

# Different Query Optimization Techniques (QOT) using Data Mining Technology

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**Abstract**— Data mining is one of the main research areas to find particular data from the large set of data. The main aim of this paper is to give more knowledge about the agriculture sector. Agriculture is one of the main economic parts of growing country. Agricultural statistical data from India as been taken here the state of Kerala. To cover Kerala state 14 districts cropped data analysis, in the 12 years pattern of statistical dataset, start from 2005 to 2017. Utilization of Query Optimization Techniques (QOT), K-Means clustering and Filter Techniques (FT). The QOT analysis is to provide variety of query generation and reports. The K-Means clustering, is usage of spatio-temporal cluster data mining techniques. It also provides changes report of the dataset. Using clustering analysis is the process of discovering groups. The FT is used to filter the data season wise and found maximum production of rice occurrence district report.

**Keyword** –Cropped area-Grouping-Query optimization-Maximum Production.

## I. INTRODUCTION

Data mining techniques were used for extraction of hidden predictive information from large databases. Spatial Temporal data mining manages data whose geometry changes over time. Applications that generate various type of data include surveillance applications, transportation systems, mobile communication systems, geographical and environmental systems and so on, to classify spatial data as being either point data, line data or region data. In this paper utilisation of Spatial Temporal Techniques were to perform different analysis methodology using Agriculture dataset.

In this paper Section II contains the related work of agricultural details of kerala state dataset with normalization of table pattern of information, Section III contain experimental result and discussion it consists of different predicates checking and grouping pattern of the result and Section IV conclusion of research work and more knowledge about for future work.

## II. RELATED WORK

The data collected from Kerala state agricultural statistical website [20]. To collect the information from the website consists of agricultural statistical data start from 2005 to 2017. The datasets are to make normalization to create different patterns of tables.

Table 1 Table Details

Table Name	Field Name
K_district	Id,dname,garea
C_area	Id,year,tcrop
Cropdetail	Id,year,cname,carea,autumn, winter,summer,tcrop
K_rainfall	Id,year,rain

In the above tables Id refer to district Id to avoid multiple entries and using references to create link of all the other tables. Here to fetch the 14 district with 12years of paddy cropped data, total cropped area, rice production season wise and rainfall data. Using QOT, Cluster and FT technique to formulates number of equation.

$$G_{11} = \Pi a_1, a_2, \dots, a_n(\sigma \text{Group}(\text{id})(K_{\text{district}})) \cup$$

$$\Pi a_1, a_2, \dots, a_n(\sigma \text{Group}(\text{id})(TCrop)) - (1)$$

Where  $G_{11}$  is grouping of district wise data from associate of two different tables. The attributes are retrieving from  $K_{\text{district}}$  to geo\_area and  $TCrop$  to average crop area from district wise.

$$G_{12} = \Pi a_1, a_2, \dots, a_n(\sigma \text{Group}(\text{id})(TCrop)) \cup$$

$$\Pi a_1, a_2, \dots, a_n(\sigma \text{Group}(\text{id})(Cropdetail)) - (2)$$

Where  $G_{12}$  result same as  $G_{11}$  but the result of comparison of total cropped area to paddy cropped area in district wise. The attributes are retrieving from  $K_{\text{district}}$  to geo\_area and  $TCrop$  to average crop area from district wise.

$$G_{13} = \Pi a_1, a_2, \dots, a_n(\sigma_{Group}(Year)(TCrop)) \cup \Pi a_1, a_2, \dots, a_n(\sigma_{Group}(Year)(Cropdetail)) - (3)$$

Where  $G_{13}$  results are same for  $G_{12}$  but the grouping patterns are taken as year wise.

$$G_{14} = \Pi a_1, a_2, \dots, a_n(\sigma_{Group}(id)(K\_Rainfall)) \cup \Pi a_1, a_2, \dots, a_n(\sigma_{Group}(id)(Cropdetail)) - (4)$$

Where  $G_{14}$  grouping of rainfall and paddy crop details as district Id wise.

