

ANALYSIS OF INCOME, EXPENDITURE AND RESOURCE USE PATTERN OF SUGARCANE IN TAMIL NADU

ABSTRACT

The core objective of the study "analysis of income, expenditure and resource use pattern of sugarcane in Tamil Nadu" is to analyze the performance of sugarcane in terms of cost and returns, resource use efficiency, and employment generation. The sample of 30 farmers growing sugarcane were selected at random from the Vazhavachannur and Perunduraipattu villages. Average and percentage analyses were used to examine cost of cultivation, labour hours used, quantity of materials used and machine hours used by farmers in each crop production. Regression analysis was employed to measure the influence of selected explanatory variables on independent variables.

Joint family constitutes about 33 per cent and nuclear family was 67 of the total sample households. Average size of holding of 3.28 acre. Total cost of cultivation for groundnut is Rs.59376.64/acre. Gross income from groundnut is Rs.140962.50/ac. Benefit Cost Ratio (BCR) of groundnut cultivation is 2.37. All the sample farmers wholly depend on the sugarcane cooperatives for selling their produce. The human labors were used for Inter cultural operation, sowing & transplanting, chemicals, fertilizer and FYM. FYM, chemicals, fertilizer and seed are the major material used in crop production. Bund Former and Rotavator are the machine used for crop production. About 89 per cent of variation in dependent variables explained by the selected independent variables such as quantity of chemicals and labor hours for inter cultural operation.

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INTRODUCTION:

Agriculture in India is one of the most important sectors of the economy. Agriculture is the primary and critical sector of our country giving livelihood and employment opportunities for vast majority of Indian population. At present Indian agriculture is at crossroads and one of the major challenges is to reverse deceleration in agricultural growth. Main reason for deceleration in agricultural growth is declining investment particularly, public investment in agriculture research and development and irrigation, combined with inefficiency of institutions providing inputs and services including rural credit and extension, post-harvest losses of food grains at 10 per cent of the total production or about 20 MT. In Tiruvannamalai, agriculture and silk weaving are the important occupation. Even though there are no perennial rivers in the district, tanks and dug wells are the major sources of irrigation. Sugarcane is one of the major crops grown in the district. Tiruvannamalai district is leading producer of Sugarcane.

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The study attempts to analyze the cost of cultivation, maximum returns, highest resource use efficiency and more employment generation from Sugarcane cultivation in Thiruvannamalai district.

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Objectives

The core objective of the study is to analyze the performance of Sugarcane grown in Thiruvannamalai District with the following specific objectives.

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- To analyses input utilization pattern, cost and returns in production of Sugarcane in study area.
- To analyze resource use efficiency in production of Sugarcane.
- To identify constraints faced by the farmers in production of Sugarcane.
- To analyses the Employment Generation capacity of Sugarcane in Thiruvannamalai district.
- To suggest the alternative crops based on the economic advantage of Sugarcane

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The hypothesis are

- Returns are higher than cost in the cultivation of Sugarcane.

- Farmers are not utilizing the resources efficiently in production of Sugarcane.
- In cost of cultivation, the material cost would be higher than machine and labor cost.
- Among the inputs, the labor use efficiency would be higher than others.
- In cultivation of crops, women employment would be more than men.
- Farmers who choose the crops based on economic criteria will be more benefited with high benefit.

Review of Literature

A review of past research helps in identifying the conceptual and methodological issues relevant to the present study.

Lalit Kumar Verma (2020) the total cost of cultivation of sugarcane of sample farms was Rs 87491.30 per hectare in which the share of total variable cost was 85.11 per cent followed by total fixed cost which was found to be 14.82 per cent. In total variable cost the shares was found to be maximum in human labour cost 40.20 per cent followed by total material cost 33.01 per cent, cost of total power used was observed to be 7.59 per cent and interest on working capital was 4.31 per cent, respectively. In materials cost, the share of seed was 17.11 per cent and fertilizer 11.36 per cent was noticed to be the major cost. While in human labour cost, the share of hired labour cost being 21.02 per cent was comparatively more than that of family labour cost 19.18 per cent. The share of machine power 5.60 per cent was more than that of bullock power 1.99 per cent. In total fixed cost, the rental value of land in Baghpat district was Rs 12000 per hectare and Rs 25.00 was paid as land revenue. The total fixed cost was comparatively more than the interest on working capital. The total cost of cultivation of sugarcane was increasing with respect to farm size of holdings and was found to be maximum under large farms Rs 92899.07 per hectare and minimum in marginal farm Rs 73661.04 per hectare. It is important to note that total variable cost was increasing with respect to the farm size.

