Drought - Situation Assessment Report, 2017

(1st June 2016 – 31st March, 2017)

Towards a Safer State…

Kerala State Drought Monitoring Cell
[*inter alia* State Emergency Operations Centre]
Kerala State Disaster Management Authority
Department of Revenue and Disaster Management
Government of Kerala
2nd Floor, ILDM, PTP Nagar
Thiruvananthapuram. Pin – 695038
Email: seoc.gok@gmail.com; Tel/Fax: +91 (0) 471 - 2364424
Web: www.disasterlesskerala.org

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1. INTRODUCTION

Indian Meteorological Department declared the onset of monsoon of 2016 on 5th June. IMD in its first stage forecast of the South-West monsoon issued on 12th April, 2016 predicted 30% probability of the monsoon rainfall to be normal (96 - 104% of long period average). In its press release dated 2nd June, 2016 IMD has reported that rainfall over the country as a whole is most likely to be above normal (>104% to110% of long period average).

The contribution of South West monsoon to the annual rainfall of the state is about 69% and that of North East monsoon is 16%. The South West monsoon rainfall as percentage of annual rainfall decreases from North (87%) to South (54%), whereas Northeast Monsoon rainfall increases from North (10%) to South (17%).

Figure 1 shows the Actual vs Normal monsoon rainfall for various seasons received by Kerala from 2005 to 2016. It is evident from the figure that it was during the 2016 monsoon season that Kerala received the lowest actual rainfall in the last 11 years. For a state like Kerala, which depend heavily on rainfall and subsequently on surface water storage for meeting its drinking water, agricultural and electricity production, this deficit is alarming and has resulted in a rare drought event in the State that requires assistance from Government of India for effective management.

1.1. DROUGHT IN KERALA

The State Disaster Management Plan 2016 contains a detailed assessment of the drought proneness of Kerala State. The Plan also provides the centralized actions initiated by Kerala State Disaster Management Authority and District Disaster Management Authorities for drought risk reduction.

Kerala state experiences three distinct seasons they being, the South West Monsoon (June-September), the North East Monsoon (October-December) and the Pre Monsoon (January-May). The Pre-Monsoon season is generally dry and receives only scanty rainfall. The South West Monsoon is the major rainfall contributor to the state, providing on an average 43% of the annual

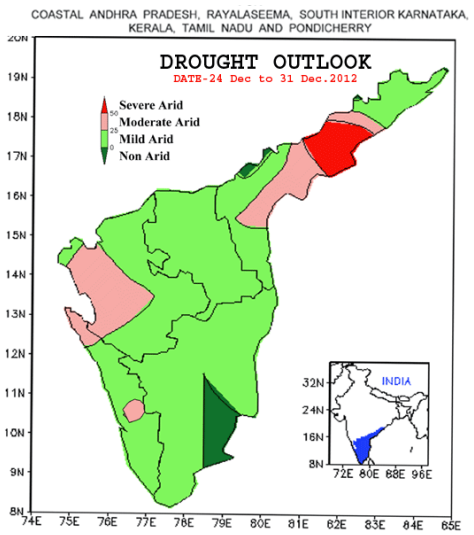
rainfall in southern districts and 83% of annual rainfall in the northern districts. The North East provides about 33% of the annual rainfall in southern districts and 9% of annual rainfall in the northern districts. The reliability of the expected rainfall in the South West Monsoon is about 96% while that of North East Monsoon is only about 40%. The hydrological year in the state begins on 1st June and ends on 31st May which is based on the long period average date of onset of South West Monsoon.

The State of Kerala experiences seasonal drought like conditions every year during the summer months. Even in the years of normal rainfall, summer water scarcity problems exist in the midland and highland regions. Drought is mainly reflected in the non-perennial rivers and lowering of ground water table. This adversely affects the rural and urban drinking water supply.

It is noticed that aridity index of different parts of the state has increased which is an indication of increase in the frequency of drought years. The changes in the land and water management practices affected the fresh water availability during summer months. Although the deviation in the annual rainfall received in Kerala, in any year from the long term average is relatively small, there is considerable variation in the rainfall availability during the different seasons.

About 95% of annual rainfall is confined to a six-month monsoon period between June and November, leaving the remaining six months as practically dry. The trend analysis on rainfall data over the last 100 years reveals that there is significant (99%) decreasing trend in most of the regions of Kerala especially in the month of January, July and November. Figure 2 shows the drought susceptibility of Kerala. Drought classification was done based on the criteria followed by Indian Meteorological Department (IMD) for meteorological drought classification. Standardized precipitation index, ground water deviation from 5 year mean, MODIS-NDVI and presence of perennial water sources in a given village was considered in a heuristic model for the preparation of the map.

The map indicates that in a given season, if the rainfall deficit is:



- >10%, the area demarcated as severe drought will start experiencing drinking water shortage
- >26%, the area demarcated as moderate drought will start experiencing drinking water shortage
- >50%, the area demarcated as slight drought areas will start experiencing drinking water shortage

In the recent past, until 2012, the state had not experienced severe meteorological, agricultural and hydrological drought. A 29% deficit in the monsoon season (June to December) in 2012 lead to agricultural and hydrological drought which peaked during the period August 2012 to May 2013. For the first time, Kerala was mapped as mild to moderately arid by Indian Meteorological Department in December 2012. Prior to this, official declaration of drought had happened in March 2010 and December 2003. In 2010, 17 taluks of the state were declared as drought affected while in 2003, 7 districts, 7 taluks and 119 villages were declared as drought hit. Table below shows the number villages that are prone to drought, in the State with and without perennial waterbodies. The villages without perennial water bodies should be given first priority when undertaking drought risk reduction and response measures.

TABLE 1: NUMBER OF VILLAGES WITH AND WITHOUT PERENNIAL WATER BODIES IN KERALA

District	Number of villages without WB			Number of villages with WB		
	Severe	Moderate	Drought	Severe	Moderate	Drought
Kasargod	0	21	0	0	64	0
Kannur	0	32	0	0	97	0
Kozhikode	0	24	3	0	86	4
Wayanad	19	1	0	13	16	0
Malappuram	0	49	0	4	82	0
Palakkad	0	42	0	14	101	0
Thrissur	0	77	7	1	161	8
Ernakulam	0	32	0	16	77	0
Alappuzha	11	3	0	64	13	0
Kottayam	10	22	0	25	37	0
Idukki	10	5	0	38	11	0
Pathanamthitta	19	1	0	47	1	0

Kollam	34	0	0	69	0	0
Thiruvananthapuram	39	4	0	59	11	0
Total	142	313	10	350	757	12
WB: Water Bodies						

Based on the analysis, it is evident that more than 50% of the land area of the state is susceptible to drought.

Drought in Kerala principally manifests as drinking water shortage. Water usage characteristics of Kerala (~450-500 litres/head), and the fact that the state's economy including majority of the electricity production is significantly depended on the South West Monsoon rainfall increases the vulnerability of the State to drought, particularly hydrological drought.

Susceptible area as % area of the state's total area	• Severe drought: 2.5% • Moderate drought: 63.8% • Slight drought: 23% • No drought: 10.7%
Major drought in the last 20 years	Drought 2012-13; The State Government had to officially declare drought in all 14 districts. An amount of ₹132.3 crs was expended by the state during the period from 2012 to 2014 for tackling the consequences of this drought directly from the National/State Disaster Response Fund. Indirect costs of the drought spell still remain unaccounted.

1.2 Time line of activities undertaken by the State Government

1.2.1 Situation assessment as on 15th October 2016

IMD reported that the South West Monsoon failed by 34%. The State Drought Monitoring Cell of the Kerala State Disaster Management Authority (KSDMA) analysed the daily rainfall data collected by IMD through the Integrated Agricultural Data Platform (IADP) from 79 rain gauges across Kerala.

It was reported by the Drought Monitoring Cell in the beginning of October that majority of the State had a deficit of rainfall. Based on interpolated rainfall, 86 villages experienced large deficiency in rainfall (>60% deficit), 1185 villages experienced deficiency in rainfall (20 to 59% deficit) and 314 villages received normal rainfall (<20% deficit) IMD criteria during the South West Monsoon season. The Cell also evaluated the trends of Normalised Vegetation Index, reservoir levels in comparison to normal, Ground Water Departure from normal and prediction of Indian

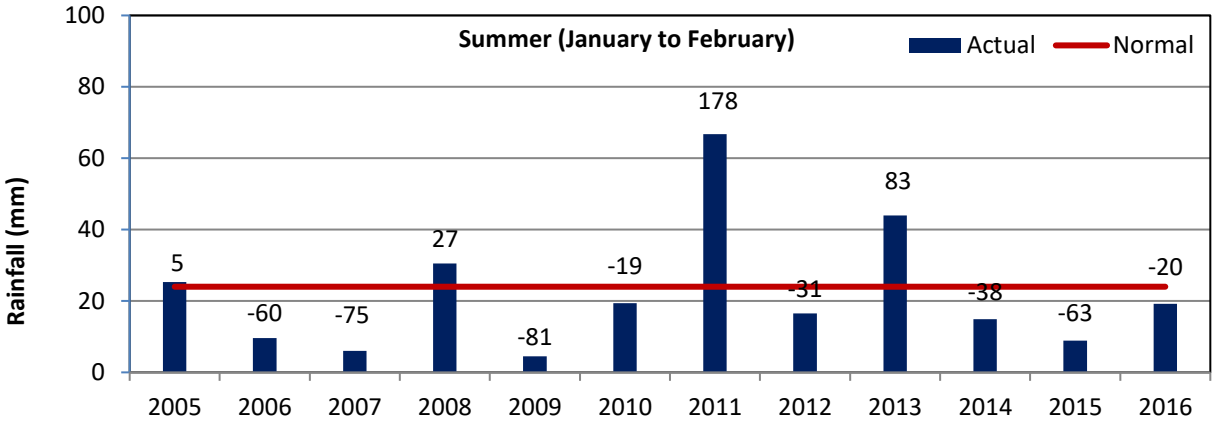
Meteorological Department based on Numerical Weather Prediction for the following 15 days. The predictions by IMD for the remaining period of the North East Monsoon also did not show any respite. The Cell also recommended that KSDMA may be convened to evaluate the drought situation and to issue specific guidelines for drought risk reduction.

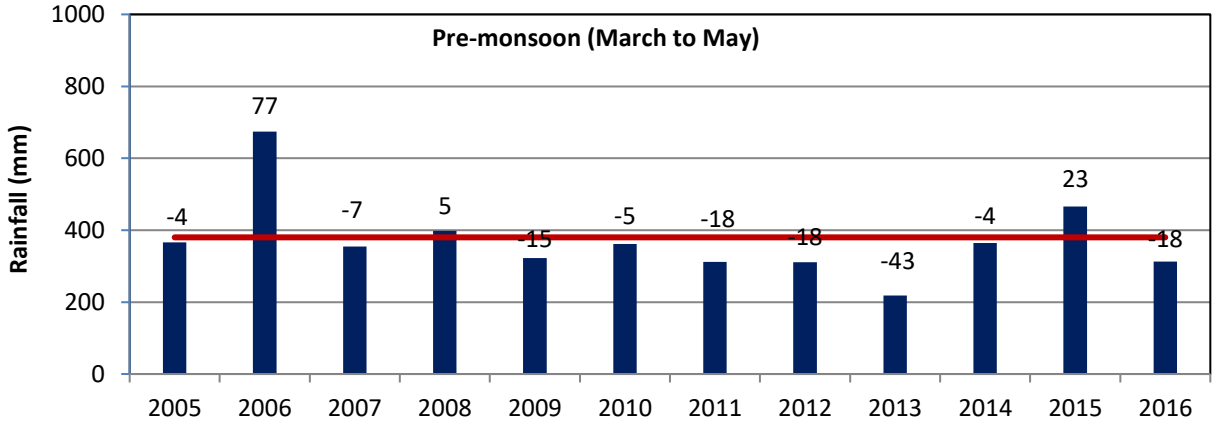
- **13th October 2016** – Hon'ble Chief Minister held a review of impending drought situation with all major stakeholder departments and issued specific risk reduction directives

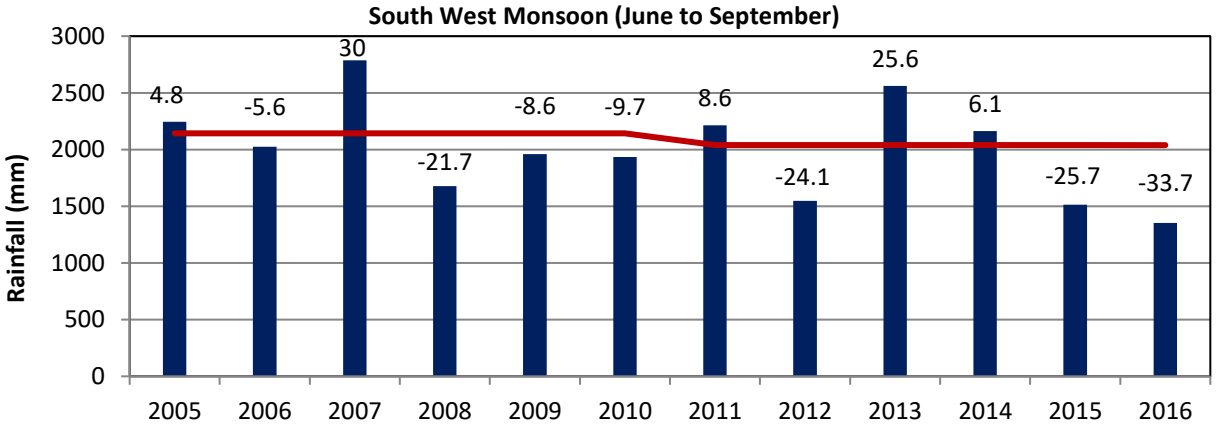
1.2.2 MEETING OF KSDMA ON 28TH OCTOBER 2016

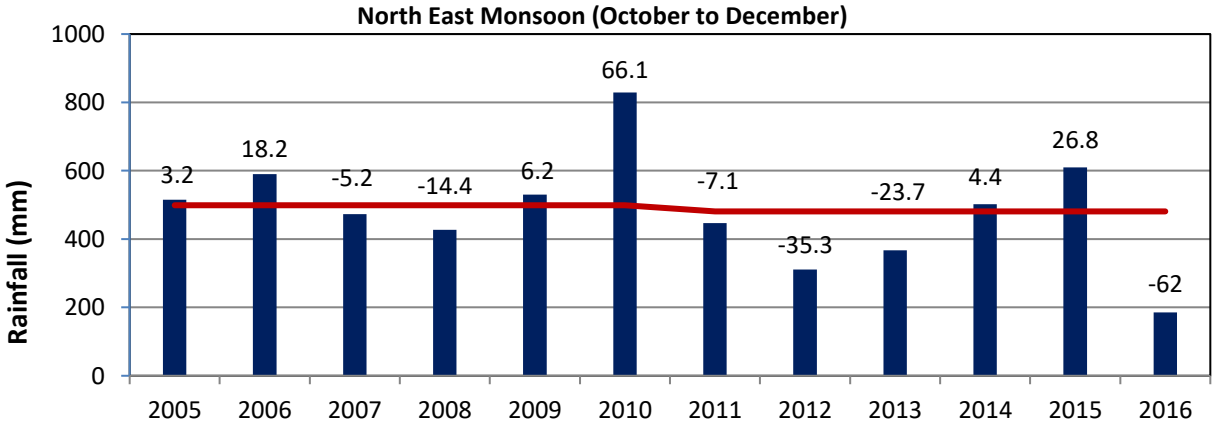
The KSDMA under the Chairmanship of Hon'ble Chief Minister met on 28th October and observed that if this trend continues the State would be heading towards severe drought. Based on available statistics pertaining to rainfall, reservoir levels trends, ground water level trends and Normalised Difference Vegetation Index (NDVI) trends, the Authority resolved to recommend to the State Relief Commissioner to declare all districts of the state as drought affected, invoking various provisions of the Disaster Management Act, 2005. The Authority also approved a 26 point drought risk reduction guidelines for implementation by District Administrations and various departments for management of drought (Annexure 1).

