

Use of Sorghum/Jowar for Various Purposes in Different States of India

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Abstract

Sorghum is a part of staple food of Indian Diet. Sorghum bicolor is cultivated in various parts of the country, and every state has specific demand of Sorghum and according to that specific demand a particular state demands for relatively much greater quantity of Sorghum for that specific industrial use. But which state demands for more Sorghum for a specific industrial demand in India is a matter of research. Thus, current research puts light on finding the demand of Sorghum for various purpose in state of Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat and thus a clear picture regarding the demand of the Sorghum for a particular purpose in the specific state of Indian sub-continent and opens the future perspective to conduct more research on the connection of different varieties of cereals and pulses and average consumption of the specific variety of that cereal or pulse in a particular state.

Keywords: Adhesive, Eating, Ethanol, Grain Alcohol, Sorghum/Jowar, Starch Alcohol

Introduction

Sorghum Bicolor, usually termed as sorghum or as *durra*, *jowar*, great millet, milo or *jowari*. Sorghum is a grass specie produced for the grain, consumed as a food for human beings, ethanol production and animal feed, and. Africa is the origin of Sorghum, and is grown widely in subtropical and tropical areas. Sorghum is global fifth-most significant cereal crop after wheat, rice, barley and maize. In 2018, a 59.34 million metric tons of Sorghum was globally produced. Sorghum cultivates in groups that sometimes reaches more than 4 m height. The small grain, and in the range of 2 to 4 mm in diameter. Sweet sorghum are mainly cultivated for syrup, forage, syrup manufacturing, and ethanol making; they are higher than Sorghum that is cultivated for grain. Cultivation of *Sorghum bicolor* a type of sorghum, sorghum wild specie belonging to genus *Sorghum*. Figure 1 shows the steps involved in the cultivation of the Sorghum crop from the selection of the climatic condition to the final yield [1]

Benefits of Sorghum Consumption:

- Highly Proteinaceous
- Contains high amount of iron
- Enhances Bone Health
- Improves Digestion
- Improves Cardio Health

- Recovers Energy Levels
- Increases Circulation

In 2011, the prime cultivator of *S. bicolor* was India (11.2%), Nigeria (12.6%), the United States of America (10.0%), Mexico (11.2%)[2] Sorghum is cultivated in a wide temperature range, toxic soils and high altitudes, and can be grown post the drought. Sorghum contains five prime features that makes it highly drought-resistant crop[2]

- Sorghum has a wide root-to-leaf ratio of surface area.
- It rolls its leaves during drought, to reduce transpiration and thus water loss.
- In prolonged drought condition, it becomes dormant instead of dying.
- Sorghum leaves are covered by waxy cuticle in order to protect it.
- It uses C4 carbon fixation thus uses only one third amount of water that C3 plant need.

At Nabta Playa on the Upper Nile, the first archaeological remains of sorghum were found, c. 8000 BC. But, these are sorghum of wild variety, with grains of small size and brittle rachis. It is assumed that sorghum is obtained from a wild specie of wild *Sorghum verticilliform* in around 7000–5000 BC in the Niger River valley. Sorghum is divided into five races by the botanists out of which durra is cultivated in India[3]

- *Guinea*, need high rainfall, it is a West African specie,
- *Caudatum*, cultivated by Nilo-Saharan population between Ethiopia and Lake Chad
- *Kafir*, grown in Africa's south region, it a drought-resistant specie
- *Bicolor*, the highly usual crop[4]

