated the success.

The Asarva charcoal market is unique to India. It is an excellent example of how a commodity market when transformed into an industrial raw material market puts pressure on the traders for new learning and adjustments. While charcoal arrivals in Ahmedabad market are increasing, the number of active traders is declining. Instead of retailing charcoal to the local small users, traders are now despatching nearly 80% of the arrivals to almost 180 towns and cities spread all over the north and north-western parts of India. Active traders and their Association are unfamiliar with the new users of charcoal and, therefore, of the marketing functions to be performed. The demand for charcoal exists and appears to be growing. Therefore, a need to step up production systems appears highly desirable as charcoal meets all the important development objectives like improvement of wastelands, development of drought-prone areas, promotion of farm forestry, generation of income/employment and the fulfilment of needs for cottage, small-scale, and other industries. Charcoal production, therefore, should merit stronger policy support.

5.2 Policy Environment

Policy environment plays a key role in the growth and development of any economic activity and is very important as in the case of charcoal. The policy environment should cover all aspects related to cultivation, conversion, transportation, and marketing. In terms of cultivation, very little technical know-how is available on a species like *Prosopis juliflora*, the charcoal of which is most preferred. Even an institution like the Behavioral Science Center (BSC) had to spend a considerable amount of time and resources to identify and experiment with the right technology to propagate *Prosopis juliflora* in saline soils as well as charcoal production and marketing. No special financing schemes exist to promote the cultivation of *Prosopis juliflora* nor for making charcoal out of it. Research and extension efforts on improved charcoal making technology are absent. Most producers use the pit method of production.

Harvesting, conversion, and transportation are all subjected to departmental controls, involving cumbersome and time consuming procedures. For instance, the government of Gujarat has banned harvesting of trees in forest areas and, therefore, the production of charcoal is carried out on private lands. The procedure established for harvesting and converting Prosopis into charcoal is controlled by the Revenue and Forest Departments. The steps generally followed are:

First Step: An application is submitted by the individual farmer producer/institution to the Revenue Department seeking permission for tree harvesting.

Second Step: Revenue authorities visit the site and give permission for harvesting.

Third Step: An application is submitted to the Forest Department for permission to convert Prosopis into charcoal.

Fourth Step: Forest officials visit the site to estimate the likely quantity of charcoal that would be produced and give permission for conversion.

Fifth Step: Farmers/producers then apply to the Forest Department for loading and transporting charcoal.

Sixth Step: In the presence of forest officials, charcoal is loaded on trucks. The truck number, number of bags loaded, destination, route, and time of departure, and estimated time of arrival are indicated in the pass issued for transport by the forest officials.

Seventh Step: Charcoal is carried to the specified market with the transit pass.

One needs to develop an understanding of the rationale behind these procedures. When a farmer decides to plant Prosopis, there is generally no need for him to inform the revenue authorities about his decision. When it comes to harvesting, the farmer has to approach the Revenue Department for permission. At best this provision can ensure that the Prosopis to be harvested has been cultivated on the private land of the applicant. For obtaining this permission, however, he has to visit the Taluka/Revenue Office several times. Since this is not a priority for the Department, the farmer's request may not get timely attention. The question still remains -- under what conditions would the farmer be refused permission?

The role of forest officials is to estimate the quantity of charcoal that would be made from the applied-for land. This is meant to ensure that the farmer does not convert into charcoal trees which are prohibited from cutting. At the time of issuing the transport permit, the forest official ensures that the quantity transported is related to the area harvested. He also ensures that the sanctioned charcoal is directly transported to the market within the time specified. By specifying the time, an effort is made to prevent the misuse of the transporting permit to carry charcoal from other places. In legitimizing the charcoal produced and transported, the farmer has to coordinate at his field: (a) the forest official who is generally located at the Taluka Headquarters and (b) the transporter who is ready to carry the load. Thus, the procedure is, restrictive, time consuming and not productive.

While these controls exist, the controlling authorities generally do not possess information or rarely make use of available information which could influence their policy decisions. For example, data available through the transit passes and the Revenue Department sanctions can be useful for planning purposes. Information can also be maintained about the area under other tree species which are also processed and converted into charcoal. Data on levels of productivity for different types of soils could be generated. Data on the price of charcoal in the market could be captured and used for analyzing the returns to cultivators and to assess the supply-demand situations. A periodic review of the role, functions, and charges levied by the intermediaries could help improve marketing efficiency. Currently information on the major consuming markets, places, and a profile of end users is not available. Compiling such information could help in understanding the changes that are taking place, and the composition of the end users over a period of time.