**Algorithm:**

**Step 1:** To create a database to fetch all the relevant records and apply normalization to avoid repetition.

**Step 2:** Using Grouping and prediction to make them produce different patterns cluster output using “(1)” to “(4)”.

**Step 3:** Based on step2 result to produce final result using Filter Technique.

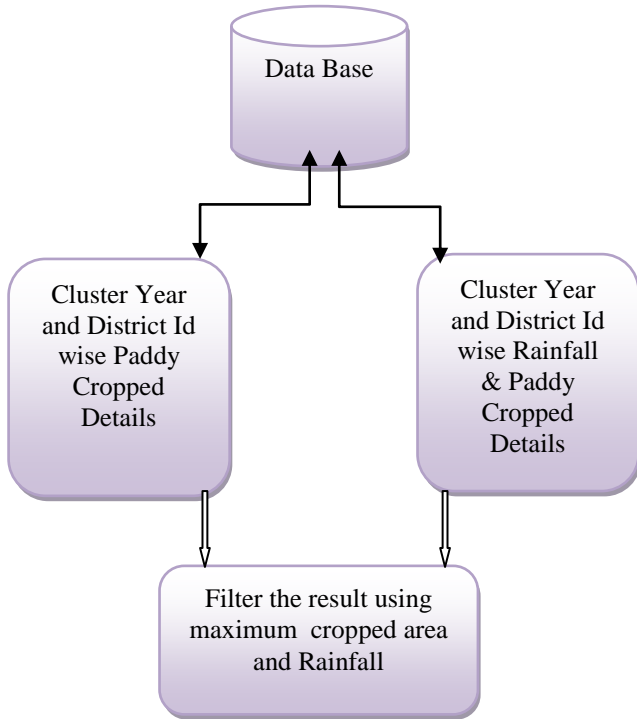


Figure 1 Data Utilization Diagram

**III. EXPERIMENTAL RESULTS AND DISCUSSION**

**A. Districtwise Total CroppedArea Vs Geo\_area**

The first section of describe the comparison of cluter output of geo\_area and average cropped area districtwise. select id,garea from K\_district union select id,avg(tcrop) as TCROP from C\_area group by id;

Table 2 K\_District Details

District_id	District_Name
1	Thiruvananthapuram
2	Kollam
3	Pathanamthitta
4	Alappuzha
5	Kottayam
6	Idukki
7	Ernakulam
8	Thrissur
9	Palakkad
10	Malappuram
11	Kozhikode
12	Wayanad
13	Kannur
14	Kasaragod

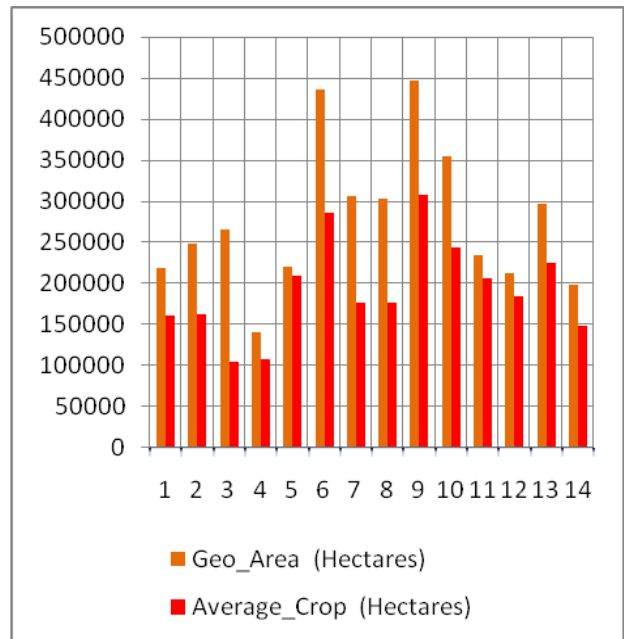


Figure 2 Comparison of Geo\_Area and Average Cropped Area [2005\_2017]

The figure 2 shows x-axis denote district id and y-axis denote hectares measurement of geo\_area and Average Cropped area. The highest geo\_area and average Cropped area is district id is 9.