Jaydeep Kumar (2023) indicates that costs of cultivation were highest on medium farms (Rs.51066.44), followed by small farms (Rs.49891.28) and small farms (Rs.47097.44) respectively. The overall average costs of cultivation were

observed (Rs.48591.25) on sample farms. The major component of the cost was human labour (34.17 percent), Machinery charge (18.18 percent), manure & fertilizers (16.18 percent), the rental value of owned land (12.35 percent), seed cost (5.90 percent), plant protection (1.71 percent) and irrigation charge (1.32 percent) respectively of the total cost of cultivation. Per hectare cost of cultivation was found of a positive trend with farm size.

Teshu Kumar (2014) the total cost of production share of operational costs, material cost and rental value of land was 36.0% (Rs. 30561.00), 23.95% (Rs.20352.74) and 36.72% (Rs.31200.00), respectively. For the medium farms, the operational cost accounted for 35.0% (Rs.31521.00), the material cost 26.20% (Rs.23432.11) and land rent for 34.88% (Rs.31200.00) of the total cost of production. The total cost of production of sugarcane planted on the large farm, the operational costs accounted for 36.6% (Rs.34678.00), the material cost of 26.43% (Rs.25044.65) and rental value of land for 32.92% (Rs.31200.00). On an average, the operational cost accounted for 36.00% (Rs.32253), the material cost 25.5% (Rs.22943), land rent for 34.77% (Rs.31200.00) of the total cost of production. No much difference was observed in the per cent share of operational cost in the total cost of production among these size groups of farms. This indicates that operational cost increased in the proportion of increase in the total cost.

Amala (2017) the total average variable cost of production of sugarcane of different size of farm holdings. The total average variable cost of marginal farmer is Rs 59,696, total variable cost of small farmer is Rs 61,620, total variable cost of marginal farmers is Rs 66,716 and total variable cost of large farmer is Rs 67,704. It reveals that there is a direct relationship between size of farm and cost of production that is if farm size increases the total variable cost will also increases in the study area. The total and net return of sugarcane production of different type of farm holding. The total return of marginal farmer is Rs 116200, small farmer return is Rs 112300 medium farmer return is Rs 108250 and large farmer return is Rs 107650. So the average return of sugarcane production is Rs 111100. Whereas this table also found that the Net

return from sugarcane production .The Net return of marginal farmer is Rs 56504, small farmer Net return is Rs 50680,Medium farmer Net return is Rs 41534 and large farmer Net return is Rs 39946, so the average net return from sugarcane production is Rs 47166.

Nasim Ahmad (2018) Technical efficiencies at nation as a whole in sugarcane production were found to be 66%, indicating thereby production changes by 34% are possible to increase with the available technology. Allocative mean efficiency for sugarcane was calculated 60%, emphasizing the possibility that farmers could reduce production costs by 40% through using optimum proportions of inputs considering its prices while selecting its quantities. The combined effect of TE and AE shown the average CE score being 40%, this means that according to Farrell's principle, the farmers may potentially reduce their overall cost of sugarcane production, on an average, by 60% to produce the existing level of output at least cost.

Borse(2009) One row strip - planting is done in the alternative rows by keeping middle row fallow. Paired row planting is done in paired row by keeping one row fallow between the two-paired rows. Some time paired row are opened by keeping the strip of recommended distance instead of opening of furrow in entire field. – Four row planting or skipped row planting - in this case sugarcane is planted in the four rows by keeping one row follow between the two four rows.