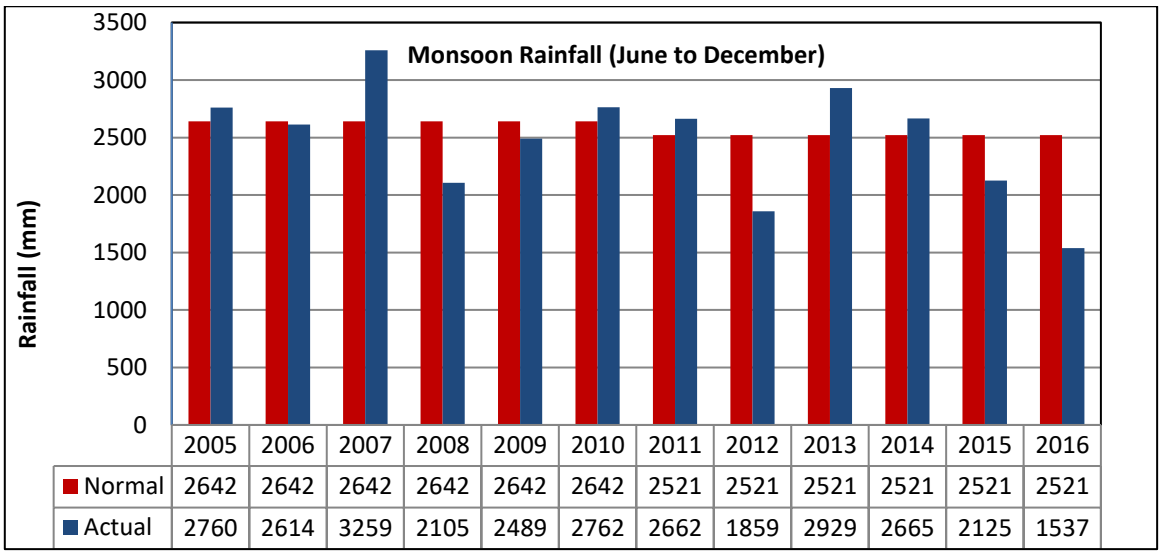
It was also decided by KSDMA that the state will initiate the drought risk reduction measures with the available balance in the State Disaster Response Fund and after evaluating the financial position and the severity of the progress of drought in January, the Government of India will be approached with a memorandum for additional financial assistance from the National Disaster Response Fund.


Summer (January to February)
Actual
Normal
Rainfall (mm)
100
80
60
40
20
0
5
-60
-75
27
-81
-19
178
-31
83
-38
-63
-20
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016


Pre-monsoon (March to May)
Rainfall (mm)
1000
800
600
400
200
0
-4
77
-7
5
-15
-5
-18
-18
-43
-4
23
-18
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016


South West Monsoon (June to September)
Rainfall (mm)
3000
2500
2000
1500
1000
500
0
4.8
-5.6
30
-21.7
-8.6
-9.7
8.6
-24.1
25.6
6.1
-25.7
-33.7
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016


North East Monsoon (October to December)
Rainfall (mm)
1000
800
600
400
200
0
3.2
18.2
-5.2
-14.4
6.2
66.1
-7.1
-35.3
-23.7
4.4
26.8
-62
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Normal	2642	2642	2642	2642	2642	2642	2521	2521	2521	2521	2521	2521
Actual	2760	2614	3259	2105	2489	2762	2662	1859	2929	2665	2125	1537

FIGURE 1: RAINFALL OF VARIOUS SEASONS OF KERALA – ACTUAL VS NORMAL (SOURCE: IMD)

- Accordingly vide GO (P) No. 555/2016/DMD dated 31/10/2016, the Government of Kerala declared all districts of the state as drought affected
- The guidelines approved by KSDMA were issued as Circular No. 42830/K3/2016/DMD dated 31-10-2016.
- Kerala Government also declared moratorium for all revenue recovery of agricultural loans for a period of 1 year vide GO (Ms) No. 598/16/Rev dated 19-12-2016.
- The Government further updated the guidelines vide Circular No. 45726/K3/2016/DMD dated 17-02-2017 after assessment of the prevailing situation
  - The measures undertaken by the Government of Kerala for drought risk reduction was also intimated to the plaintiff of WP(c) No. 857/2015 - Swaraj Abhiyan Vs Union of India and Others based on the directions received from National Disaster Management Authority.
- Hon'ble Ministers were given charge of each district and the District Collectors were directed to convene an extended meeting of the District Disaster Management Authorities in the chairpersonship of the Minister in-charge of the district to discuss the various drought risk reduction measures to be undertaken

The district administrations under the leadership of the Collectors have been instructed to implement all the decisions related to drought management on the ground. The Collectors are

asked to monitor all the indicators of drought on the ground: collect data on rainfall on a daily basis from sources other than IMD that includes rain gauges maintained by private plantations and important water storages in the district and a weekly basis communicate the same to the State Disaster Management Authority. The Collectors are also asked to monitor all local information related to demand for relief employment, prices of food grains and the availability of fodder. All relief activities such as relief, employment, distribution of food grains, supply of drinking water and procurement and sale of fodder are coordinated by the District Collectors.

The District Collectors have already directed all the line departments at the district level to participate in drought management, prepare contingency plans and mobilize their staff and resources. The technical departments have identified works and have prepared estimates so that there is adequate work on the shelf to provide relief employment in the drought-affected areas.

The District Collectors concurrently assess the situation related to scarcity of drinking water and fodder, and issue appropriate instructions regarding conservation of drinking water, supply of drinking water through tankers, repair of hand pumps, augmentation and minor repair of existing public water supply system, procurement and sale of fodder, and setting up of fodder depots and cattle camps.

1.3 CONTINUED MONITORING AND DROUGHT MANAGEMENT BY STATE GOVERNMENT

As part of coordinating relief and mitigation activities, the District Disaster Management Authorities that are set up under the chairmanship of the Collector consisting of Panchayat Raj officials and the district officials meet every week and review the progress of drought relief and mitigation measures in the district. The District Disaster Management Authorities are made fully functional and the following actions have been taken/being taken to tackle the drought situation. State Government is constantly monitoring the severity of the crisis.

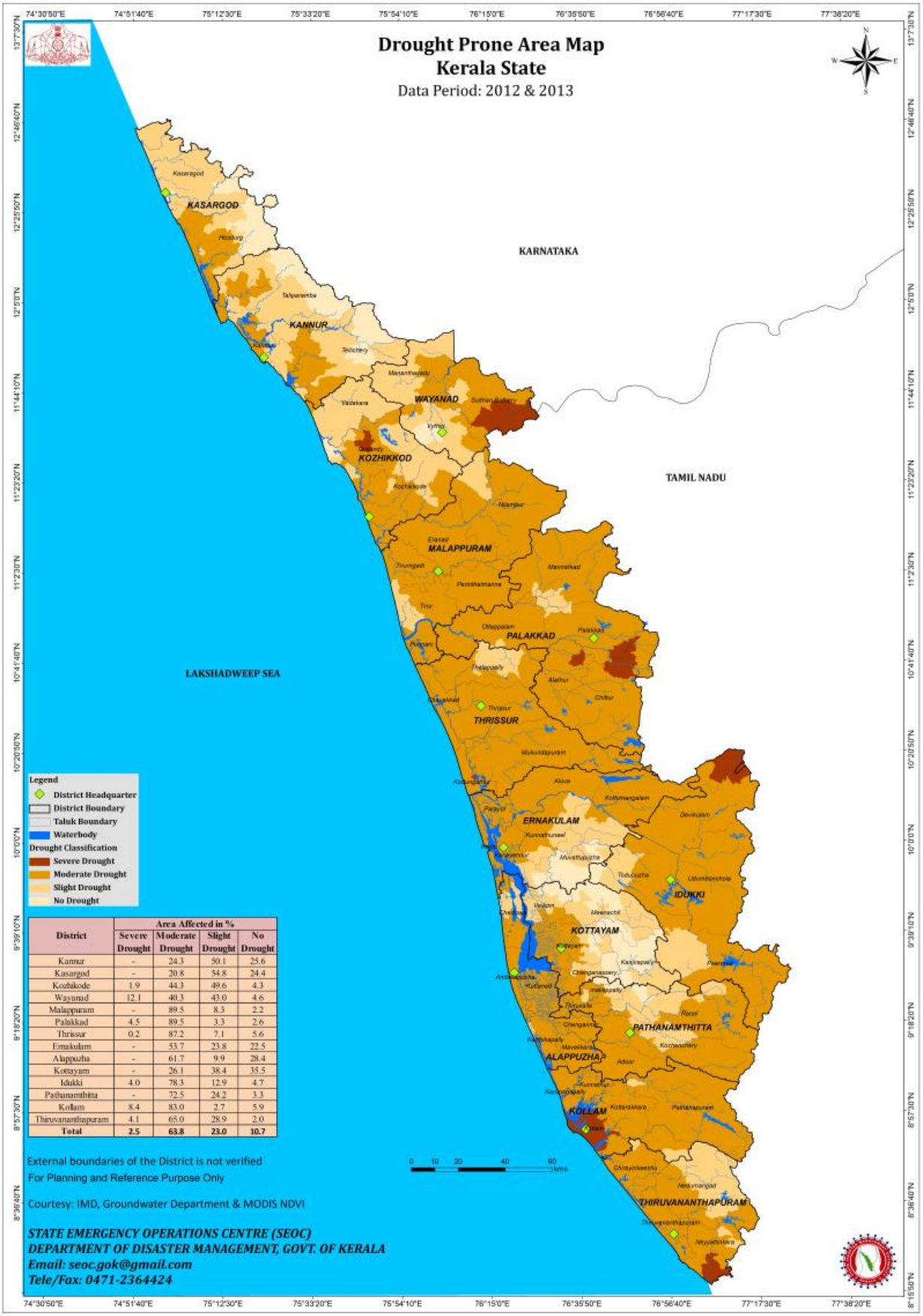
- **11-11-2016, 17-12-2016, 5-01-2017, 30-01-2017** and **15-02-2017** – Chief Secretary reviewed drought risk reduction initiatives of district administration through video conference and issued specific guidelines
- **31st January 2017** – Hon'ble Chief Minister reviewed the drought situation of all districts and gave specific instructions to the district administrations through video conference
- **4th March 2018 –** Hon'ble Chief Minister reviewed the drought situation of all districts and gave specific instructions to the district administrations through video conference. He stressed on the need to follow the priority of water use declared by KSDMA
- Minister for Revenue and Disaster Management reviewed the drought response meetings on the following dates in the respective districts

Date	District
21-01-2017	Thrissur
22-01-2017	Ernakulam
23-01-2017	Alappuzha
28-01-2017	Kollam
30-01-2017	Pathanamthitta
03-02-2017	Kasargode
14-02-2017	Thiruvananthapuram

- Ministers in charge of each district, Chief Secretary and the State Relief Commissioner are constantly reviewing the progress of the drought risk reduction activities undertaken by the districts. Ministers in charge of the respective districts held the drought response review meetings on the following dates in the respective districts

Date	Minister for	District
12-11-2016	PWD	Alappuzha
20-11-2016	Transport	Wayanad
17-12-2016	Fisheries	Kollam
21-12-2016	Corporation	Thiruvananthapuram
20-01-2017	Animal Husbandry	Kottayam
28-01-2017	Power	Idukki
12-02-2017	LSGD	Malappuram
21-02-2017	Fisheries	Kollam
21-02-2017	Excise	Kozhikode
19-02-2017	Health	Kannur

- **6th March 2017** – Kerala State Disaster Management Authority was held and drought response measures were reviewed
- State Drought Monitoring Cell is concurrently assessing rainfall, ground water level and reservoir levels and is advising the State government regarding the situation on ground and measures needed from the State level to support the Districts in smooth implementation of Drought Risk Reduction activities
- District Collectors has developed a strategy for drought management in active consultation with all the district level heads of departments of stake holder departments
- Funds available with the Govt. of Kerala from various sources have been pooled and have been handed over to major departments for immediate relief activities
- Vide GO (Rt) No. 4743/2016/DMD dated 11-11-2016 an amount of ₹20 crores was released to districts for drought response from SDRF
- Vide GO (Rt) No. GO (Rt) No. 714/2017/DMD dated 20-02-2017 an amount of ₹22.5 crores was released to districts for drought response from SDRF
- **On 21-02-2017 to 23-02-2017**, assistance of Indian Airforce was sought to douse forest fire in Mukkunnimala region of Thiruvananthapuram City. This was the first time in the history of Kerala that helicopters were used for dowsing forest fire
- **On 2-03-2017**, assistance of Indian Airforce was sought to douse forest fire in Parambikulam Tiger Reserve, Palakkad district
- Vide GO (Rt) No. 662/2017/LSGD dated 09-03-2017, all Local Self Governments were permitted to use their own funds or plan funds for supply of drinking water within the respective LSG jurisdictional area.



District	Area Affected in %			
	Severe Drought	Moderate Drought	Slight Drought	No Drought
Kannur	-	24.3	50.1	25.6
Kasargod	-	20.8	54.8	24.4
Kozhikode	1.9	44.3	49.6	4.3
Wayanad	12.1	40.3	43.0	4.6
Malappuram	-	89.5	8.3	2.2
Palakkad	4.5	89.5	3.3	2.6
Thrissur	0.2	87.2	7.1	5.6
Ernakulam	-	53.7	23.8	22.5
Alappuzha	-	61.7	9.9	28.4
Kottayam	-	26.1	38.4	35.5
Idukki	4.0	78.3	12.9	4.7
Pathanamthitta	-	72.5	24.2	3.3
Kollam	8.4	83.0	2.7	5.9
Thiruvananthapuram	4.1	65.0	28.9	2.0
Total	**2.5**	**63.8**	**23.0**	**10.7**

FIGURE 2: DROUGHT PRONE AREA MAP OF KERALA (SOURCE: STATE DISASTER MANAGEMENT PLAN 2016)

2. AGRICULTURAL SCENARIO OF THE STATE

The total geographic area of the State is 38,86,287 ha. The net cropped area in Kerala during the Kharif and Rabi seasons was 18,16,584.43 ha, which occupies 47% of the total area in the State. The share of agriculture to the State GSDP is about 11.6% (Economic Review of Kerala, 2015). Table 2 provides a brief picture of the agricultural statistics of the state.