Similarly, the charcoal making technology and its impact on the cost of production and quality is not known.

5.3 Conclusion

Households and some of the industrial consumers have stopped using charcoal as fuel because of rising prices. One kilogram of charcoal costs more than one kilogram of grain. Rising price is a function of both short supply and increased demand. Increased supply would certainly change the situation and benefit all segments of charcoal users. Comprehensive changes in the government policy on charcoal, therefore, are necessary. Currently, the policy on charcoal lacks a broader perspective. *Prosopis juliflora* provides a good opportunity to make wealth out of wastelands, promote employment opportunities, improve land use patterns, and make available a good raw material needed by industry. Charcoal remains a neglected subject within the concerned government departments/ministries. What is needed is a bold policy statement making adequate financial, administrative, and extension provisions to encourage charcoal making as a vibrant activity. In addition, it will also increase levels of employment and income for people from drought-prone areas. This will help agencies concerned with energy, environment, forests, cottage industries, transport, and most importantly, the rural development to meet their development objectives.

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Annexure 1.1 : Arrival of Charcoal at Ahmedabad Market from1986-87 to 1989-90 (No of bags of 40 kg)

Place of Origin	1986-87	1987-88	1988-89	1989-90	Total	Annual Average	Per cent
Districts of Gujarat							
Ahmedabad	8,929	1,658	17,400	6,800	34,787	8,697	1
Baroda	220	0	0	0	220	55	0
Bharuch	27,190	0	360	6,995	34,545	8,636	1
Bhavnagar	201,673	318,813	162,609	108,779	791,874	197,969	33
Banaskantha	20,571	6,207	72,491	327,454	426,723	106,681	18
Dang	3,473	0	0	0	3,473	868	0
Gandhinagar	6,494	1,577	19,746	12,918	40,735	10,184	2
Jamnagar	17,440	109,730	9,103	1,620	137,893	34,473	6
Junagadh	0	0	2,000	0	2,000	500	0
Kheda	810	3,367	0	0	4,177	1,044	0
Kutch	3,900	0	3,173	1,191	8,264	2,066	0
Mehsana	3,130	8,670	3,620	2,190	17,610	4,403	1
Panchmahal	0	740	613	155	1,508	377	0
Rajkot	4,975	21,110	8,905	200	35,190	8,798	1
Surat	4,705	2,253	2,470	0	9,428	2,357	0
Sabarkantha	400	0	0	0	400	100	0
Surendranagar	117,938	118,957	336,964	222,230	796,089	199,022	33
Valsad	2,929	0	0	0	2,929	732	0
Other States							
Maharashtra	6,015	3,622	16,416	7,860	33,913	8,478	1
Tamil Nadu	0	0	0	791	791	198	0
Karnataka	0	660	680	322	1,662	416	0
TOTAL	430,792	597,364	656,550	699,505	2,384,211	596,053	100

Annexure 1.2 : Arrival of Charcoal at Ahmedabad Market in1986-87 (No of bags of 40 kg)