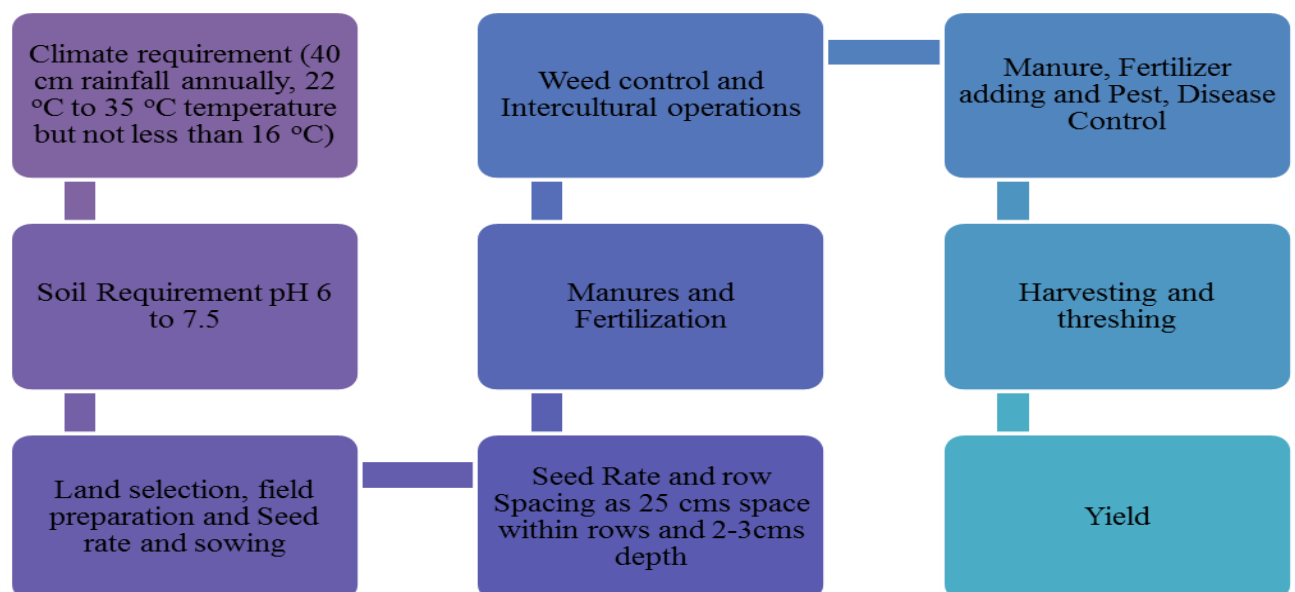


Figure 1: Shows the Steps Involved in the Cultivation of the Sorghum Crop from the Selection of the Climatic Condition to the Final Yield

Sorghum is produced in multiple countries globally. The grains are used as a food for human, and for manufacturing animal feed, liquor, or bio-based ethanol. Gluten free, highly resistant starch is present in sorghum. Sorghum is rich and diversity of phenol based compound in comparison to other important crops of cereal in our country, where it is usually called *jowar*, *jwaarie*, *jondhalaa*, and *jola*, sorghum is highly consumed grain and a means of nutrition in Deccan plateau, Maharashtra, Rajasthan, Telangana and Karnataka[5], [6].

Alcoholic beverage:

Sorghum in China is termed as *gaoliang*, and is fermented and distilled to make one type of clear spirits termed as *baijiu* and the clear spirit known is Maotai (or Moutai). In Taiwan, on the island called Kinmen, sorghum in plain form is converted into liquor form of sorghum. In many countries in Africa, including Mali, Burundi, Burkina Faso, Zimbabwe, Nigeria and Ghana, white and red sorghum is utilised for making conventional opaque beer. Red sorghum gives a pink-brown shade to beer[7].

Bio-based ethanol:

In South America, the United States, and Australia sorghum crop is utilised majorly for feeding livestock and in an increasing ethanol plant number. Sweet sorghum stalks are used in few countries for manufacturing biofuel by crushing and fermentation of the juice into ethanol. In the United States of America, Texas A&M University is conducting trials to figure out the most efficient variety for ethanol manufacturing from stalks and sorghum leaves in the USA[8].