TABLE 2: LAND USE PATTERN OF KERALA 2014-15 (ECONOMIC REVIEW OF KERALA, 2015)

Sl. No	Land use	Area in % of State's total area
1	Forest	28
2	Cultivable waste	3
3	Fallow other than current fallow	1
4	Current fallow	2
5	Net area sown	53
6	Land put to non-agricultural use	11

The agricultural sector of Kerala is characterised by the following:

- Less area under food crops
- Predominance of perennial crops like coconut, rubber, spices tea, coffee, cashew etc.
- Predominance of small and marginal farmers (92%)
- Low level of productivity
- High cost of production
- High percentage of senile and old plantations
- **Highly sensitive to annual rainfall**
- Low Per capita land - 0.12 ha
- High Labour Cost

Agricultural crops in the state are broadly classified as food crops and non-food crops. Food crops are cereals, millets, sugar crops, spices, condiments, fresh fruits, vegetables, etc. The major non-food crops are rubber, betel leaves, lemon grass, etc. Figure 4 shows the major crop growing areas of Kerala.

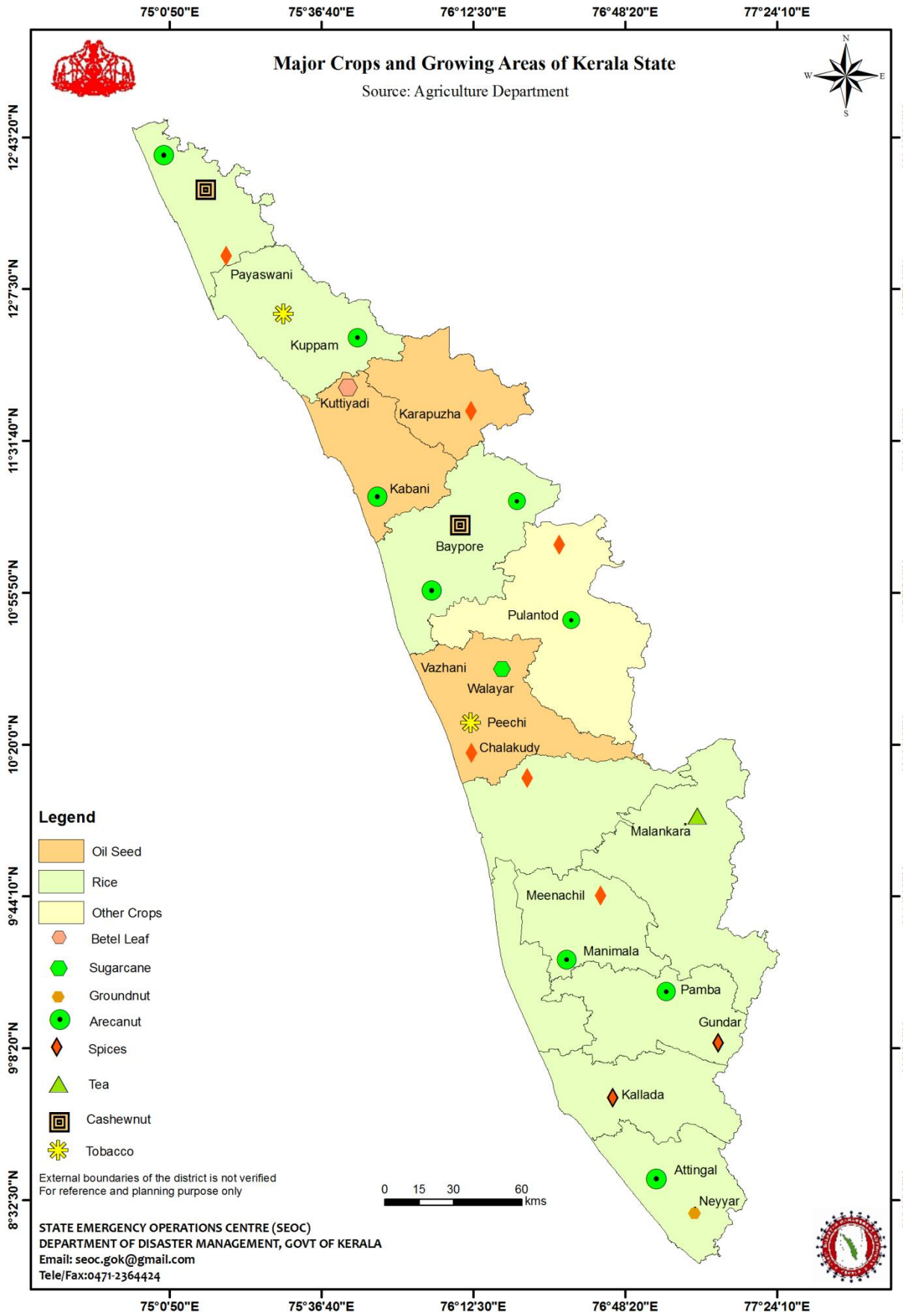


FIGURE 3: MAJOR CROPS AND CROP GROWING AREAS OF KERALA

Table 3 shows the statistics related to principal crops produced in the state.

TABLE 3: AREA AND PRODUCTION OF PRINCIPAL CROPS OF KERALA, 2016-17

Sl. No	Crops	Area ("000 ha)	Production ('000 tonnes)
1	Rice	132.68	368.243
2	Wheat	0.0004	0.0006
3	Jower	0.1530	0.1202
4	Maize	0.0779	0.0735
5	Ragi	0.0328	0.0379
5	Small millets	0.0165	0.0116
6	Tur	0.1670	0.2672
7	Gram	0.0670	0.1073
8	Other pulses	0.1129	0.2855
9	Groundnut	0.3474	0.4913
10	Sesamum	0.0004	0.0001
11	Potato	0.5520	8.76
12	Garlic	0.0759	0.3743
13	Canegur	0.8270	9.3436
14	Cotton*	0.0790	0.1185
15	Cardamom**	39.73	16
16	Cashewnut**	45.436	29.715
17	Coffee**	85.359	67.700
18	Tea**	30.205	65.174
19	Pepper**	85.431	40.69
20	Ginger**	4.8	22.989
21	Turmeric**	2.47	6.820
22	Arecanut**	96.686	125.925
23	Banana**	61.936	545.431
24	Other plantains**	56.761	468.320
25	Tapioca**	75.496	2943.919
26	Coconut**	793.856	5947

*Production in '000 bales of 170 kg each; **Economic Review of Kerala, 2015 (Figures of 2014-15); Source: Directorate of Economics and Statistics, Kerala

2.1 ANIMAL HUSBANDRY SECTOR

Small and marginal farmers and landless labourers own majority of the livestock resources. Hence sustainable development of the livestock sector would lead to more inclusive development and empowerment of women. Livestock sector contributed 27.62% of the Agriculture GDP of the State during 2014-15 (at constant price with base year 2011-12) while in 2013-14 the share was 25.25 per cent. Thus in 2014-15 the share of the sector in Agriculture GDP has increased, the sector as a whole recording a positive growth rate of 4.3 percent over 2013-14.

Kerala has about 1.7 million breeding cattle. Most of the cattle holding are one cow farms. Per capita availability of milk is about 220 gm/day. Part of milk required for the state is imported

from outside the state. About 10% of the GDP of the state is contributed by this sector. During 2014-15, a total of 5568.77 lakh litres of milk was procured by the dairy co-operative societies in the State of which 3535.14 lakh litres were sent to the dairies and 2033.63 lakh litres were marketed locally by the societies. The average milk procured per day by APCOS during the year 2014-15 was 1026 MT against the previous year average of 942 MT. The procurement/day/society during 2014-15 was 348 litres and during 2013-14 it was 335 litres. The procurement of milk by Kerala Co-operative Milk Marketing Federation (KCMMF) increased to 3636.81 lakh litres against the sale of 4487.02 lakh litres during 2014-15 which shows a wide gap between procurement and supply. The shortfall between milk procurement and sales was met by arranging milk mostly from State milk federations of Karnataka, Tamil Nadu, Andhra Pradesh and Maharashtra and purchase of skimmed milk powder.

3. INCIDENCE AND SPREAD OF DROUGHT

The rainfall deficit persisted and consequently the reservoir levels and ground water levels further depleted during the North East Monsoon (October to December) season. Overall deficit for the North East Monsoon season was 62% (cf. Figure 1). Acute drinking water shortage began to be reported from across the state. Irrigation had to be regulated as reservoir storages were alarmingly at its lowest. As on date the cumulative storage in reservoirs are only 36% which more than 50% below the long period average storage. This lead to crop stress, and farmers at some places even had to burn the crop as they dried up beyond recovery. Farmers have chosen to leave large parts of cultivable land are temporary fallow during the Rabi season due to lack of sufficient irrigation as the Government warned of likely reduction in water availability. Unlike previous years when water shortage in the State was felt only in late March, this year drinking water supply had to be undertaken even during the monsoon months of November in districts such as Wayanad, Alappuzha and Palakkad.

A centuries old tradition was broken for the first time in the history of Kollengode temple in the banks of Gayatri River in Palakkad, Kerala. The highlight of the annual festival at the temple is the ritual of bathing the main idol of Lord Vishnu in the river. This year, water was brought in a huge cooking vessel to bath the deity as the river was completely dry.

It is after this evaluation that the State has arrived at the conclusion that the drought conditions are severe in nature and is of rare occurrence that is beyond the coping capacity of the State, requiring additional assistance from Government of India for extending appropriate relief assistance to the public. The State Drought Monitoring Cell requested all line departments to conduct loss estimates in sectors such as agriculture, animal husbandry, and power, and requested all District Collectors to compile the requirements for immediate relief needs such as provision of drinking water to the most affected population. Parameters such as Rainfall, Water Level in

Reservoirs, Ground Water Level, Agricultural Crop Loss and Human Animal Conflict reports are closely monitored.

Chapter 4 shows the drought losses and assistance required for drought risk reduction in the State.

3.1. Rainfall, Reservoir Storage and Ground Water Level during the monsoon season of 2016

IMD in its first stage forecast of the South-West monsoon issued on 12th April, 2016 predicted 30% probability of the monsoon rainfall to be normal (96 - 104% of long period average). However, the monsoon had a delayed start as it set in over Kerala only on 6th June 2016. Eventually, the rainfall was 34% less than normal. In its press release dated 2nd June, 2016 IMD has reported that rainfall over the country as a whole is most likely to be above normal (>104% to 110% of long period average). Based on this prediction, all departments were instructed to prepare for a normal monsoon condition. IMD in its forecast of North East Monsoon rainfall expected 90-100% rainfall of long period average. However, eventually the rainfall received was 62% less than normal.

Thus in both the monsoon seasons, the rainfall received in the state was cumulatively about 40% less than normal.

3.2.1 Overall Performance of the 2016 Monsoon Season (June-December)

Figure 4 shows the rainfall departure from normal for the period from June to September 2016. Figure 5 shows the rainfall departure from normal for the period from October to December 2016. Table 4 shows the district wise departure of rainfall during the South West monsoon and Table 5 shows the departure during the North East Monsoon from normal. Station wise departure of rainfall is given as Annexure 2.

TABLE 4: DISTRICT WISE SOUTH WEST MONSOON RAINFALL 2016

South West Monsoon Rainfall of 2016			
District	**Actual Rainfall (mm)**	**Normal (mm)**	**Departure%**
Alappuzha	1135.3	1745.9	-35
Kannur	1991	2669	-25

Ernakulam	1569.4	2065	-24
Idukki	1569.5	2276.2	-31
Kasargode	2252.9	3007.5	-25
Kollam	950.8	1332.3	-29
Kottayam	1330.7	1897.3	-30
Kozhikode	1888.1	2603.1	-27
Malappuram	1252.9	2060.4	-39
Palakkad	1034.9	1572.7	-34
Pathanamthitta	1091.4	1715.7	-36
Thiruvananthapuram	572.4	871.3	-34
Thrissur	1219.6	2197.5	-44
Wayanad	1073.8	2632.1	-59

TABLE 5: DISTRICT WISE NORTH EAST MONSOON RAINFALL

North East Monsoon Rainfall of 2016			
District	**Actual Rainfall (mm)**	**Normal (mm)**	**Departure%**
Alappuzha	208.4	572.1	-64
Kannur	84.4	345.1	-76
Ernakulam	295.1	489.3	-40
Idukki	174	564.2	-69
Kasargode	71.1	337.9	-79
Kollam	406.8	638.6	-36
Kottayam	252.3	535.1	-53
Kozhikode	74.5	422.2	-82
Malappuram	118.3	448.3	-74
Palakkad	137.6	428	-68
Pathanamthitta	425.8	624.2	-32
Thiruvananthapuram	112.4	522.7	-79
Thrissur	152.1	469.4	-68
Wayanad	104.9	332.5	-68

It can be seen from the tables and figures that all 14 districts of Kerala experienced severe rainfall shortage. This deficit has particularly adversely affected the districts such as Wayanad, Palakkad and Thrissur. Based on interpolated rainfall, 1117 villages experienced large deficit, 391 village experienced deficit and 17 villages experienced normal rainfall during the North East Monsoon season. For a state like Kerala which is heavily dependent on monsoon rainfall, these deficits caused an unprecedented drought situation, especially when the predictions of IMD were for excess rainfall.

3.2.2 Reservoir storage at the end of Monsoon Season (June-December)

The rainfall deficits lead to initiate an assessment of the water level status in the major reservoirs of the State. Most of the reservoirs of the state registered a low storage for the season. In the peculiar case of Kerala, where ground water storage is comparatively less due to

topographical and geological factors, majority of the drinking water and household water supply depends on surface water. Most of the streams in Kerala are non-perennial particularly in the high and mid lands. Given the reduced rainfall, streams in the high and midlands of Kerala have dried up in the month of December 2016 itself resulting in water stress in the forest areas and the villages in high and midlands. This situation was anticipated in the month of October 2016 itself and KSDMA had in its guidelines directed all District Administrations to identify and categorise water stress areas requiring drinking water supply on a priority basis. Table 6 shows the storage status in the hydro-electric and multi-purpose reservoirs of Kerala in comparison with the full reservoir level and minimum draw down level. Cumulatively, these reservoirs were to be at 65% of its storage capacity in the month of March while the present level is only 36%.

