

I INTRODUCTION

Sugarcane (*Saccharum officinarum*) belongs to the family of Graminae and it is now broadly accepted that *Saccharum* species originated in India. The cultivated canes are classified into two categories: thin, tough north Indian varieties *Saccharum barberi* and *Saccharum sinense*, and thick, juicy noble canes *Saccharum officinarum*. Sanskrit word 'Sharkara' meaning shakkar in Hindi and sugar in English is believed to have been used as *Saccharum* in Latin.

Sugarcane is native to India. Since ancient times, it has been grown in India. Sugarcane and its products, sugar and syrup, have long been known in India. The manufacture of sugar and syrup was known in India for at least a few centuries before the Christian era, and certainly by 400 A.D. Sugarcane cultivation and sugar production spread from India to Srilanka, Java, China in the East, Persia in the sixth century, and Spain in the eighth century. The Arabs introduced sugarcane cultivation and syrup production to Egypt, North America, Spain, and Sicily. Sugar, on the other hand, was a luxury item in ancient times, and it was also employed for medical purposes. It is a major agro-industrial crop grown in tropical and sub-tropical regions of the world, with over 120 countries growing it. It covers over 23.80 million hectares and produces approximately 1,661 million tonnes. Sugarcane production provides livelihood for around 52 million farmers, and an equivalent number of agricultural labourers work on sugarcane farms (Anonymous2020).

Sugarcane is a tropical crop grown mostly in Cuba, Argentina, the United States, Australia, Brazil, the Philippines, Indonesia, South Africa, India, and China. Brazil is the largest producer of sugarcane in the world (671.39 million tonnes) on 8.51 million hectares with yield of 78.85 tonnes per hectare. India ranks second in terms of acreage and production of sugarcane. China (1.70 million ha), Thailand (0.93 million ha), and Pakistan are all major sugarcane producers (1.02 million ha). Countries such as Australia, Cuba, Indonesia, Mexico, and South Africa, the area under crop ranges from 0.30 to 0.70 million hectares. Sugarcane is grown in India, especially in the subtropics, under a variety of agro-climatic conditions, weather extremes, and flood and drought-prone areas; despite these constraints, sugar output continues to rise steadily and efficiently (Anonymous2020).

As previously said, India's agro-climatic conditions are favourable for the production of sugarcane, which serves as a stable raw material for a number of products. Sugarcane

production, along with its other linked avenues, is the basis India for the rural people. The production and processing of this commodity employs around 35 million farmers and a significant workforce, accounting for about seven per cent of the country's rural population.

After cotton, India's sugar sector is one of the largest in agro-based industries. There are 732 sugar mills in operation, which use about 40-50 per cent of the cane harvested to generate roughly 339 million tonnes of sugar, with the remaining cane going to the Khandasari and jaggery industries. In rural areas, the sugar business is the single major employer. It employs more than five lakh people directly, with a large number of others working in industries that use sugar industry by-products as raw materials, such as paper mills, distilleries, and confectioneries. These industries partly or entirely rely on the by-products of the sugar industry such as bagasse, molasses, alcohol, press mud, boiler ash and protein etc. Sugarcane is vital to India's agro-industrial sector, as well as the rural economy (Murthy, 2010).

Sugar factories in rural India support a large number of economic activities. They help a variety of people, including transport operators, agro-service agencies, input dealers, petty business people and financial institutions, in addition to helping the economic situation of sugarcane farmers and agricultural labourers. The most of the plant employees come from the neighbouring area. Sugar mills thus provide jobs in rural areas. In their areas of operation, many sugar companies also encourage education and cooperative movements.