Table 3 Percentage of Average Cropped Area % [2005 to 2017]

id	Geo_Area (Hectares)	Average_Crop (Hectares)	% Of Cropped Area
1	218781	160928	74
2	248788	162742	65
3	265277	104602	39
4	141011	107406	76
5	220442	209057	95

6	436328	285878	66
7	305826	176580	58
8	302919	175884	58
9	447584	307636	69
10	355446	244263	69
11	234641	206701	88
12	212966	183717	86
13	297112	224403	76
14	199166	148688	75

The table 3 describes the percentage calculation of geo\_area and Average \_crop area. The highlighted data denote as percentage wise above 70% cropped area compared to the geo\_area details. The district is 1,4,5,11,12,13 and 14. In this output the overall highest percentage cropped area is district Id 5.

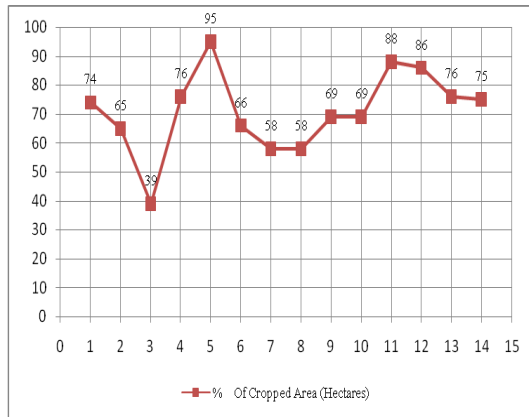


Figure 3 Percentage of Average Cropped Area [2005 to 2017][x-Axis Denote District ID]

The figure 3 shows the percentage of cropped area flow based on the table 3.

Table.4.Comparison of Average for Paddy Crop\_Area and Total\_crop [2005\_2017]

id	Paddy_Crop area (Hectares)	Total_crop (Hectares)	%
1	2674	160928	1.66
2	2995	162742	1.84
3	2657	104602	2.54
4	33854	107406	31.52
5	15338	209057	7.34
6	1584	285878	0.55
7	10249	176580	5.80
8	24404	175884	13.88
9	90180	307636	29.31
10	9523	244263	3.90
11	3263	206701	1.58
12	10830	183717	5.89
13	6585	224403	2.93
14	4240	148688	2.85

The table 4 describes detail of average cropped area compared with total cropped area. The highlighted data

denote above 10% of paddy cropped area details. The result of district id 4, 8 and 9 are above 10% paddy cropped areas.

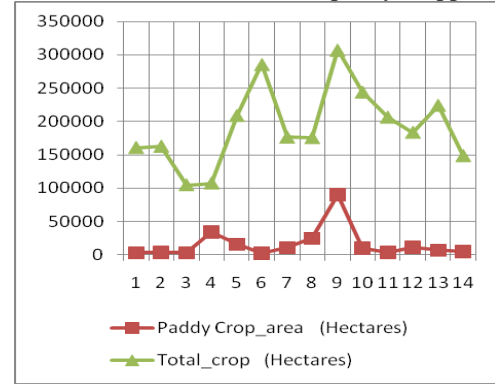


Figure 4 Comparison of Average paddy crop\_area and total cropped area based on table 4.[x-axis denote District ID]

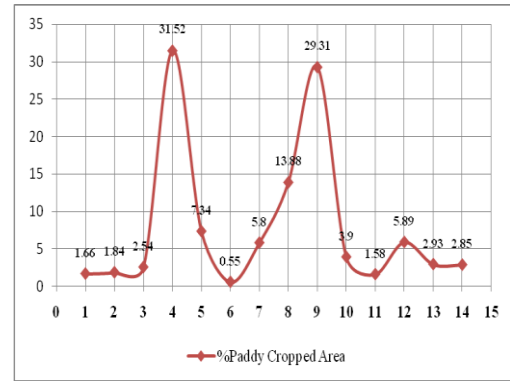


Figure 5 Percentage of Average paddy crop\_area based on table 4.[x-axis denote district ID]

select year,avg(tcrop) as TCROP from C\_area group by year union select year,avg(carea) from Cropdetail group by year

