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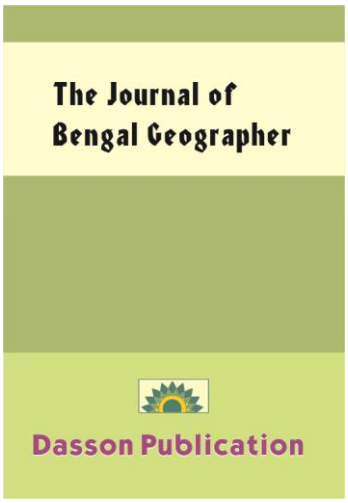

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Irrigation and its impact on Paddy cultivation in the rain shadow region of Southern India

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Abstract

Paddy is the most important staple food crop caters more than half of the world's populations which requireshigh amount of water for growing.The unscientific and excessive use of water to meet the irrigation demand of food crops particularly paddy thatcreate an over exploitation of underground water that would bring out the problems in sustainable water resource management. The struggle for water resources has becoming intense in many parts of the world particularly in the agricultural sector. Inefficient use of groundwater for crop production has depleted aquifers and reduced groundwater. In the case of Kerala [humid and tropical climate] located in the southern part of India where 44 rivers and many check dams satisfied their water demand andprovide ideal conditions for different variety of paddy cultivation. Despite, some of the areas in Kerala especially the rain shadow regions of Chitturknown for "granary of Kerala" now faced severe drought and poor groundwater potential that leads paddy cultivation in grave yard. The Water dispute problem with adjacent Tamil Nadu state also creates pressure in food crop cultivation. Due to these prevailing conditions,the existing water sourceswould be unable to satisfy the great demand of irrigation water that forced farmers from high water demand paddy crops to crops that required less water demand and also some of the farmers who converted land from food crops to plantation crops.With this background, the present study examines the availability and its efficiency of water for paddy cultivation in Chittur, a predominant paddy producing region in Kerala. To achieve this objective, data collected from landsat-8 imageries, amount of water requirements of paddy collected from Centre for water resource development and management, are mainly incorporated in this analysis. The study concludes that the supply of irrigation water is not enough for even the single cropping season in the entire region. This would highlight the need for proper management of available water in a proper manner.

Key Words: *Paddy cultivation, water demand, food security, GIS and Chittur*

1. Introduction

Kerala is considered as a water rich state, despite Kerala's reward of natural resource, the state finds itself rising under enormous pressure on the two natural resources of land and water. Efficiency in their use is therefore stands as great significance. One of the major inputs in

agriculture production is the irrigation water. It has been well documented that water is an essential input influencing the scale and pattern of agricultural growth. Development of irrigation source enhances the elasticity of the supply of water with favourable effect on the agricultural growth (Gupta K.R. 1980). An analysis of yield of paddy in irrigated and unirrigated conditions confirmed that irrigation has a great effect on enhancing the yield levels by one sixth about 500 Kg per hectare to that of unirrigated level (Lathika 2010). Similarly, the studies which have conducted in different reputed institutions such as Kerala Agricultural University, Central Plantations Development and Management have shown that irrigation can enhance the productivity of the crops in the state (Surendranet.al.,2012).As per the classical classification land is the primary requisite for production and when agriculture is concerned water also forms an important component (Kerala Agricultural development policy 2016). Therefore the objective of agriculture development should be of raising productivity per unit of water, especially irrigating water.

It is to be noted that agricultural sector is a major fresh water consumer and around 70percent of the world's fresh water withdrawal is for irrigationpurposes (Chapagian and Hoekstra 2010). The world water development report (WWDR 2012) has also reported that the global water consumption of agriculture is predicted to increase by 19 percent or to reach to 8815km^3 per year by 2025. Moreover the water shortage is further exacerbated by the increase in variability of water distribution due to the impacts of climate change. Hence the water resource management is an essential issue for satisfying the increasing demand of agriculture with rising population and consequent increased demand of food. It is pretend to noticed that many of the existing irrigation projects in India faces the situation of supply falls far short of demand, where the deficit is more than 50 percent of the supply and the irrigation projects yield much less water than expected due to water losses salinity in water and failure to reach water to all those who are in need of it (Joseph 2001).For efficient use of water, there is a dire need to manage of sustainable water management technologies. The irrigation water management means the comprehensive control of such functions as taking convergence, regulation, measurement, distribution, application at the proper time in proper amounts and drainage of excess water.All are aiming at the common target of increasing production and improving techniques of farming. Thus considering the existing irrigation systems, the proper estimation of different components of water requirement of crops in the field (eg; evapo-transpiration, seepage, percolation and runoff) can lead to effective use of the available water resources and to optimize land areas cultivated with limited amounts of irrigation water (Angus 1991).The competition for water resources is becoming intense in many of the world's rice producing area to meet the required quantity of water for their proper growth and increased production.

