AN EMPERIACAL STUDY ON JAGGERY (GUR) INDUSTRY IN SIRAJGONJ DISTRICT

A THESIS
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Student No.: 1105032
Session: 2011-12
Semester: January – June, 2012

MASTER OF SCIENCE (MS)
IN
FOOD ENGINEERING AND TECHNOLOGY

DEPARTMENT OF FOOD ENGINEERING AND TECHNOLOGY

HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR

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In partial fulfillment of the requirements for the degree of

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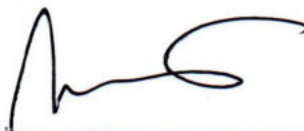# AN EMPERICAL STUDY ON JAGGERY (GUR) INDUSTRY IN SIRAJGONJ DISTRICT

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DEPARTMENT OF FOOD ENGINEERING AND TECHNOLOGY

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i

ABSTRACT

Jaggery (Gur) is a natural, traditional product of sugarcane. It can be defined as a honey brown coloured raw lump of sugar. Sirajgonj District has large number of Jaggery manufacturing units, mostly located in the rural areas. Around one-third of the rural population in the study area is employed in Jaggery making industry. It is found that the manufacturers are producing majorly for distilleries and local licker producers, and for the food-plate or common man's consumption. In the district, the major clusters which are having more numbers of manufacturing units are Kutirchar, Kalinja, and Sharutia. From 3 clusters, 35 plants were selected randomly for the study work. The paper examines the socio-economic status of the manufactures, cost-return analysis, profitability and operational efficiency of the jaggery processing units in the study areas. The study shows that 68.57% and 31.43% of the manufacturers live in nuclear and joint family respectively and monthly income of the families vary from TK. 2,500 to TK. 15,240. Agriculture is the main profession of 85.71% manufacturers. The study shows that 51.43% of the manufacturers are illiterate and they have no training certificate regarding jaggery manufacture. The rate of illiteracy is 47.59% in the manufacturer's family. The study reveals that average profit earned by small, medium and large units are TK. 21,260, TK. 32,606.25 and TK. 40,300 respectively in a season. Only 3% and 5% of the manufacturer get government and private financial support respectively. The manufacturers are not interested in any new product of jaggery; they just want to earn more profit through jaggery.

CONTENTS

CONTENTS(CONTD.)

LIST OF TABLES

LIST OF FIGURE

CHAPTER I

INTRODUCTION

Bangladesh is one of the largest sugarcane *(Saccharum officinarum)* producer countries of the world. Sugar and jaggery is product of sugarcane that is Sugarcane is the main raw material required for the Jaggery industries. Again Bangladesh is one of the largest producers of the sweeteners in the world including Sugar and Jaggery. Since remote past Jaggery has been an important item of food. And even today, Bangladesh is one of consumers of jaggery.

Jaggery (Gur) is a natural, traditional sweetener made by the concentration of sugarcane juice. Jaggery is consumed mostly by the rural population in Bangladesh. With enhanced standard of living and higher income, the jaggery demand has shifted to white sugar. Jaggery can be defined as a honey brown colored raw lump of sugar. It contains all the minerals and vitamins present in sugarcane juice and that is why it is known as healthiest sugar in the world. In some of the South American countries it is known as Pamela. At the time of production of sugar it requires a mix up of chemicals like sulphure-dioxide, lime, phosphoric-acid, formic-acid and bleaching agents, and that is why all the contents of sugarcane cannot be found in sugar, whereas jaggery has all the contents and even the scientists have proved that all the essential vitamins and minerals are missing from sugar as compared to jaggery. The acceptable taste and nutritive value of jaggery has attracted man since ancient times. Jaggery is also called "Non Centrifugal Sugar" or Artisan Sugar. It forms an important item of Bangladeshi diet for its high nutritive value and as a sweetening agent. White sugar contains mainly sucrose (99.70%), where as jaggery has sucrose (51.00%), protein (0.25%), glucose (21.20%) and minerals (3.40%) in addition to traces of fats (0.02 to 0.03%), calcium (0.39%), vitamin A, vitamin B, Phosphate (0.025%) and provides 383 Kcal/100g jaggery. Dietary sucrose (sugar) is mixed blessings which makes food more attractive and appetizing but excessive consumption often leads to various kinds of pathological conditions like, dental caries, coronary thrombosis, ischemic heart disease, diabetes, acidity, depression and obesity etc., Some studies have also shown that high sugar intake leads to higher cancer risk.

Jaggery which is an alternate sweetener from sugarcane is health friendly. In Ayurveda jaggery is considered to be the best of all the sugarcane products. In Ayurvedic way of medicine it is used as medicine, blood purifier and also it prevents disorders of bile.

Per capita consumption of sucrose in Bangladesh is much lower (15 kg), compared to that of developed countries (50 kg). Major share (above 75%) of sucrose consumption in rich countries has been through manufactured foods. But, excessive sucrose consumption leads to aforesaid problems. To over-come these problems many of these countries are seriously looking for alternative sweeteners from sugarcane crop. Bangladesh has one of such eco-friendly sweetener jaggery. It has great potentiality to be exported to many countries like, Great Britain, Canada, Chili, Egypt, Fizzy, Iran, Iraq, Kuwait, Malaysia and Nepal through surplus production. The methods of converting sugarcane and manufacturing sugar, gur and khandasari are different but a great value is added in the manufacturing of these consumable final products. Further it offers employment opportunity to millions of people. Jaggery is prepared in many districts of the country where sugarcane is grown extensively. It is known by different terms in different parts of the country, like Gul, Gud, Gur, Vellum etc.

Being a health friendly sweetener, quality jaggery and its value added products such as jaggery chocolate and confectionaries made of various combinations of cereals, it is possible to significantly increase export of jaggery in solid powder and liquid forms. Jaggery produced using chemicals has lower export potential. Hence, there is a need to popularize scientific and eco-friendly methods of jaggery production.

The jaggery industry has been considered as one of the small cottage industry in Bangladesh. From time immemorial, sugarcane crop has been known as a profitable crop by the cultivators and also the preparation of jaggery..

It is estimated that half of the sweetening requirement in Sirajgonj district is met by jaggery. The jaggery industry in the district even in the country has thus, been continued to be an industry of great importance and relevance.

Jaggery industry has undergone several changes over the years. Kolhus used for crushing sugarcane have been replaced by power crushers in many parts of the country including Sirajgonj. This has helped improving the efficiency of the industry by the way of

enhanced extraction percentage of juice from cane. The process of preparation of jaggery has also undergone considerable changes. As a result of these changes the jaggery industry is offering a stiff competition to sugar industry for sugarcane. The sugar industry claims that the discriminatory policies of the government have helped diverting large portions of sugarcane towards jaggery industry, especially at times of sugar shortage.