Recognizing the importance of sugarcane production in India, the Government of India established the Central Sugarcane Research Institute in Cuddalore, Tamil Nadu, and the Sugarcane Breeding Institute in Coimbatore, Tamil Nadu, in the late 1940s. These organisations have been in charge of research and providing as a repository for information on all areas of the crop in India. Aside from that, agricultural universities and other state and federal government organisations have made significant contributions to crop productivity and area expansion. These institutions' technology has shown to be quite beneficial to farmers. There has been a steady increase in sugarcane and sugar production in recent years, thanks to the introduction of partial sugar control, which allows the industry to pay additional prices to farmers over and above the FRP (Fair and Remunerative Price) set by the Union Government from what accrues from the sale of sugar on the free market. Sugarcane is a long-term crop that takes between 12 and 18 months to mature, depending on the climate. Sugarcane cultivation is

found between 36.7°N and 31.0°S latitudes, and at altitudes ranging from sea level to 1000 metres. Sugarcane can be grown in a wide range of soil types, including loam, clayey loam, black cotton soils, brown or reddish loams and even laterites. Sugarcane thrives in well-drained alluvial to medium black cotton soils at optimal depths in the pH range of 5.5 to 8. It requires hot and humid climate with average temperatures ranging from 21°C to 27°C and rainfall ranging from 75 mm to 150 mm. Temperature above 20°C, paired with open skies, aid in the acquisition of juice and its thickening in the second half. Excessive rainfall leads to poor sugar content, whereas, a lack of rainfall results in a fibrous crop. Irrigation is essential in locations where rainfall falls below the prescribed level. The climate, as well as other factors such as soil quality and irrigation, have aided in the expansion of sugarcane cultivation in the state.

Sugarcane is one of the major commercial crops in Karnataka and India. In sugarcane, cultivation, irrigation is given after 15-20 days intervals. When it comes to water conservation in sugarcane farming, drip irrigation is used since it saves irrigation water. Sugarcane research institutes recommend a number of improved varieties based on maturity groups and characteristics, such as C0-671, C0-997, C0-7704 for short duration varieties, C0-86032, C0-740, C0-1184 for mid-late varieties, C0-93076 for jaggary manufacturing, C0-7201, C0-7634, C0-671 for high sugar and tonnage varieties. C0- 1148, C0-6907 for strong red rot resistance and C0-265 for Karnataka's salt-affected soil.

Sugar, jaggary and khandsari are common products made from sugarcane. About half of the cane is used to make white sugar, 40 per cent for jaggary and 10 per cent for seed, feed, chewing gum and juice. The milling industry in India is characterised by a wide range of jaggary and khandsari goods. Sugarcane by products includes molasses, bagasse, filler mud, sugarcane wax and cane garbage. White sugar contains less calcium and iron than brown sugar. Molasses is used to make alcohol. Sugarcane contains 7-12 per cent sucrose, 4-13 per cent ash and non-sugar, 0-2 per cent inert sugar, 8-16 per cent fiber and 70-80 per cent water after harvesting (Anonymous2020)

Water is the most valuable natural resource because it has no equivalent in its primary functions. Around 1,170 mm of rain falls on the country each year, resulting in 400 million hectares of surface runoff. In many parts of the world, including India, demand for available water resources is rapidly outpacing economic supply and rivalry for restricted water is

intensifying among diverse sectors of the economy. Ground water resources are rapidly depleting, posing a threat to the farming community, which is being compelled to adopt improved water management practises in order to achieve sustainable output.

Micro irrigation has revolutionized agriculture in many countries of the world. This system's key features are frequent, slow and low-volume water applications directly to the plant root zone or to the land surface beneath the plant. It is based on the basic notion of simply irrigating the crop's root zone and keeping the soil moisture around optimum levels. Water, in addition to land, is a crucial aspect in the advancement of agriculture. In a big country like India, which has a geographical area of 328 million hectares, less than 45 per cent of the land is cultivated and only 35 per cent of this cultivated land or 65 million hectares receives irrigation.

Given that water is today's limiting issue; we must make the best use of it possible, given that India is the world's second largest country in terms of what ???. To save water and boost water use efficiency in agriculture, drip irrigation is described as the application of water through point or line sources (emitters) on or below the soil surface at a low operating pressure. However, it provides additional economic and social benefits to society. For various crops, the reduction in water consumption due to drip irrigation over surface irrigation ranges from 30 to 70 per cent. On-farm irrigation efficiency is expected to be above 90 per cent with a properly built and managed drip irrigation system, which is significantly greater than the efficiency achieved with flood irrigation.