TABLE 6: STATUS OF RESERVOIRS AS ON 10-03-2017

Reservoir	Present Level (m)	Min. Draw Down Level (m)	Full Reservoir Level (m)	Effective Storage (mcm)	Storage (%)
IDUKKI	710.178	694.944	732.43	438.557	30
PAMBA	963.65	963.168	986.332	0.21	42
KAKKI	962.088	908.304	981.456	199.069	0
SHOLAYAR	801.441	779.374	811.68	72.092	48
IDAMALAYAR	146.22	115	169	431.78	42
KUNDALA	1755.1	1735.836	1758.696	5.4	69
MADUPPATTY	1589.5	1554.48	1599.59	30.6	55
KUTTIADI	747.675	737.616	758.037	12.301	36
THARIODE	767.75	750.5	775.6	90.15	45
ANAYIRANKAL	1198.49	1188	1207.008	16.55	34
PONMUDI	687.7	678.8	707.745	8.64	18
NERIAMANGALAM	454	445	456.59	3.82	69
PORINGAL	412.8	405.689	423.976	7.5	25
SENGULAM (SBR)	846.85	844.86	847.6	-	0
LOWER PERIYAR	250.9	237.74	253	3.69	81
KAKKAD	186.35	181.36	192.63	-	0

Cumulative storage statistics of the major reservoirs listed above as on 10-03-2017 for the last 10 years is give in Table 7.

TABLE 7: CUMULATIVE EFFECTIVE STORAGE (MCM) STATISTICS OF RESERVOIRS AS ON 10-03-2017

Reservoir	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007
IDUKKI	440.2650	619.0320	849.7700	759.8040	324.5475	645.5490	861.9700	649.9730	521.2290	704.2930	732.7580
PAMBA	0.3100	4.4000	6.8000	1.4600	0.1000	7.0000	7.6700	7.1500	12.9200	6.2500	2.7500
KAKKI	200.3440	258.5400	285.1500	225.4380	197.4800	289.5060	298.7300	292.4800	326.1130	278.8500	239.9750
SHOLAYAR	72.7288	88.4464	108.0565	107.8314	73.7483	109.4740	102.9462	112.1219	100.4120	83.1505	100.8364
IDAMALAYAR	432.6200	412.0400	596.4150	528.7900	342.9700	600.4400	420.4400	463.5200	331.2700	506.5750	510.4000
KUNDALA	5.4000	7.7870	7.7870	7.7870	6.6900	7.7490	7.7100	7.7100	7.7870	7.7870	7.7870
MADUPPATTY	30.8000	38.9000	41.4000	30.6000	34.4000	34.6000	42.9000	36.8000	33.8000	39.0250	35.7000
KUTTIADI	11.5650	19.8540	20.7690	23.3900	11.4100	26.9722	25.7520	22.9020	2.0030	0.9822	4.8550
THARIODE	91.3500	87.1500	91.7500	55.3500	97.7500	51.9500	78.7500	84.7500	77.9500	67.3500	56.3500
ANAYIRANKAL	16.5500	45.4550	41.9450	23.8250	17.2700	45.6935	44.9150	31.0300	10.1050	40.7300	30.3700
PONMUDI	8.5000	16.7900	29.3700	19.7450	15.9100	7.1400	22.5200	27.3700	26.0700	32.3700	39.0700
NERIAMANGALAM	3.8600	3.1250	3.4100	3.8600	2.7000	3.0500	2.9700	3.0250	4.1300	2.5750	2.9250
PORINGAL	6.1700	6.7500	10.2750	6.3100	6.2400	8.2500	16.3000	6.3800	11.9000	9.0000	4.7400
SENGULAM (SBR)	0.5452	0.4938	0.5752	0.5672	0.5672	0.5552	0.5672	0.5452	0.5552	0.5372	0.4938
LOWER PERIYAR	3.6500	2.8800	2.7600	2.6100	2.4800	2.1400	2.2300	3.7400	2.3300	3.6500	3.5100
KAKKAD	0.4043	0.4241	0.4092	0.5227	0.6382	0.7208	0.2902	0.3268	0.6812	0.6522	0.5458

3.2.3 GROUND WATER STORAGE AT THE END OF MONSOON SEASON (JUNE-DECEMBER)

According to Central Ground Water Board, 82% of Kerala's ground water is replenished annually by rainfall. In a hard crystalline bed rock region like Kerala (excluding some sedimentary regions such as Alappuzha) the theoretical difference of phreatic and deep aquifers is not practically seen. Majority of households in the State depends on the 69 lakh open wells that tap into the phreatic aquifers of the State. It is often noticed that extraction of water from deep bore wells and tube wells tend to affect the water level of surrounding open wells. These phreatic aquifers are replenished by ponds, streams and fresh water lakes. A reduction of 40% monsoon rainfall thus would affect about 50% of the replenishment of ground water in the State. A decline of >2 m from long period average ground water level below ground level is defined as a cause of concern according to the Manual for Drought Management, 2009 published by Ministry of Agriculture, Government of India.

Ground water level data from open wells were assessed to identify any draw-down. Maps pertaining to the ground water draw-down with respect to the mean derived from available data were prepared (Figure 6 to 13). The maps are only pictorial representations of the departure and have not been interpolated with consideration to subterranean features, topography and soil conditions. Kottayam, Kollam, Palakkad and Wayanad showed the highest and most wide spread ground water draw-down during the monsoon season measuring to a maximum of about 10 m from normal at some open wells, respectively.

3.2.4 AGRICULTURAL CROP LOSS

From October 2016 onwards, various districts have reported the occurrence of agricultural crop loss. In the early weeks of November 2016, the reports were minimal and sporadic as the Kharif season crop was not very badly affected given the availability of water in the reservoirs and the phreatic aquifers due to summer rainfall from March to May 2016.

However, the situation aggravated from mid November 2016 and the Rabi yield and cropped area loss are substantial. Crop loss has been reported also due to numerous natural fire events triggered by intense heat in cultivated areas. Details of crop loss are provided in Chapter 4.