REVIEW OF LITERATURE

Awika et.al. conducted a study on specialty sorghums, their brands, and baked and extracted residues were observed for antioxidant actions using three methods: oxygen radical absorbance capacity (ORAC), ABTS, and 2,2-diphenyl-1-picrylhydrazyl (DPPH). All sorghum samples were tested for phenolic contents. Phenol percentage of the sorghums was greatly associated with their antioxidant action calculated by aforementioned three methods. The ABTS and DPPH, which are highly low cost and simple, are shown to have identical predictive strength as ORAC on sorghum antioxidant function. The survey do not put light on demand of Sorghum for various purpose in different states of India [9].

Vanderlip et. al. conducted a study with grain sorghum that involved sampling many times during the rising cycle. Sampling was mostly shown by calendar date, days after sowing or emergence, or crop height. Sampling had no real relationship with the morphological or physiological age of the crop. Even though at few specific stages of sorghum growth, it is usually well established, the growth pattern of sorghum was not fully explained. The study explained grain sorghum hybrids of different maturities, ten stages of development were defined: three-leaf, emergence, growing-point, five-leaf, and differentiation, final leaf visible in whorl, hard dough, half-bloom, boot, soft dough, and physiological maturity. Such stages show the standard to explain the timing of treating sorghum and sampling. The survey do not put light on demand of Sorghum for various purpose in different states of India [10].

Andrew et. al. conducted a study on the Sorghum bicolor genome and the diversification of grasses, study shows that dedicated evolution creates one duplicated chromosomal segment to come out to be only a few million years old. Nearly 24% of genes are grass-specific and 7% are sorghum-specific.

Current gene and microRNA duplications may be responsible for sorghum's drought tolerance. The survey do not put light on demand of Sorghum for various purpose in different states of India [11].

Research Question:

Which is the most common use of Sorghum in Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat?

METHODOLOGY

Design:

A Questionnaire form was distributed in the wholesale grain market of different cities of Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat. The questionnaire form was distributed in all shops dealing with wholesale grain selling. Questionnaire form shown in Table 1 was distributed amongst all wholesale grain dealers and questionnaire form filled by various wholesale Sorghum dealers was considered for further analysis and depending upon the data entered by the wholesale dealer's further study was conducted.

Table 1: Shows the questionnaire form distributed amongst the wholesale dealers of grains in different cities of Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat

NAME:	
AGE:	
OCCUPATION:	
How long you are doing wholesale dealing of grains? :	2 to 6 years: 6 years or more:
What all cereals you sell? :	Wheat: Maize: Sorghum: Barley:
What quantity of Sorghum you sell monthly? :	1,000 lakh Kg: More than 1,000 lakh Kg:
For what purpose Sorghum is demanded the most? :	Eating: Ethanol: Grain Alcohol: Starch Alcohol:

	Adhesive Production:
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Data Collection:

The questionnaire form distributed amongst the wholesale grain dealers of different locations of Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat and grain dealers who were mainly dealing with rice primarily were considered for the survey and an average result of different locations of a state is considered as the result of that state, a total data of 10 dealers was considered for the analysis. Table 2 shows the data of the demand of Sorghum for eating, ethanol, grain alcohol production, starch alcohol production, adhesive production in different states of India.

Table 2: Shows the Average Demand of Different Locations for Different Purpose i.e. Eating, Ethanol, Grain Alcohol, Starch Alcohol, and Adhesive Production in Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat according to the Data Collected by the Survey

State	Average demand of Sorghum for Eating	Average demand of Sorghum for Ethanol Production	Average demand of Sorghum for Grain Alcohol Production	Average demand of Sorghum for Starch Alcohol Production	Average demand of Sorghum for Adhesive Production
Maharashtra	22%	22%	11%	31%	14%
Uttar Pradesh	37%	27%	14%	13%	9%
Andhra Pradesh	28%	24%	9%	35%	4%
Gujarat	50%	22%	11%	10%	7%

Data Analysis:

The data collected in the survey is further analysed by comparing the data collected by the survey. Figure 2, 3, 4, and 5 shows the average demand of Sorghum for eating, ethanol production, and grain alcohol production, and starch alcohol production, adhesive production in Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat.