DIST/PLACE	April	May	June	July	August	Sept	Oct	Nov	Dec	Jan	Feb	March	Total
Ahmedabad	3,719	1,300	2,112	0	173	0	0	0	0	0	1,180	445	8,929
Baroda	0	0	0	0	0	0	0	0	0	0	0	220	220
Bharuch	2,999	500	2,553	3,800	11,282	4,250	0	1,806	0	0	0	0	27,190
Bhavnagar	4,930	18,865	9,270	2,240	10,352	12,765	17,555	18,210	25,515	31,766	41,805	33,915	201,673
Bombay	0	0	225	250	1,230	0	450	220	810	1,880	1,760	0	6,015
Banaskantha	895	1,216	1,206	508	1,187	1,111	2,150	2,708	5,228	2,560	1,610	5,420	20,571
Dang	0	1,420	500	0	453	0	0	0	875	900	200	0	3,473
Gandhinagar	0	0	1,072	385	0	0	470	630	1,829	1,625	1,446	866	6,494
Jamnagar	200	600	0	0	0	200	2,470	800	2,600	5,150	440	7,580	17,440
Junagadh	0	0	0	0	0	0	0	0	600	0	0	0	0
Kheda	610	0	200	0	0	0	0	0	0	0	0	0	810
Kutch	0	0	250	1,500	0	0	0	0	0	840	870	440	3,900
Mehsana	0	1,000	400	0	400	450	0	0	0	0	440	440	3,130
Panchmahal	0	0	0	0	0	0	0	0	0	0	0	0	0
Rajkot	200	151	0	800	590	600	2,014	400	0	220	0	0	4,975
Surat	775	1,000	1,750	200	0	0	250	730	1,130	0	0	0	4,705
Sabarkantha	0	0	0	0	0	0	0	0	0	0	0	400	400
Surendranagar	5,160	6,635	9,010	1,223	2,969	7,274	4,930	8,100	25,914	25,960	25,561	21,116	117,938
Valsad	644	0	0	975	0	0	0	0	850	1,310	0	0	2,929
TOTAL	20,132	32,687	28,548	11,881	28,636	26,650	30,289	33,604	65,351	72,211	75,312	70,842	430,792

Annexure 1.3 : Arrival of Charcoal at Ahmedabad Market in 1987-88 (No of bags of 40 kg)

DIST/PLACE	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
Ahmedabad	0	0	175	0	0	0	0	0	0	0	656	827	1,658
Bhavnagar	45,452	30,515	24,030	25,055	2,000	46,380	15,640	23,230	21,430	25,670	21,375	38,036	318,813
Bombay	0	0	0	695	0	100	660	0	0	0	997	1,170	3,622
Banaskantha	0	0	1,260	2,205	0	1,177	950	0	200	415	0	0	6,207
Gandhinagar	1,007	200	0	0	0	240	0	0	130	0	0	0	1,577
Jamnagar	5,410	11,180	18,200	1,540	0	0	10,100	25,260	22,440	14,060	880	660	109,730
Karnataka	660	0	0	0	0	0	0	0	0	0	0	0	660
Kheda	0	0	2,967	400	0	0	0	0	0	0	0	0	3,367
Mehsana	660	0	1,043	0	0	220	2,800	1,760	1,760	220	0	207	8,670
Panchmahal	0	0	0	0	0	180	360	0	0	0	0	200	740
Rajkot	0	640	650	6,380	0	10,270	2,850	0	0	0	0	320	21,110
Surat	0	0	0	0	0	0	0	0	1,753	0	500	0	2,253
Surendranagar	17,465	12,050	21,038	220	0	200	659	6,405	10,606	11,965	12,451	25,898	118,957
TOTAL	70,654	54,585	69,363	36,495	2,000	58,767	34,019	56,655	58,319	52,330	36,859	67,318	597,364

Annexure 1.4 : Arrival of Charcoal at Ahmedabad Market in 1988-89 (No of bags of 40 kg)

DIST/PLACE	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
Ahmedabad	460	1,980	3,300	0	0	0	220	1,100	3,300	3,080	2,640	1,320	17,400
Bharuch	0	0	0	0	0	0	0	0		0	0	360	360
Bhavnagar	32,946	43,681	10,070	40,393	4,400	0	2,467	6,037	8,885	4,270	2,440	6,820	162,609
Banaskantha	1,800	1,393	8,413	4,722	150	37	142	410	10,249	14,170	19,185	11,820	72,491
Gandhinagar	0	1,722	9,951	6,082	820	1,171	0	0		0	0	0	19,746
Bombay	0	425	0	0	10,703	0	1,141	2,130	1,316	701	0	0	16,416
Karnataka	0	0	0	0	680	0	0	0		0	0	0	680
Junagadh	0	0	0	2,000	0	0	0	0		0	0	0	2,000
Jamnagar	0	1,827	4,776	0	0	0	660	220		500	920	200	9,103
Rajkot	200	200	0	0	920	2,665	3,960	360		0	400	200	8,905
Panchmahal	140	140	108	0	0	0	0	0	225	0	0	0	613
Kutch	650	853	225	180	160	0	0	445	220	220	0	220	3,173
Surat	0	980	1,100	0	0	0	0	0	390	0	0	0	2,470
Surendranagar	28,365	45,415	56,455	2,684	1,333	340	7,100	16,705	28,160	45,787	42,880	61,940	336,964
Mehsana	0	0	608	110	261	539	1,650	0	350	0	102	0	3,620
Total	64,561	98,616	95,006	56,171	19,427	4,752	17,340	27,407	53,095	68,728	68,567	82,880	656,550

