EXECUTIVE SUMMARY

1. Production of Guar

Guar is an agricultural produce spreading over into Indo-Pakistan subcontinent for numerous generations. India and Pakistan provide better agro-climatic conditions for the cultivation of guar though it has also been successfully grown in U.S.A., South Africa, Brazil, Zaire and Sudan.

India is the world leader for production of guar, which is grown in the north-western parts of country encompassing states of Rajasthan (Churu, Nagaur, Barmer, Sikar, Jodhpur, Ganganagar, Sirohi, Dausa, Bikaner, Hanumangarh and Jhunjhunu districts), Gujrat (Kutch, Banaskantha, parts of Mehsana, Sabarkantha, Vadodara and Ahmedabad districts) and Harayana (Bhiwani, Gurgaon, Mahendragrh and Rewari districts) and Punjab (Bhatinda, Ferozpur, Muktsar and Mansa districts). During 1970s guar was also grown regularly in the State of Uttar Pradesh, Madhya Pradesh and Orissa. As the processing facilities have been closed down in U.P. and M.P., the cultivation in these states is negligible now. In Orissa too guar is not cultivated any more. The annual production of guar during last three years ranged from 11,00,000 MT to 12,87,000 MT.

In Pakistan, before 90s, about 80% of the guar was grown under irrigated conditions therefore the per hectare yields were higher. During that period guar was grown in Punjab, Multan, Muzaffargarh, Mianwali and Sargoda. The other areas include Bahawalpur, Banawalnagar and Sind Province. The annual production of guar during this period ranged between 180,000 MT to 250,000 MT annually.

The guar is also cultivated in USA, Brazil and in some African countries like South Africa, Malawi, Zaire and Sudan. The total production of guar seed in these countries is estimated at 15,000 TPA. The agro-climatic conditions in

Australia are also quite conducive to the cultivation of guar. Efforts have been made to promote cultivation of guar in Australia by the Department of Agriculture and Rural Industrial Development Agency. Similarly it is reported that countries like China and Thailand are also trying to grow guar. Therefore, in the future guar may not remain monopoly of India and Pakistan.

2. Traditional Uses of Guar

The traditional uses of guar are as following :-

a. Human Consumption

- Immature pods are dried, salted and preserved for future use
- Immature pods are dried and fried like potato chips
- Green pods are cooked like French beans
- Mature seeds are used as an emergency pulse in time of drought

b. Cattle Feed

- Plants are cut and fed as green forage.
- Beans are boiled in a large kettle and fed to cattle a high protein source.

c. Medicinal Purposes:

- Plants are mashed, then mixed with oil and used as a poultice on cattle boils.
- Leaves are eaten to cure night blindness.
- Seeds are used as a chemotherapeutic agent against smallpox.
- Boiled guar seeds are used as poultices for the plague, enlarged livers, head swellings and on swellings due to broken bones.
- Seeds are used as laxative.

d. Crop and Soil Improvement:

- Plants are used as shade for ginger
- Guar commonly is used as a cover crop and green manure.

3. Guar Products

The most important industrial use of Guar is in the form of Guar Gum. Approximately 90% of total Guar produce is used for production of Guar Gum and rest is used for culinary purposes and cattle feed etc. Guar Gum is derived from Guar seed that is of about 3 mm. diameter and contains a germ which is highly proteinous which divides the endosperm into two halves. Constituents of the different components of guar seeds are given below

CONSTITUENTS OF GUAR SEED

Part of Seed	Protein %	Ether Extract %	Ash %	Moisture %	Fibers %	Type of Sugar
Hull (14-17%)	**5**	**0.3**	**4**	**10**	**36**	**D-glucose**
Endosperm (35-42%)	**5**	**0.6**	**0.6**	**10**	**1.5**	**Galactomannon**
Germ (43-47%)	**55.3**	**5.2**	**4.6**	**10**	**18**	**Glucose**

4. Processing

The guar gum is produced from endosperm and consists mainly of gummy Polly groups of monogalactoses with small amount of fibre and minerals. Different grades are made on the purity and present viscosity of the powders in water.

Several methods have been used for the manufacture of different grades of guar gum but due to its complex nature, the thermo mechanical process is generally used for the manufacture of edible grade and industrial grade guar gum. In this process the undehusked splits of guar seeds are first cleaned to remove the foreign materials. The undehusked splits thus obtained are then heated in a rotary standard temperature furnace (where the outer coating of the fibre becomes brittle and can be removed in further process). The hot

undehusked splits are taken to scraper machine where undehusked splits are scraped from the outer solid layer of fiber and clean splits are obtained which are known as dehusked splits. The endosperms contained in dehusked splits then undergoes differential grinding and shifting to get various grades of guar gum.