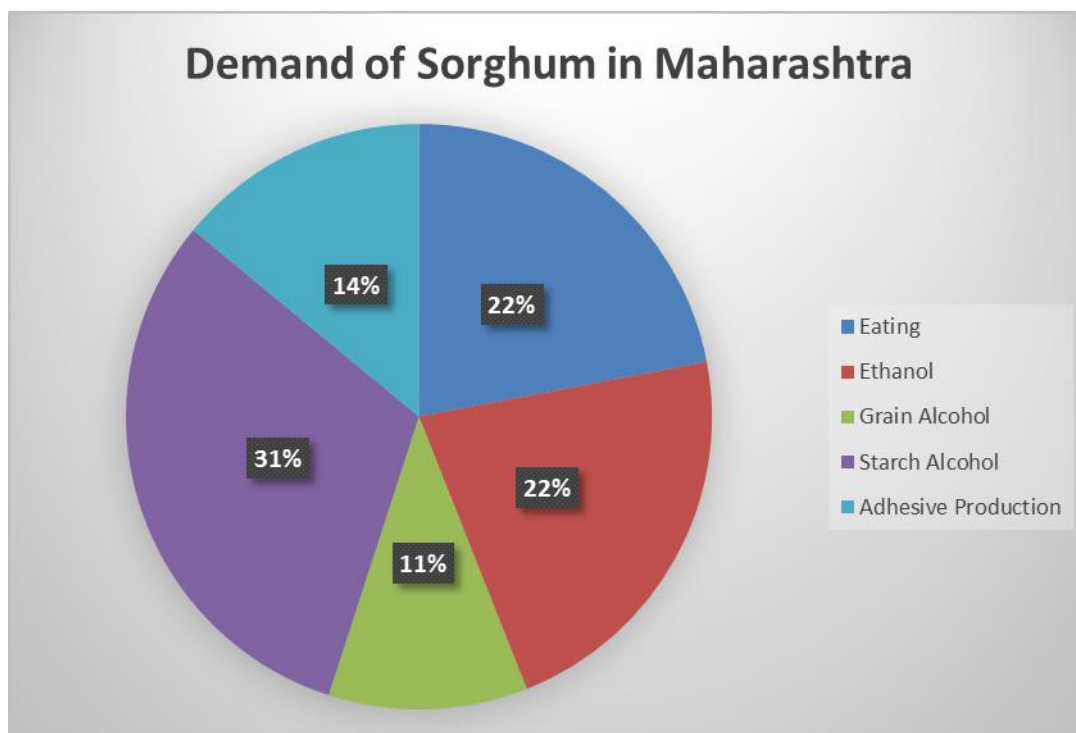


Figure 2: Shows the Results of Average Demand of Sorghum for Various Purpose i.e., Eating, Ethanol, Grain Alcohol, Starch Alcohol, and Adhesive Production in Maharashtra

The results of average demand of Sorghum for various purpose i.e. Eating as 22%, Ethanol Production as 22 %, Grain Alcohol Production as 11%, Starch Alcohol Production as 31 %, and Adhesive Production as 14% in Maharashtra.