Annexure 1.5 : Arrival of Charcoal at Ahmedabad Market in 1989-90 (No of bags of 40 kg)

DIST/PLACE	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
Ahmedabad	440	0	1,100	440	0	0	0	860	440	1,100	660	1,760	6,800
Bharuch	0	215	1,180	0	0	0	400	0	0	0	3,000	2,200	6,995
Bhavnagar	8,410	7,620	24,802	650	1,000	1,640	3,200	5,180	9,985	7,795	20,815	17,682	108,779
Kutch	0	0	0	0	0	0	0	0	0	0	761	430	1,191
Bombay	0	0	0	0	0	3,300	1,607	1,210	412	861	0	250	7,640
Banaskantha	18,590	36,055	33,791	19,813	29,430	15,200	41,600	23,500	22,635	29,172	27,652	30,016	327,454
Gandhinagar	0	7,990	2,820	2,108	0	0	0	0	0	0	0	0	12,918
Jamnagar	0	0	0	1,000	0	0	0	0	0	620	0	0	1,620
Karnataka	0	322	0	0	0	0	0	0	0	0	0	0	322
Madras	0	0	0	0	0	0	0	0	791	0	0	0	791
Maharashtra	0	220	0	0	0	0	0	0	0	0	0	0	220
Mehsana	0	0	0	0	0	0	0	2,190	0	0	0	0	2,190
Panchmahal	155	0	0	0	0	0	0	0	0	0	0	0	155
Rajkot	0	0	0	0	0	200	0	0	0	0	0	0	200
Surendranagar	41,364	36,872	33,150	6,600	0	0	2,760	6,255	14,040	33,820	22,822	24,547	222,230
Total	68,959	89,294	96,843	30,611	30,430	20,340	49,567	39,195	48,303	73,368	75,710	76,885	699,505

Annexure 2.1: Village-Wise Arrival of Charcoal from Surendranagar District 1989-90 (No. of bags of 40 kg.)

Village	Taluka	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Total
Aajawa	Not identified	0	0	0	440	440
Ajitgadh	Halvad	5,500	440	440	1,100	7,480
Amarapar	Chotila	880	220	0	880	1,980
Ambardi	Muli	0	0	0	440	440
Aswada	Not identified	0	0	660	11,635	12,295
Bagwadi	Not idnetified	0	0	0	1,100	1,100
Bajana	Dasada	660	0	660	2,640	3,960
Bavali	Dhrangadhra	660	0	440	220	1,320
Bharad	Dhrangadhra	4,844	0	640	2,860	8,344
Bhojpara	Chotila	440	0	0	0	440
Bhopka	Not identified	440	0	0	0	440
Chachana	Limbdi	1,540	0	0	0	1,540
Chadadhra	Halvad	220	0	0	0	220
Chamaraj	Wadhavan	0	0	335	0	335
Chuli	Dhrangadhra	0	0	220	0	220
Dahisara	Not identified	0	0	0	220	220
Darod	Limbdi	220	0	0	0	220
Dhama	Dasada	0	0	2,200	440	2,640
Dhangadhra	Dhrangadhra	440	0	4,020	0	4,460
Dhrumath	Dhrangadhra	1,760	220	0	1,520	3,500
Dhulkot	Halvad	220	0	0	0	220
Doyali	Not identified	0	0	0	220	220
Echhvada	Dasada	5,920	1,320	440	880	8,560
Fatehpur	Dasada	6,380	1,100	660	1,760	9,900
Gala	Dhrangadhra	440	0	0	0	440
Gautamgadh	Muli	220	0	0	0	220
Ghanshayampur	Halvad	1,100	0	220	0	1,320
Golasan	Halvad	440	0	0	3,250	3,690
Halvad	Halvad	2,200	0	0	0	2,200
Hematpur	Muli	220	0	0	0	220
Ingrodi	Lakhtar	872	0	0	0	872
Jalwadi	Not identified	170	0	0	0	170
Jambu	Limbdi	220	0	0	0	220
Jesada	Dhrangadhra	2,640	0	220	1,100	3,960
Jogad	Halvad	0	0	0	1,100	1,100
Joravarpur	Dasada	440	0	0	0	440
Kamalpur	Dasada	0	0	0	660	660
Kedariya	Halvad	440	0	0	0	440
Khampalia	Muli	2,200	440	0	0	2,640
Kharghoda	Dasada	440	0	0	0	440
Khod	Halvad	1,100	0	0	0	1,100
Kidi	Halvad	0	0	220	0	220
Koyaba	Halvad	880	0	0	0	880
Kuda	Dhrangadhra	440	0	1,100	1,100	2,640
Limbdi	Limbdi	1,760	0	0	640	2,400
Mahadevgadh	Muli	1,320	0	0	0	1,320
Malaniyad	Halvad	1,540	0	660	0	2,200
Malvan	Dhrangadhra	3,520	440	1,100	1,320	6,380
Mangadh	Halvad	7,010	880	440	2,400	10,730
Mayapur	Halvad	0	0	220	0	220