1.1Water resource of Kerala

The humid tropical region of Kerala is considered as a region of receiving high rainfall and with rich water resources. The average annual rainfall of the state is 2943mm,which is almost three

times higher than of India (1170mm) but with high variability (Rao 2008),the bulk of which (70%) is received during the South West Monsoon (June-September).The state also get rains from the North East Monsoon during October to December. However spatial and temporal distribution pattern is mainly responsible for the frequent floods and drought in Kerala. Even though the state does not suffer from too wide inter annual variation in the rainfall (Jacob 1996). But, the large deviationhasoccurred in the monthly rainfall and rainfall across the region, which make irrigation is a necessity for the stabilization of the water requirement of the crops (Kannan 1989).The average annual rainfall in the low land of Kerala ranges from 900mm in south to 3500mm in the north. In the mid land annual rainfall ranges from 1400mm in the South to about 6000mm in north. In the high land annual rainfall varies from 2500mm in the south to about 6000mm in the north (Ministry of environment and forest,2015).

As regards the pattern of water resources of Palakkad district, comprises of rivers, streams and ponds. About 75.56 percent of the area in the district is falls within Bharathapuzha basin and the remaining 13.33 percent, 8.89 percent and 2.22 percent falls in Bhavani, Chalakkudy and Kadalundy river basin. The total water potential available of Palakkad district is 6602 MCM and utilizable surface flow in the district as per CWRDM report is 1579 MCM(CWRDM-1999).The gross irrigation demand for the district is 1146 mm^3 in which 981 mm^3 is from surface water and 165 mm^3 from ground water sources. The study indicate that the water balance analysis was done for the current scenario and future demand for agriculture, domestic and industrial demand purposes will be 3841 mm^3. However the secondary data showed that utilizable water resources of Palakkad district is less and will create a deficit scenario, when compared to the available water resources (Surendran et.al 2012).Now the study attempts to illustrate the development of irrigation potential created and utilized in Kerala and in Chittur.

2. Study Area

The present study has been conducted inChitturtaluk of humid tropical region of Kerala. The taluk is located in the South Eastern part of Palakkad district between $10^0$35’ North to $10^0$45’ North latitudes and $76^0$40’ East to 76^0 52’ East longitudecovering an area of about 1136.23 km^2(Fig.1).Almost the entire area falls under rural category and only 1.3 percent area is fall under urban. The agriculture is the main economic stay and about 45 percent of the people are engaged in this activity. Paddy is the major land use category of Chitturtaluk and it has helped the district of Palakkad to earn the name “Granary of Kerala”. Area of Chitturtaluk is 113623 hectares of paddy land in 1971 occupied 28933.74 hectare which is 25.46 percent but in 2015 the paddy land occupied 14101.35 hectares that is 12.41 percent. It indicates that nearly half of the area has reduced .Still this regionalone contributed to more than two third of the Palakkad’s total paddy production(54.58 percent) according Economics and Statistic Department of Palakkad district 2015-16. Cropping seasonsare mainly paddy based; the three seasons are defined by the paddy- paddy- fallow system. In this area, drought is a major factor limiting paddy production in the Kharif season(May-September). Especially drought is also experienced during the end of the

