III.METHODOLOGY

Methodology is of vital importance in the any economic study. It include salient features of study area, sampling design, methods of data collection, analytical tools used and term and concept involved in study. The details on the above aspects in this study are described in this chapter.

In this chapter, salient features of Vijayapura district, sampling design, analytical techniques, various terms and concepts are presented as follows.

3.1 Description of the study area

3.2 Sampling design and data source

3.3 Data collection

3.4 Analytical tools and procedures

3.1 Description of the study area

Karnataka is the eighth largest state in India with an area of 190 lakh ha. It is situated between 11.5° & 19.0° N latitude and between 74° and 78° E longitude in the southern plateau. The State receives an average annual rainfall of about 1139 mm both from southwest and north-east monsoons. Important crops grown in the state were jowar, ragi, maize, bajra and wheat among cereals; red gram, green gram, red gram and Bengal gram among pulses; groundnut, sunflower and safflower among oilseed crops and cotton, sugarcane and tobacco among commercial crops.

Karnataka comprises of 30 districts, of which 12 districts were located in Northern part of the state, Vijayapura district in state was preferred for the study purposively based on the frequency of drought occurrence in the district over the period.

Total geographical area of Vijayapura district is 10.53 lakh ha comprising 1, 977 ha under forest, 8.39 1akh ha net area under cultivation and remaining is not available for cultivation. It could be noted that, 1.89 lakh ha out of 8.39 lakh ha of net cultivated area is utilized for cultivation more than once. Net area irrigated in the District accounts for 27% of net area under cultivation (Anonymous 2012)

Vijayapura district derives its name from its headquarters town, Vijayapura. It is also called as Vijapur in Kannada which means city of victory and also considered as Punjab of Karnataka since five rivers flow in this district namely Don, Bhima, Krishna, Malaprabha, and Ghataprabha.

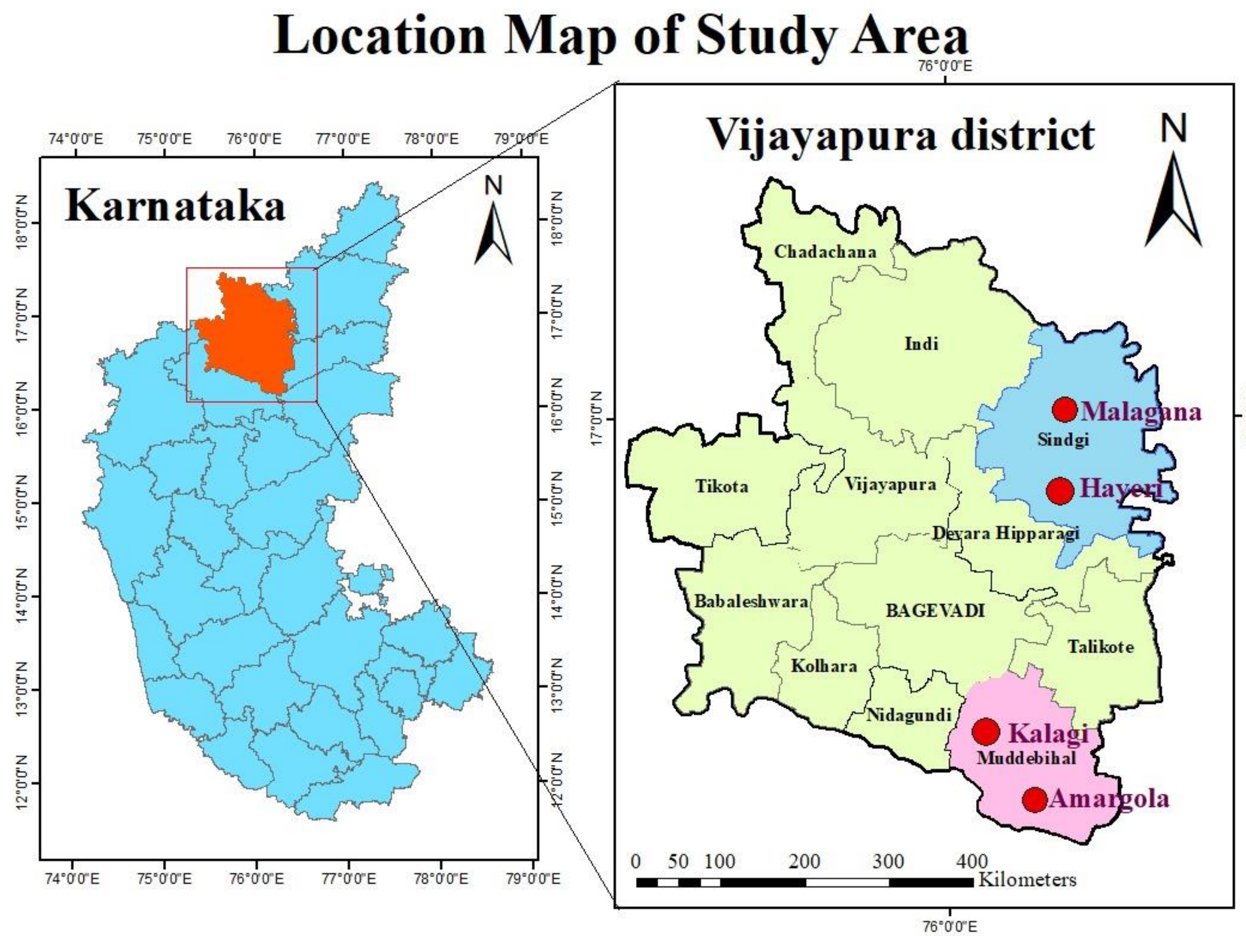
Vijayapura district is situated in the Northern part of Karnataka. It is bound on the North by Sholapur districtt (Maharastra) and on North West by Sangali district (Maharastra). The other sides were bounded by Gulbarga, Bagalkot and Belgaum district of Karnataka state.