(continued Annexure 2.1)

Village	Taluka	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Total
Mayurnagar	Halvad	660	220	220	220	1,320
Methan	Dhrangadhra	2,420	0	440	1,520	4,380
Mithadhar	Not identified	0	0	0	440	440
Mithagodha	Dasada	0	0	0	220	220
Miyani	Halvad	220	220	1,760	1,100	3,300
Mulada	Dasada	880	0	0	0	880
Muli	Muli	220	0	0	0	220
Naguwadi	Not identified	880	220	440	5,720	7,260
Nagvada	Dasada	880	0	0	0	880
Nana Goraiya	Dasada	660	0	0	0	660
Narali	Dhrangadhra	1,100	0	0	880	1,980
Naranpura	Not identified	220	0	0	0	220
Navadhariya	Not identified	0	0	440	1,300	1,740
Navagam	Chotila	0	0	0	1,100	1,100
Navaghatila	Halvad	0	0	0	440	440
Odu	Dasada	220	220	0	0	440
Padariyana	Not identified	0	0	0	1,760	1,760
Pandatirath	Halvad	660	0	0	0	660
Panshina	Limbdi	1,980	0	0	0	1,980
Parnala	Limbdi	1,980	0	0	0	1,980
Patwada	Not identified	0	0	0	1,100	1,100
Pipali	Dasada	0	0	220	0	220
Pratapgadh	Halvad	880	0	0	0	880
Raisangpar	Halvad	1,100	0	0	440	1,540
Ralol	Limbdi	3,080	0	0	0	3,080
Ramgiri	Dasada	660	0	0	880	1,540
Ranipat	Muli	880	0	0	0	880
Ratanpar	Dhrangadhra	620	0	0	0	620
Rozva	Dasada	1,980	0	0	2,200	4,180
Sali	Dasada	0	0	440	0	440
Sara	Muli	1,320	0	0	220	1,540
Soladi	Dhrangadhra	0	0	0	440	440
Songadh	Chotila	0	0	0	660	660
Sujangadh	Muli	2,860	0	0	0	2860
Sujitgadh	Not identified	660	0	0	0	660
Sundargadh	Halvad	220	0	0	444	664
Sundari	Halvad	2,420	0	0	0	2,420
Surajpura	Dasada	220	0	0	0	220
Surel	Dasada	5,940	0	440	1,540	7,920
Talawadi	Not identified	440	0	0	0	440
Thala	Dhrangadhra	8,790	0	440	6,800	16,030
Tikar	Halvad	5,720	440	220	3,300	9,680
Vanala	Limbdi	400	0	0	0	400
Varali	Not identified	0	0	0	220	220
Vasadva	Dhrangadhra	0	0	0	440	440
Vavdi	Dhrangadhra	220	0	0	660	880
Velala	Muli	0	0	0	660	660
Wadhwan	Wadhwan	0	220	0	220	440
Zadiana	Dasada	0	0	3,740	5,720	9,460
Zanzari	Not identified	880	0	0	0	880

Annexure 3.1: Highly Regular Destinations for Charcoal Despatches From Ahmedabad Market
(No. of bags of 40 kg.)