Vandana Kumari (2018) an average sugarcane cultivation, farmers in the area spent 33.71 percent of the total operating cost, on hired human labour, 1.08 percent on bullock power, 11.98 per cent on machinery used for different operations. Out of total operational cost, shared of material cost seed (setts), fertilizer, plant protection chemicals and irrigation charges was 21.79 percent, 17.69 percent, 4.26 percent and 6.47 percent respectively. In other words of the cost constituents, the share of hired labour was recorded to be the maximum, indicating the fact that sugarcane production in the area is largely depend upon hired labour. Human labour utilization was maximum in planting; inter cultivation, followed by harvesting and transportation cost of seed occupied the

second important position in the cost of cultivation of sugarcane, as it is the basic input on which the inters production depend.

Murali (2012) Mechanical operations proved that it was superior to manual operations. It reduced cost of production and enable efficient utilization of resources with better work output. For e.g. Furrow method of irrigation requires about 320 man-hour as against drip irrigation requires of only 30 man-hours. Manual harvesting required about 1,000 man hour with the cost of Rs 55,000 to harvest 100 t/ha (Rs.550/tonne) against Rs 32,500/ha (Rs 325/t) with the labour engagement of 12 man-hours/ha. Now it is inevitable to use modern sugarcane machinery, which is now available in the-country like sugarcane planters weeding machinery and imported harvesters. Although their initial cost is very high but advantages accrued in their use are much more. There is an enormous need to use drip irrigation and mechanical harvesters to mitigate acute labour scarcity.

Saravanan (2016) it is observed that out of the 150 sample sugarcane farmer households selected for the study, the majority of them belonged to nuclear family; their family consist of 2-4 members; their age were between 40–60 years and had a small family monthly income of Rs.25,000 to Rs.50,000. The educational status of the farmers was secondary level. Realized a total return of Rs.74867.80 per acre.

Design of the Study

Designing a suitable methodology and selection of analytical tools are important for meaningful analysis of any economic problem. Thandrapattu block of Tiruvannamalai district is selected based on purposive sampling method (non-probability) for the present study since Agricultural College and Research Institute, Vazhavachannur is located in this block. Based on the discussion with extension officials the following villages were considered for the study viz., Valavachanur, Perunduraipattu, Vanapuram, Veppur, Tanipadi, Tandrapattu, Keelsirupakkam, Aandapattu. The sample of 30 farmers growing Sugarcane were selected at random from the Vazhavachanur , Perunduraipattu villages as follows.

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Table: 01 sample size of the respondent

Sl. No,	Crop	Nature of the crop	Sample size	Selected Villages
1	Sugarcane	Sugar	30	1. Vazhavachannur, 2. Perunduraipattu,

Source: First-hand information.

Sugarcane occupies **54.9 percent** of the total area of all Crops in Tiruvannamalai district. Secondary data were collected from the Department of Economics and Statistics which is used as the base for selection of crops for the study. Primary data for the study is collected by face to face survey method from 30 farmers using pre-prepared interview schedule. The study was undertaken from August 2020 to March 2021.

Tools of Analysis:

The choice of the statistical tool of analysis was decided with reference to the objectives of the study and the nature of the data collected. The collected data were tabulated, analyzed for drawing meaningful inferences. Average and percentage analyses were used to examine the nature of production, income and expenditure for crop production, labour hours used for different crop production activities, materials used; machine hours used by farmers in each crop production.

Regression Analysis

In this study, regression analysis was employed to measure the influence of selected explanatory variables on independent variables.

Factors influencing the yield of the Groundnut:

There are numerous factors, determining the yield of Groundnut in the sample households. The major independent variable influencing yield of Groundnut are irrigation, labor hours for inter cultural operation, quantity of seed in kg, quantity of FYM in kg, quantity of chemicals in lit, land holding size in acre, quantity of fertilizer in kg, . Hence, a linear type of production function was fitted to the data separately for Groundnut.

Sugarcane

$$Y = a + b_1 X_1 + b_2 X_2 + e_t$$

Where,

Y = Yield of Sugarcane in kg

X₁ = Quantity of Chemicals in lit

X₂ = Labor hours for Inter cultural Operation

a = Constant

e_t = Disturbance terms

b₁ and b₂ are Regression Coefficient

Garette's Ranking

To study the problems faced by farmer at farmers market and factors that attract the consumers to farmer market Garette's ranking technique was used. The order of merit assigned by the respondents were converted into ranks by using the following formula.

$$\text{Per cent position} = \frac{(R_{ij} - 0.5) 100}{N_j}$$

Where,

R_{ij} = Rank given for ith factor by jth individual

N_j = Number of factors ranked by jth individuals

By using Garette's score table the percent positions of each rank was converted into scores.¹ Then, for each factor, the score of individual despondence were added together and divided by the total number of respondents for whom scores were added. The mean scores of all the factors were arranged in descending order and ranks were given. The factor having the highest mean value was considered to be the most important.