Study on existing conditions of jaggery is imperative with a view to improving the jaggery preparation process. There is attention, worth mentioning, has hardly been paid to this industry till recently. It has been realized that by organizing jaggery industry on a systematic and scientific basis a good deal of national wealth could be saved from being lost and ameliorate the conditions of Bangladeshi farmers. This is particularly true in view of the enormous problems being faced by sugar industry in the country.

There are hardly any systematic efforts made to improve jaggery industry which is so vital from the point of view of its importance in the economy and greater employment potential. There has been a steady increase in the demand for jaggery in view of the fact that the jaggery is not only the chief source of sweetening agents for rural masses but has considerable forward linkages in the economy. The production of jaggery has not been able to keep pace with increasing demand for it. As a result, the prices of jaggery have increased sharply in recent years. Hence, there is an immediate need for a detailed inquiring into the various aspects of production and marketing of jaggery.

Jaggery industry in Bangladesh is a well-known cottage industry. It provides rural employment opportunities and plays an important role in the economy of Bangladesh. Jaggery is manufactured from sugarcane juice and is very widely used not only in individual households but also in many eateries, restaurants, clubs and hostels and it has certain industrial applications as well. Manufacture of sugar involves many technical aspects and the capital investment is also on the higher side. Compared to this, production of jaggery is very simple and the capital cost is also very limited. Due to its wide applications, the market for jaggery is continuously growing.

In recent years the Bangladeshi sugar industry has found itself entangled in a complex web of problems of high stocks, low prices, poor profitability, high raw material cost, financial crunch, and weak international competitive edge. A look into the present

3

position of jaggery industries in Sirajgonj from the view point of cost and returns in production of jaggery, the behavior of arrivals and prices as well as export competitiveness may help in better understanding of the industry to harvest to its best competitive advantage. This information will have an impact on manufacturers' income and industry performance in the state.

Existing problem identification of jaggery industry is the goals and objectives of this study, and finding out their appropriate reason will serve as fundamental factor for selecting strategies and investigating the prospects of their applicability. Hence, the study is undertaken with the following specific:

1. To explore the existing situation of jaggery manufactures in study area and also see the socio-economic status of jaggery makers.
2. To examine the Cost and Returns of jaggery manufacturing units in study area.
3. To identify the major barriers facing by jaggery manufacturers of this industry in study area.

The study of this kind would help in identifying the extent of profitability in jaggery production and problems of marketing besides identifying various constraints in production and marketing of this product.

CHAPTER II

REVIEW OF LITERATURE

Significant number of research works has been carried out regarding jaggery industry. So an attempt has been made to review some of the available information related this research in this chapter.

Murlidharan (1981) investigated the cost of establishing gur units with different capacities and it ranged from Rs. 36,000.00 for 5 HP, Rs. 43, 920.80 for 7.5 HP, Rs.46, 678.00 for 10 HP and Rs.65, 185.00 for 15 HP units. On an average the unit processing cost of gur worked out to be Rs.43.05 per quintal. The input cost was the highest for single element which was Rs.9.77 per quintal (22. 69%) of the total cost. The next highest cost was labour expenses which was Rs.8.64 per quintal (20.02 %). The fixed cost amounted to be Rs. 7,878.56 and variable cost was Rs.18, 361.69 with a total cost of Rs.26, 240.25.

The study on economics of processing and marketing of gur in Indore district of Madhya Pradesh by Ananth Ram (1989) revealed that a sum of Rs.6.80 per quintal of gur was the processing cost of sugarcane under power of kolha units. He noticed that the processing cost differed from unit to unit. The level of capital investment, type of crusher used and the quantity of sugarcane crushed were the factors influencing the processing cost.

Raju and Ramesh (1989) worked out cost of production in jaggery on per hectare basis of sugarcane cultivated. The cost of production of jaggery worked out to be Rs.28, 417 per hectare of sugarcane area. About 70 per cent of the total cost accounted for the production of sugarcane. The other major items of cost were wages paid to human labor, rent paid for the use of crushers and chemical ingredients. The jaggery production from one hectare of sugarcane worked out to be 93.28 quintals. The net returns of jaggery production per hectare form sugarcane were estimated to be Rs.5, 127 with a total return of Rs. 33,724.

In a study by Rohal *te al.* (1989) the average cost of processing of sugarcane in to khandasari worked out to Rs.8.54 per Kg. The economic analysis of capital structure in

khandasari unit showed a better capital turn over (Rs.1.83per rupee investment). Which indicated further scope of capital investment in the industry?

Suryawanshi *et al*. (1994) reported that the cost of jaggery production was Rs.565 per quintal. They further noticed that 98 quintals of jaggery was prepared from the sugarcane grown on one hectare. They reported that the per hectare total cost of sugarcane cultivation was Rs. 41,484 and the out-put per hectare was 89.93 tons. The cost of production per ton of jaggery was Rs.446.

Anonymous, (1998) stated that in the conventional method of jaggery manufacture, juice extraction is only 55-60%, compared with 80-82% in a typical cane sugar factory. It is recommended that jaggery be manufactured from juice extracted in a factory; the process by which this is done at Jaknur factory, India, is described. Since less cane would be required to make a given quantity of jaggery, more would remain for sugar manufacture.

Malik and Singh (1999) analyzed the cost and returns of sugar cane production in Haridwar district of western uttar Pradesh. In case of reserve area (< 10 kms from sugar mills) cost A1, A2, B1, B2, C1, C2, gross income from main product and by product were Rs.21605, Rs.21605, Rs.24724, Rs.3390.8, Rs.28231, Rs.37415, Rs.45002 and Rs.4419 respectively. In far area (>10 kms from sugar mills) the above costs in the same order were Rs. 21366, Rs.21366, Rs.24498, Rs.33293, Rs.28009, Rs.42758, and Rs.4416 respectively.

Ramaswamy *et al*. (1999) stated that jaggery making is a traditional enterprise in Tamilnadu and is more profitable to cane producers than supply to the factory. But, higher profitability is counter veiled by price risk in jaggery. Traditionally, jaggery making is under taken by cane growers in their own farm. The trend changed with the entry of new enterprisers who venture jaggery manufacturing as a pure enterprise by procuring cane from the cane growers. The substantially higher price, immediate disbursements of sale proceeds for the sale of cane, missing registration in time with factory, delay in cutting and complex procedure of transactions with the factory make the cane growers favor cane supply to jaggery making. On the other hand absence of price risk, labor shortage in the case of own jaggery making, financial and technical assistance extended by the factory are the major factors attracting supply of cane to factory. Linear probability model was estimated to identify the determinants of sugarcane supply to sugar

factory. A two stage procedure was employed to estimate the equation. Profitability in opting for jaggery production emerges as a significant variable in influencing the farmer not to be in favor of cane supply to the factory, the education and farm size were non significant variables in influencing the cane growers' decision to supply cane to the factory. The insignificance of farm size indicates sugarcane supply to factory is neutral to scale. The experience in jaggery making has negative influence on the cane supply to factory. Labour shortage had significant influence in encouraging farmers to supply the cane to the sugar mills. Distance of factory appears less significant in the decision process as the modern transport system viz., tractor had made transport of cane a non issue. Therefore the dummy variable, ownership of tractor had no influence on cane supply decision to factory.