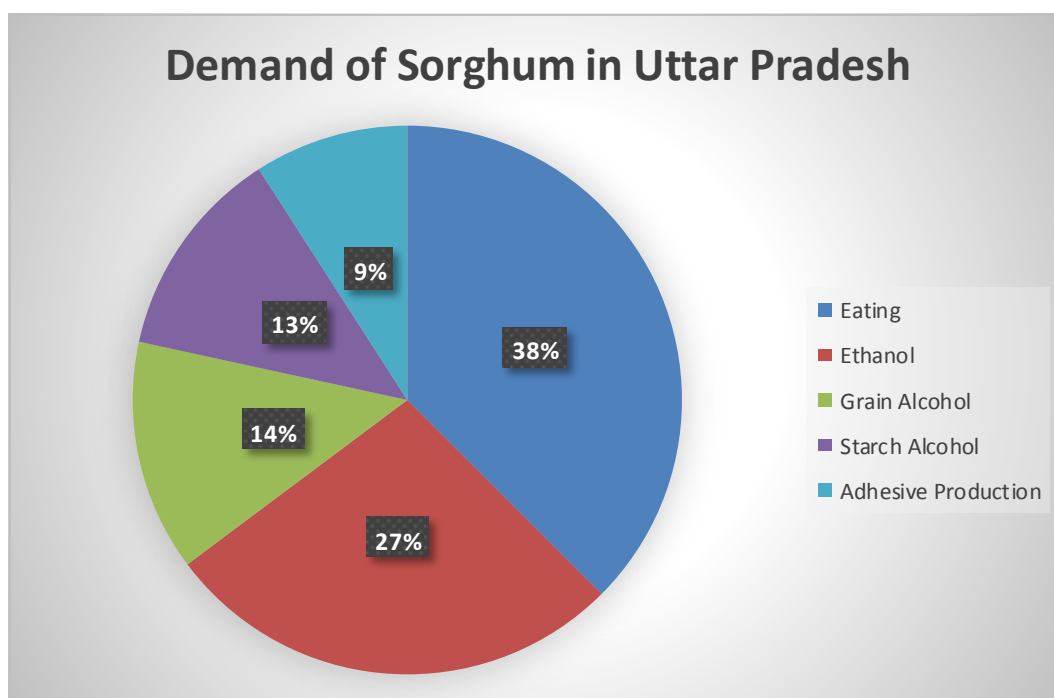


Figure 3: Shows the Results of Average Demand of Sorghum for Various Purpose i.e., Eating, Ethanol, Grain Alcohol, Starch Alcohol, and Adhesive Production in Uttar Pradesh

The results of average demand of Sorghum for various purpose i.e. Eating as 37%, Ethanol Production as 27 %, Grain Alcohol Production as 14%, Starch Alcohol Production as 13 %, and Adhesive Production as 9% in Uttar Pradesh.