¹ Henry E. Garette, "Statistics in Psychology and Education (Bombay: Vakils, Feffer and Simons private limited, Eighth Indian print, 1973), pp. 328 -330.

Result and Discussion

General Characters of Sample farm Households

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Table: 02 Family Type of the sample households

Sl. No,	Family Type	Number of Households	% to Total
1	Joint family	10	33.33
2	Nuclear Family	20	66.67
3	Total	30	100.00

It is observed from the table 02 that about 33 per cent of family live together as joint family. In the joint family system availability of family labor is more and they share the farm works. The remaining 67 per cent of the family follow the nuclear type family systems.

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Table: 03 Land holding pattern of the sample households

SL. No.	Particulars	Area in ac	% to total
1	Area owned in ac	98.50	93.36
2	Area leased in	7.00	6.64
3	Total area	105.50	100.00
4	Average size of holding	3.28	--

Land holding pattern of Sugarcane growing farmers is presented in table 03. The sample farmers owned about 98.50 acre of land with average size of holding of 3.28 acre. Area leased in is about 6.64 per cent of the total area under cultivation.

Comment [hI29]: support to research findings

Cropping pattern

Table: 04 Cropping pattern of the sample households

SL. No.	Particulars	Area in ac	% to total
1	Area under sugarcane	102.50	97.16
2	Area under other crop	3.00	2.84

3	Total area under crop	105.50	100.00
4	Irrigated area under sugarcane	102.48	--

Cropping pattern of sugarcane growing farmers is presented in table 04. The Total under crop is 72.43 acre of which area under sugarcane is 52.09 per cent while area under other crop occupies 47.91 per cent. Irrigated area under sugarcane is 36.48 acre.

Varieties wise area under sugarcane

Table: 05 Varieties wise area under sugarcane

Sl. No	Crop	Sl. No	Variety	Area in Acre	Percent to total
2	Sugarcane	1	CO86032	102.50	100.00

Varieties wise area under paddy is presented in table 05. Sugarcane variety CO86032 occupies 100.00 percent of total area under sugarcane.

Cost of cultivation of sugarcane

Table: 06 Cost of cultivation of sugarcane in the sample households (Rs./ac)

Sl. No.	Particulars	Amount (Rs./ac)	% to total
1	Seed	10790.29	18.17
2	FYM	1322.55	2.23
3	Urea	419.89	0.71
4	DAP	1135.27	1.91
5	MOP	408.30	0.69
6	Complex	1382.81	2.33
7	Gypsum	0.00	0.00
8	Growth regulators	0.00	0.00
9	Herbicides	1017.07	1.71
10	Fungicides	1062.44	1.79
11	Insecticides	1415.13	2.38

12	Combine harvester	0.00	0.00
13	Rotavator	1634.89	2.75
14	Bund former	926.83	1.56
15	Earthling up	926.83	1.56
16	Transplanting	0.00	0.00
17	Weeding	1354.54	2.28
18	Harvesting	30898.78	52.04
19	Transport	4681.02	7.88
20	Packaging	0.00	0.00
21	Total cost	59376.64	100.00

Cost of cultivation of sugarcane in the sample households is furnished in the table06. total cost of cultivation for sugarcane is Rs.59376.64/acre of which harvesting constitutes 52.04 per cent of total cost of cultivation followed by seed with 18.17 per cent, transport with 7.88 per cent, rotavator with 2.75 per cent, insecticides with 2.38 per cent, complex with 2.33 per cent, weeding with 2.28 per cent, FYM with 2.23 per cent, DAP with 1.91 per cent, fungicides with 1.79 per cent, herbicides with 1.71 per cent, bund former with 1.56 per cent, earthling up with 1.56 per cent, urea with 0.71 per cent and MOP with 0.69 per cent of total cost of cultivation.