Table 5 Yearwise Average for Paddy Crop\_Area and Total\_crop [2005\_2017]

year	Paddy_Crop_Area (Hectares)	Total_Crop (Hectares)	%
2005_2006	19695.86	213266.14	9.24
2006_2007	18823.50	208395.79	9.03
2007_2008	16352.71	197221.00	8.29
2008_2009	16733.21	192495.93	8.69
2009_2010	16715.21	190619.86	8.77
2010_2011	15227.64	189104.36	8.05
2011_2012	14868.14	190125.50	7.82
2012_2013	14091.21	185123.86	7.61
2013_2014	14257.93	186905.00	7.63
2014_2015	14109.21	187473.14	7.53
2015_2016	14062.14	187684.07	7.49
2016_2017	12242.71	184572.14	6.63

Table 5 describes the details of year wise average paddy crop area compared with total crop area. The above 8% paddy

crop area from year of 2005 to 2011. The least percentage in the year of 2016\_2017 it consists of only 6.63%.

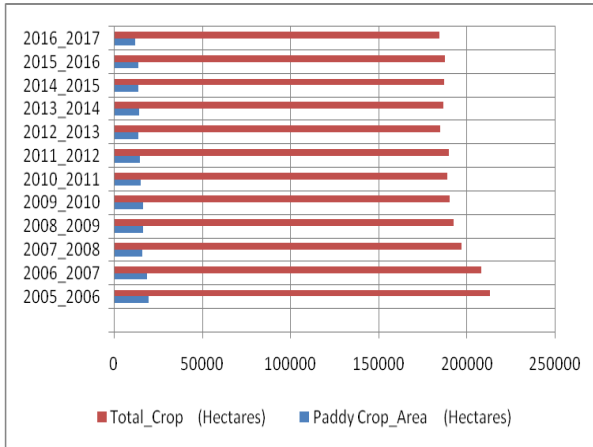


Figure 5 Comparison of Average paddy crop\_area with Total Crop\_Area based on table 5.

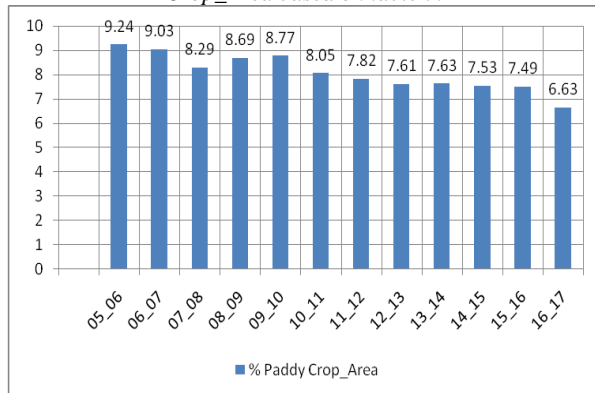


Figure 6 Paddy Crop area % Yearwise based on table 5.[x-axis denote year 2005 to 2017]

**B.Rainfall Vs Paddy\_Crop and Rice Production**

In this section cluster is taken for crop\_area and rainfall. The cluster is considered district id wise and yearwise.

```
select Id,avg(carea) as Crop_Area from Cropdetail group by id union select id,avg(rain) from K_rainfall group by id;
```

Table 6 DistrictWise Comparison of Rainfall and Paddy\_crop Area [2005\_2017]

id	Avg_Rainfall (mm)	Avg_CropArea (Hectares)
1	1786.16	2674.25
2	2382.13	2994.83
3	2657.17	2761.19
4	2541.03	33853.92

5	3032.86	15337.50
6	1584.33	3548.99
7	3334.30	10249.00
8	2862.90	24404.42
9	2292.35	90179.75
10	2662.93	9522.50
11	3263.33	3504.15
12	2493.65	10830.00
13	3260.56	6585.25
14	3297.98	4239.83

Table 6 describe districtWise Comparison of Rainfall and Paddy\_crop Area, Here the comparison is divided into two ways.First one highest paddy crop area second one highest rainfall. In the firstway highest paddy\_crop occur two district id that is id 4 and 9.In the second way highest rainfall is considered as above 3000mm rainfall occur area 5,7,11,13 and 14.