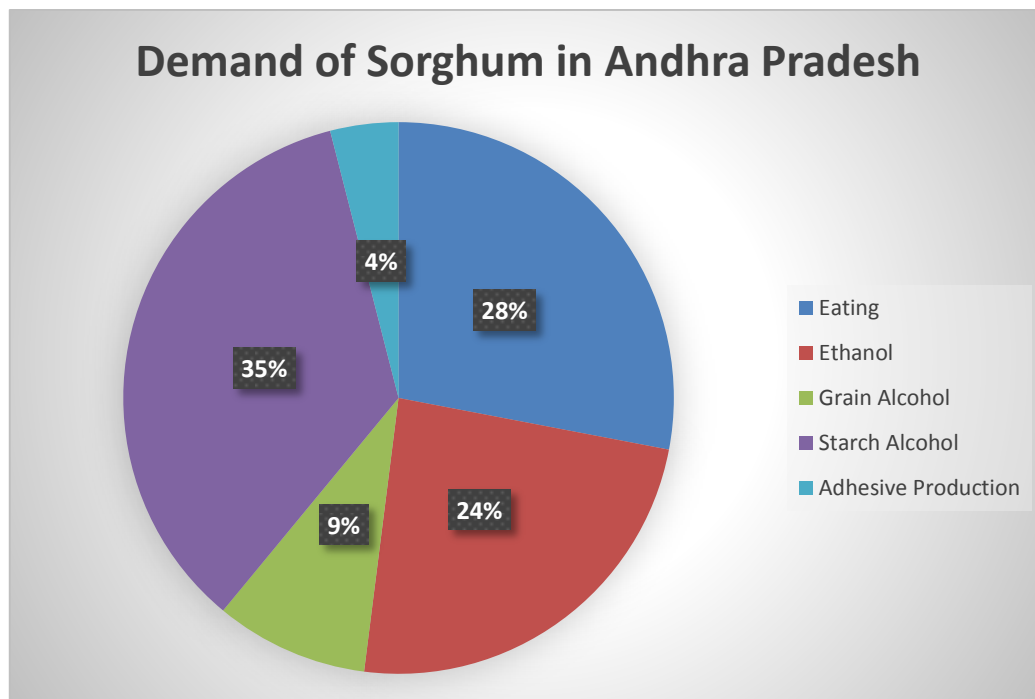


Figure 4: Shows the Results of Average Demand of Sorghum for Various Purpose i.e., Eating, Ethanol, Grain Alcohol, Starch Alcohol, and Adhesive Production in Andhra Pradesh

The results of average demand of Sorghum for various purpose i.e. Eating as 28%, Ethanol Production as 24 %, Grain Alcohol Production as 9%, Starch Alcohol Production as 35 %, and Adhesive Production as 4% in Andhra Pradesh.

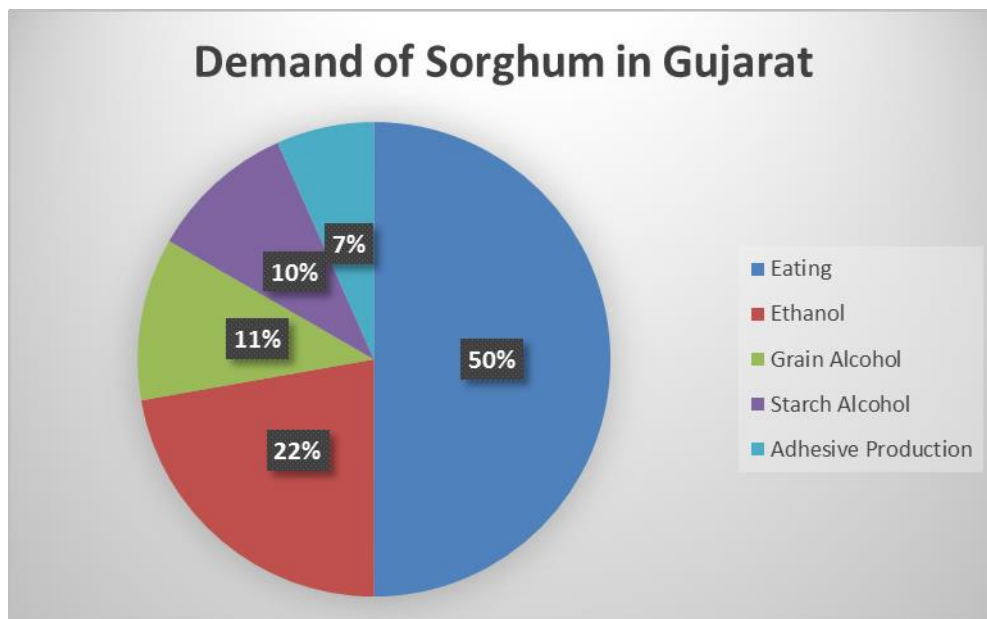


Figure 5: Shows the Results of Average Demand of Sorghum for Various Purpose i.e., Eating, Ethanol, Grain Alcohol, Starch Alcohol, and Adhesive Production in Gujarat

The results of average demand of Sorghum for various purpose i.e. Eating as 50%, Ethanol Production as 22 %, Grain Alcohol Production as 11%, Starch Alcohol Production as 10 %, and Adhesive Production as 7% in Gujarat. Figure 2, 3, 4, and 5 shows the average demand of Sorghum for eating, ethanol production, grain alcohol production, starch alcohol production, adhesive production in Maharashtra, Uttar Pradesh, Andhra Pradesh, Gujarat.