Lohar *et al.* (2000) estimated per tonne cost of production of sugarcane, per quintal production of jaggery, per quintal manufacturing of sugar and profitability of production of jaggery and sugar. The study was conducted with sample of 30 jaggery producers from six villages in Karveer, Tahsil, Kolhapur district, Maharashtra, India and it revealed that profitability is more in jaggery production.

Pawar (2001) studied the jaggery processing in India, and the study revealed that; India produces 10.3 million tons of jaggery (gur) annually. Tremendous scope exists for *improving the manufacturing process. This paper reports on data collected from 23* processing units in the Satara and Kolhapur districts of Maharashtra, and makes recommendations for the production of quality jaggery.

Shivaramu *et al.* (2002), undertaken a detailed survey of jaggery-making units in Cauvery Command Area (Karnataka, India) to evaluate the performance of a triple pan jaggery making furnace compared to local types. It was noted that the local types, i.e., single pan and double pan furnaces, took more time in boiling and also affected the quality of jaggery produced. Local furnaces also contained less safe inorganic clarificants and bleaching agents (sodium bicarbonate and sodium hydrosulfites) as compared to the triple pan jaggery, which contained bhendi mucilage. Because of the shorter boiling period, the daily production rate of jaggery in a triple pan furnace was 11.5 q, as compared to 7-8 q in local types. Using the triple pan furnace, the net returns were almost 2-2.5 times more (Rs.122000/year) than with local types (Rs.51,000-65,000/year). In conclusion, the triple pan furnace is more efficient than the local types of furnaces.

Patil *et al.* (2003) conducted study on effect of S fertilizer on the yield and quality of sugarcane during 1997/98 and 1999/2000, in Kolhapur, Maharashtra, India. Increasing the rate of S increased the cane and commercial cane sugar yields and improved the juice quality, but had no significant effect on juice purity. S improved the quality of jaggery and increased its recovery. S at 80 kg/ha was superior but statistically at par with the 60 kg/ha treatment.

Usha *et al.* (2004), conducted a study to investigate the prevailing processing practices being followed by jaggery manufacturers in the Cauvery Command Area of Karnataka, and Study revealed that High income manufacturers used a triple pan furnace, while the majority used a double pan furnace due to lower investment and skill required. It was found that sodium bicarbonate, sodium hydrosulfite and sodium formaldehyde sulfoxylate were the inorganic additives commonly used by all. Besides this, some used trisodium phosphate, while the majority used Magnafloc, of which the chemical composition was not known. Some chemicals were found to be unlabelled and the safety limits not set by quality control institutions. Organic additives include bhendi mucilage and coconut or castor oil to get the light golden yellow colour and crystalline texture of jaggery. Pan cleaning with dilute HCl was regular and daily among triple pan furnace users, but a majority of double pan furnace users cleaned their pans once in every 3 days. None of the manufacturers used disinfectants. A majority of manufacturers stored jaggery in jute bags or in open storage with an average storage time of less than one week. 40% of the manufacturers felt a need for an improvement in colour and hardness and were concerned with discoloration during storage. It is concluded that jaggery manufacturers in are not satisfied with the jaggery they produce. This may prompt them to use chemicals indiscriminately to achieve good colour and texture. The manufacturing units are also unhygienic.

Mungare *et al.* (2005) conducted an experiment at the Regional sugarcane and jaggery research station, Kolhapur, Maharashtra, India to investigate the clarification efficiency of some synthetic and herbal clarificants suitable for quality jaggery. Based on this it was concluded that application of synthetic clarificants viz., Bhendi Powder SN 22 mg/lit (2ppm) with Bhendi plant 2 kg/100 lit of sugarcane juice is recommended for maximum removal of scum, improving the colour and higher jaggery recovery.

CHAPTER III

RESEARCH METHODOLOGY

The survey was conducted on 35 random units of Jaggery manufacturing units of the major clusters of three upazila (Kamarkhand, Sirajgonj and Raygonj) of Sirajgonj district. For this, a proper questionnaire was made.

3.1 Location of Study Area

Sugarcane is one of the important cash dominant grown in Sirajgonj, which plays a major role in economy. The crop is grown on large hectares of land with a appreciable production capacity. It is cultivated extensively in several Districts of the country. Sirajgonj district is well known for significant amount of quality jaggery production.

Sirajgonj District is located in the Northern part of the country. Sirajganj District of Rajshahi division with an area of about 2497.92 km², is bounded by Bogra District on the north, Pabna district on the south, Tangail and Jamalpur districts on the east, Pabna, Natore and Bogra districts on the west. It lies between North latitude 24.333° and East longitude of 89.616°.Sirajgonj is the 5th largest District in Rajshahi division. The main rivers are Jamuna, Baral, Ichamati, Karatoya and Phuljuri. About 10% area of the Chalan Beel is located in the Tarash upazila of this district.

Jaggery industry is the most popular industry in sugarcane dominated area of Sirajgonj Sirajgonj (Map-4.1) i.e. Kamarkhand, Sirajgonj & Raygonj Upazila. Sirajgonj district is known for sugarcane production since long back. There are several sugar factories in the adjoining districts but their production capacity is declining day by day due to old technology, and that is the reason behind quick growth of jaggery industry.

The thing which should be underlined here is, there is no established working sugar factory and no initiative has been taken by government to establish sugar factory due to low production & high-cost. Jaggery production units are grown like anything in the area and they have paid considerable value to the manufacturers. The samples from Kutirchar, Kalinja and Sharutia are 22, 7 and 6 respectively. The chosen jaggery clusters are

9

Kutirchar: Kutirchar is one of the largest and flourished clusters of Sirajgonj district. In this cluster the maximum manufacturers are processing at large level of production, they are working more than 18 hours in a day and having all the possible required facilities for the industry, from this cluster, 22 sample units were randomly selected for the survey.

Kalinja: Kalinja is a block headquarter of the district which has the maximum number of crushers (small-units) in the district, 8 random units were chosen from Kalinja cluster for the survey.

Sharutia: Sharutia is another important cluster of the district which is closely situated with the district. This cluster has good number of jaggery processing units but the production volume is much less than Kutirchar cluster, 6 random units were chosen for this study.