Table 7 Year Wise Comparison of Rainfall and Paddy\_crop Area [2005\_2017]

year	Avg_Crop_Area (Hectares)	Avg_Rainfall (mm)
2005_2006	19695.86	3225.29
2006_2007	18823.50	3120.76
2007_2008	16352.71	3374.71
2008_2009	16733.21	2351.49
2009_2010	16715.21	3090.59
2010_2011	15227.64	3259.79
2011_2012	14868.14	2639.41
2012_2013	14091.21	2706.41
2013_2014	14257.93	2819.21
2014_2015	14109.21	3057.52
2015_2016	14062.14	2534.32
2016_2017	12242.71	1901.49

Table 8 Rice Production in the district of palakkad[id=9]

year	Autumn (Tonnes)	Winter (Tonnes)	Summer (Tonnes)	Total (Tonnes)
2005_2006	112132	153728	774	266634
2006_2007	100669	151829	17605	270103
2007_2008	108300	118856	17088	244244
2008_2009	111561	105045	23537	240143
2009_2010	112866	136538	16827	266231
2010_2011	96030	106825	15300	218155
2011_2012	92523	121202	10688	224413
2012_2013	89411	94532	5286	189229
2013_2014	97030	127876	13159	238065
2014_2015	95178	132295	8925	236398
2015_2016	95152	122157	11150	228459
2016_2017	102664	40730	881	144275
Total	1213516	1411613	141220	2766349

The table 7 describes highest rainfall in the year of 2005\_2006 to 2010\_2011 and paddy crop area also increases in this duration. The year of 2008\_2009 duration the rainfall is minimum 2351.49mm but the paddy crop area in hectares is not affected. The duration of 2011\_2017 rainfall slightly decreases and paddy crop also decrease but the year of 2014\_2015 duration rainfall 3057mm but paddy crop area not increases.

**C. Maximum Paddy\_Crop Details**

In this section to discuss about maximum paddy\_crop detail and season wise rice maximum rice production distict and year details.

```
select Id,year,carea from Cropdetail where carea=(select
max(carea) from Cropdetail where carea in (select
max(carea) from Cropdetail group by id));
```

id	year	Carea
9	2005_2006	113919

```
select id,year,autumn from Cropdetail where autumn=(select
max(autumn) from Cropdetail where autumn in(select
max(autumn) from Cropdetail group by id));
```

id	year	autumn
9	2009_2010	112866.00

```
select id,year,winter from Cropdetail where winter=(select
max(winter) from Cropdetail where winter in(select
max(winter) from Cropdetail group by id));
```

id	year	winter
9	2005_2006	153728.00

In the above query maximum rice production in the district of Palakkad [id=9] is maximum autumn and winter season year.

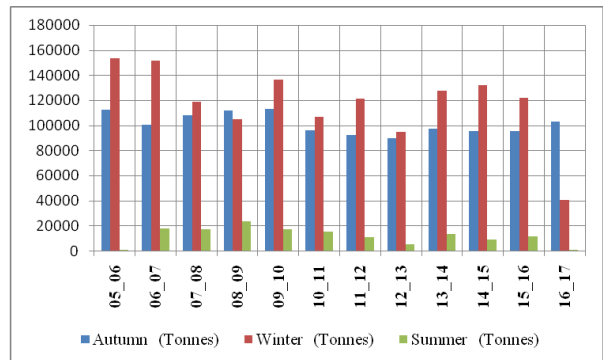


Figure 7 Rice Production in the district of palakkad[id=9] Seasonwise[2005\_2017] based on Table 8. [x-axis-> year[2005 to 2017] and y-axis->Rice in Tonnes]

```
select id,year,summer from Cropdetail where
summer=(select max(summer) from Cropdetail where
summer in(select max(summer) from Cropdetail group by
id));
```