5. By-Products

A by-product of the guar processing is guar meal (mixture of husks and germ) which is a potential source of protein. It is used for cattle as well as poultry feeding. Toasting of guar meal improves its nutritive value. It can be used up to 10% in poultry diet and can replace up to 100% protein supplements such as ground nut oil cakes in ruminants.

The gum is a Polysaccharide with a straight chain of mannose units and one galactose is 2:1. The gum contains about 6% protein.

Guar is more than 6 times as effective as starch in thickening power and is used for upgrading starches. Various derivatives of Guar Gum are available that will stiffen gels even up to a water content of 99%. Commercially important derivatives of Guar gum are :

a) Hydroxy Alkylated Guar gum
b) Carboxy Methylated Guar gum
c) Oxidised Guar gum
d) Acetates of Guar gum
e) Cationic derivatives of Guar gum
f) Sulphated Guar gum
g) Guar gum formate
h) Guar gum acryl amide
i) Borate cross linked Guar gum
j) Reticulated Guar gum
k) Carboxy methyl hydroxy propyl Guar gum

l) Depolymerised Guar gum

6. Uses of Guar Gum

The uses of guar gum & the share of various end uses are as following :

a. Technical

i.	Oil well drilling	50-55%
ii.	Textile Printing	
iii.	Paper	
iv.	Explosive	
v.	Mining	
vi.	Tobacco	
vii.	Water treatment	
viii.	Fire fighting	

b. Food-Human and Animal

i.	Frozen Foods	35-40%
ii.	Bakery	
iii.	Dairy Products	
iv.	Canned Foods	
v.	Dressing	
vi.	Instant Mixes	
vii.	Beverages	
viii.	Pet Foods	

c. Pharmaceuticals

i.	Laxative	5%
ii.	Slimming Aids	
iii.	Diabetic Treatment	
iv.	Tablet preparation	
v.	Ointment	

d) **Cosmetic and Miscellaneous**

i.	Hair Setting	5%
ii.	Soaping and Shampoos	
iii.	Lipsticks	
iv.	Mosquito coils	

7. **Indian Industry**

Indian industries are manufacturing either Guar Gum Split or Guar gum Powder. There are more than 110 split units in India, and total installed capacity is more than 6 lakhs tones per annum. All the split units have indigenous plant and machinery. Split is available in various grades, in terms of purity 90%, 92%, 95% and 97%.

There are more than 25 units which manufacture textile grade powder from splits. The total industry is estimated at about 2.25 lakhs to 2.50 lakhs tones per annum. The products manufactured in India are mainly food grade guar gum powder and some modified guar gum derivatives for textile printing industry. There are a few large manufacturers like IGI, HICHEM, Dabur, Vikas WSP etc. who produce value added derivative for export as well as domestic market.

The total domestic consumption of guar gum powder inclusive of splits from various end-use sectors is about 30,000 TPA presently (Textiles 5,000 MT, paper 2,500 MT, Explosive 1,500 MT, Food & Pharma 800 MT, Oil well Drilling 130 MT, Cosmetic & others 150 MT). This is expected to reach over 50,000 MT by the year 2005.

8. **International Markets :**

The major share of the guar processed in India is exported either in form of semi processed product i.e. refined splits or in form of guar powder. In the recent years export of modified/derivatives gums have also started. The exports of guar products during last three years is given in the following table.

EXPORT OF GUAR PRODUCTS FROM INDIA

Qty. in MT

Value in lakh Rs.

S.N.	Products	1998-1999		1999-2000		2000-2001	
		Qty.	Value	Qty.	Value	Qty.	Value
A	Guar Meal	348	272	184	122	172	124
B	Refined Guar Splits	33647	26539	44518	31576	43955	20598
C	Pulvarised & Treated Gum	58000	45959	67393	48680	83856	38774

Source: Export Statistics, APEDA 2000 - 2001

USA is the major importing country followed by Germany. Both of these countries account for more than 50% of India's exports of guar products. The other important importing countries from India are Netherland, U.K., Japan and Italy.

9. Conclusion

The major conclusion of the study are given below :

Guar Production:

a) Production pattern of Guar is erratic as it is largely grown in rain fed areas.

b) India has dominant position in production of guar in the world with estimated share of about 80%.

c) It is possible to increase area under guar particularly in Rajasthan where Bajra is grown on more than 40 lakh hectares. At current level of productivity and prices, the cultivation of guar is more profitable, as compared to competing crops like Bajra and Moong.

d) Productivity is poor because farmers cultivate on marginal soils and hardly use any inputs. Good quality seeds are not available.