3.2 Population

According to population census of Bangladesh 2001, total population of Sirajgonj district has been measured at 3215873, made up of 92% Muslim, 6.5% Hindu and 1.5% other. Males make up 51.14% of the population and females 48.86%and the Growth in population for 2001 to 2011 is around 28.09 percent.

3.3 Land Situation

Total cultivable land 179964.02 hectares, fallow land 15701.64 hectares, forestry 50.48 hectares; single crop 19.54%, double crop 59.18% and treble crop land 21.28%; cultivable land under irrigation 74.34%.

Regarding land control among the peasants, 21.85% are landless, 22.41% marginal land owners, 32.37% small land owners, 17.58% intermediate land owners and 5.79% rich land owners; cultivable land per head is 0.07 hector.

3.4 Profession of the People

People involved in varied profession such as agriculture 35.49%, agricultural laborer 21.45%, wage laborer 5.77%, commerce 11.98%, service 5.49%, handicraft 5.59%, industrial laborer 2.78%, others 11.45%.
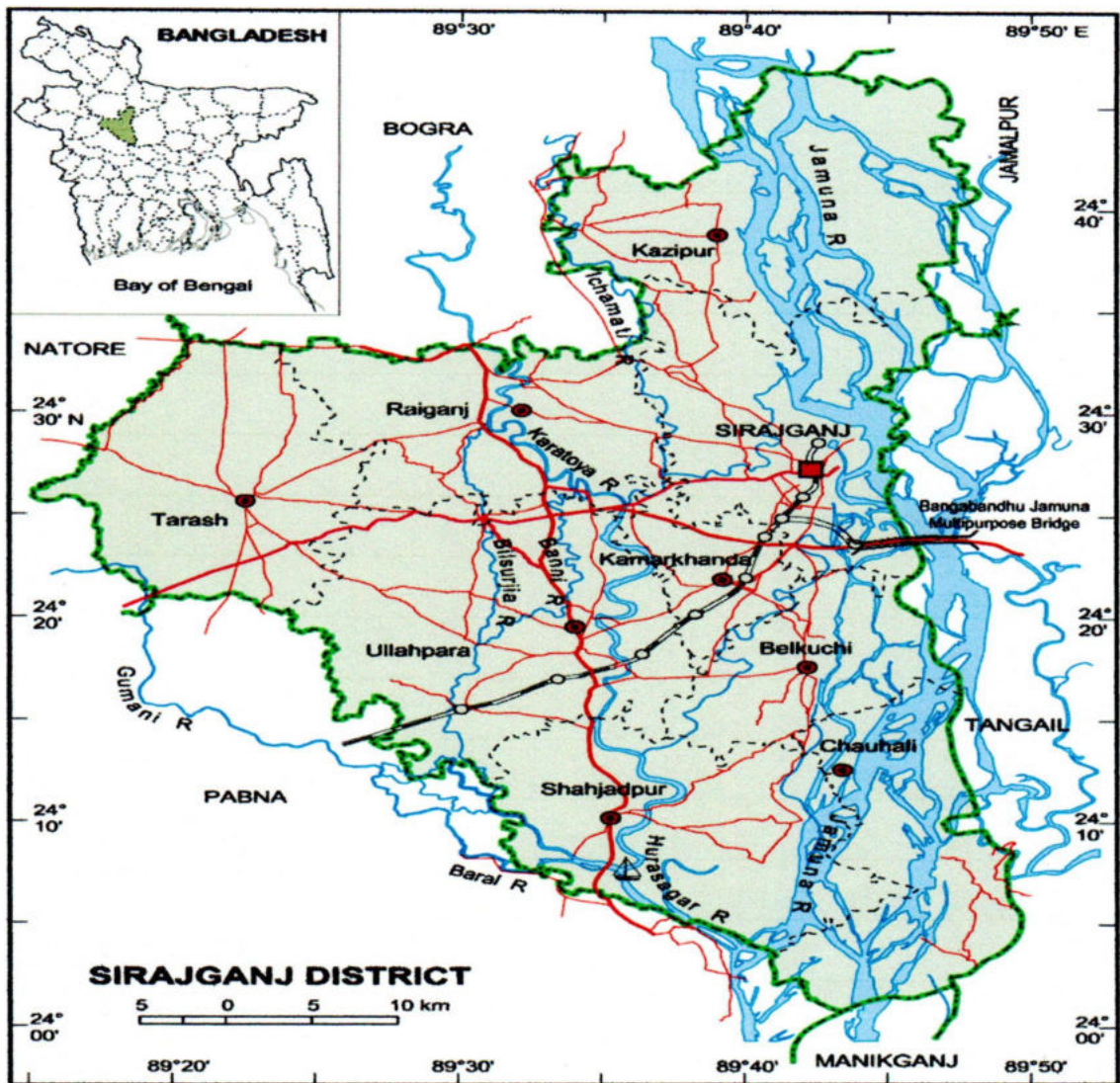
Fig: 3.1: Location of Study Area (Sirajgonj District)

3.5 Weather and Climate

The weather and climatic condition of this district is highly favorable for agriculture, especially for the cultivation of sugarcane. The annual average temperature reaches a maximum of 34.6 °C, and a minimum of 11.9 °C. The annual rainfall is 1610 mm (63.4 in).

3.6 Cropping Pattern

The principle agricultural crops of the study area are rice of different varieties such as broadcast aman, aus and HYV boro and sugarcane, jute chilly, mustard, potato, lentil etc. Rice is the major food crop and sugarcane is the main cash crop of the study areas

3.7 Communication and Marketing Facilities

Communication of the villages with Sirajgonj district and Thana head quarter of Kamarkhand, Raygonj and Sirajgonj was vacillated by pucca and well-built kuccha roads. The villages are easily accessible by rickshaws, bi-cycle, motor-cycle, motor car, bus etc.

There are some big bazzars named Nolkahat, Chandidasgatihat, sialkolhat and some small bazzars at a short distance in the study area where jaggery and other products are bought and sold. The people of the study area can easily carry their crops and products to the bazzars by different vehicles

3.8 The Survey Method

In order to collect information from the farmer, the survey method was employed due to three reasons (i) survey, though certifying a certain type of detail, enables quick investigation of much large number cases (ii) its results have a wider applicability and (iii) it entails much less cost. The main object of survey method is that the investigator has to relay upon memory of the manufacturers. To overcome this, repetitive visits were made to collect data. The procedure follower for collecting data for this research is discussed below.