id	year	summer
4	2014_2015	60549.00

The above query district of Alappuzha[id=4] maximum in the summer season in the year of 2014\_2015.

```
Select c.id,c.year,c.carea,c.autumn,
c.winter,c.summer,c.tcrop from Cropdetail as c where c.id=9;
select c.id,c.year,c.carea,c.autumn,c.
winter,c.summer,c.tcrop from Cropdetail as c where c.id=4;
```

Table 9 Rice Production in the district of Alappuzha [id=4] seasonwise[2005\_2017]

year	Autumn (Tonnes)	Winter (Tonnes)	Summer (Tonnes)	Total (Tonnes)
2005_2006	16555	43429	11764	71748
2006_2007	22287	40111	27762	90160
2007_2008	14128	21366	26776	62270
2008_2009	26254	21999	55997	104250
2009_2010	28912	22672	46392	97976
2010_2011	23856	9235	58234	91325
2011_2012	30522	28301	53157	111980
2012_2013	32362	15188	57043	104593
2013_2014	20589	36195	50082	106866
2014_2015	28432	14114	60549	103095
2015_2016	30662	4172	54501	89335
2016_2017	32592	10025	59822	102439
Total	307151	266807	562079	1136037

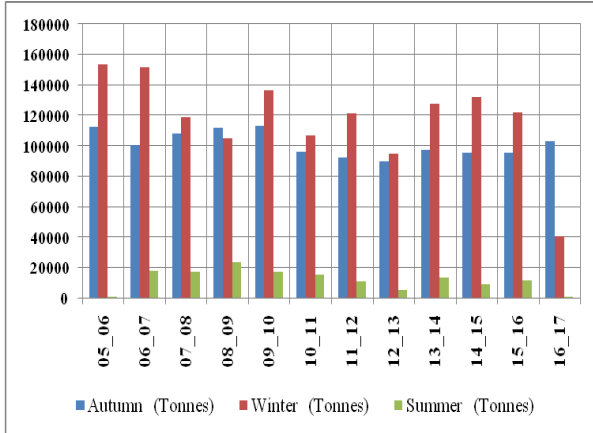


Figure 8 Rice Production in the district of Alappuzha in the seasonwise based on Table 9. [x-axis-> year[2005 to 2017] and y-axis->Rice in Tonnes]

Table 10 Comparison of Rainfall for Palakkad[id=9] and Alappuzha[id=4]

year	Avg_Rainfall (mm) [id=4]	Avg_Rainfall (mm) [id=9]
2005_2006	2654	2852
2006_2007	2960.5	2500.2
2007_2008	2977	3075.9
2008_2009	2617.2	1666.6
2009_2010	2625.9	2735.4
2010_2011	3036.8	2649.5
2011_2012	2209.6	2217.6
2012_2013	2038.9	1995.4
2013_2014	2858.3	2226.7
2014_2015	2410.4	2496.5
2015_2016	2294.6	1697.6
2016_2017	1809.1	1394.8

The table 10 describes average rainfall details of palakkad and Alappuzha district. The maximum duration of rainfall in the year of 2010 to 2011, in the district of Alappuzha and in the year of 2007 to 2008 Palakkad district contains highest rainfall.