Destination	1986-87	1987-88	1988-89	1989-90	Total
Kota	41,465	46,224	110,393	169,730	367,812
Dehradun	23,505	53,772	84,360	122,577	284,214
Surat	20,996	57,237	53,332	54,075	185,640
Saharanpur	35,278	51,660	16,895	21,501	125,334
Delhi	45,919	21,717	25,984	28,797	122,417
Baroda	5,866	23,040	22,226	7,838	58,970
Rishikesh	4,227	9,403	12,637	8,445	34,712
Veraval	5,729	29	13,169	12,414	31,341
Pontasahil	250	11,215	2,630	12,672	26,767
Bharuch	475	6,299	8,303	3,353	18,430
Ankleshvar	3,482	6,840	4,902	2,600	17,824
Valsad	1,488	3,872	5,415	4,260	15,035
Gaziabad	5,260	8,075	570	530	14,435
Ratlam	296	8,930	2,954	1,847	14,027
Navsari	240	5,515	4,140	3,550	13,445
Rajpipla	1,079	3,555	2,839	5,527	13,000
Muradabad	3,577	6,689	570	1,258	12,094
Bilimora	800	2,386	3,226	3,560	9,972
Kanodara	737	3,985	3,020	1,680	9,422
Junagadh	220	225	3,115	4,389	7,949
Indore	817	250	4,700	2,043	7,810
Himatnagar	2,102	997	1,751	1,278	6,128
Gandhinagar	1,239	990	1,426	1,313	4,968
Godhra	631	1,078	1,665	1,280	4,654
Vidyanagar	1,225	1,141	1,356	440	4,162
Jodhpur	615	2,717	240	230	3,802
Jaipur	1,223	775	860	750	3,608
Nadiad	635	617	575	1,115	2,942
Pethapur	440	543	650	817	2,450
Kalol	416	862	505	458	2,241
Unjha	234	1,011	446	223	1,914
Siddhpur	598	460	260	240	1,558
Vijapur	573	328	50	325	1,276
Kukarwada	240	250	405	369	1,264
Bavla	288	220	318	269	1,095
Talod	220	110	318	162	810
Sujangadh	187	186	254	175	802
Kheda	211	162	160	105	638
Idar	224	119	125	40	508

Annexure 3.2: Fairly Regular Destinations for Charcoal Dispatches From Ahmedabad Market

(No. of bags of 40 kg.)

Destination	1986-87	1987-88	1988-89	1989-90	Total
Dehgam	381	112,057	80	0	112,518
Bombay	2,100	0	67,543	10,985	80,628
Meerut	18,155	17,212	4,190	0	39,557
Udhna	5,326	7,943	0	2,270	15,539
Kherdi	0	735	2,316	10,055	13,106
Pritampur	0	860	4,510	1,260	6,630
Dahod	0	694	4,181	1,136	6,011
Amreli	2,688	0	1,233	1,348	5,269
Selvas	0	250	1,125	3,443	4,818
Palanpur	1,729	1,868	753	0	4,350
Bantava	899	0	1,332	1,822	4,053
Nandurbar	0	1,415	1,361	820	3,596
Nani Daman	0	250	1,124	1,948	3,322
Bhilwada	310	530	1,635	0	2,475
Keshod	240	0	1,583	456	2,279
Ishwarpura	0	665	910	660	2,235
Vyara	0	475	930	710	2,115
Vapi	270	0	845	943	2,058
Neemuch	0	770	230	1,030	2,030
Porbandar	710	235	1,039	0	1,984
Visnagar	0	520	730	468	1,718
Jetpur	627	0	144	725	1,496
Anand	824	200	251	0	1,275
Kadi	42	0	263	947	1,252
Balotra	437	0	505	230	1,172
Randheja	0	111	617	195	923
Modasa	48	0	40	700	788
Sanand	440	276	13	0	729
Jafrabad	398	0	100	55	553
Dholka	0	161	48	170	379
Prantij	217	18	48	0	283

Annexure 3.3: Occasional Destinations for Charcoal Despatches From Ahmedabad
(No. of bags of 40 kg.)