Vijayapura district is located in the northern part of Karnataka state. It falls in the northern maidan region, between 150 50’- 170 28’ north latitudes and 740 59’- 760 28’ east longitudes and lies between two major rivers namely the Krishna and the Bhima. The district is bounded on the north by Sholapur district of Maharastra State, on the west by Belgaum district, on the east by Gulbarga district and on the south by Bagalkot district of Karnataka. Vijayapura district is land locked district and is accessible both by rail and road. The broad gauge line of SW Railway connecting Hubli-Sholapur passes through the district. The NH 13 Bangalore to Sholapur and NH-213 of Hubli-Sholapur pass through the district. Vijayapura district is connected with other district headquarters through state highways.

3.1.1 Geology

Majority of the area is dominated by Basalt and other trap intrusions. Granite and grano-diorite followed by lime stones, flat elevated beddings rising steep from, otherwise very gently undulating grano-diorite were observed. Schists occur as random paths within the grano-diorite landscape. Shale’s and sand stone patch occur as intermittent belts interspersed between the Meta sediments and grandiosities. They give rise to deep clay profiles mostly qualifying for Vertisols. Again critical analysis of consecutive five yearly rainfalls indicated that of five years, one year was found to be the worst, one year bad, moving average of two years moderate and one year the best. However, the occurrence of these years did follow any definite pattern.

Because of very low rainfall with higher co-efficient of variation, (30.8 %) desiccating wind velocity, high potential evaporation and less stored soil moisture crops frequently experience severe moisture stress.



Location Map of Study Area
Karnataka
Vijayapura district
N
74°0'0"E
75°0'0"E
76°0'0"E
77°0'0"E
78°0'0"E
79°0'0"E
12°0'0"N
13°0'0"N
14°0'0"N
15°0'0"N
16°0'0"N
17°0'0"N
18°0'0"N
Chadachana
Indi
Sindgi
Malagana
Hayeri
Tikota
Vijayapura
Devara Hipparagi
Babaleshwara
BAGEVADI
Talikote
Kolhara
Nidagundi
Kalagi
Muddebihal
Amargola
0 50 100 200 300 400
Kilometers

3.1.2 Climate

The district experiences semi-arid climate with extreme summers. It enjoys a climate with hot summers and chilly winters. Incidence of drought occurs due to inadequate and erratic distribution of rainfall in space and time. The dust storms and severe heat waves were common during April and May months. The district experiences the temperature variation between 200C and 420C. The temperature begins to rise by the end of February, till the month May, which is the hottest month. Coldest months were December and January. The year is divided in to summer season from March to May, monsoon season from June to September, post-monsoon season from October to November. The highest monthly rainfall recorded 149.2 mm in September and the lowest is 3.4 mm in the month of February. The district receives an average annual rainfall of 578 mm. The normal rainfall of the district received is varied from 569 to 595 mm and the normal rainy days also varied from 36.5 to 39.5 mm in the year.