3.8.1 Selection of the study area

The area in which an industry survey is to be carried out depends on the particular purpose of the survey and the possible co-operation from the farmers. Keeping in mind the importance of selecting an appropriate area with respect to manpower and other facilities, the jaggery manufacturing area Sirajgonj, Kamarkhand and Raygonj Thana of Sirajgonj district were purposely selected. The reason why these areas were selected for the study is as follows:

❖ A large number of jaggery industries were there in the area. Number of industry and the behavior of the people are satisfactory for the collection of data.

❖ The study areas were easily accessible.

❖ No study of this type was conducted earlier in this areas

3.8.2 Selection of the Sample

The design of sampling used in the study was random sampling technique. Firstly, a list of industry and manufacturers were collected from the selected areas. From this list 35 industry and its manufactures were selected based on the following considerations:

❖ Interest of the manufacturer of jaggery industry
❖ Existing manufacturing facilities
❖ Socio-economic conditions of the manufacturers

3.8.3 Preparation of the Survey Schedule

According to the objective of the study, the preliminary survey schedule was designed for recording data. The schedule was then pretested. The questions in the schedule were modified and rearranged accordingly. The schedule was prepared in logical sequence. It included items regarding technical aspects of industry and question on the socio-economic characteristics jaggery manufacturer, questions on the detailed information about the use different inputs and outputs.

3.8.4 Period of Survey

The industry survey for this study was conducted during the period from November 2011 to 2012. The survey covered a whole jaggery manufacturing period.

3.8.5 Collection of Data

The industries of the selected areas were visited by the researchers himself to collected data related to jaggery industry.

The farmers were personally interviewed by the researchers and data were collected by the repeated field visits.

3.9 Technical Aspect

3.9.1 Energy Used to Operate the Engine

Several type of energy sources are available in selected areas. During the study the manufactures were asked about the type of energy they used for the operation of the crushing machine

3.9.2 Source of cost

Specifically averages were used for estimating cost and returns. The average cost and returns per quintal of jaggery produced was computed. Similarly, cost per unit of jaggery processing established was worked out. Appropriate percentages were worked out for the purpose of comparison. The major cost items involved in jaggery processing units have been detailed as follows.

3.9.2.1 Raw material cost

Sugarcane is the only raw material used in jaggery processing. All the jaggery processors processed the sugarcane grown on their own lands and/or the sugarcane purchased from neighboring farmers. Hence, the sugarcane cost was computed taking sugar factory price wherever owned sugarcane was used. Actual price paid including the transport charges was considered wherever it was purchased.

3.9.2.2 Processing cost

Different chemicals/materials are used in jaggery processing; the costs of chemicals/materials used in jaggery processing were calculated at the actual price paid by the processor including transportation charges. The other costs included in processing were, wages paid to labor, interest on investment and depreciation. Fuel cost is another big field of processing cost. In the study area, electric power and in some places natural gas is available nevertheless all manufacturer use fuel oil. The actual wages paid to the labor were considered as labor charges. Bagasse was the bye-product of the jaggery processing units. Bagasse was the major source of fuel for the jaggery processing units. However, the bagasse produced from each unit was not sufficient to meet the entire fuel requirement of the respective processing units. A part of the fuel requirement was

therefore, met by purchasing from other processors. The actual price paid for purchasing the fuel including the transportation cost was considered.

3.9.3 Data related to Revenue and Profit

Profit is the ultimate goal of the jaggery manufacturers. While carrying out the survey work the manufacturers were asked about the total return and profit in a season.

3.9.4 Qualification of the Manufacturers

During the survey work the manufacturers were asked whether they have any training certificate or not regarding jaggery manufacturing process.

3.9.5 Data Related to External Support

While continuing the survey work the manufacturers were asked whether they get any government or private support regarding the technical and financial aspect

3.9.6 Data Related to Hurdled Faced by the Manufacturers

During the study the manufacturer were asked about the hurdled they faced in the way of smooth jaggery manufacturing.

3.9.7 Data relevant to Socio-economic Status of Jaggery Manufacturers

With respect socio-economic study of the manufacturers and profitability by running jaggery industry, the data that taken were: family size and composition, literacy levels, occupations, land holding, annual income, sources of annul income, household assets, basic needs etc. The data were collected using following technique: the manufacturers were briefed about the aims and objective of the study before going to make an interview. They were interviewed when they had no work in hand. To ensure co-operation of the respondent, the researchers sometimes took the assistance of the persons who commanded respect and confidence of the respondents. In order to minimize the response error, question were asked in simple local Bangla language, after using local terms and units of measurement. To check the correctness and reliability of the information cross-checks were made by asking questions neighboring manufacturers.

3.9.8 Nature and Sources of Data:

For evaluating the objectives, both primary and secondary data were used in the study. Pre-tested and well structured schedules were used for eliciting the required information from the respondents. The data pertaining to area under sugarcane, inputs used and output realized in sugarcane cultivation along with their market values, investment requirements for establishing jaggery processing units in physical and monetary values, cost incurred in jaggery processing and quantities of jaggery produced were collected through personal interview method. Information on place and time of sale, price received, cost incurred in marketing were also collected from the respondents. The data for the study were collected through personal interview method for the year 2011-2012. The primary data was collected from the sample farmers who are cultivating sugarcane and having jaggery processing units in their fields. 35 sample manufacturers were selected randomly from each selected cluster, with a total of 35 sample manufacturers having jaggery units as well as growing sugarcane. Similarly, two important jaggery markets were selected from the above selected taluks that is Bhadraghat market and Paslia market where highest arrivals of jaggery were observed. The information on area under sugarcane, numbers of processing units operating in the study area were obtained through various statistical reports published by the Office of the District Statistical Officer.

3.9.9 Problems Faced in Collecting Data

❖ Most manufacturers initially hesitate to provide the data for technical aspects and answer the question because the researchers were stranger to them. To overcome this problem, a good deal of time was spent to gain their confidence.

❖ It was difficult to convince the manufacturers on the utility of this study because most of them were ignorant and illiterate.

❖ Sometimes the manufacturers were not available at the industry or home in such case repeated visits were needed to conduct a single interview.