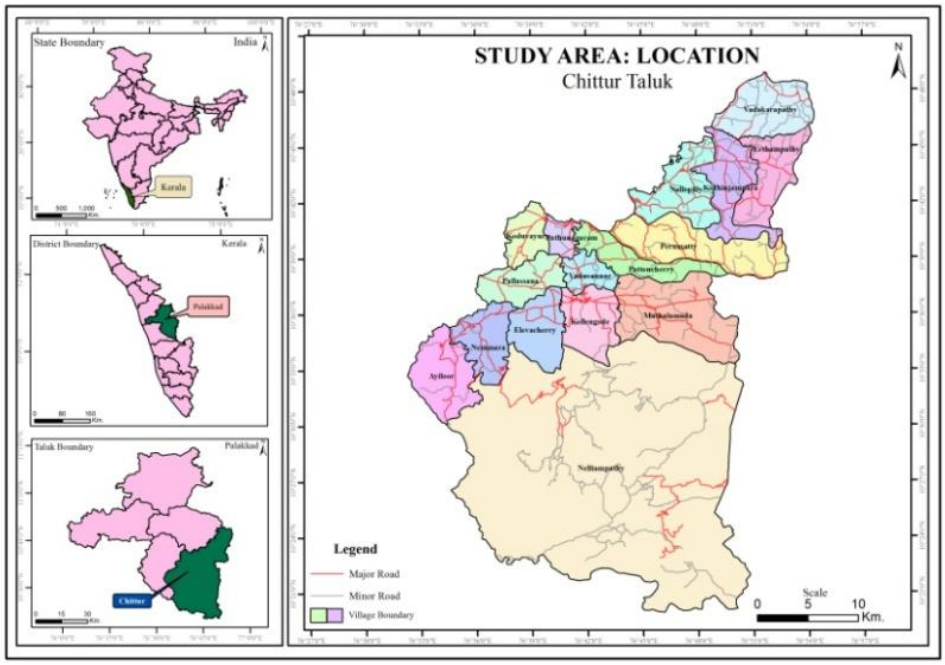

Fig: 1 Study Area Map

Rabi season (October – January)especially in Eastern Palakkad that is in Chitturtaluk because the climate is similar to rain shadow region of Tamil Nadu. Here, majority of the area is under irrigation and water shortage experience in both the season. That is why the study focused on the irrigation water availability and actual irrigation water requirement of paddy in the taluk and then examine role of irrigation potential in the taluk.

In Kerala the required amount of water per tonne of rice produced both in kharif and rabi crop is 2438.74 m^3(KokilaJayaraman 2016). In this context of Palakkad district of Kerala as many as 120 days (4 months) of paddy variety has required mean per day water demand of 8,400 litres per hectare and the total quantity of water required for the entire season is 10.8 lakh litres per hectares for their normal growth. Any change in the availability of the calculated quantity of water affect the growth and production of paddy (Richard Scaria 2016). The following table.1gives the total water requirement paddy crop cultivated in Chitturtaluk.

Table: 1

Total water requirements of Paddy in agro ecological units of Chitturtaluk

Sl.No.	Seasonal crops	Crop	Total water requirement of paddy in mm (AEU)					
			AEU 14	Per Hectare requirement of water in m^3	AEU 22	Per Hectare requirement of water in m^3	AEU 23	Per Hectare requirement of water in m^3
1	Paddy	Virrippu	1397	13970	1489	14890	1612	16120
2		Mundakan	1418	14180	1501	15010	1603	16030
3		Puncha	1353	13530	1447	14470	1517	15170

Source: CWRDM 2015 (Centre for Water resource Development and management-Water management division, Agriculture)

Here, majority of the area is under irrigation and water shortage experience in both the season. That is why the study focused on the irrigation water availability and actual irrigation water requirement of paddy in the taluk and then examine role of irrigation potential in the taluk.

2.1 Cropping season in the Chitturtaluk

Cropping season in the taluk are based on hydrological year (June-May).It is divided into three seasons as Kharif(Virippu), Rabi (Mundakan) and Summer (Puncha).But in the Chittur only two season have been taken for paddy cultivation viz.,Kharif(Vrippu) and Rabi(Mundakan).In this area, drought is the major limiting factor for paddy cultivation in summer season (Puncha).The table.2 which explain the duration of crop growing and planning season.

Table: 2

Cropping season in the Chitturtaluk

Sl.No	Cropping Season	Duration	Planting season(irrigated crop)
1	Virippu	85-110	April-May to Sep-Oct
2	Mundakan	110-125	Sep- Oct to Dec- Jan
3	Puncha	85-110	Dec- Jan to March – April

3. Objective

1. To understand the spatial variations of paddy cultivation in the study area
2. To examine the irrigation water potential for paddy cultivation in the study area.