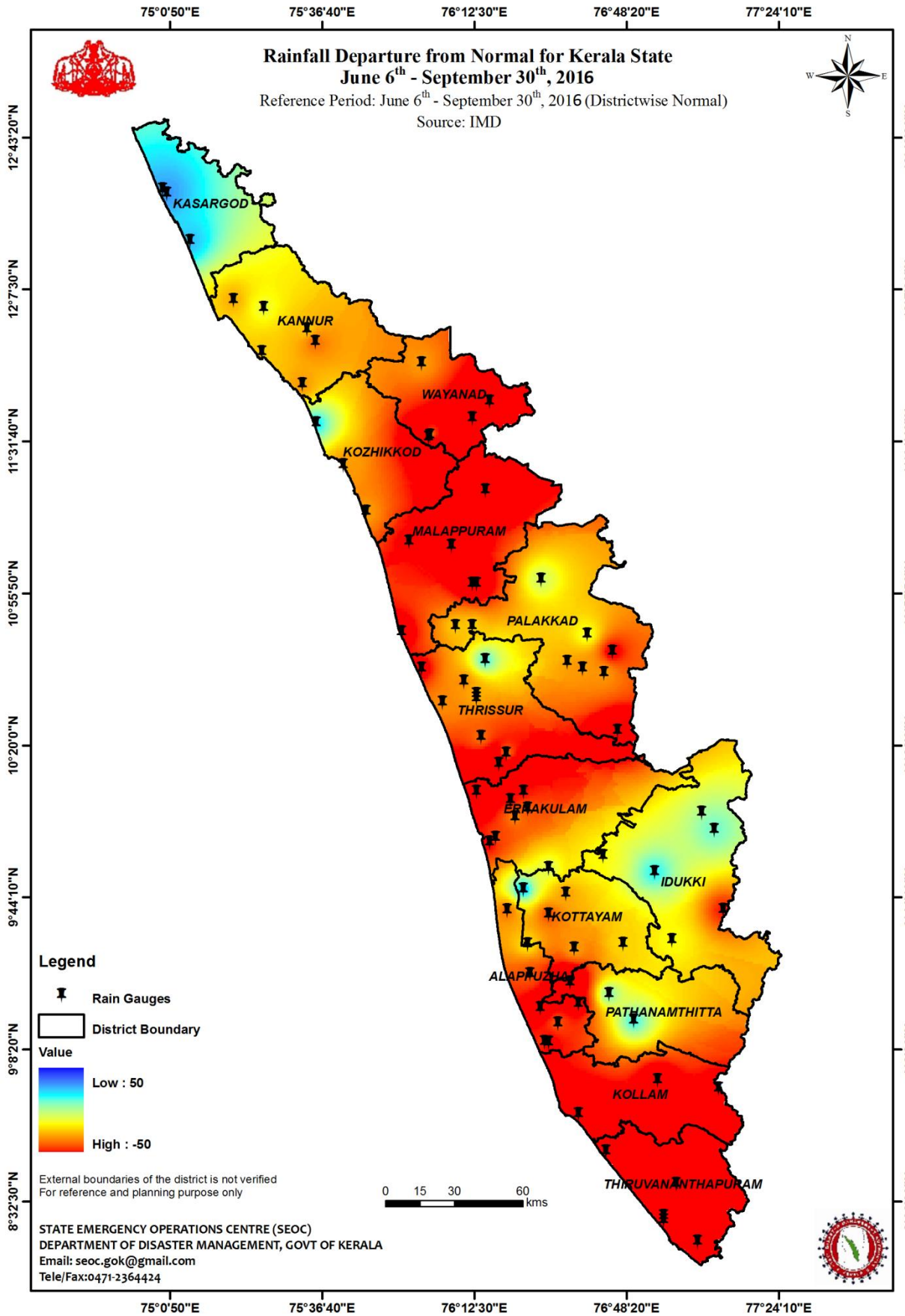


FIGURE 4: RAINFALL DEPARTURE FROM NORMAL – SOUTH WEST MONSOON SEASON

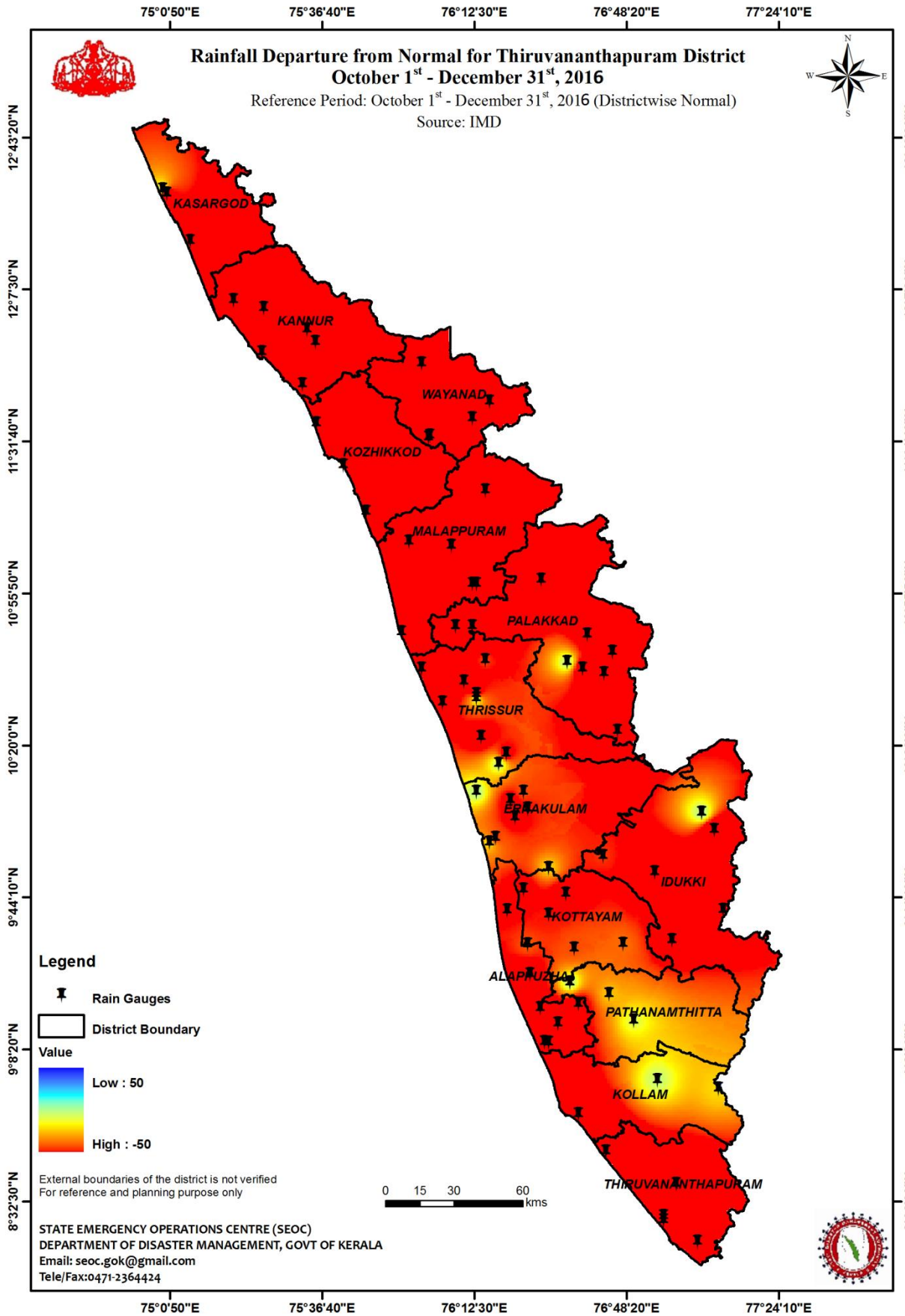


FIGURE 5: RAINFALL DEPARTURE FROM NORMAL – NORTH EAST MONSOON SEASON

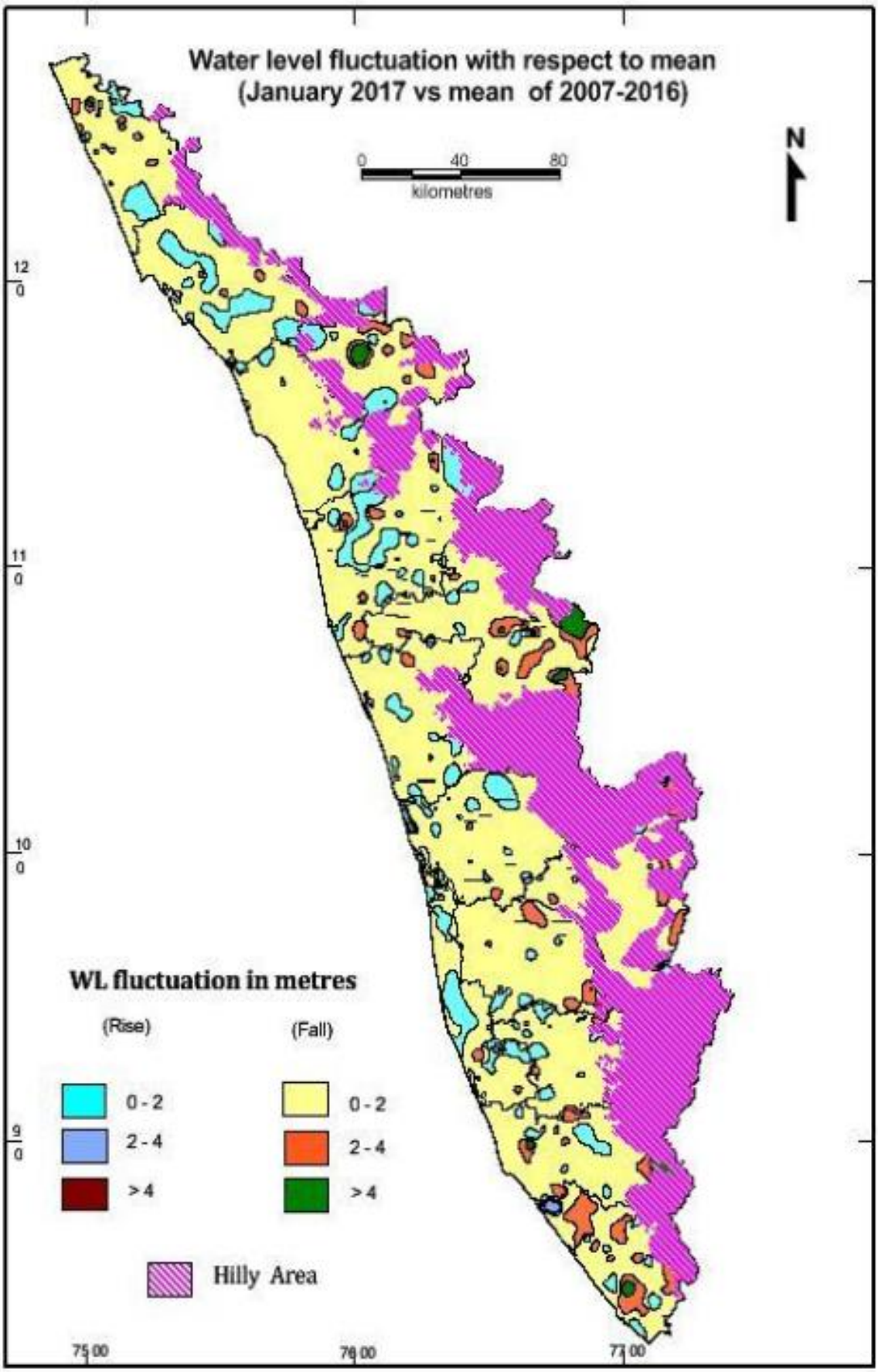


FIGURE 6: GROUND WATER FLUCTUATION WITH RESPECT TO MEAN (2007-2016) OF JANUARY 2017 (CGWB, 2017)