3.9.10 Analysis of Data

Data were analyzed with a view to achieving the objective of the study. The analysis of data was done using tabular method. Simple and weighted average, percentage etc.

were used. The tabular methods are widely used in industry based researches because it is convenient and easy to understand

In respect to technical aspects, data on used energy, various costs, profit and return, external support, barriers etc. were determined according to prescribed method. Socio-economic characteristics of manufacturer i.e. family size and composition, literacy levels, occupations, land holding, annual income, sources of annul income, household assets, basic needs etc. of the manufacturers were calculated

3.9.11 Terms and Concepts Used in the Study:

- ➢ Shed: It is made up of wood or straw, mainly used for providing shade while preparation of jaggery. It is also used for storing jaggery.
- ➢ Furnace: It is used for boiling the cane juice. It is built with bricks and cement.
- ➢ Pan: It is a flat open vessel made up of iron. The general dominations are 2 ½ feet height and 3 ½ feet radius. It is mainly used for boiling the cane juice up to 85-90°C.
- ➢ Cane crusher: It is a machine made up of iron, used to crush the cane and to extract juice from the sugarcane.
- ➢ Electrical motor: It is electrical machines, used for crushing cane and to lift the sugarcane juice from bani and transfers it to boiling pans.
- ➢ Filter plate: It is made up of iron used for filtering sugarcane juice.
- ➢ Bani: An underground construction made up of cement and bricks used for collecting juice.
- ➢ Gori (strainer): It is made up of iron, mainly used to remove waste materials and scum from juice during boiling.
- ➢ Hutta/Agarwali: Made up of iron which is small in size, mainly used to transfer hot juice to moulds/buckets to provide uniform shape and size to jaggery.
- ➢ Ash-spade: Made up of iron, thin and long in shape used for removing the ash from the furnace.
- ➢ Moulds: Moulds are made up of crude iron having a shape of bucket with a capacity to accommodate 20 to 22 kgs of jaggery.
- ➢ Processor: He is a person, who undertakes the processing of sugar cane into jaggery on his own processing unit.

3.9.12 Formula used to Determine Cost and Return Analysis

The jaggery processing units considered for the study were established in different years. Therefore, the written down values of all the machineries/equipment were considered and compounded to the reference year (2011-12) for the purpose of computing cost of establishing jaggery processing unit. Cost of each machinery/equipment including the shed requirement for establishing jaggery processing unit was considered. The most important equipment for establishing a processing units are furnace, pan, cane crusher, motor, filter plate, bani, gori, hetta, ash-spade, mould etc.

Formula for the estimation of Cost, Revenue and Efficiency:

i. Cost and return to the Jaggery Producing Units:

This was used to determine the profit margin of jaggery manufacturing units and is specified as follows:

$$\pi = TR\text{-}TC$$

$$\pi = (Price \text{ X } Quantity) \text{ - } TC$$

Where:

π = Profit

TR = Total Revenue (Sales)

TC = Total Cost

Profit in terms of output is given by total revenue (TR) from the sale of output or income earned from business operation less the total cost (TC) incurred in producing the finished marketable output.

Total Revenue is quantity of product multiplied by the current market rate of the output which is assumed to be constant. Total cost is a function of output, because cost increases in the level of output. Hence, for this study, total cost is equal to Sugarcane cost (raw material) + operating cost + fixed cost.

ii. Measurement of Unit Performance by Efficiency:

As a measure of unit performance, efficiency ratio, profitability ratio and operational efficiency are specified as follows:

I. Efficiency ratio (ER)= TR / TC

II. Profitability ratio (PR)= π / TC

However, if ER>1 and PR>1 then the unit evaluated is operationally

efficient and vice-versa.

III. Long run unit cost minimization (LRUCM): The operational efficiencies with respect to local optimum and global optimum performances was calculated using LRUCM such that manufacturing unit with the minimum lowest output-unit cost industry size would be the most operationally efficient for that size locally and the one with that characteristic in the industry will be the most operationally efficient globally. The LRUCM is specified as follows as the value of the least unit-output cost incurred by the most efficient production unit (ΩL) divided by the value of unit-output cost incurred by the production unit whose performance is being compared (Ωi), multiply by 100 as specified below:

LRUCM= (ΩL / Ωi) X 100

Where:

ΩL denotes the production units with least production cost (cost efficient)

Ωi denotes the production units whose output is being compared.

CHAPTER IV

RESULTS AND DISCUSSION

The result of the present study in the form of several tables along with adequate discussion have been presented in this chapter.

4.1 Socio-economic Aspects

From the data generated from field survey, the ages of the manufacturers interviewed raged between 32 to 60 years, with the mean age being 45.86 years. This implies that decisions were made by the active and productive age bracket .Around 60 percent of the manufacturers were less than 50 year and this should, have a positive effect on productivity.

4.2 Types of Family:

The manufactures' family has been classified into two types namely joint family and nuclear family. Joint family consists a group of persons living together and taking meals from the same kitchen under the administration of the same head of the family. Joint family includes wives, sons, unmarried daughter's father, mother, brothers etc. (in some cases grand father, grand-mother, and aunt). On the contrary, nuclear family consists only father, mother, sons and unmarried daughters leading by a single head. Table 4.1 shows that 68.57 percent families were nuclear and 31.43 percent were jointed in the study area.

Table-4.1: Family Types:

Types	No.
Nuclear	68.57%
Joint	31.43%

Source: Field Survey

4.3 Family Size and Composition

Members of the whole family were classified into four age groups viz below 15 years, 16 to 45 years, 46 to 65 years and above 65 years. Family size and composition by age are shown in the table 4.2.

It is evident from table 5 that 16.58 percent of the male members of the families belonged to the under 15 year's age group, 28.14 percent were under the age group of 16 to 45 years, 9.04 percent were under the age group of 45 to 65 years and only 1.005 percent were above 65 years. On the other hand 12.56 percent of the whole members were aged below 15 years, 20.1 percent were under 15 to 45 years, 11.06 percent were under 46 to 65 years and only 1.5 percent of the population was above 65 years old. Out of the total family members 54.77 percent were male and 45.24 percent were females.

4.4 Level of Education

The educational status of family members is shown in table 4.3. It is evident from the table that 27.1 percent of the family members of all families were educated up to primary level, 12.65 percent up to secondary level , 9.03 percent up to intermediate, 6 percent have completed graduation and rest 47.59 percent were illiterate.

Table-4.2: Information about Family Member:

Member	Age limit			
	<15	16-45	45-65	>65
Male	16.58%	28.14%	9.04%	1.005%
Female	12.56%	20.1%	11.06%	1.5%

Source: Field survey

Table-4.3: Educational Qualification of Family Members:

Category	Percentage
Primary	27.1%
Secondary	12.65%
Intermediate	9.03%
Graduation	3.61%
Illiterate	47.59%

Source: Field Survey

4.5 Qualification of the Manufacturer

Table 4.4 shows the qualification of the jaggery manufacturers. It is patent from the table that no manufacturer has any training certificate regarding jiggery manufacture. 2.88 percent has completed graduation, 17.14 percent intermediate, 11.43 percent, 17.14 percent primary school and rest 51.43 percent is illiterate.

Table-4.4: Qualification of the Manufacturer:

Fact	Percentage
Training Certificate	0%
Graduation	12.88%
Intermediate	17.14%
High school	11.43%
Primary School	17.14%
Illiterate	51.43%

Source: Field Survey

4.6 Occupation

Agriculture was the main occupation of the heads of the households of the sample manufacturer. Table 4.5 shows both the main and secondary occupations of the heads of the households. It is observed that agriculture is the main occupation for 85.71 percent

22

heads of households and it is secondary occupation for 11.42 percent households head. Business was main profession for 2.86 percent of the households head and secondary profession for 37.14 percent. Teaching was primary profession for 8.57 percent of the households head. 42.88 percent of the households head were affiliated with other secondary professions.