4. Methodology

The study is based on the primary and secondary data sources. The irrigated area of different sources like canal, wells, tube wells, ponds and tanks in the panchayath of Chitturtaluk is drawn from Amenities and land use of district in the census hand book of Palakkad (District Census Handbook, 2011).The irrigation water supply through different irrigation project is gathered from Department of irrigation Division in Chitturtaluk, Palakkad district for the year 2015. To generate area under paddy field in 2015, landsat-8 Operational Land Imagery has been downloaded from www.earthexplorer.com. Then Maximum likelihood classification algorithm has been adopted to generate paddy area. Gross cropped area of the taluk was collected from Agricultural Statistics, Department of economics and Statistics, Palakkad. The secondary data on water requirement of paddy collected from Centre for Water resource Development and management-Water management division, Agriculture (CWRDM). These collected data have analyzed with the help of proper statistical techniques and tools like

1. **Crop Water requirement in Volume:**

$$= (\text{Totalwaterrequirementofcropinm3})X(\text{irrigatedarea in m3})$$

2. **Per hectare irrigation water availability :**

$$= (\text{Totalwatersupplyunderirrgationprojectinm3}) / (\text{TotalAreaunderirrigationprojectinhectare})$$

3. **Irrigation water Deficiency of a crops**

$$= \text{Irrigationwaterappliedperunitareaofithcrop} - \text{requiredwaterperunitareaunderithcrop}$$

The agro ecological zones and units of Chitturtaluk delineated by National Bureau of Soil Survey and Land use planning (NBSS&LUP) based on slope, rainfall, soil depth, length of growing period etc was used for the present study. These units formed the basis for the computation of agricultural water demand. Since, each zone has a similar combination of constraints and potential for land use and serves as a focus for the targeting recommendations. The taluk has been classified into three agro ecological zones and three agro ecological units. (Nair et.al, 2012) as given in table.3.

Table: 3

Agro Ecological Zones of ChitturTaluk

Sl.No	Agro ecological zones (AEZ)	Agro ecological units (AGU)	Name of panchayath in each (AEU)	Average rainfall in mm	Temperature 0 C	
					Maximum	Minimum
1	AEZ-4 High hills	AEU-14 Southern high hills	Nelliyampathy	2500-3500	29.1(April)	16.4 (Dec)
2	AEZ-5	AEU-22 Palakkad	Koduvayur, Pudunagaram,	2000-2500	36.9 (March)	21.9(Jan)

	Palakkad plains	Central plains	Vadavannur, Pallassena, Elevancherry, Kollengode, Nemmara, Ayiloor and Municipality			
		AEU- 23 Palakkad Eastern plain	Eruthempathy, Kozhinjapara, VadakarapathyNallepilly, Perumatty, Pattencherry and Muthalamada	1500-2000	37.7(Mar-April)	20.3(Jan)

Source: National Bureau of Soil Survey and Land use planning (NBSS&LUP),(Nair et.al, 2012)

5 Results and Discussion

5.1 Source wise Irrigated area in the panchayaths of Chitturtaluk

As regard the pattern of irrigation sources it is noticeable from the table.4 that in Chitturtaluk has three major sources of irrigation as canal, well and tank. In addition to these three irrigation sources some areas particularly the high land are irrigated directly from the streams or from waterfalls and from lift irrigation under minor irrigation scheme. Out of 26382 hectares of net irrigated areas, 175472.2 hectares (66.51%) of area is irrigated using water from canal. The irrigation from canal is mainly intended for paddy crop. However, the area with a gross irrigation facility still hovers around 17.89 percent whereas in Palakkad it is found to be 36.63 percent. In the study region it is about 41.30 percent. About 6228.1 (23.61%) hectares of land is irrigated through wells and tube wells. These wells are maintained and operated by the individual farmers. But the electricity is free of cost for the large, medium and small farmers as it run for the agriculture purposes. Through lift irrigation under minor irrigation scheme accounts 1974.6 hectares (7.48%) of land are irrigated.Only 632.1 hectares (2.4%) of water irrigated from the ponds. As regards the pattern of irrigation from different sources, it is found from the table that the irrigation through canals has taken as a dominant place compared to other sources especially in Chitturtaluk and also in Palakkad district. But in Kerala the canal irrigation accounts only 20.98percent.

A glance in the table 4portraying the source wise net area irrigated of panchayathsin Chitturtaluk, reveals that there exists a wide spread panchayath wise disparity with regards to the contribution of different sources to the net area irrigated. The panchayath wise breakup obviously reveals that thehighest area under canal irrigation have noticed in Elevancherry, Pudunagaram and Vadavannurwith cent percent ofarea irrigated by canal itself. Next comes Pattencherry, Ayiloor and Koduvayurpanchayaths have canal irrigation in between 99 percent and 94 percent of their farm land. Pallassena, Nemmara and Kollengode show more than 82 percentages of their land under canal irrigation. Where us the medium level of irrigation is noticed in Nallepilly and Muthalamadapanchayaths around 77 percent. Kozhinjapara and Perumatty have canal irrigated at 58.78 percentages and 50.90 percentages respectively. The

lowest area under canal irrigation has found in Eruthempathy (23 percent) and in Vadakarpathypanchayathhas(4.7 percent).