Depth of water stream of the river has been very much reduced due to siltation. Because of deposition of silt, the water all along the run of the river flows extremely slowly. It over flows on the cultivable lands temporarily submerging them and making them unfit for cultivation.

3.1.3 Cropping pattern of Vijayapura district

Total area under cereals and minor millets production in Vijayapura was 4.09 lakh ha. Total area under pulse production in Vijayapura was 3.34 lakh ha. Total area under oil seed production was 2.11 lakh ha and total area under commercial crop production in Vijayapura was 1.81 lakh ha.

3.2 Sampling design and data source

3.2.1 Selection of the sample

The sample 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 will taken up both the drip as well as flood irrigation system, and there no sufficient study carried out in the district and hence, the Vijayapura district will be selected for the study.

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 & 15 marginal farmers finally are chosen. The total sample size will be 120.

Table 3.1: Sampling design used for selection of sample farmers

<table>
<tr><th>District</th><th>Taluks</th><th>Villages</th><th>Sample size</th></tr>
<tr><td rowspan="4">Vijayapura</td><td rowspan="2">1.Muddebihal</td><td>1.Amaragola</td><td>15 Drip
15 Surface</td></tr>
<tr><td>2.Kalagi</td><td>15 Drip
15 Surface</td></tr>
<tr><td rowspan="2">2.Sindagi</td><td>1.Malagana</td><td>15 Drip
15 Surface</td></tr>
<tr><td>2.Hayeri</td><td>15 Drip
15 Surface</td></tr>
</table>

3.3 Data collection

The sample farmers were interviewed personally by using pretested schedules prepared for the purpose. The information on some selected socio-economic characters of the farmers, land holding, cropping pattern, inventory of implements, machinery etc. was also collected. The opinions of the respondents on the production aspects of sugarcane were documented. Every effort was made to elicit accurate information from the sample farmers. The assistance of Agricultural Officer, field assistance and cane supervisors of the sugar factory and local leaders were also used in contacting the farmers, which helped to create confidence in the minds of the respondents. The data pertaining to the crop grown during the agricultural year 2019-2020 was collected during January – February of 2019 by survey method.

3.4 Method of Analysis

The techniques used in the analyses of data, keeping in view of the objectives of the study are presented as follows:

1. Comparative economics of drip irrigation and flood irrigation methods in Sugarcane cultivation
2. Estimate the contribution of drip irrigation technology on output growth in sugarcane cultivation.
3. Estimate the resource use efficiency in sugarcane cultivation
4. Constrains faced by the sample farmers in sugarcane cultivation

3.4.1 Cost and returns of sugarcane cultivation

To study cost and returns structure of sugarcane cultivation, tabular method of presentation is adopted with frequency, percentages and ratios. This is briefly presented in this section. It could be noted that farmers of this region were more familiar with acre as the unit of measurement of land area rather than hectare, so the data was collected in terms of acre and same has been presented.

3.4.1.1 Cost and return concepts

The total costs were divided into broad categories:

a. Variable costs
b. Fixed costs

a. Variable costs

The variable costs included the costs of seeds, manure, fertilizers, wages paid to human and bullock labour, machine labour charges, plant protection chemicals, irrigation and interest on operational cost.

Seeds

The cost of purchased seed sets was based on actual amount paid by the respondents. The imputed value of farm produced seed was based on the prices which prevailed in the market during the time of planting.

Farm yard manure

The cost of purchased manure was based on actual amount paid by the respondents. The prevailing price per cart load was used to impute the value of farm yard manure produced on the farm.