The seed replacement rate in guar is only 0.1% perhaps the lowest in all the cultivated crops.

e) It is possible to grow Guar seed in arid and semi-arid areas of non-traditional states like Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh and Uttar Pradesh. But it would depend on assured market and remunerative price.

f) It is possible to have two crops in a year in certain areas where irrigation facilities are available. Second crop can be taken after Rabi (April-July) but short duration varieties would be needed which should mature before onset of the monsoon.

g) Agricultural Scientist of the country are confident of developing the thermo-photo-insensitive varieties of Guar which would be suitable for non-traditional areas and for cultivation in the summer. Further research on development of varieties of Guar with higher gum content, disease resistance, more productivity etc. is going on.

h) The industry's knowledge about the developments in agricultural research is poor. In case of guar although chemical analysis of different varieties is available and the processors could exercise preference for varieties with higher gum contents, but is not being done due to lack of knowledge by the trade and industry. The parameters for buying are quite subjective like colour, shape and size. Even farmers are not aware of varieties suitable for their area.

i) Guar is considered as a minor crop by the State Agriculture Departments and Agricultural Universities, who give more attention to crops like cereals, oil-seeds and pulses.

j) For the optimum utilization of soil moisture, guar can be grown as an intercrop or as mixed crop with Bajra. With marginal reduction in the yield of Bajra, there would be additional production of guar and farmer's profits would be higher besides advantages of nitrogen fixation in soil by guar.

Market:

a) India is single major producer of Guar in the world and Guar splits and Powders are being exported to more than 60 countries. The total export of Guar Gum is estimated at 1.5 Lakh MT per annum by the year 2005 and onwards. With India's captive consumption of Gaur Gum about 50,000 TPA, the total demand of Guar Gum by the year 2005 has been estimated at 2.0 Lakh MT.

b) Value-addition is poor. The pulverized gum is largely sold as a commodity. About 40% of the exports are still in form of refined splits.

c) The growth in exports during last 4 years was due to failure of guar crop in Pakistan which offered an opportunity to Indian exporters. A normal crop in Pakistan could jeopardize India's position.

d) Cheaper substitutes of Guar are available Guar for industrial application. Tamarind kernel powder has considerably replaced Guar Gum in textile sector. Similarly Cassia Tora is expected to substitute guar gum in textiles, pet food etc. Only food and pharmaceutical end-users have stable demand due to increasing preference for natural products.

e) USA and Germany are the major importing countries accounting for more than 50% of exports from India. Considerable quantities

of value added derivatives are being re-exported from European countries.

f) In the global market, India is in a dominant position. At present there isn't any competition. However there is a cut-throat competition amongst the exporters of India.

g) The steep increase in the price of Guar is a cause of concern for the end-users. For major non-food applications Guar is being replaced by cheaper substitutes.

h) There is a good potential for marketing of value added Guar based health foods, dietary fiber, slimming-aid, fat replacers, medicines etc. in the international markets. For technical grades, the potential for exporting value added derivatives exists in the areas of oil-drilling and textiles.

i) Imports of Guar gum in some of the European Countries are from Intra European trade only. Countries like Austria, Ireland, Sweden, Greece, Portugal etc. hardly import any Guar Gum from India. Similarly countries like Mexico and Canada largely import from USA.

j) The value addition/margins of overseas suppliers from re-exports is much more than the value addition/margins of Indian Suppliers.

k) The information on domestic consumption as well as export potential is also not available to industry.

l) Harmonised product codes meant for Guar products are not being used by internationally important trading countries. While India is

using Harmonised product codes, US and E.U. countries are using different codes which is perhaps resulting in some discrepancies in the data.

10 RECOMMENDATIONS:

10.1 Augmentation of Guar Supply:

There is a strong relationship between price and consumption of most of the products. In order to ensure steady growth in the consumption of guar products it would be very important to contain the price of guar seed at a level which is remunerative to farmers as well as affordable for the consumers. Steps need to be taken for increasing the farmers' income by improving productivity. This can be done by:

a) Good quality seeds, suitable for different agro climatic conditions should be made available. The use of improved and appropriate seeds can increase the productivity up to 20-25%.

b) The scientific management of crop is very important. The present level of knowledge of farmers and use of inputs like high yielding varieties of seed, rhizobium culture, weedicides, pesticides and fertilizers is poor. Thus there is an urgent need to educate the farmers. For this initially 15-20 training programme should be organised in selected villages having higher production by using the resources of ICAR, State Universities and other institution. Demonstration farms should also be organized.