Wells and tube wells are the second important sources of irrigation. Well irrigation includes both open well and bore well. In Vadakarapathy panchayath shows more than 94 percentages of its irrigation through wells. Next adjacent panchayath Eruthempathy has the second largest percentages of well irrigation(77 percentages). Perumattypanchayath is the third important well irrigated panchayath where, 42 percentages is under well irrigation. In Kozhinjapara wells contribute about 34 percentages of its irrigation. Muthalamada and Nallepillypanchayath also have some area under well irrigation about 16.64 percentages and 13.83 percentages. The share of well irrigation is very small or absent in other panchayath. Though tanks are the third important source of irrigation its share varies from 1 to 9 percentages. The highest percentage is seen in Nallepillypanchayath (12.8 percent). The other sources of irrigation includes direct from streams and or from waterfalls. Nelliyampathypanchayath has its entire agricultural area irrigated through tanks and minor streams. A few panchayath also have some share of their agricultural land irrigated from other sources mainly through lift irrigation. It is to be mentioned in the table.3 that the areas where tube wells and wells are large in number are the areas with least canal irrigation distribution. The given fig.2explains about the sources of irrigation and its panchayat wise distribution.

Table: 4

Source wise net irrigated area in the panchayath of Chitturtaluk

	Canal		Well/ Tube well		Tanks/Lakes		Others-Waterfall		
Panchayath	Area in Hectare	Percent	Area in Hectare	Percent	Area in Hectare	Percent	Area in Hectare	Percent	Total Area
Eruthempathy	317.7	21.59	1153.4	78.38	0.4	0.03	0	0	1471.5
Kozhinjampara	1251	72.86	336	19.57	130	7.57		0	1717
Nallepilly	1176	77.38	194.8	12.82	149	9.8		0	1519.8
Pattencherry	1771	98.62	0.7	0.04	24	1.34		0	1795.7
Perumatty	2345	62.56	1075.4	28.69	62	1.65	266	7.1	3748.4
vadakarapathy	144.5	4.29	2983	88.66	37	1.1	200	5.94	3364.5
Elavancherry	710.4	100		0		0		0	710.4
Ayiloor	1540.6	95.05	17.5	1.08	10.1	0.62	52.7	3.25	1620.9
Nemmara	1431	88.79	12.4	0.77	24.7	1.53	143.5	8.9	1611.6
Pallassena	1242	89.35	38.5	2.77	85	6.12	24.5	1.76	1390
Nalliampathy	0	0		0		0	1152	100	1152
Koduvayur	725	100		0		0		0	725
Kollengode	1379.5	82.69	98.9	5.93	73.9	4.43	115.9	6.95	1668.2
Muthalamada	1461.5	79.65	317.5	17.3	36	1.96	20	1.09	1835
Puthunagaram	495	100		0		0		0	495
Vadavannur	1059	100		0		0		0	1059

Municipality	498	100		0		0		0	498
Chitturtaluk	17547.2	66.51	6228.1	23.61	632.1	2.4	1974.6	7.48	26382