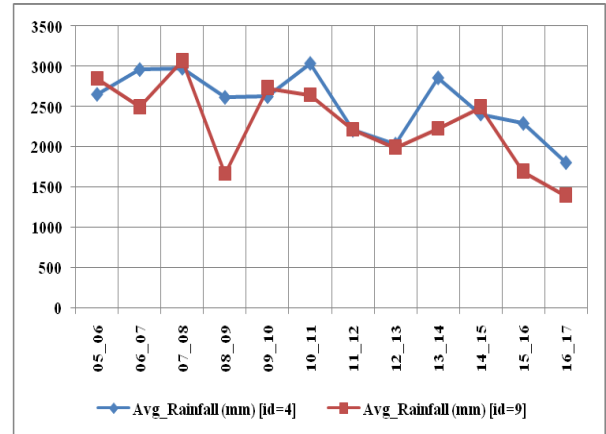


Figure 9 Comparison of rainfall for palakkad and Alappuzha based on table 10. [x-axis-> year[2005 to 2017] and y-axis->Rainfall in mm]

The figure 9 flow chart of rainfall details Palakkad and Alappuzha district. The rainfall slightly decreases from the year 2011 to 2017. The minimum rainfall occurs in the year of 2016 to 2017 duration in both the districts.

The figure 10 comparisons are rice production in the hectares basis. The two district rice production comparison flow chart. The Alappuzha district is highest rice production per hectare. The year 2007\_2008 duration only Palakkad district highest rice production per hectare. The highest difference in the year of 2016\_2017 nearly 0.96 tonnes rice production increases in Alappuzha district compared to Palakkad district.

**Table.11.Comparison of Rice Production,Paddy\_Crop\_Area , % of Paddy\_Cropping and Production of Rice based on Hectares (district of palakkad[id=9] and Alappuzha[id=4])(2005\_2017)**

year	Paddy_Carea (Hectares) [id=9]	Total_C area (Hectares) [id=9]	% Paddy_c roping (Hectares) [id=9]	Total_Rice Production (Tonnes) [id=9]	Producti on of Rice per Hector (Tonnes) [id=9]	Paddy_Carea (Hector s) [id=4]	Total_C area (Hectar es) [id=4]	% Paddy_c roping (Hectare s) [id=4]	Total_Ri ce Producti on (Tonnes) [id=4]	Production of Rice per Hector (Tonnes) [id=4]
2005_2006	113919	329558	34.57	266634	2.34	28768	121411	23.69	71748	2.49
2006_2007	109208	337239	32.38	270103	2.47	31060	113763	27.30	90160	2.90
2007_2008	99173	324548	30.56	244244	2.46	33335	109455	30.46	62270	1.87
2008_2009	96190	314687	30.57	240143	2.50	34143	105043	32.50	104250	3.05
2009_2010	100522	314371	31.98	266231	2.65	33440	105158	31.80	97976	2.93
2010_2011	87511	303461	28.84	218155	2.49	37060	108489	34.16	91325	2.46
2011_2012	83992	302348	27.78	224413	2.67	36251	107389	33.76	111980	3.09
2012_2013	79201	291194	27.20	189229	2.39	36195	104287	34.71	104593	2.89
2013_2014	82896	301712	27.48	238065	2.87	37403	106619	35.08	106866	2.86
2014_2015	82912	300622	27.58	236398	2.85	34415	103135	33.37	103095	3
2015_2016	81120	293440	27.64	228459	2.82	31724	101498	31.26	89335	2.82
2016_2017	65513	278456	23.53	144275	2.2	32453	102621	31.62	102439	3.16