c) At present the large acreage of guar is under rainfed conditions, therefore production is dependent on the vagaries of nature. The cultivation of guar should be promoted in irrigated areas too. This can

be done with the help of State Agriculture Department by providing extension services and inputs to the farmers.

d) A number of farmers in Rajasthan feed guar seed to their cattle. This is a wasteful practice as it can't be digested by the animals. The farmers need to be educated on this and advised to switchover to cattle feed or other concentrated feeds like deoiled cakes, guar meal etc.

e) For the cultivation of summer crop of guar in irrigated areas, suitable short duration varieties should be developed. New varieties having high gum content, bold size, white colour need to be developed. Photo-thermo-insensitive varieties also need to be developed for cultivation in non-traditional areas/different climate conditions.

f) Guar should be promoted as an intercrop wherever Bajra is grown. This will give additional production of guar without affecting the yield of Bajra. This needs to be promoted on priority basis as this would increase production of Guar without increasing the area by replacing other crops.

g) For production of a range of new varieties of guar suited to different agro-ecological conditions and having the desirable processing traits, the agricultural institutions such as Agricultural Universities in the guar growing states of Rajasthan, Haryana, Punjab, Central Arid Zone Research Institute (CAZARI) at Jodhpur, All India Co-ordinated Research project on Arid Legumes at Bikaner and Bureau of plant Genetic Resources, New Delhi, needed to be encouraged and supported.

For the commercial multiplication of the new varieties of guar seeds, companies like Indo-American hybrid Seeds, pioneer Seeds, Madyco, State Seeds Corporations, National Seeds Corporation, Nath Seeds etc. need to be encouraged.

h) For the research on guar and extension activities it would be desirable for the industry to develop backward linkages. The agricultural research institutions and government agricultural departments have several priorities and certain limitations. For ensuring long term supply of raw materials at a reasonable price the industry would have to take some initiative. There are many successful examples in the country where industry has developed backward linkages i.e. Pepsi for tomatoes in Punjab, Amul and other State Dairy Federations for milk. Even sugar mills provide extension services and at a few places distribute tissue cultured plants to the sugarcane growers. In tandem with research institutions the industry could immediately start activities like adoption of 'seed villages', purchase and distribution of guar seed besides extension activities.

i) In order to overcome quality complaints on account of microbial problems, suitable sterilization techniques like irradiation need to be tried.

j) Efforts in development of new equipment and machinery for processing guar and testing the quality of raw material and finished products are required.

k) Concerted efforts in the area of agricultural research for guar i.e. plant breeding and agronomical practices should be undertaken (keeping in view the industry requirement) in close interaction with the industry.

l) Varieties having high yield and gum content with proven inbuilt resistance to various diseases and having short duration need to be evolved suitable for various agro climatic zones. Increased emphasis on hybrid technology needs

to be given. Developing suitable hybrids would boost the guar seed production substantially.

m) The studies on soil moisture retention and its optimum utilization by the crops particularly in rainfed areas with poor rainfall need to be carried out and practices should be made popular through incentives to farmers.

n) Different countries are following different product codes for reporting import and export statistics which causes difficulty in assessment of the consumption in some countries e.g. Netherlands. APEDA could take it up at appropriate level to ensure consistency in use of product codes all over the world. The present systems for classification also need improvement. At present there is only two categories i.e. refined guar splits, guar gum treated and pulverized. Third category should be added i.e. modified/Chemically derived guar. This would help in better understanding of the value added products.

10.2 R&D Activities

a) The price realization on protein rich 'Kurma' is very poor due to toxicity. A few units have facilities for toasting of Kurma (low cost equipment needs to be developed). Possibilities of developing other value added products (as from soybean) should be explored. Higher realization on by-products can bring down the price of guar gum.

b) In order to overcome quality complaints on account of microbial problems, suitable sterilization techniques like irradiation need to be tried.

c) Concerted efforts in the area of agricultural research for guar i.e. plant breeding and agronomical practices should be undertaken (keeping in view the industry requirement) in close interaction with the industry.

d) Efforts in development of new equipment and machinery for processing of guar and testing the quality of raw material and finished products is required.

e) Varieties having high yield and gum content with proven inbuilt resistance to various diseases and having short duration need to be evolved suitable for various agroclimatic zones. Increased emphasis on hybrid technology needs to be given. Developing suitable hybrids would boost the guar seed production substantially.

f) In rainfed areas where guar is being grown specially in Rajasthan, the studies on management of watershed development programmes need to be intensified so that in case of erratic rainfall, the irrigation at critical stages be provided to achieve higher productivity.

g) Cropping system research determining most promising output in terms of biological productivity and economic profitability under optimum input conditions needs to be intensified and demonstrated to farmers. This would encourage mixed cropping of guar in additional areas.

h) The studies on soil moisture retention and its optimum utilization by the crops particularly in the rainfed areas with poor rainfall need to be carried out and practices should be made popular through incentives to farmers.