Source: Land use and Amenities of Palakkad district census 2011

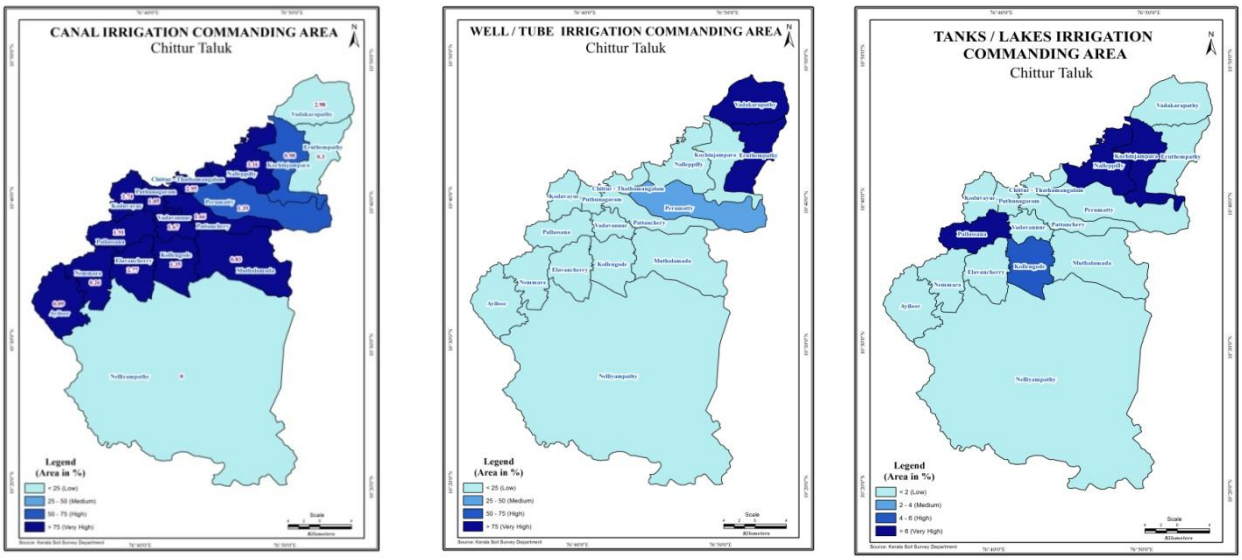

Fig: 2 Irrigation sources and Commanding area

5.2Irrigation water availability for paddy cultivation in Chitturtaluk

Paddy crop is a natural habitat of wetland ecosystem and thrives under well drained high rainfall conditions. As monsoon rains area inherently uncertain, erratic, and variable by nature, this need to be supplemented by assured irrigation during dry spells, this need to be supplemented by assured irrigation during dry spells, monsoon breaks or deficient rainy seasons. Since the advent of green revolution and introduction of high yielding paddy varieties, the cultivation of rice has necessities the irrigation requirements. In the taluk paddy is mainly grown in two season in a year that is Virippu (May to September) and Mundakan (October –January).Irrigation through canal is prominently for Mundakan crop which is being considered as the second crop, Where as the first crop is followed by rainfed. That means it is persistent upon the emolument of rain. By which canal irrigation is reachable for the requisite from the farmers. That indicates it is based on the demand of needy. Panchayat wise irrigation gap in Virippu as well as Mundakan-Virippu Season has been illustrated in Fig.3.

Table: 5

Irrigation water availability of paddy among the panchayaths of Chitturtaluk

Sl.No.	Panchayath	Net cropped area in Hectare	Gross cropped area in Hectare	Required water in Virippu in mm^3	Required Water in Mundakanmm^3	Total water requirement in two season mm^3	Irrigation water availability in mm^3(Irrigation projects)	Irrigation gap in Mundakan season mm^3	Irrigation gap in Virippu&Mundakan season mm^3
1	Eruthempathy	68.32	136.64	1.10	1.10	2.20	1.53	0.43	-0.67
2	Kozhinjampara	511.23	1022.46	8.24	8.20	16.44	6.02	-2.22	-10.41
3	Nallepilly	1931.68	3863.36	31.14	30.96	62.10	5.66	-25.48	-56.44
4	Pattencherry	1354.43	2708.86	21.83	21.71	43.54	8.53	-13.31	-35.02
5	Perumatty	1657.33	3314.66	26.72	26.57	53.28	11.29	-15.43	-41.99
6	vadakarapathy	374.74	749.48	6.04	6.01	12.05	0.67	-5.38	-11.38
7	Elavancherry	992.94	1985.88	14.78	14.90	29.69	4.01	-10.78	-25.68
8	Ayiloor	491.94	491.94	7.32	7.38	14.71	16.39	9.07	1.68
9	Nemmara	534.9	1069.8	7.96	8.03	15.99	15.23	7.26	-0.77
10	Pallassena	1323.77	2647.54	19.71	19.87	39.58	5.98	-13.73	-33.60
11	Nalliampathy	15.45	30.9	0.22	0.23	0.45	0.00	-0.22	-0.45
12	Koduvayur	1105.28	2210.56	16.46	16.59	33.05	3.49	-12.97	-29.56
13	Kollengode	1064.76	2129.52	15.85	15.98	31.84	7.78	-8.08	-24.06
14	Muthalamada	849.68	1699.36	13.70	13.62	27.32	8.24	-5.46	-19.08
15	Puthunagaram	300.4	600.8	4.47	4.51	8.98	2.38	-2.09	-6.60
16	Vadavannur	817.4	1634.8	12.17	12.27	24.44	5.10	-7.07	-19.34
17	Municipality	707.1	1414.2	10.53	10.61	21.14	2.40	-8.13	-18.74
18	**Chitturtaluk**	14101.35	27710.76	218.25	218.54	436.80	116.94	-101.32	-319.86