4.7 Status of basic needs

Table 4.6 gives information about basic needs situation of the manufacturers. In the study area, 100 percent of the total populations have drinking water from tube well. 57.14 percent and 42.86 percent family use pucca and kaccha toilet respectively. Table 9 also shows the monthly medical cost of the families. Monthly medical cost of 17.14 percent family is up to Tk. 200, 17.14 percent up to 201 to 350, 20 percent of the families within 351 to 500 and rest 45.7 percent of the families above 500.

Table 4.7 shows the family assets. 37.14 percent families passes Radio, 57.14 percent posses television, 4 percent posses Refrigerator, 5.71 percent posses computer and 68.57 percent posses Electric Fan

Table-4.5: Information about Occupation

Category	Occupation				
	Agriculture	business	Office Work	Teaching	Other
Primary	85.71%	2.86%	2.86%	8.57%	
Secondary	11.42%	37.14%			42.88%

Source: Field Survey

Table-4.6: Information about Basic Need

Fact		Percentage
Supply of Drinking water	Tube Well	100%
	Dug Well	
	Treadle Pump	
Toilet	Kaccha	57.14%
	Pucca	42.86%
Monthly Medical Cost	Up to 200	17.14%
	201-350	17.14%
	351-500	20%
	Above 500	45.71%

Source: Field Survey

4.8 Family Assets

The following table shows the percentage of assets possessed by the respondent families in the study areas.

Table-4.7: Information about Family Assets:

Assets	Percentage
Radio	37.14%
Television	57.014%
Refrigerator	11.43%
Computer	5.71%
Electric Fan	68.57%

Source: Field Survey

4.8 Income

Amongst the jaggery manufacturer average annual income varied from Taka 3,000 to Taka 16,000. The average annual income for about 5.71percent family was below Taka 30,000 and 17.14 percent family had average annual income ranging from Taka 30,000

24

to 50,000. Only 7 percent manufacturers could earn an income within TK.81,000 to 100.000.

Table-4.8: Average Annual Income:

Annual Income Range	No. of Manufacturer	Percent	Average Taka
Below 30,000	2	5.71	2,500
30,000 to 50,000	20	17.14	4212.32
51,000 to 80,000	6	57.14	5936.23
81,000 to 100,000	7	20	1524056

Source: Field Survey

4.9 Technical Characteristics of the Jaggery Industry

4.9.1 Jaggery Units

During data collection it was observed that the units were producing on different scale of production ranged 1 to 4 quintals finished Jaggery per day. For the appropriate study the units were classified in to three categories small, medium and large. This classification has been made according to the capital investment, crushing capacity and per day production capacity of the unit. The Capital investment for a season in establishing a jaggery unit or plant is around TK.870863.63 to TK. 1686000, which can produce from 1 to 4 quintals, finished marketable Jaggery every working day. On the basis of data and observation, working units were classified in three categories on the basis of their production size.

i.   **Small Unit**- has production capacity of up to 1.5 quintals (Qtl) per day and sugar cane crushing capacity of around 10 to 12 Qtl per day. The capital investment in establishment of this size of plant is around ` 800,000 where cost of land is not included.

ii.   **Medium Unit**-has production capacity of 1.5 to 2.5 Qtl per day and sugar cane crushing capacity of around 12 to 14 Qtl per day. The capital investment in establishment of this size of plant is around 120,000 where cost of land is not included. And;

iii.   **Large Unit**- has production capacity of 2.6 to 4 quintals jaggery per day and sugar cane crushing capacity of around 14 to 18 quintals per day. The capital investment in establishment of plant is around 160,000 where cost of land is not included.

Table-4.9: Per Day production and Crushing Capacity:

Fact	Small Unit	Medium Unit	Large Unit
Production Capacity (Qtl) (Finished Jaggery in a Working Day)	1 to 1.5	1.5 to 2	2 to 3
Crushing Capacity (Qtl) (In a Working Day)	10 to 12	12 to 14.	14 to 18

Source: Field Survey

Table -4.10: Cluster wise Jaggery Producing units

Cluster	Small	Medium	Large
Kutirchar	14	5	3
Kalinja	5	2	1
Sharutia	4	1	1

Source: Field Survey.

Table4.11: Approximate Production in a Season (Avg.)

Units	Average Production (Qtls.)
Small	21,000
Medium	31,500
Large	42,000

Source: Field Survey

4.9.2 Used Energy

The study areas are furnished with various types of energy, but almost all the manufacturers use fuel oil for operating of crushing machine.

26

Table-4.12: Cost for fuel:

	mall	Medium	Large
Petroleum	100	100	100
Natural gas	0	0	0
Electric power	0	0	0

Source: Field survey

4.9.3 Cost and return Analysis

The result of cost and return analysis as a measure of profitability among the jaggery manufacturers exposed that jaggery manufacturing units as whole recorded an average total cost and total revenue of TK.1,275,371.21 and TK. 1,307,993.123 respectively with an average profit of TK. 31,388.82. For the large size of production units were also had an average total cost and total revenue of TK. 1685000 and 1725000 respectively with an average profit TK. 40,300. In the medium size of production units average total cost and total revenue recorded as TK. 1,270,250 and 1,306,856.25 respectively and an average profit TK. 32,606.25. And in small size of production units an average total cost and total revenue of TK. 870863.63and TK. 892123.12respectively and an average profit in this category was found TK. 21260.22. The study revealed that units of medium and large sizes were able to cover their operating expenses with significant level of profit but small size units were earning a marginal profit. The profit earned by this category was very low as compared to other two sizes.

Table-4.13: Summary distribution of Cost and return analysis of Jaggery manufacturing units

Parameters	Small	Medium	Large	Overall
Total Cost (TC) (TK.)	870863.63	1,270,250	1685000	1,275,371.21
Total Revenue (TR) (TK.)	892123.12	1,306,856.25	1725000	1,307,993.123
Profit (л)	21260.22	32,606.25	40,300	31,388.82
Profitability Ratio (л/TC)	0.0244	0.0257	0.0239	0.0246
Efficiency Ratio (TR/TC)	1.024	1.028	1.023	1.026

4.9.4 Measurement of Performance of Jaggery Manufacturing Units

I. Profitability Ratio: Table 3.2 is presenting the profitability ratios of Jaggery category wise small, medium and large manufacturing units 0.0244, 0.0257and 0.0239 respectively. This means that every ` 100 invested by small, medium and large units each gained Tk. 2.4, TK.2.5 and Tk.2.4 respectively.