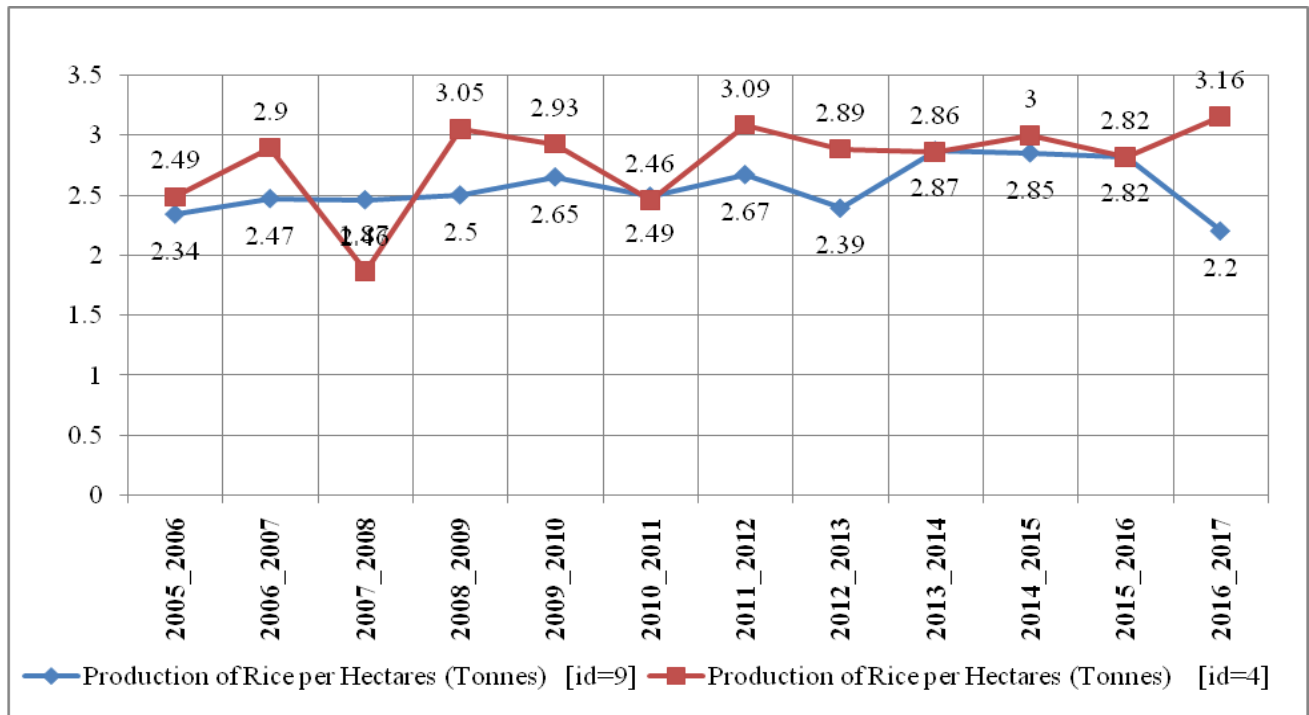


Figure 10 Comparison of Production of Rice based on Hectares

#### IV. CONCLUSION AND FUTURE SCOPE

This paper was based on different ways of discussion to conclude the result, based on the cropped area percentage. The highest percentage cropped area is district id 5. The above paddy cropped area in the district id is 4, 8 and 9. The above 8% paddy crop area from year of 2005 to 2011. The least percentage in the year of 2016\_2017, it consists of only 6.63%. In the district wise Comparison of Rainfall and Paddy\_crop Area. The highest paddy\_crop occur in two districts id that is id 4 and 9. The highest rainfall above 3000mm rainfall occur area 5, 7, 11, 13 and 14.

The highest rainfall in the year 2005\_2006 to 2010\_2011 and paddy crop area also increases in this duration. The year of 2008\_2009 duration the rainfall is minimum 2351.49mm but the paddy crop area in hectares is not affected.

The maximum rice production in the district of Palakkad is maximum autumn and winter season. The district of Alappuzha maximum in the summer season.

The rainfall details Palakkad and Alappuzha district. The rainfall slightly decreases from the year 2011 to 2017. The minimum rainfall occurs in the year of 2016 to 2017 duration both the district.

The comparisons are rice production in the hectares basis. The alappuzha district is highest rice production per hectare. Based on the overall analysis it can be concluded that were concentrated only paddy crop area and rice production. The overall cropped area kottayam[id=5] but paddy crop production was high in the district of palakkad and alappuzha. The paddy cropped area highest in the district of palakkad but final rice production wise comparison, per hectare basis, Alappuzha is highest. But the overall comparison paddy crop area and rainfall both decreases from 2005 to 2017.

In future research analysis of the groundwater level and other food cropped production could be given more thrust. And also to find the parameter for rainfall decreases reason.

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