Source: CGWB (2013)

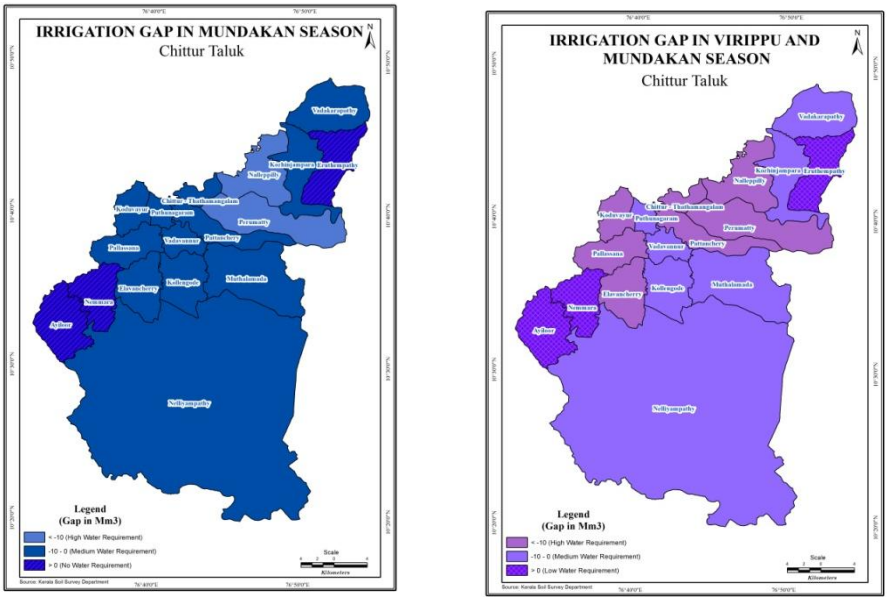

Fig: 3 Irrigation Gap in Mundakanseason and Mundakan and Virippu Season

There are hardly five or six times the canal irrigation water is distributed in Mundakan season. For the timely enhancement of paddy cultivation, the distribution of water is executed on the growing needs in each stage. Firstly for the field preparation, followed by sowing, then germination next is in the application of fertilizers and finally the water distributed when it becomes maturing stage. That is so productivity and production from the paddy cultivation enables prime manner which is being received on the precise measure of water. At the season of virippu adequate amount of rainfall, at the attainment of canal water, paddy cultivation earn good profit making crop than the rest of the crops harvests due to its assured price in the market.

Analysis of irrigation water availability and water requirement for paddy in various panchayath(table.5) indicates the severe deficit of water both in Virippu and Mundakan seasons. In Mundakan season Very high deficit of water exists in the paddy dominant panchayaths of the taluk such as Nallepilly (-25.48 mm^3), Perumatty (-15.43mm^3), Pallassena (-13.73), Pattencherry (-13.31mm^3), Koduvayur (-12.97mm^3) and Elevancherry (-10.78mm^3). If this statistics were taken for both the seasons of Virippu and Mundakan, the deficit of water will be doubled. Least deficit exists in Eruthempathy(-0.67mm^3) and Nemmara (-0.77$mm^{3)}$ and Nelliyampathy (-0.45mm^3). On the other hand surplus of canal irrigation water has been found in Ayiloor (1.68 mm^3), this is due to the fact that area under paddy cultivation is comparatively lesser than the area under canal irrigation. It should be clearly noticed that the current irrigation scenario is not yet fulfilled the irrigation water demand of paddy in the least paddy producing panchayaths. Especially in the Eruthempathy which was once leading paddy producing panchayath in Chitturtaluk.

6. Conclusion

Canal irrigation has been the most popular methods of irrigation practiced in the agricultural field of Chitturtaluk. But the efficiency level is 20 percent and has high transmission losses. Canal is the single main source, through which the water is being delivered to the farm lands by the way of flood irrigation method. From the main canal water is accessed through the outlet then from the branch canal to the sprout and from the sprout to the field reaches through sluice. Definitely flood irrigation results water leakage and also the exact quantity of water does not reach to the needy places. Thus, it can be obviously revealed that except North Eastern part of panchayaths of vadakarapathy and Eruthempathy, all the other panchayaths canal irrigation have played a dominant role.In the North-eastern area, predominant irrigation sources are tube wells and bore wells leading to declining water table and how far this method can sustain ecology is a pertinent question that need to be addressed.