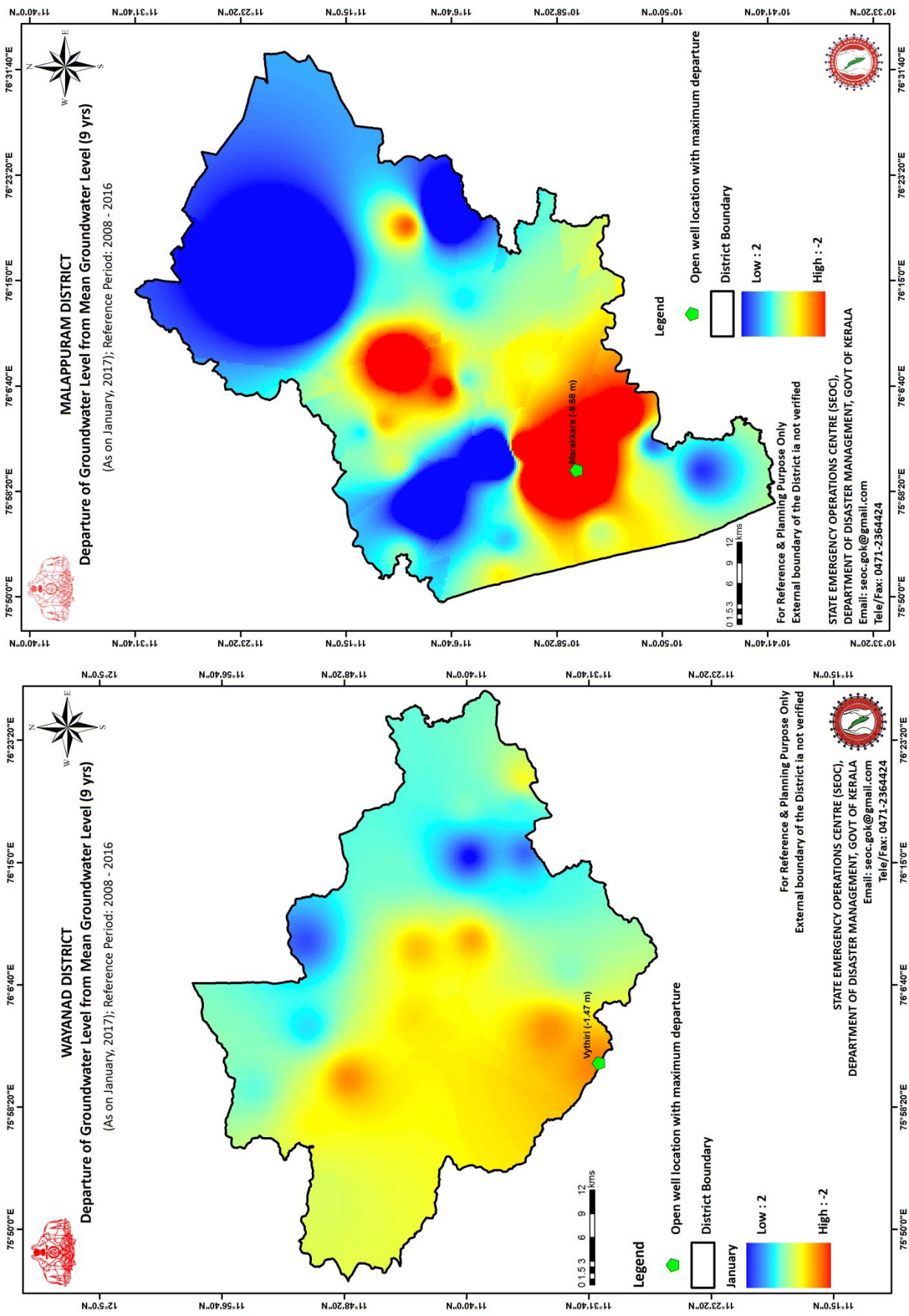


FIGURE 7: DEPARTURE OF GROUND WATER LEVEL – WAYANAD & MALAPPURAM

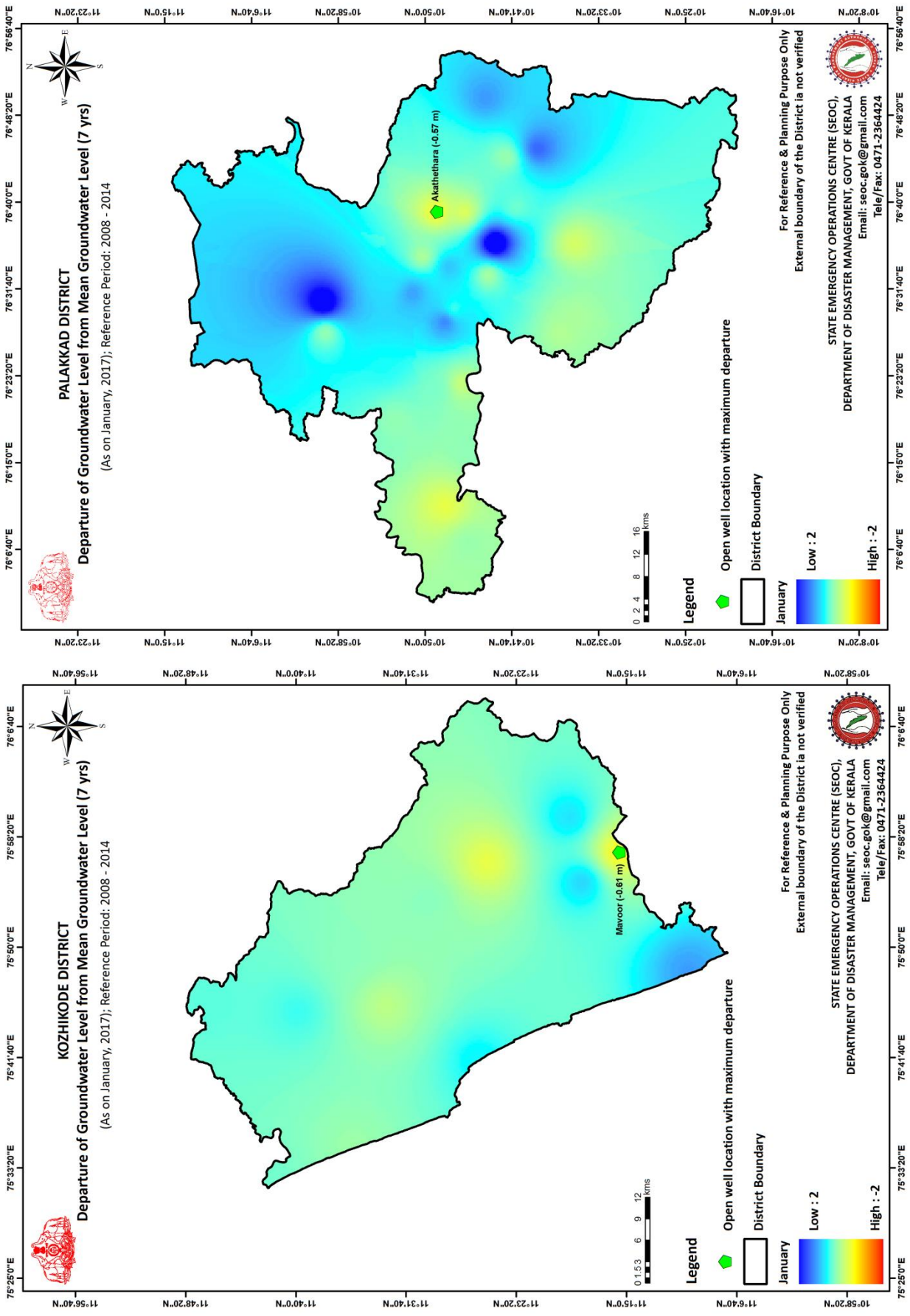


FIGURE 8: DEPARTURE OF GROUND WATER LEVEL – KOZHIKODE & PALAKKAD

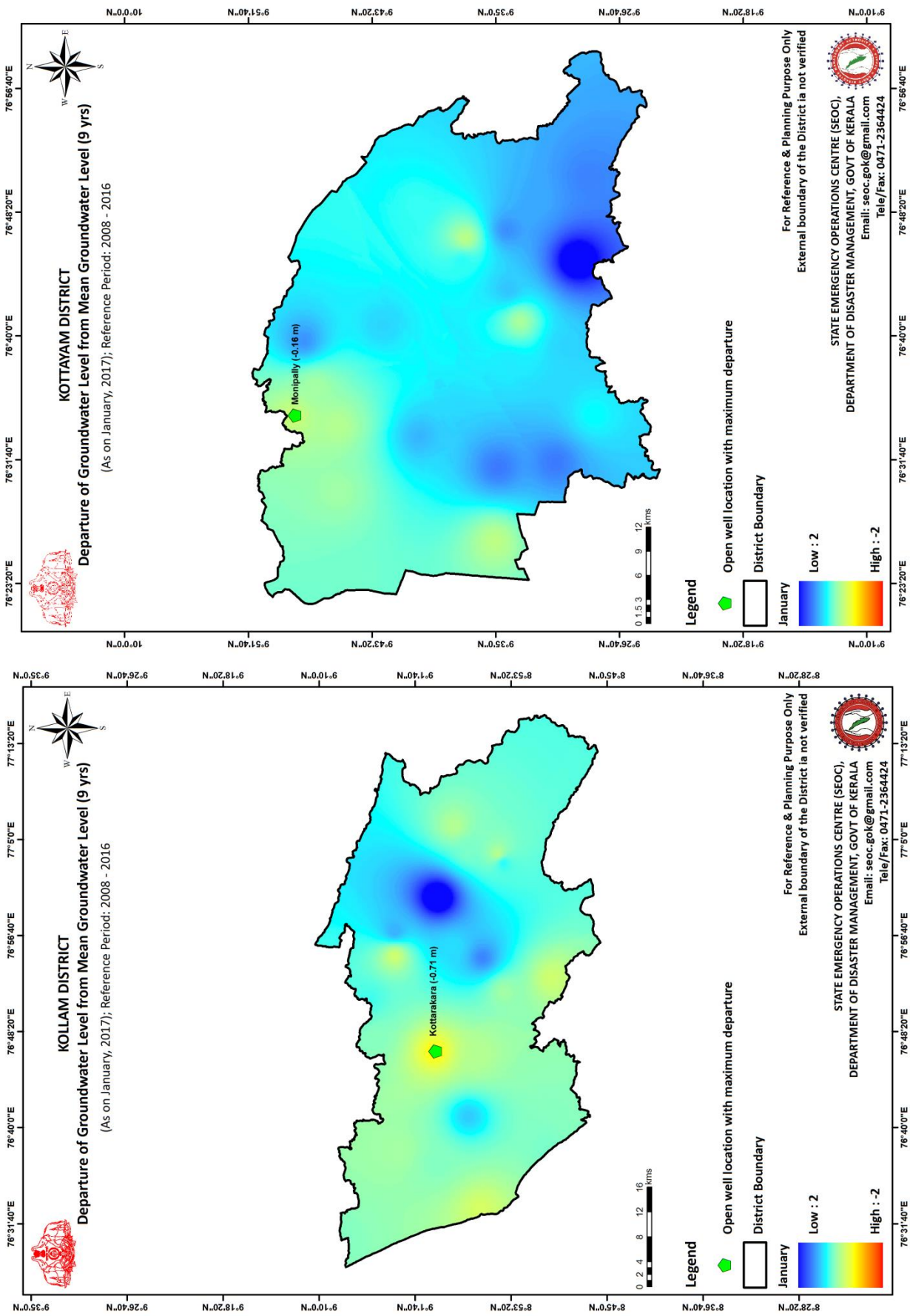


FIGURE 9: DEPARTURE OF GROUND WATER LEVEL – KOTTAYAM & KOLLAM

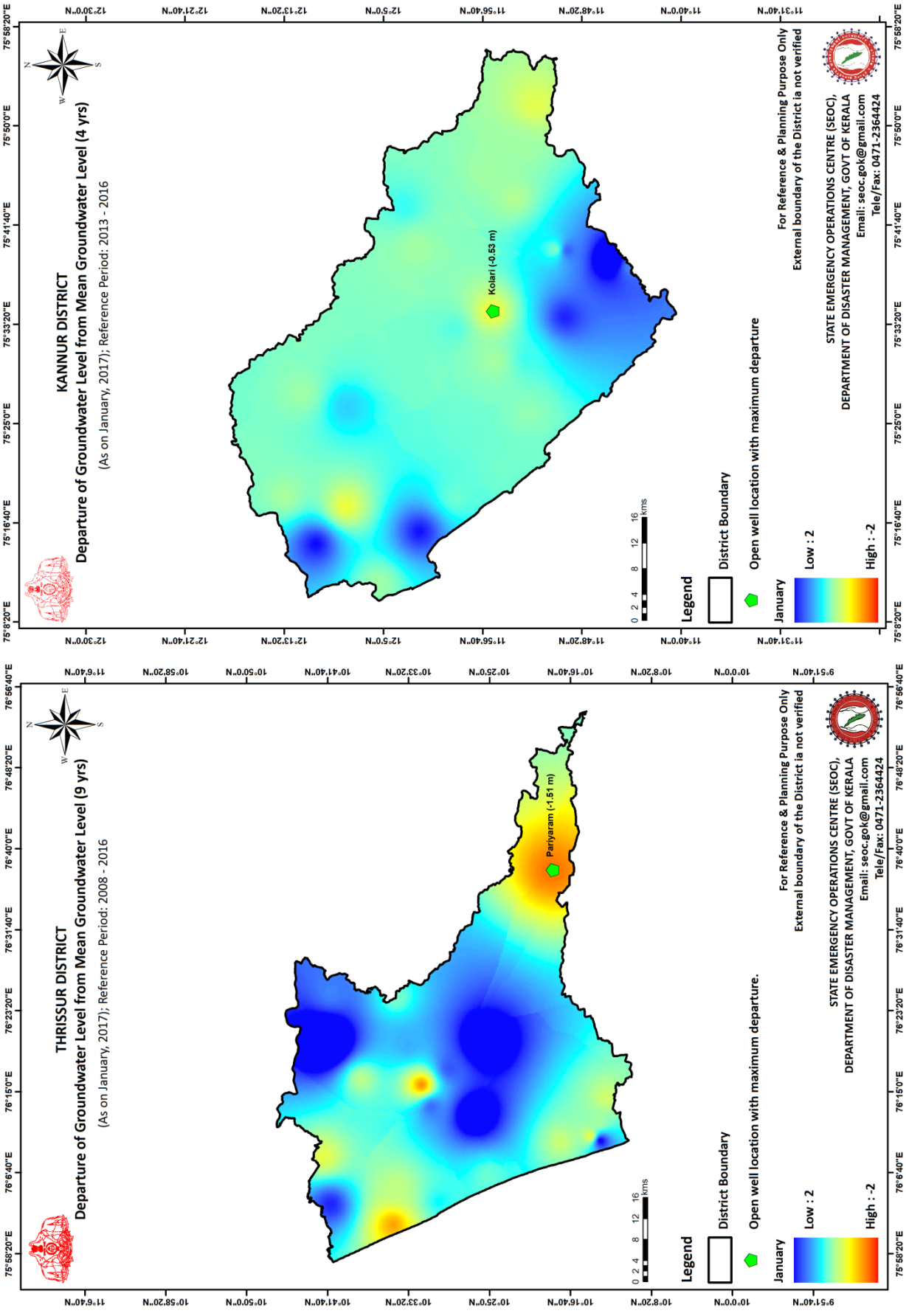


FIGURE 10: DEPARTURE OF GROUND WATER LEVEL – THRISSUR & KANNUR

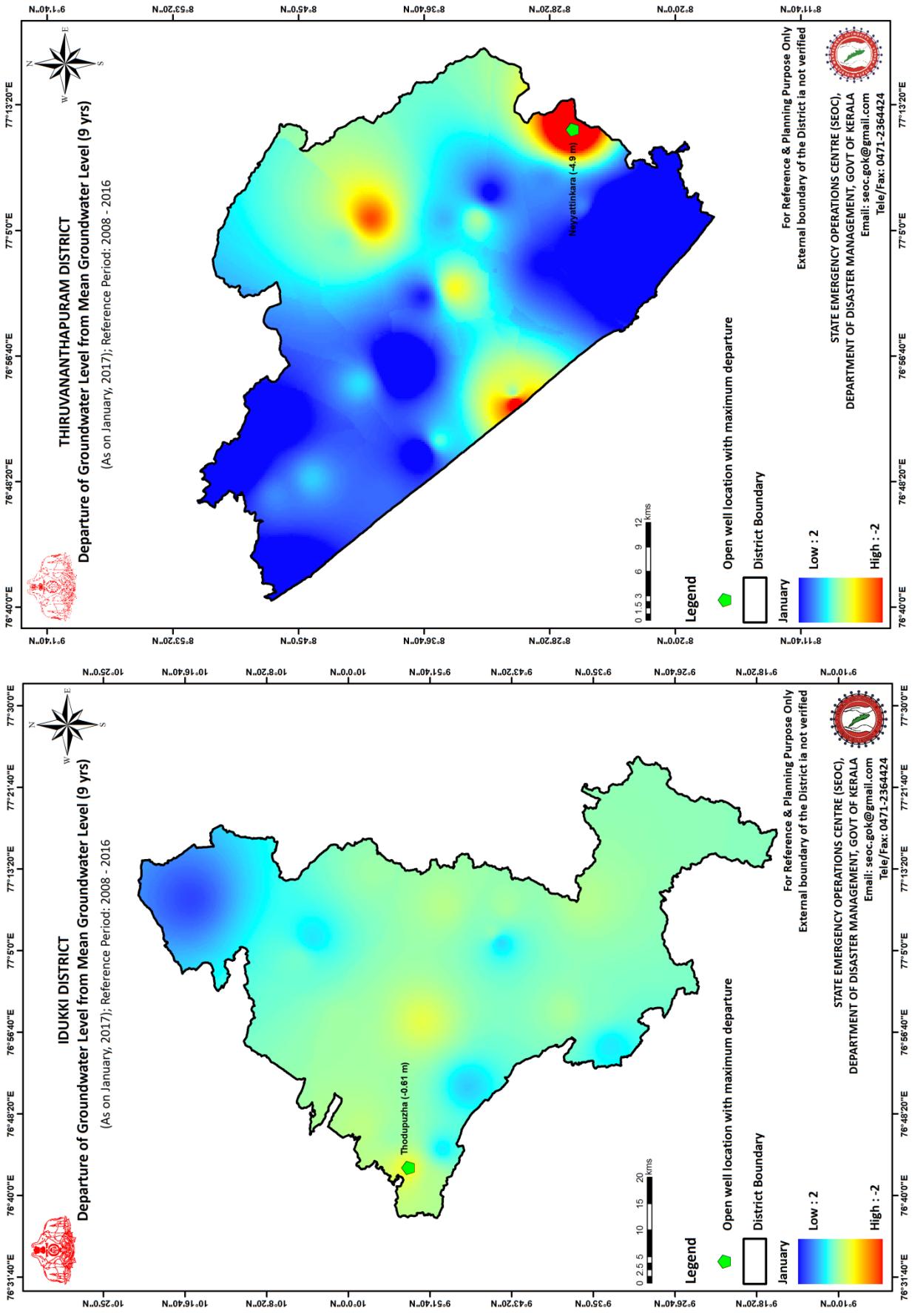


FIGURE 11: DEPARTURE OF GROUND WATER LEVEL – IDUKKI & THIRUVANANTHAPURAM

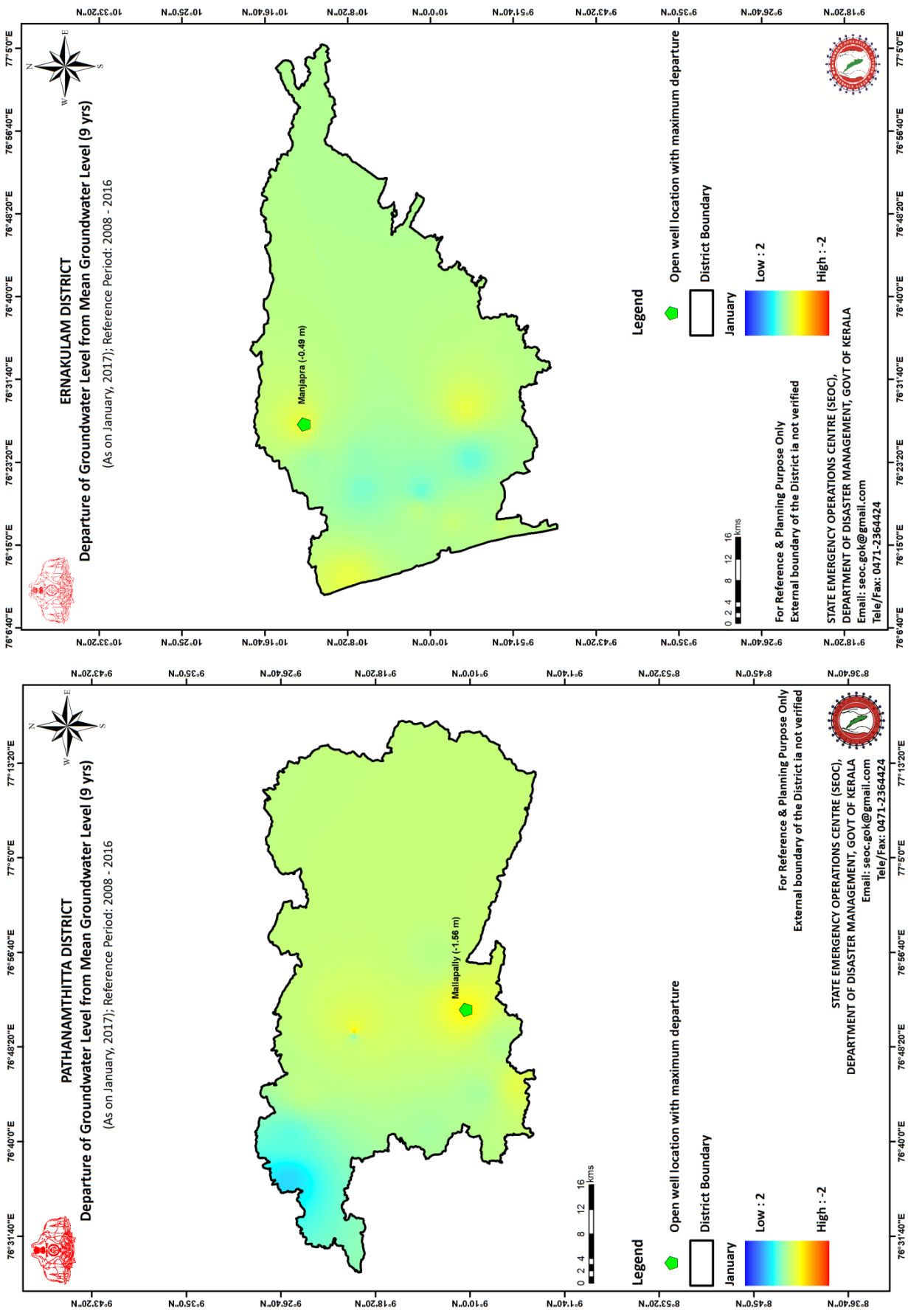


FIGURE 12: DEPARTURE OF GROUND WATER LEVEL – PATHANAMTHITTA & ERNAKULAM

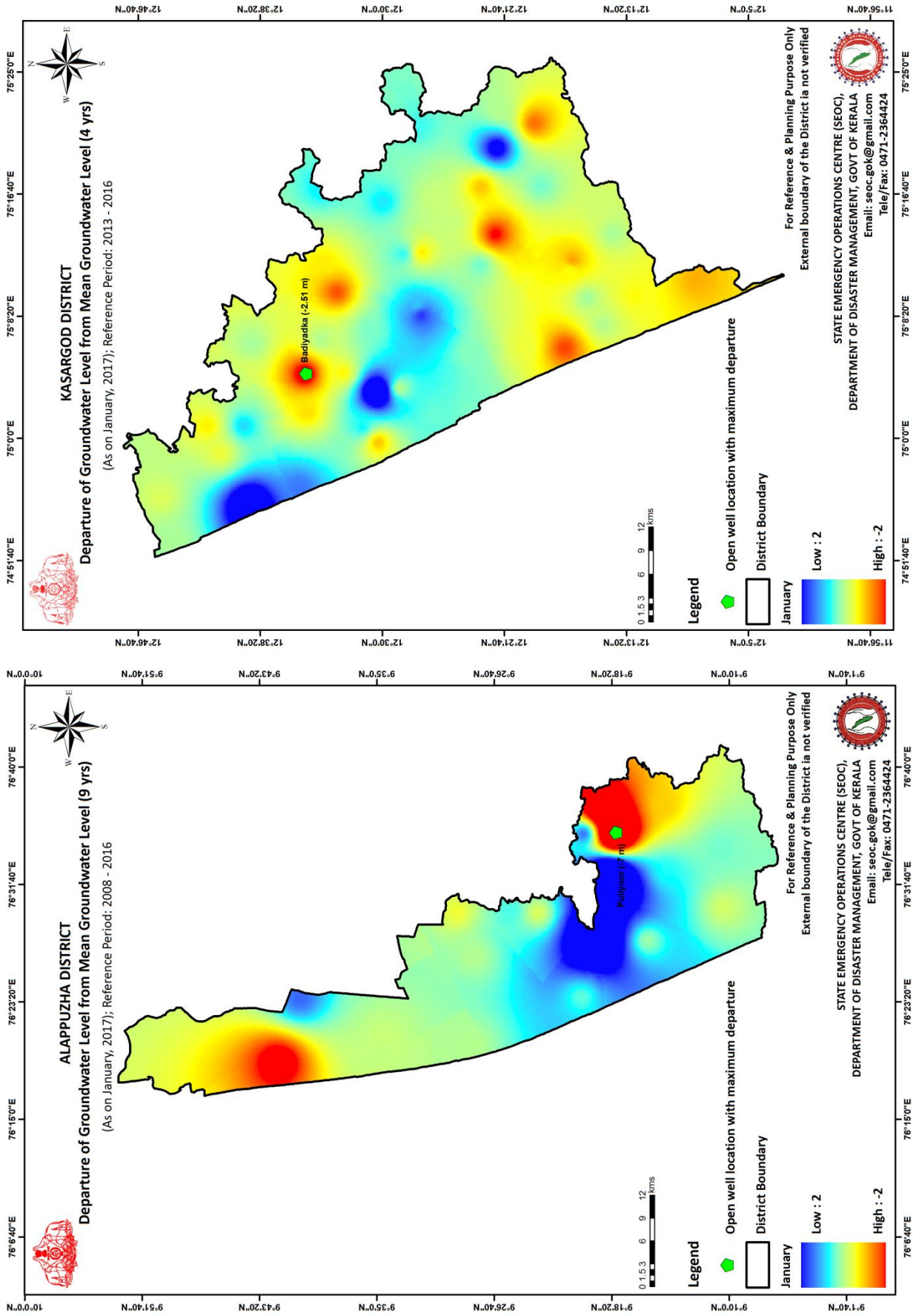


FIGURE 13: DEPARTURE OF GROUND WATER LEVEL – ALAPPUZHA & KASARGODE

3.2.5 NORMALISED DIFFERENCE VEGETATION INDEX

Kerala's Drought Monitoring Cell gathers data regarding NDVI through the Global Agriculture Monitoring System platform which is openly accessible. The platform provides NDVI data from 2002 till date on an eight (8) day temporal resolution from TERRA and AQUA platforms. The platform also provides query options and provides spatial aggregating option for representative purposes. The mean NDVI is calculated with 8 day temporal resolution data over a period from 2002 to till date. As desired by the IMCT, the data spatial aggregate for 2011-12, 13-14 and 14-15 which were normal monsoon years in Kerala are plotted against the spatial aggregate of 2016-17. The data is aggregated for the respective hydrological years with 1st June being the start date and 31st May being the end date. Normalized Difference Vegetation Index (NDVI) is an indicator of the vigour of vegetation cover. This product is derived from the MODIS sensor on-board Terra Satellite. This parameter ranges from -1 to +1 where from about +0.5 to +1 represents vigorous green cover.