In 2020, India had 46.02 lakh hectares of sugarcane planted, with an annual yield of 3,705.48 lakh MT. Uttar Pradesh has the largest sugarcane area (22.08 million hectare) among Indian states followed by Maharashtra with 8.22 million hectares under cultivation. Other notable sugarcane-growing states are Tamil Nadu, Karnataka, Gujarat, Andhra Pradesh, Uttarakhand, Bihar, Haryana, Punjab and Madhya Pradesh. The subtropical northern region of the country has more than 60 per cent of the total crop area; however, productivity is higher in the tropical zone, with Tamil Nadu (107.6 tonnes per hectare) leading the way, followed by Karnataka, Maharashtra and Andhra Pradesh (Anonymous2020).

Sugarcane is grown on 4.29 lakh hectares in Karnataka, with the production of 38.18 million ton of sugarcane and a productivity of 85.50 tonnes per ha (Indiastat 2019-2020). The leading districts in terms of sugarcane area are Belgaum, Bagalkot, Mandya, Vijayapur and

Bidar. Because the soil and climatic conditions are most conducive for planting the cane in different seasons, Karnataka offers significant potential for boosting cane cultivation and achieving larger yields.

Vijayapura District ranks fourth in sugarcane cultivation in Karnataka. Sugarcane is grown on 0.78 million hectares of land in Karnataka, yielding roughly 22.08 million tonnes of sugarcane every year (2015-16). Sugarcane growing in Vijayapura district contributes significantly to rural socio-economic development by mobilising rural resources and creating more revenue and job opportunities. It is strategy of income and livelihood security for the state's small and marginal farmers. However, water shortage in the sugarcane region is reducing cane productivity, posing a challenge to India's long-term sugarcane production.

The study will be taken up in Vijayapura district as the area under sugarcane cultivation is increasing over the years. Due to upper Krishna command area covering entire district, the sugarcane cultivation is taken up in both the drip as well as flood irrigation system, and there are no sufficient studies carried out in the district and hence, in Vijayapura district Muddebihal and Sindagi taluks will be randomly selected and in each taluk Amaragola, Kalagi, and Malagana, Hayeri villages are selected. In each village 15 small and 15 marginal farmers finally are chosen. The total sample size will be 120. Move this paragraph to methodology chapter!!!!

The specific objectives of the study are

1. To analyze the comparative economics of drip irrigation and flood irrigation methods in sugarcane cultivation.
2. To estimate the contribution of drip irrigation technology on output growth in sugarcane cultivation.
3. To estimate the resource use efficiency in sugarcane cultivation under drip and flood irrigation methods
4. To document the constraints faced by the sample farmers.

The hypotheses outlined for the study are:

- There is no difference in Cost of cultivation in drip and flood irrigation methods
- Net returns are higher in drip irrigation compared to flood irrigation
- Drip irrigation technology has no impact on output growth
- There are no differences in resource use efficiency in drip and flood irrigation methods of sugarcane cultivation

Limitations of the study

The current research has its own set of constraints. Because, no farm records were kept, the primary data was gathered from the respondents based on their memory. As a result, the information would undoubtedly be biased, even if procedures were taken such as periodic cross-checking to reduce the mistake on a recall basis. The study is focused on a specific topic and the data gathering period was too brief to generalize and draw conclusions. As a result, the findings must be considered in the context of the research area's conditions and cannot be applied to a larger geographical area. The research, on the other hand, was carried out with great care and discipline.

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Presentation of the study:

A comprehensive description of the study undertaken is presented in the following Six chapters.

- **Introduction:** The nature and importance of research problem, specific objectives and hypotheses of the study is presented in this chapter.
- **Review of Literature:** A few reviews of past studies which are in tune with the specific objectives are presented in this chapter.
- **Methodology:** This chapter comprises of a concise depiction of the study area, nature and sources of data collection, sampling technique employed and analytical tools used for evaluating objectives through testing hypotheses.
- **Results and Discussion:** A comprehensive presentation of research outcome and its interpretation along with its relevance to past literature is presented in this chapter.

- **Summary and Conclusion:** Brief summary of the major findings of the study along with policy recommendations drawn from the findings have been presented.
- **References:** Record of all the reviewed journals, reports, articles, theses etc., arranged in a proper order are presented in this section.