Income parameters of sugarcane

Table: 07 Income parameters of sugarcane in the sample households (Rs./ac)

Sl. No.	Particulars	Amount (Rs./ac)	% to Gross Income
1	Total cost (Rs./ac)	59376.64	42.12
2	Yield (kg/ac)	44750.00	--
3	Price (Rs./kg)	3.15	--

4	Gross income (Rs./ac)	140962.50	100.00
5	Net income (Rs./ac)	81585.86	57.88
6	BCR	2.37	--

Income parameters of sugarcane in the sample households is presented in the table07. Average yield of sugarcane is 44750 kg/ac and the price is Rs.3.15/kg. Gross income from sugarcane is Rs.140962.50/ac of which total cost constitutes 42.12 per cent and net return occupies 57.88 per cent. Benefit Cost Ratio (BCR) of sugarcane cultivation is 2.37. Accept the sugarcane cultivation since the Benefit Cost Ratio of sugarcane cultivation is greater than one.

Place of sale

Table: 08 Place of sale by sugarcane growing famers

Sl. No.	Place of Sale	Number of Farmers	% to total
1	Local Traders	0.00	0.00
2	Direct Procurement Centre	0.00	0.00
3	Aggregators	0.00	0.00
4	Regulated Market	0.00	0.00
5	Wholesale Market	0.00	0.00
6	Cooperatives	30.00	100.00
7	Mill Owners	0.00	0.00
8	Total Number of Farmers	30.00	100.00

Place of sale by sugarcane growing famers are presented in table08. The marketing place taken into consideration are local traders, Direct Procurement Centre, aggregators, regulated market, cooperatives, and mill owners. All the sample farmers wholly depend on the sugarcane cooperatives for selling their produce.

Resource use Efficiency

Human labor hour usage pattern

Table: 9 Human labor hours usage pattern in sugarcane growing sample households

Sl. No.	Particulars	Hours	% to total
1	Sowing & transplanting	140.19	45.35
2	FYM	1.00	0.32
3	Fertilizer	1.37	0.44
4	Chemicals	10.47	3.39
5	Inter cultural operation	156.08	50.49
6	Total men hours	309.11	100.00

Human labor hour usage pattern in the sugarcane growing sample households is presented in the table9. The human labors were evaluated for different farm operations such as sowing and transplanting, FYM, fertilizer, chemicals, intercultural operations. Total human labor hours in sugarcane cultivation is 224.40/ac. Inter cultural operation constitutes 50.49 per cent of the total human labor hours followed by sowing & transplanting, chemicals, fertilizer and FYM constitutes 45.35 per cent, 3.39 per cent, 0.44 per cent and 0.32 per cent respectively.

Material usage patterns

Table: 10 Material usage patterns in the sugarcane growing sample households

Sl. No.	Particulars	Quantity	% to Total
1	Seed (Kg/ac)	3.10	0.28
2	FYM (Kg/ac)	563.41	51.46
3	Fertilizer (Kg/ac)	126.83	11.58
4	Chemicals (ml/gm/ac)	401.48	36.67

	Total Material	1094.82	100.00
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Material usage patterns in the sugarcane growing sample households is presented table10. FYM occupies 51.46 per cent of total material usage followed by chemicals, fertilizer and seed constitutes 36.67 per cent, 11.58 per cent and 0.28 per cent of total material usage respectively. Chemical usage for sugarcane is the least and this shows that sugarcane is resistant to pest and diseases up to some extent owing to the variety CO86032.

Machine usage patterns

Table: 11 Machine usage patterns in the sugarcane growing sample households

Sl. No.	Particulars	Hours	% to total
1	Harvester	0.00	0.00
2	Rotavator	1.49	36.17
3	Bund Former	2.63	63.83
4	Total machine hours	4.12	100.00

Machine usage patterns in the sugarcane growing sample households is presented table11. Bund Former constitutes 63.83 per cent of total machine hours followed by rotavator occupy 36.17 per cent of total machine hours.