Fertilizers and plant protection chemicals

The cost of fertilizers and plant protection chemicals was based on the actual prices paid by the sample farmers including the cost of transportation and other incidental charges, if any.

Labour

Hired labour was charged at the prevailing wage rate paid per day (8 hours) in the study area for men, women and bullock pair during the study period. The same wage rates were imputed for family labour also. Here women days were converted into man days i.e., 1.66 women days= 1 man day based on wage differential.

Machine labour charges

Hired machine labour charges were calculated based on the prevailing machine labour charges with driver on per hour basis. The imputed value of owned machine labour charges were calculated based on prevailing rate.

Irrigation

Irrigation charges consisted the charge paid by sample farmers to watershed department per year on acre basis and channel making cost in canal water use regime and the cost incurred on digging bore well, channel making, repair and maintenance and electricity in bore well water use regime.

Interest on operational cost

Interest on operational cost was computed at the rate of seven per cent.

b. Fixed costs

These costs comprises of the non-cash items such as depreciation of farm machinery and implements, land revenue and the rental value of land. The computation of different items of the fixed cost components are as follows.

Land rent

Under canal water use regime the opportunity cost of land from the next best alternative (Paddy) is considered.

Whereas in bore well water use regime the opportunity cost of land from the next best alternative (two crops of pulses) is considered.

Depreciation

Depreciation of implements was calculated by the straight line method, i.e., by dividing the original cost less junk value of the implement by its expected life. This was apportioned to individual crop in proportion to the acreage under the crop.

Land revenue

Land revenue was charged at the rates levied by the Government.

Interest on fixed cost

Interest on fixed cost was computed at the rate of 12 percent.

3.4.1.2 Procedure for determining the value of the product

The value of the product was computed at the actual prices received by the respondents from the sugar factory during the study period.

Gross return

Total value of produce is referred to as the gross return. This includes the per tonne price and transportation charges paid by the sugar factory.

Net return

Net Return obtained by subtracting the total cost from gross return.

Net returns per rupee of variable cost

It is obtained by dividing the net returns by total variable cost.

Net returns per rupee of total cost

Net returns per rupee of total costs are obtained by dividing net returns by total cost of cultivation.

Cost of production

Cost of production is calculated by dividing total cost of cultivation by average yield on per acre basis.

3.4.2 Resource use efficiency in cultivation of sugarcane

To study the resource use efficiency in sugarcane cultivation a modified Cobb-Douglas type of production function was fitted separately for canal and bore well water use regime farmers. This was done with a view to determine the extent to which the important factors have contributed in increasing yield of sugarcane. This also helps to determine whether the factors were used optimally in the production of the crop or not.

Heady and Dillon (1966) indicated that Cobb-Douglas type functions have been most popular of all possible algebraic forms in farm – firm analysis. This algebraic model provides a compromise among,

a) Adequate fit of the data
b) Computational feasibility and
c) Sufficient degree of freedom.

They further indicated that Cobb-Douglas type of function has the greatest use in diagnostic analysis, reflecting marginal productivities at the mean level of output.

The general form of the function is $Y = AX_i^{b_i}$ where ‘X’ is the variable resource measure, ‘Y’ is the output, ‘A’ is the constant and ‘b_i’s are the regression coefficients. The equation is estimated in log linear form by the method of Ordinary Least Square (OLS). This type of function allows either constant, increasing or decreasing returns to scale and it does not allow an input-output curve embracing all these simultaneously with all the other inputs held in fixed magnitudes, the marginal product is expected to decline.

The following functional form was fitted for the sugarcane crop on per farm basis.

$Y = a\ X_1^{b1}\ X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5}$ …………………………….(1)

Where,

Y = Per farm yield of Sugarcane(tonnes)

X_1 = Total labour (human+bullock+labour) in hours

X_2 = fertilizer per farm (kg)

X_3 = Water per farm (litters)

X_4 = Seed setts per farm(tons)

X_5 = Area in acre

The above function was converted into the linear form by taking logarithmic transformation of all the variables.