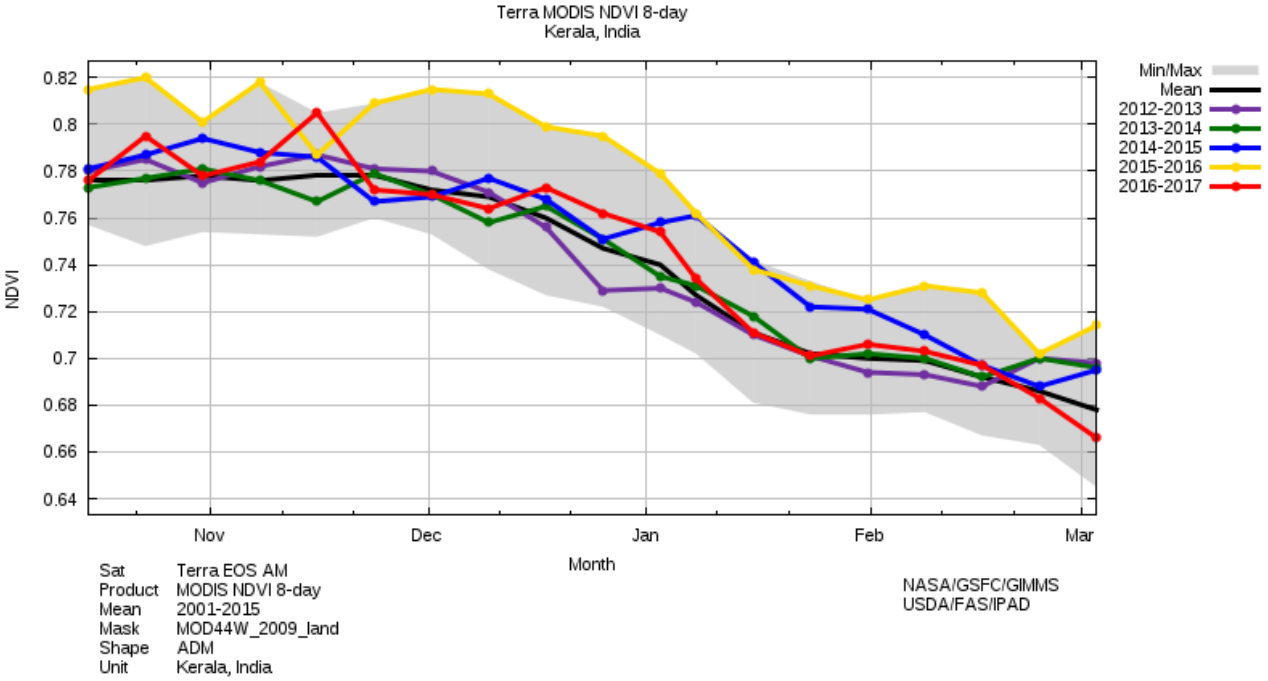


FIGURE 14: NDVI AGRREGATE OVER KERALA – COMPARISON BETWEEN MEAN OF THE MONTHS OF OCTOBER TO MARCH FROM 2012-13 TO 2016-17

Brighter the green cover and its vigour (a proxy of good crop) nearer will be the value of NDVI to +1. This parameter is monitored every 8 days and compared against long period average.

Figure 14 shows the time trend of NDVI aggregated over Kerala. A comparison of NDVI in 2012-13 (the last instance of significant drought) and that of 2016-17 is give in comparison to the long period mean, minimum and maximum NDVI aggregate. It may be noted that the green cover over Kerala has been consistently below normal and is also below the 2012-13 situation.

The Manual for Drought Management, 2009 states that 'the states declare drought only when the deviation of NDVI value for the normal is 0.4 or less. However, NDVI value needs to be applied in conjunction with other indicators and values'. In a perennially vegetation covered tropical state like Kerala, the possibility of drastic departure of NDVI by an order of 0.4 will not be occur. This may also be attributed to the maritime location of the state and the constant humidity fed to the soil and vegetation.

However, the declining trend can be attributed to the setting in of hydrological and agricultural drought as a consequence of the meteorological drought which eventually leads to crop wilting. This may also be read in conjunction with the agricultural crop loss reports provided by Agriculture Department which indicates that about 41,592 ha of crop area is damaged due to drought. It is significant to note from the figure that since October 2016, the green cover vigour over Kerala has been on a degrading trend. The trend clearly captures the reduced health of vegetation cover. The trend also indicates that the green cover vigour will further degrade and may remain below mean in the months to come and this situation will eventually lead to low yields during the Rabi season, as well. It is worthy to note that the aggregate NDVI value of March 2017 is lower than the 2011-12 period.

3.2.6 Position Regarding Drinking Water Supply till 31-03-2017

Table 8 provides the details of drinking water supply trips undertaken in different districts till 31-03-2017. It is evident from the table that local demand for potable drinking water is high in the state and thereby district administrations are forced to provide additional drinking water supply through tankers and water kiosks.

TABLE 8: DRINKING WATER SUPPLY TRIPS UNDERTAKEN BY DISTRICT ADMINISTRATIONS

Sl. No	District	Number of trips undertaken
1	Thiruvananthapuram	2,098
2	Kollam	6,758
3	Alappuzha	10,366
4	Pathanamthitta	3,263
5	Kottayam	5,339
6	Idukki	3953
7	Palakkad	22,777
8	Thrissur	4,793
9	Ernakulam	62,598
10	Kozhikode	12,010
11	Wayanad	420
12	Malappuram	360
13	Kannur	22,711
14	Kasargod	2,552
	Total	**1,59,998**

3.2.7 River Flow Data as on 31-12-2017

Table 9 provides the river flow data till 31-12-2017 for various rivers of Kerala. Please note that most of the rivers have no runoff indicating a low base flow level as well.

3.2.8 Agriculture Crop Loss Data

The Directorate of Agriculture has reported that a total of 41,592 ha have been reported as damaged during 2016-17 Kharif and Rabi period together. Of this, 2286.77 ha were damaged during Kharif and the remaining during Rabi season. Detailed crop loss statistics provided by Directorate of Agriculture is enclosed herewith.

TABLE 9: DRINKING WATER SUPPLY TRIPS UNDERTAKEN BY DISTRICT ADMINISTRATIONS

Sl. No	Basin	Station Name	Latitude	Longitude	District	Observed Discharge (cumecs) on 31.12.2016	Truncation Level (cumec)	Difference of stream flow from truncation level flow(cumec)	Volume of flow at truncation level(Vtl)(m3)	Volume of	
										Deficit flow (Vd)m3	Surplus flow(Vs)m3
1	Neyyar	Amaravila	8.3916	77.0981	Thiruvananthapuram	1.1	2.52	-1.42	217728	122688	
2	Neyyar	Ottasekharamangalam	8.47507	77.1255	Thiruvananthapuram	0	1.42	-1.42	122688	122688	
3	Karamana	Mangattukadavu	8.49666	77.0041	Thiruvananthapuram	4.01	0	4.01	0		346464
4	Karamana	Maruthankuzhy	8.51269	76.9774	Thiruvananthapuram	0.47	0	0.47	0		40608
5	Vamanapuram	Mylamoodu	8.75075	77.0028	Thiruvananthapuram	0.23	0.43	-0.2	37152	17280	
6	Vamanapuram	Valayinkil	8.69887	77.0992	Thiruvananthapuram	0.86	0.86	0	74304	0	
7	Vamanapuram	Vamanapuram	8.72302	76.8966	Thiruvananthapuram	12.2	14.1	-1.9	1218240	164160	
8	Ayiroor	Ayiroor	8.7728	76.7216	Thiruvananthapuram	0	0.22	-0.22	19008	19008	
9	Mammom	Mamam	8.67652	76.8293	Thiruvananthapuram	0.79	0.18	0.61	15552		52704
10	Ithikkara	Ayoor	8.892	76.8666	Kollam	12.34	0.11	12.23	9504		1056672
11	Pallikkal	Anayadi	9.119	76.633	Kollam	2.23	2.19	0.04	189216		3456
12	Kallada	Kaduvathode	9.09	76.801	Kollam	0					
13	Kallada	Punalur	9.036	76.917	Kollam	3.39	5.84	-2.45	504576	211680	
14	Achenkovil	Kalleli	9.215	76.865	Pathanamthitta	0.46	2.83	-2.37	244512	204768	
15	Achenkovil	Kollakadavu_GD	9.2519	76.5869	Alleppey	0	1.56	-1.56	134784	134784	
16	Achenkovil	Konni-GD	9.2308	76.8542	Pathanamthitta	0	6.31	-6.31	545184	545184	

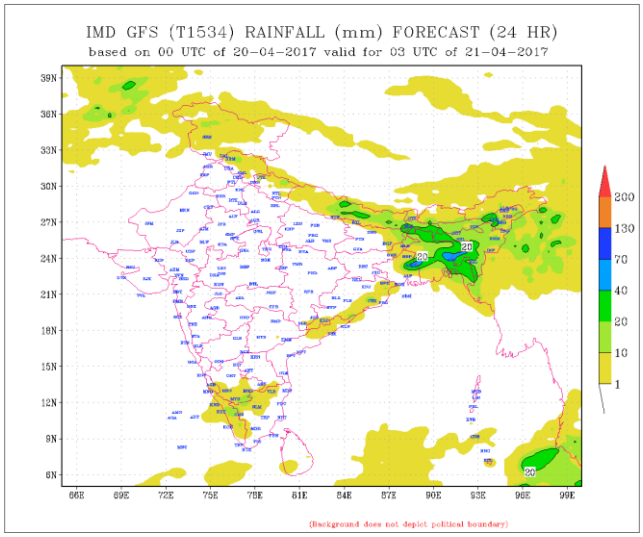
17	Achenkovil	Pandalam	9.235	76.673	Pathanamthitta	0	7.42	-7.42	641088	641088	
18	Pamba	Erapuzha	9.334	76.605	Alleppey	42.17	0	42.17	0		3643488
19	Pamba	Kurudamannil	9.349	76.741	Pathanamthitta	29.3	34.2	-4.9	2954880	423360	
20	Pamba	Maramon	9.338	76.704	Panthanamthitta	33.58					
21	Manimala	Manimala	9.492	76.748	Kottayam	0	0.25	-0.25	21600	21600	
22	Manimala	Mundakayam-GD	9.5357	76.8868	Kottayam	0	0	0	0		
23	Manimala	Thondara	9.3611	76.5883	Pathanamthitta	0	0	0	0		
24	Meenachil	Cheripad	9.7024	76.7864	Kottayam	0	0.3	-0.3	25920	25920	
25	Meenachil	Palai	9.71	76.684	Kottayam	0	0	0	0	0	
26	Meenachil	Peroor	9.631	76.566	Kottayam	0	0	0	0	0	
27	Meenachil	Teekoy	9.701	76.823	Kottayam	0	0	0	0	0	
28	Periyar	Kalady	10.153	76.436	Ernakulam	1.9	50.9	-49	4397760	4233600	
29	Periyar	Mangalapuzha	10.127	76.34	Ernakulam	0	0	0	0	0	
30	Periyar	Marthandavarma	10.115	76.35	Ernakulam	7.53	0	7.53	0		650592
31	Muvattupuzha	Kakkadassery	9.9978	76.6	Ernakulam	0.13	4.34	-4.21	374976	363744	
32	Muvattupuzha	Kalampur	9.998	76.6	Ernakulam	0.32	3.59	-3.27	310176	282528	
33	Muvattupuzha	Muvattupuzha	9.988	76.579	Ernakulam	1.57	52.45	-50.88	4531680	4396032	
34	Muvattupuzha	Thodupuzha	9.979	76.583	Ernakulam	2.88	47.82	-44.94	4131648	3882816	
35	Chalakudy	Vettilappara	10.2916	76.44695	Thrissur	12.85					
36	Karuvannur	Karikkadavu	10.3747	76.4462	Trichur	0	0	0	0	0	
37	Karuvannur	Karuvannur	10.402	76.216	Thrissur	23.34	0	23.34	0		2016576
38	Karuvannur	Kurumaly	10.4121	76.2634	Trichur	0	0	0	0	0	
39	Karuvannur	Manali	10.4393	76.2634	Trichur	0	0	0	0	0	
40	Puzhakkal	Kundukkad	10.593	76.273	Thrissur	0	0	0	0	0	
41	Bharathapuzha	Cheruthuruthy	10.7515	76.2814	Trichur	0	0	0	0	0	