Onthe other hand lack of location specific scientific information on irrigation scheduling for different crops are also being highlighted by the study. It is being observed that, the present irrigation practices of the state are of general nature and does not account for all the soil types and climate in different agro-ecological zones. Irrigation water charges are based practically in all state on the basis of area and type of crop and has no reference to the volume water used. Irrigation charges are based practically on available surface water especially canal irrigation

water which is insufficient to meet the total irrigation need. This indicates that the cultivation of crops has been adopted through exploitation of ground water. Proper irrigation scheduling can help to eliminate or reduce instances where too little or too much water is applied to crop. Therefore the study indicates towards a need for an irrigation schedule for various crops which is location specific, considering the soil types and agro ecological conditions and scientific crop water requirements. It can increase the area under irrigation, production and yield of crops. Thus, it would helps to achieve a domestic as well as global food security in a sustainable manner.

The study concludes that the supply of irrigation water does not enough for the single crop season in the entire region. The deficiency water could notice proportionate with the area under paddy. That is higher the area higher the water deficiency and vice versa. In this context irrigated water management has emerged as a prominent role to achieve increased paddy production and productivity. Through regular and proportionate distribution water according to the type of crop. Thereforescientific crop water requirement are required for efficient irrigation scheduling. Thereby increasing area under irrigation, augmenting and efficiently using the available irrigation water shall helps to substantially improve the production of crops. Thus, it would helps for achieving a domestic as well as global food security in a sustainable manner.

7. References

1. *Angus.J.F(1991),'The evolution of methods for quantifying risk in water limited environments', In: Muchow RC, Bellamy JA(eds), Climatic risk in crop production; Models and Management for the semi arid tropics and Subtropics.CAB International Wallingford, pp 39.53.*
2. *CGWB (2013), Ground water information booklet of Palakkad district- Kerala State. Report of the Central Ground water board, New Delhi, India.*
3. *Chapagain. A.K & A.Y. Hoekstra (2010), 'The green, blue and grey water foot print of rice from both a production and consumption perspective', Value of water research report series No.40, UNESCO-IHE-Institute for Water Education, pp 1-30.*
4. *CWRDM (1999), Water resource information for all the river basin in Kerala, Report of the Centre for Water resource development and Management, Kozhikode, India.*
5. *District census hand book of Palakkad district (2011),Amenities and Land use of Palakkad district, Directorate of Census Operations, Kerala. www.census.org.in*
6. *Jacob.J(1996), ' Institutional Interventions in Water Management: A micro level study of organization of Irrigation in Kerala', Trivandrum, centre for development studies.*
7. *Joseph.C.J(2001), 'Beneficiary Participation in irrigation water management- The Kerala Experience', Discussion paper No.36,Kerala research programme on local Development, Centre for development studies, Trivandrum, pp 1-30.*
8. *Kannan.K.A(1989),'Agricultural Stagnation and Irrigation in Kerala', Economic and political weekly. Vol.24 (19).*

9. *KokilaJayaram(2016), 'A water foot prints Analysis for Agriculture in India, Division of Agricultural Economics, ICAR- Indian Agricultural Research Institute, New Delhi, pp. 1-99.*
10. *Lathika(2010),'Water management for irrigation in Kerala', Economic & Political weekly. Vol.45930), pp.73-80.*
11. *Nair, K.M., Anil Kumar, K.S.,Naidu, L.K.G., Dipak Sarkar &Rajasekharan, P (2012), Agro ecology of Palakkad district, Kerala, NBSS Publ. No. 1038, National Bureau of Soil Survey and Land use planning, Nagpur, India, pp. 146.*
12. *Rao G.S.L.H.V.P (2008),'Agricultural Meteorology' Prentice Hall of India, private limited, New Delhi, pp. 364.*
13. *Richard Scaria (2016), 'Ecological and Economic implication of change in paddy cultivation, Department of Geography, Kannur University.*
14. *Surendran. U.,Sushanth. C.M., George Mammen, and joseph.E.J (2015), 'Modeling the crop water requirement using FAO- CROPWAT and assessment of water resources for sustainable water resource management: A case study in Palakkad district of humid tropical Kerala, India, Elsevier- Aquatic Procidia 4(2015), pp. 1211-1219.*
15. *WWDP (2012),'Managing water under Uncertainty and Risk: The United Nations World water development Report-4, Volume.1, World water Assessment Programme (WWAP), Paris, France.*