$U = a + b_1 Z_1 + b_2 Z_2 + b_3 Z_3 + b_4 Z_4 + b_5 Z_5$ ………………………(2)

Where,

U = ln Y

a = ln a

Z = ln X

Structural break in production relation

Before proceeding for decomposition analysis, it is necessary to ensure that, whether there is structural break or not in the production relations between the drip irrigation sugarcane growers and the surface irrigation sugarcane growers. The dummy variable technique was used to identify the structural break in the production relation between the potential by fitting separate regression functions for demonstration drip irrigation sugarcane growers and the surface irrigation sugarcane growers.

The pooled regression of data with sample farmers data was fitted by incorporating the differences in irrigation technology between drip irrigation sugarcane growers and the surface irrigation sugarcane growers. As dummy (technique of production) variable with value "1" for drip irrigation sugarcane growers and “0" for the surface irrigation sugarcane growers.

The following log linear estimable form of equations were used for assessing structural break in production relation between demonstration drip irrigation sugarcane growers and the surface irrigation sugarcane growers.

$$\ln Y_1 = \ln A_1 + \sum_{i=1}^{5} b_{1i} \ln X_{1i} + U_1 \ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

$$\ln Y_2 = \ln A_2 + \sum_{i=1}^{5} b_{2i} \ln X_{2i} + U_2 \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$\ln Y_p = \ln A_P + \sum^{5} b_{pi} \ln X_{pi} + U_p \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

Where,

Subscripts ‘1’ represents drip irrigated growers, ‘2’ surface irrigated growers and ‘p’ represents the pooled production function drip and surface irrigation sugarcane growers together with the technique of production as dummy variable; bji, represent the output elasticities of i^{th} input on the j^{th} farm. 'D' is the dummy variable for technique of production and other variables are the same as defined earlier.

If the regression co-efficient of 'dummy' variable found to be significant then that implies a structural break in the output growth due usage of drip irrigation technology, then one can proceed for decomposing the output differences into its contributing sources.

Contribution of drip irrigation technology on output growth in sugarcane cultivation.

The output decomposition model as developed by Bisalaiah (1977) was used for investigating the contribution of various constituent sources to the productivity difference between the potential farm and farmers field. In the present study decomposition model is used to know the contribution of drip irrigation technology on output growth in sugarcane cultivation. Study uses output decomposition model, to decompose the technological ascepts between drip and surface irrigation in sugarcane cultivation to know difference in output due to technical change and change in input quantities.

The Decomposition Model for analyzing the contribution of input gaps to the yield gap was derived by subtracting equation (3) from equation (4) as follows:

$$\ln Y_2 - \ln Y_1 = (\ln A_2 - \ln A_1) + \sum_{i=1}^{5} (b_{2i} \ln X_{2i} - b_{1i} \ln X_{1i}) + (U_2 - U_1) \ldots\ldots\ldots\ldots (6)$$

Adding and subtracting $\sum b_{2i} \ln X_l$ in the above equation and rearranging the terms, the following decomposition model is arrived at.

$$\ln Y_2 - \ln Y_l = (\ln A_2 - \ln A_1) + \sum^{5} (b_{2i} - b_{1i}) \ln X_{1i} + \sum^{5} b_{2i} (\ln X_{2i} - \ln X_{1i}) + (U_2 - U_1) \ldots\ldots (7)$$

i=1 i=1

By using the logarithmic rule equation (15) can be written as

$$\ln Y_2/\ln Y_1 = (\ln A_2/\ln A_1) + \sum^5_{i=1}(b_{2i}-b_{1i}) \ln X_{1i} + \sum^5_{i=1} b_{2i}(\ln X_{2i}/X_{1i}) + (U_2-U_1) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

This is the decomposition model for decomposing the output difference between the drip and surface irrigation sugarcane growers. This equation involves decomposing the logarithm of ratio of per-acre potential farm yield and the actual yield on sample farms (LHS). This is approximately a measure of percentage change in per acre output between the drip and surface irrigation farmers

The summation of first and second terms on the right hand side of the decomposition model together represented the productivity difference between the drip and surface irrigation sugarcane grower, attributable to the difference in the irrigation technology. The third term provided the productivity difference between the drip and surface irrigation farmers attributable to the differences in the input use.