10.3 Information

a) It has been observed that there is lack of information on production of crop and also international demand pattern. It is important to make available timely and correct information on crop production forecasts, price-trends, demand, etc. The use of professional agencies in this regard is suggested. The information should be disseminated fast amongst processors. Modern communication

techniques like websites should be used for quick availability of the information.

b) There is need for quick dissemination of information on agricultural research, developments in technology etc., to the industry.

10.4 Market Development

a) Efforts should be done for reaching and establishing a presence in new markets. Market development efforts in countries like Austria, Ireland, Sweden, Greece, Portugal, Canada, Mexico etc. should be undertaken so that supplies to these countries may be made directly.

b) Special incentives could be given for export of branded (Indian brand) Guar products. This will help in the practice of developing a brand equity for the product. A brand signifies to some extent consistent quality and reliability in the international markets. The mindset of exporters has to shift from taking the relatively easier practice of commodity trade and shift to value added specialty products and branded products.

c) Proper incentive schemes could be considered for development of value added products by devising some value addition norms by the concerned departments.

d) For the long term survival of guar industry, it is very important to develop domestic demand. The association of guar gum processors should take up with the Ministry of Food Processing and authorities administering PFA to permit use of guar in processed food. There should be considerable programmes planned by the Research institutions to promote the applications of guar products as food ingredients. These programs must address the food processing industry, as also the exporters within that sector.

e) Efforts should be done for 'de-commoditisation' of guar powder. The guar processing units need marketing orientation. The product diversification is desirable with inclusion of value added products branded and packed as per users requirement. Making blended formulations doesn't entail high investments. Products like stabilizers should be made and efforts should be done for marketing in India and Middle-East to start with. Similarly derivatives like guar hydroxypropyl could be made and marketed in Middle-East and other countries. There is potential for exporting modified guar gums for the textile industry (carboxy methyl, hydroxypropyl, hydroxyethyl guar gum). The guar based preparation as health foods, natural medicines etc. also have good prospects and are sold at a premium.

f) Indian processors should be encouraged to participate in intenational exhibitions, conferences, etc., on food ingredients, hydrocolloids, etc., which would help Indian industry.

g) As the world leaders in processing guar gum already have collaboration in India or Pakistan with large units, the medium scale could think of strategic alliances with other overseas companies. Like processing stabilizer for food additives manufacturing/distribution companies, processing oil-drilling chemicals for the companies supplying other chemicals to oil-drilling companies or directly supplying to the latter.

10.5 Concerted/Joint Efforts

The industry sector has to put its act together and market "India Inc". The software services sector has done it. Consortium efforts in further popularizing the Indian product with overseas end user companies, in developing backward linkages, in undertaking research and development on the important aspects, on developing and information bank, in self regulation, etc., are needed. It will be rather difficult for individual units to try and penetrate the value added products

markets internationally, and to provide technical services to end users. Perhaps a consortium can do it better. The industry association can examine similar efforts in other sectors to draw guidelines on how to make it operate smoothly.

10.6 Training

The skill levels of the technical manpower of the industry needs to be upgraded. This can be done by organizing seminars, wherein technical staff of processors could interact with experts. For keeping the industry updated, experts from the developed countries may be invited for such interactions.

Short duration training courses could also be organized for production and quality control staff. These courses could be on plant hygiene, safety, energy conservation, operational efficiencies, new processing techniques, new guar derivatives, quality problems, methods for improving quality, use of the latest equipments in processing/quality control, ISO etc.

10.7 Dedicated Research Institution on Guar

Currently various institutions are engaged in some research on guar, these efforts are defused for want to close co-ordination. A central body is required to monitor work on all aspects of guar i.e. Agricultural Research, R&D on Processing Techniques, Development of New Applications, Development of New Value Added Derivatives, Training, Exports promotion, collection and Dissemination of Information. This institute may be set up at a suitable location in close interaction with the Association of Guar Gum processors.

Flavours and Fragrances Development Centre have been set up at Kannauj (U.P.) by the Central Government. This institute is doing developmental work encompassing cultivation of aromatic plants, processing techniques, R & D work, collection and dissemination of Information, Market Development etc.

The Institute also undertakes the processing of flavours, essential oils and perfumes on job work basis in the pilot plant which the institute has set up. The officials of APEDA as well as Association of Guar Gum Processors may visit this institute and consider one for Guar on similar lines.