Destination	1986-87	1987-88	1988-89	1989-90	Total
Birlapur	0	550	23,970	0	24,520
Bhopal	0	0	10,706	9,107	19,813
Mandi Dip	0	0	10,120	3,290	13,410
Nagda	0	9,689	651	0	10,340
Jamnagar	0	0	1,895	4994	6,889
Punjab	3,328	1,880	0	0	5,208
Mandsaur	0	0	1,220	2,843	4,063
Kalyan	0	2,525	220	0	2,745
Ultadanga	0	0	600	1,885	2,485
Rajkot	0	0	855	950	1,805
Rampur	976	750	0	0	1,726
Pune	0	0	1,230	358	1,588
Nathdwara	216	0	0	1,335	1,551
Kandla	0	1,170	250	0	1,420
Shilam	0	0	235	960	1,195
Valod	0	250	0	830	1,080
UP	600	260	0	0	860
Kanpur	530	0	290	0	820
Maharashtra	0	225	543	0	768
Bardoli	0	0	250	507	757
Pali	0	0	430	272	702
Thana	0	0	225	465	690
Devgadhbaria	0	0	220	461	681
Jasdan	48	0	600	0	648
Virpur	464	0	0	170	634
Bodeli	0	0	220	382	602
Rajasthan	213	342	0	0	555
Nizamabad	0	0	368	180	548
Balsinor	0	96	410	0	506
Shivri	0	250	0	230	480
Kutiyana	240	0	0	227	467
Dhoraji	0	0	235	229	464
Nandasan	28	420	0	0	448
Bareja	288	0	0	149	437
Petlad	224	190	0	0	414
Mahudi	0	0	215	195	410
Vanthali	0	0	240	162	402
Bagsara	250	0	100	0	350
Gariyadhar	230	0	75	0	305
Mehsana	0	0	225	44	269
Padra	0	0	200	64	264
Sadra	0	0	16	165	181
Khedbrahma	0	0	80	50	130
Pilvai	32	54	0	0	86

Annexure 3.4 Rare Destinations for Charcoal Despatches from Ahmedabad (No. of bags of 40 kg.)

Destination	1986-87	1987-88	1988-89	1989-90	Total
Therubali	0				
Katni	0				
Badnawar	0				
Falakata	0				
Shahibabad	0				
Purena	0				
Upleta	0				
Harduva	0				
Palam	1,640				
Valoti	0				
Ratanpur	927				
Roha	0				
Gondal	0				
Dhari	0				
Jamjodhpur	0				
Ulhasnagar	0				
Pardi	0				
Jhansi	0				
Deesa	0				
Derol	0				
Golana	410				
Khambhat	0				
Agra	336				
Nagpur	0				
Tonk	310				
Vijaynagar	300				
Ajmer	0				
Rudki	0				
Udaipur	275				
Chandrapur	0				
Kanjari	0				
Nasirabad	0				
Savarbandar	0				
Shihor	0				
Mandvi	0				
Amalsad	0				
Ladnum	200				
Kankroli	150				
Chhatral	0				
Sabarmati	128				
Vagodiya	0				
Jambusar	0				
Lunavada	0				
Chiloda	0				
Satlasan	0				
Vadali	80				
Halol	0				
Ranpur	0				
Abu road	0				
Mehmadabad	0				
Ahmedabad	61				
Savli	0				
Chandrala	0				
Jhalod	0				
Dabhan	0				
Sakarda	0				
Koba	0				
Viramgam	0				
Piplej	48				
Metpur	0				
Bayad	0				
Naeka	26				
Kapadvanj	0				
Shamlaji	0				
Rajpur	0				
Shertha	0				
Chhala	0				
Manasa	0				

Annexure 4.1: Wholesale Prices of Charcoal at Ahmedabad per Maund (20 kg)

Month	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
Apr.		13	NA	23	29	35	35	32	44	34	44	
May		17	NA	20	36	33	49	34	48	44	43	
Jun.		17	NA	24	36	34	32	40	44	44	60	
Jul.		18	NA	26	37	23	48	46	46	41	59	
Aug.		19	NA	30	23	30	30	32	46	46	54	
Sep.		15	NA	23	30	21	38	33	43	43	61	
Oct.	17	12	NA	32	25	26	26	36	47	52	60	
Nov.	14	21	16	32	36	33	36	39	45	52	54	58
Dec.	17	27	22	26	35	28	34	40	54	56	56	61
Jan.	18	30	18	24	36	21	30	52	40	55	64	54
Feb.	18	25	22	28	40	28	28	48	36	48	65	
Mar.		NA	15	32	32	31	30	45	38	47	56	