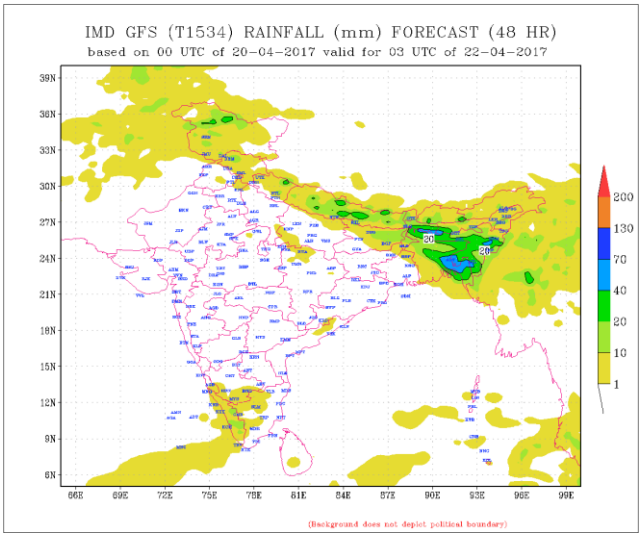
42	Bharathapuzha	Chittady	10.559	76.526	Palghat	0	0.4	-0.4	34560	34560	
43	Bharathapuzha	Kuttipuram	10.842	76.023	Malappuram	7.7	0	7.7	0		665280
44	Bharathapuzha	Pambadi	10.751	76.434	Palghat	0	0	0	0	0	
45	Bharathapuzha	Thiruvegapura	10.88	76.114	Malappuram	0	1.64	-1.64	141696	141696	
46	Bharathapuzha	Vandazhi	10.586	76.526	Palghat	0.49	0	0.49	0		42336
47	Bharathapuzha	Vithinissery	10.603	76.632	Palakkad	0.005	1.107	-1.102	95644.8	95212.8	
48	Bhavani	Chittor (Attappadi)	11.0588	76.6538	Palghat	1.01	1.36	-0.35	117504	30240	
49	Bhavani	Kalkandiyoor	11.1644	76.6833	Palakkad	0.58	0.58	0	50112	0	
50	Kadalundy	Chittathuppara	11.087	76.145	Kozhikkode	0					
51	Chaliyar	Ambittampotty	11.4197	76.241	Malappuram	1.3	1.64	-0.34	141696	29376	
52	Chaliyar	Kanjirapuzha	11.741	76.073	Malappuram	0.03	0	0.03	0		2592
53	Chaliyar	Karimpuzha	11.3061	76.2564	Malappuram	0	1.71	-1.71	147744	147744	
54	Chaliyar	Koodathai	11.3989	75.9539	Kozhikode	0	0	0	0	0	
55	Chaliyar	Mukkom	11.3183	75.9911	Kozhikode	0	0	0	0	0	
56	Chaliyar	Punnapuzha	11.325	76.2725	Malappuram	7.63	3.99	3.64	344736		314496
57	Korapuzha	Kollikkal	11.4364	75.9039	Kozhikode	0	0	0	0	0	
58	Korapuzha	Kunnamangalam	11.3014	75.8553	Kozhikode	0	7.93	-7.93	685152	685152	
59	Kuttyadi	Kadiyangad	11.5992	75.7761	Kozhikode	0.065	2.88	-2.815	248832	243216	
60	Kabani	Baveli	11.8542	76.1161	Wayanad	0.88	1.92	-1.04	165888	89856	
61	Kabani	Kakkavayal	11.6556	76.1597	Wayanad	0.38	0.87	-0.5	75168.0	42336	
62	Kabani	Kelothkadave	11.8027	76.0754	Wayanad	7.94	0	7.94	0		686016

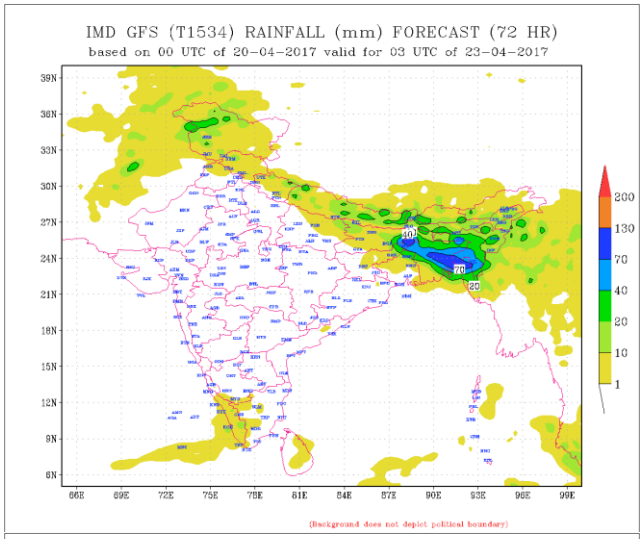
63	Kabani	Munthanga(Ponkuzhi)	11.6694	76.3572	Wayanad	1.43	1.41	0.02	121824		1728
64	Kabani	Panamaram	11.741	76.073	Wayanad	0.11	0.25	-0.14	21600	12096	
65	Mahe	Vanimal	11.7044	75.6857	Kozhikode	0	0.25	-0.25	21600	21600	
66	Thalassery	Pathippalam	11.788	75.569	Kannur	0					
67	Anjarakandy	Kannavam	11.844	75.662	Kannur	0	0.4	-0.4	34560	34560	
68	Anjarakandy	Meruvambai	11.8747	75.5775	Cannanore	8.53	0.52	8.01	44928		692064
69	Valapatanam	Anungode	11.927	75.775	Kannur	0	0.67	-0.67	57888	57888	
70	Valapatanam	Koottupuzha	12.066	75.722	Kannur	0	0.6	-0.6	51840	51840	
71	Valapatanam	Palapuzha_GD	11.9491	75.736	Cannanore	1.16	6.38	-5.22	551232	451008	
72	Valapatanam	Payyavoor	12.057	75.574	Kannur	0					
73	Kuppam	Mangara	12.1392	75.4201	Cannanore	0	4	-4	345600	345600	
74	Peruvamba	Kithapram(Perumba)	12.113	75.2936	Cannanore	0	0	0	0	0	
75	Kavvayi	Vellur	12.166	75.203	Kannur	0					
76	Kariangote	Kakkadavu	12.267	75.281	Kasaragod	0	0	0	0	0	
77	Nileswar	Chayyam	12.275	75.184	Kasargode	0					
78	Chandragiri	Moonamkadavue	12.4319	75.1282	Kasaragod	0.67	1.69	-1.02	146016	88128	
79	Chandragiri	Padiyathaduka	12.546	75.204	Kasaragod	0	0	0	0	0	
80	Chandragiri	Pallangod	12.5645	75.2449	Kasaragod	0	0	0	0	0	
81	Mogral	Madhur	12.553	75.011	Kasaragod	0	0	0	0	0	
82	Shiriya	Shiriya D/S	12.662	75.046	Kasaragod	0	0	0	0	0	
83	Shiriya	Shiriya U/S	12.664	75.048	Kasaragod	0	0	0	0	0	
84	Shyria	Angadimugar	12.683	75.008	Kasargode	0					
85	Uppala	Anakkal	12.7511	74.9948	Kasaragod	0	0	0	0	0	
86	Uppala	Uppala	12.692	74.908	Kasaragod	0	0	0	0	0	
87	Manjeswar	Manjeswaram	12.714	74.899	Kasaragod	0	0	0	0	0	

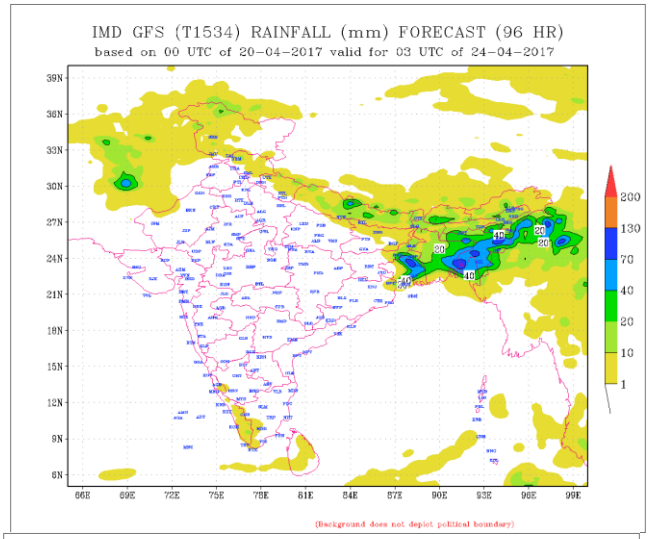
*Truncation level is calculated based on the calendar year (January to December) data covering monsoon and non monsoon period. In most of the gauging stations no discharge is recorded from January to May. Hence the 75% dependability is reduced to zero.

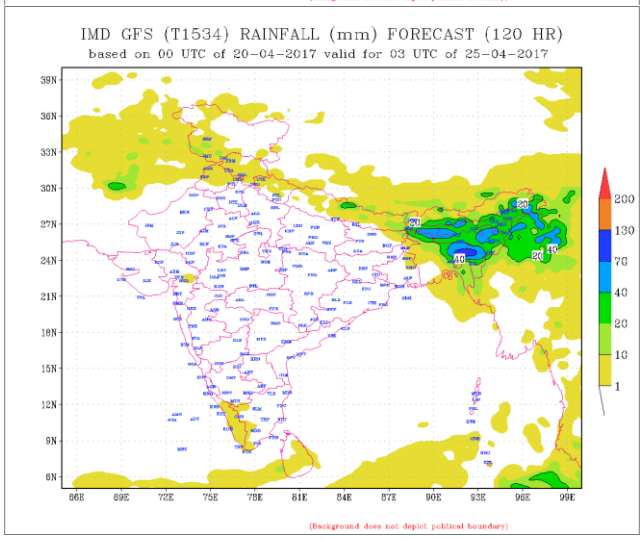
3.2.9 PREDICTIONS FOR NEXT 10 DAYS OF RAINFALL

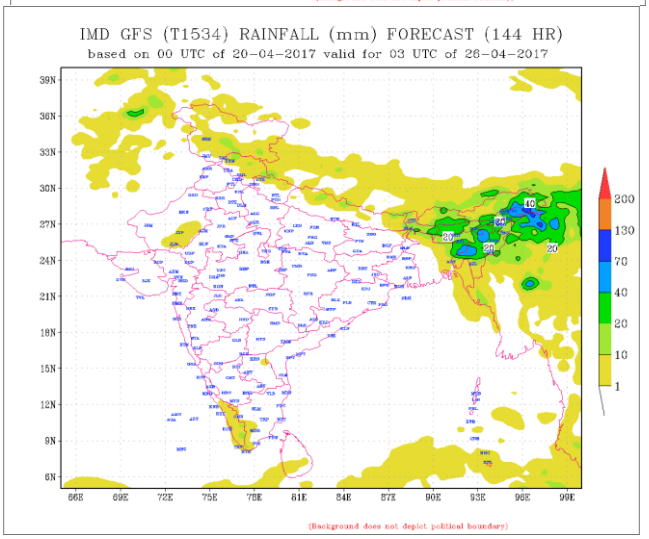


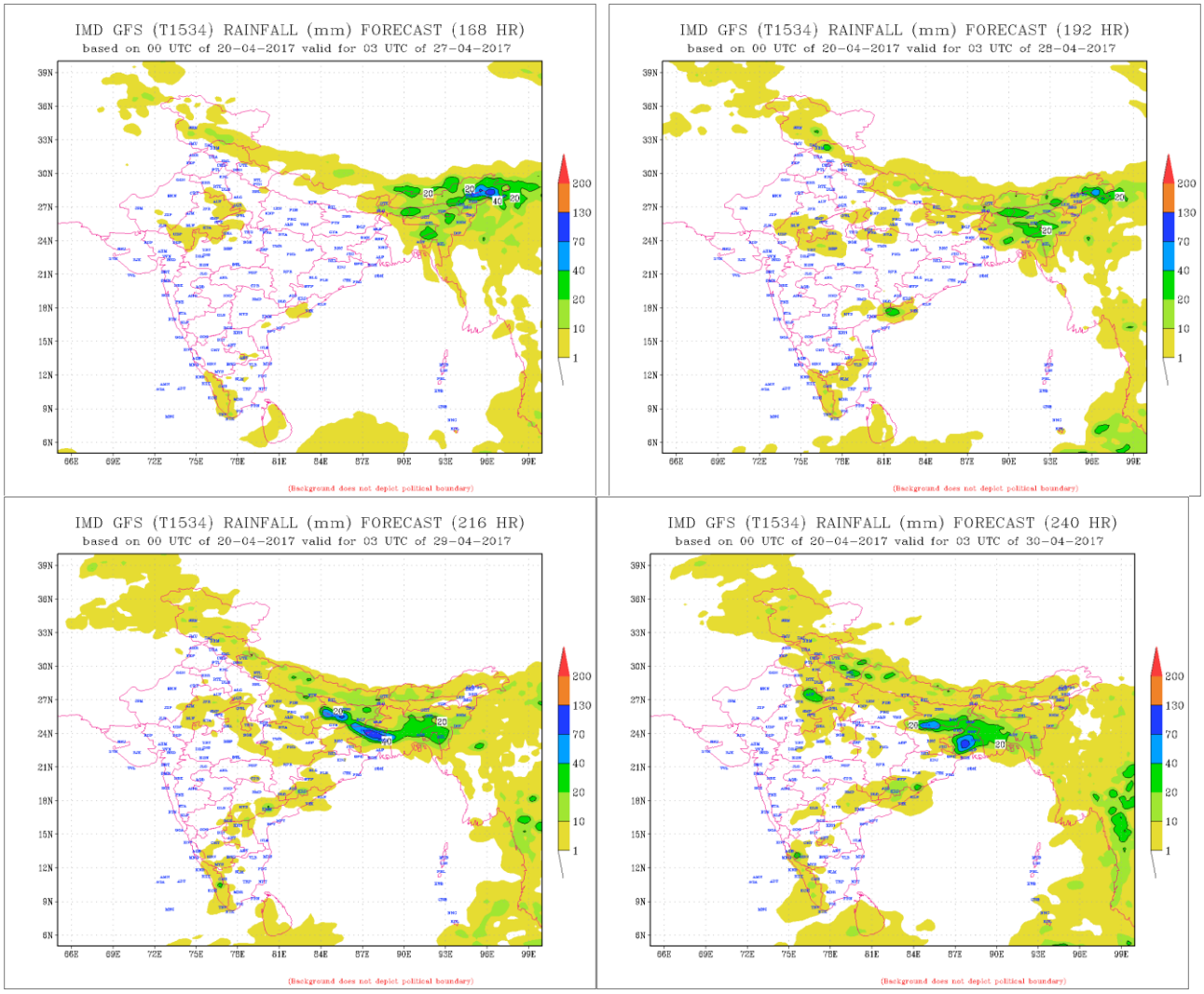












From the forecast for the next 10 days (starting 21-04-2017), rainfall activity over Kerala may be on the lower side. If this trend continues, the situation will be even more difficult in the month of May.

4. RECOMMENDATIONS

Government may consider declaring all the districts based on the evaluation of the deficit of rainfall in the South West Monsoon Season, North East Monsoon Season, Ground Water departure, declining trend of Normalised Vegetation Index, position regarding drinking water supply, river flow data, agricultural crop loss data reported from all districts and the possibility of only trace rainfall (ranging from 1 to 10 mm) for the next 10 days as available from Indian Meteorological Department.

Photo plates indicating the severity of drought

LSGD - Mukkam – Dry Quarry, Kozhikode Photo dtd. 17/01/2017

Rugmavathy, Peruvembu 15.1.2017

Raveendran, Pattanchery 16.1.2017

Malampuzha Reservoir, Palakkad

A dry quarry pond in Adimaly Gramapanchayath, Devikulam Taluk, Idukki (Photo dtd. 14/1/2017)

Fully dried pond at Marayoor Area, Idukki (Photo taken on 15/1/17)

Present drinking water scenario in Vadakarapathi GP in Palakkad

Dried up Chiturpuzha- source of kodumb & polpully-pumping as on 27/01/2017

Bathing Lord Vishnu’s idol of Kollengode temple, Palakkad in a cooking vessel as Gayathri River dried