Table: 12 Estimates of regression model for factors influencing the yield of sugarcane

Sl. No.	Variables	Notation	Mean	Co-efficient	t Stat
1	Yield of sugarcane in tonne	Y	152.92	-	-
2	Quantity of chemicals in lit	X ₁	1371.74	0.04 ***	2.13
3	Labor hours for inter cultural operation	X ₂	533.27	0.14 ***	3.01

Comment [h130]: tonnes

Estimates of regression model for factors influencing the yield of sugarcane are furnished table12. Yield of sugarcane is dependent variable. Quantity of chemicals, and labor hours for inter cultural operation are the independent variables. Co-

efficient of multiple regression is 0.89 which implies that 89 per cent of variation in dependent variables explained by the selected independent variables. Quantity of chemicals and labor hours for inter cultural operation is significant at one percent level.

Intercept	:	23.53
Co-efficient of multiple regression (R ²)	:	0.89
F- Value	:	112.42
Number of observation	:	30.00
Significant at one percent level	:	***
Significant at five percent level	:	**
Significant at ten percent level	:	*

$$Y = a + b_1 X_1 + b_2 X_2 + e$$

$$Y = 23.53 + 0.04 *** X_1 + 0.14 *** X_2 + e$$

Comment [hI31]: Results for objectives 3,4,5 are missing

Conclusion

Average size of holding of 3.28 acre. Total cost of cultivation for groundnut is Rs.59376.64/acre. Gross income from groundnut is Rs.140962.50/ac. Benefit Cost Ratio (BCR) of groundnut cultivation is 2.37. All the sample farmers wholly depend on the sugarcane cooperatives for selling their produce. The human labors were used for Inter cultural operation, sowing & transplanting, chemicals, fertilizer and FYM. FYM, chemicals, fertilizer and seed are the major material used in crop production. Bund Former and Rotavator are the machine used for crop production. About 89 per cent of variation in dependent variables explained by the selected independent variables such as quantity of chemicals and labor hours for inter cultural operation.

Reference

- Amala,R.and N.Rajagopal, Economic Analysis of cost and return and profitability of Sugarcane production in Cuddalore district Tamil Nadu, International Journal of Management, IT & Engineering, 7(8), pp 71-81, 2017
- Borse, M.K. M.R. Patil*, Sunil D. Patil And K.C. Deshmane ,“Economics of strip v/s conventional method of sugarcane planting in western Maharashtra,”International Journal of Agricultural Sciences, 5(1), 24-28, 2009.
- Jaydeep Kumar, RR Kushwaha, Vishal Mehta, Sachin Kumar Verma and Pushpendra Kumar, “Study on cost and returns of sugarcane production in Sitapur district of central plain in Uttar Pradesh,” International Journal of Statistics and Applied Mathematics, 8(4), 33-36, 2023.
- Lalit Kumar Verma and Arun Solanki, “Cost and Returns Analysis of Sugarcane Production in Baghpat district of Western Uttar Pradesh, India,” International Journal of Current Microbiology and Applied Sciences, 9(1), 2020.
- Murali, P. and R. Balakrishnan, “Labour Scarcity and Selective Mechanisation of Sugarcane Agriculture in Tamil Nadu, India,” Sugar Tech, 14(3), pp 223–228, 2012.
- Nasim Ahmad, ²D.K. Sinha, ³K.M. Singh, “Economic analysis of growth, instability and resource use efficiency of sugarcane cultivation in India: an econometric approach,” Indian Journal of Economics and Development, Vol 6 (4), 2018.
- Saravanan, A. “Resource-use Efficiency of Sugarcane Production in Sathyamangalam Taluk of Erode District of Tamil Nadu: An Economic Analysis,” Agricultural Situation in India, 21-28, August 2016.
- Teshu Kumar, H. L. Singh, Subhash Kumar Jawla and Sharad Sachan, Cost and Returns of Sugarcane Production at Different Size Groups of Farms in District Meerut (U. P.), India,” Annals of Agri-Bio Research, 19(3), pp561-565, 2014.
- Vandana Kumari Land Resource Use Efficiency and Analysis of Sugarcane Cultivation in East Champaran District of North Bihar, Journal of Emerging Technologies and Innovative Research, 5(8), pp 791-795, 2018.