II. Efficiency Ratio: The calculated efficiency ratio for Jaggery manufacturers in small, medium and large the categories are 1.024, 1.028 &1.023 respectively although the whole sampled unit efficiency ratio is 1.026. It means that the whole sampled manufacturers are having a positive efficiency ratio and it also the indication of efficient business operations.

III. Long Run Unit Cost Minimization: Generate efficiency is a prime goal for all kind of manufacturers. This can be defined as "the ability for a production unit to execute its strategic plans while maintaining a fit balance between expenditure and productivity. In other words, it's the ability to get things done without costing the production unit a small fortune.

4.9.5 Hurdles Facing by Jaggery Manufacturers

In the survey, it was observed that in all three categories (small, medium and large) manufacturer are facing common problems, but the impacts of these hurdles are different for each. The major problems which were identified are low profit, transportation, high raw material cost, and lack of research and development but after ranking these problems it was found that low profit is the major problem of small category of units whereas transportation is the major barrier for medium and large category manufacturers. While interviews during the survey, manufacturers expressed their views that, "If we have our own transportation up to market (distilleries and exporters) we would enjoy much more profit than current status". The reason identified that due to lack of unity and of inter-competition, the manufacturers are not ready to form any association, cooperative or society for development of transportation and research and development facilities and that is the mediators are enjoying a better part of the profit by providing the transport and market facility to the manufacturers. Medium and large manufacturers were not much affected by high raw-material prices, because they were getting a huge market of licker/distillery industry. For small category of manufacturer the low profit was major hurdle but they were also affected by lack of transportation facility because the major market for small manufacturer was local-mandi and zonal-mandi. It is also observed that the manufacturers do not get enough technical or financial support from government or private sector. Table 4.14 shows that only 3 percent manufacturer get financial support from government and 5 percent from private sectors. No manufacturer gets any technical support.

Table-4.14: Information on Support:

Types	Technical (%)	Financial (%)
Government	0	3
Private	0	5

Source: Field Survey

The manufacturers of all the categories were not much aware about research and development part in this industry, and they were quite satisfied with their products. The reason was found behind this was, manufacturers thought that only Jaggery is a popular

product by their business, no other product is having this much demand in the market like distilleries and lickers.

Table 4.15: Impedance to Jaggery Manufacture

problems	percentage
Fuel Cost	30
Transportation	10
Low Profit	60
High Price of Chemical	39
Low repairing facilities	14
Government Tax	0

Source: Field Survey

CHAPTER V

SUMMARY AND CONCLUSION

The significant findings of the study are stated below:

1. The overall socio-economic condition of the jaggery manufacturer is not appreciable at all. Educational qualification, average income, fulfillment of basic needs etc. are not up to mark.

2. It was found during survey that there is no research and development for product development and value-addition of Jaggery products in the manufacturers units, although the value added products of Jaggery is having good market demand.

3. There is a need for improving the transport facilities for this industry. It was found that the jaggery manufacturers are not in a mindset to form any kind of association of society for the cluster's development. One regulating authority which can conduct R & D and develop the business behavior among manufacturers is also needed.

4. There is need for financial assistance and marketing support to small manufacturers, they are not able to expand their business because of tough competition and low profit margin.

Jaggery industry of Sirajgonj is having large no. of manufacturing units in all three categories. The dependency on this industry is quite dense in the study area. Current paper used cost and return measures of production operating efficiency such as profitability ratio, efficiency ratio and operational efficiency (based on least cost unit minimization) to examine the performance of Jaggery manufacturing units. The study found that medium and large manufacturing units are more profitable whereas small manufacturers are just able to generate the minimum profit. The inference of this finding is that the manufacturing of jaggery has the potential of improving the standard of living in the study area. With the development of this industry such problems like unemployment, low-level of education, could be alleviated. On the macro level this industry could be able to export good quality jaggery if research and development facilities could be developed by government.

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APPEDIX

An Empirical study on Jaggery Industry in Sirajgonj District

Name of the respondent...

Mobile No..

Cluster No. ....

Name of the cluster...

Address...

....

1. Socio-economic Information:

1.1 Which religion do you practice? ....

1.2 Family types

Types	
Nuclear	
Joint	

1.3 Information About family Members:

Member	Age limit			
	<15	16-45	45-65	>65
Male				
Female				

1.4 What is your occupation?

Occupation	Agriculture	Business	Teaching	Office work	Other
Primary					
Secondary					

1.5 How money income generation member are there in your family..........?

1.6 Information about income & Expenditure of the family

Facts	Amount (TK)
Income	
Expenditure	
Savings	

1.7 What are the numbers of dependent members In your family? ....

1.8 Information about Family asset

Assets	
Radio	
Television	
Refrigerator	
Computer	
Electric Fan	

1.9 Amount of land:

Types of land	Amount
Doweling house	
Cultivable land	
Barren	

1.10Types of house:

Types	
Bricked	
Unbricked	
Mixed	

1.11 Information about basic need

Fact		
Source of drinking water	Tube well	
	Dug well	
	Treadle pump	
Toilet	Kacha	
	Pucca	
Monthly medical cost	Up to 200	
	201-350	
	351-500	
	Above 500	

1.12 Qualification of the manufacturer:

Training certificate	
graduation	
Intermediate	
High school	
Primary school	
Illiterate	

1.13 Educational Qualification of other members

Factors	Number
Primary	
Secondary	
Intermediate	
Graduation	
Illiterate	

2. Information Regarding Plant

2.1Area of land required for plant set up...........................

2.3 Cost related Questions

Type of cost	Amount (TK)
Machinery	
Repairing	
Labor	
Housing	
Raw material (Sugarcane)	
Chemicals	
Fuel	
Transportation	

2.2 Type of fuel used

	electrical	Natural gas	oil
Energy			

2.4 Information about return

Fact	Amount (TK)
Approximate sale per day	
Total sale in a season	

Table-2.5: Per Day production and Crushing Capacity:

	Small Unit	Medium Unit	Large Unit
Production Capacity(Qtl) (Finished Jaggery in a Working Day)			
Crushing Capacity(Qtl) (In a Working Day)			

2.6 How long the plants remain operative in a year?........................

2.7 Estimate crushing capacity of plant per day?................................

2.8 What is approximate production capacity of the plant per day?.....................

2.9 What is the approximate price per quintal of Jaggery?...........................

2.10 Information on Support:

Types	Technical	Financial
Government		
Private		

Table 2.10: Impedance to Jaggery Manufacture

problems	percentage
Fuel Cost	
Transportation	
Low Profit	
High Price of Chemical	
Low repairing facilities	
Government Tax	