RESULT AND DISCUSSION

Sorghum has been seen to be a means of a healthy diet since ages. Regularly consuming sorghum in the diet provides the person a numerous health benefits, out of all the most important is the prevention of cancer and is achieved by the presence of rare antioxidants present in the bran layer of the sorghum grain. The fibre rich Sorghum (Jowar) cereal makes the cereal highly efficient for healing digestive health and also reduces blood LDL cholesterol level and in return encourages cardiovascular health. Sorghum is rich in tannin which makes rare enzymes that breaks the carbohydrates and restricts sugar massed form spiking the blood glucose levels in human body, thus prevents the person eating sorghum from diabetes. The presence of high calcium and magnesium content in Sorghum is very effective in improving bone health, while similarly, as a result of high copper and iron increases blood circulation in the body. Sorghum works for an efficient alternative food for patients having gluten energy issue. Sorghum (Jowar) is also highly beneficial in regulating stable energy levels in the body throughout the day.

The results of the study conducted to find out the average demand of Sorghum for different purpose i.e. eating, ethanol production, and Grain alcohol production, starch alcohol production, adhesive production in different states. The average demand of Sorghum for Eating was 22% in Maharashtra, 37% in Uttar Pradesh, 28% in Andhra Pradesh, and 50% in Gujarat. The average demand for Ethanol production was 22% in Maharashtra, 27% in Uttar Pradesh, 24% in Andhra Pradesh, and 22% in Gujarat. The average demand Sorghum for grain alcohol production 11% in Maharashtra, 14% in Uttar Pradesh, 9% in Andhra Pradesh, and 11% in Gujarat. The average demand of Sorghum for

starch alcohol production was 31% in Maharashtra, 13% in Uttar Pradesh, 35% in Andhra Pradesh, and 10% in Gujarat. The average demand of Sorghum for Adhesive production was 14% in Maharashtra, 9% in Uttar Pradesh, 4% in Andhra Pradesh, and 7% in Gujarat. Table 2: Shows the average demand of Sorghum for different purpose including eating, ethanol production, and grain alcohol production, starch alcohol production in Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat according to the data collected by the survey.

CONCLUSION

Jowar is the most significant fodder and food cereal crop harvested throughout our country, Sorghum is widely called as “Jowar” in our country. Since this crop is grown in both Rabi and Kharif season, thus makes the cereal crop a significant one. Jowar is 5th highly significant crop of cereal across the globe after wheat, rice, barley & maize. The nutritional importance of sorghum is similar to that of corn and that is why it is attaining value as livestock feed. Sorghum (or) Jowar is also utilized for ethanol manufacturing, manufacturing grain alcohol, starch manufacturing, adhesives making and paper making, along with being used as food and feed for livestock. Jowar (or) Sorghum growing is attaining popularity because of its ability of extreme drought tolerance.

The study conducted shows that the average demand of Sorghum for Eating was 22% in Maharashtra, 37% in Uttar Pradesh, 28% in Andhra Pradesh, and 50% in Gujarat. The average demand for Ethanol production was 22% in Maharashtra, 27% in Uttar Pradesh, 24% in Andhra Pradesh, and 22% in Gujarat. The average demand Sorghum for grain alcohol production 11% in Maharashtra, 14% in Uttar Pradesh, 9% in Andhra Pradesh, and 11% in Gujarat. The average demand of Sorghum for starch alcohol production was 31% in Maharashtra, 13% in Uttar Pradesh, 35% in Andhra Pradesh, and 10% in Gujarat. The average demand of Sorghum for Adhesive production was 14% in Maharashtra, 9% in Uttar Pradesh, 4% in Andhra Pradesh, and 7% in Gujarat. Table 2: Shows the average demand of Sorghum for different purpose including eating, ethanol production, and grain alcohol production, starch alcohol production in Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat as per the data gathered by the survey. Thus, current research puts light on finding demand of Sorghum for different purpose in various state like Maharashtra, Uttar Pradesh, Andhra Pradesh, and Gujarat and opens the future perspective to conduct more research on the connection of different varieties of cereals and pulses and average demand for that specific purpose in a particular state.

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