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GOVERNMENT OF INDIA

MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER YEAR BOOK HIMACHAL PRADESH (2016-2017)

NORTHERN HIMALAYAN REGION
DHARAMSHALA
(H.P)
May, 2018

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By

Rachna Bhatti
Scientist 'B'

NORTHERN HIMALAYAN REGION
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FOREWARD

For an efficient management and development of ground water resources, it is imperative to have a reliable database on water level and water quality. Central Ground Water Board, in addition to various other activities on scientific studies related to groundwater, collects data from a network of National Hydrograph Network Stations also called Ground Water Monitoring Wells and prepares a scientific base for the proper planning and judicious use of available groundwater resources.

Most of the area in Himachal Pradesh is hilly, mountainous with few intermontane valleys in between them. The traditional ground water structures, which are under observation at present, are open wells mostly located in the valley area. Therefore, the ground water regime monitoring programme is concentrated mostly in valley area of the state and at some places in hard rock area. Efforts are however going on to increase the number of observation wells and include the piezometers of state government under the groundwater regime monitoring.

The measurement of these National Hydrograph Network Stations is carried out four times in a year during the month of January, May, August and November and water samples are collected during pre-monsoon period viz., May for chemical analysis. The analysis of the data indicates the changes in ground water scenario and thereby helps in adopting measures if required in the area under monitoring for the sustainable development and management of the ground water resource. The human induced problems like depletion in water level, water logging, can be identified from the maps prepared during the analysis of water level data.

This report presents the water level data for the National Hydrograph Network Stations collected during the year 2016-2017 and its analysis and interpretations in the form of tables, maps and their descriptions to bring out the overall ground water scenario and the changes in ground water regime during the ground water year. The chemical results are awaited and will be issued separately.

The field data has been collected, processed and compiled by the scientific officers of NHR, Dharamsala. This report has been compiled by Rachna Bhatti, Scientist 'B' at CHQ, Faridabad. A untiring work of map preparation was done by Ms Poonam, Draughtsman from CHQ, Faridabad. Over all the work was done under the supervision of ***Sh. Vidya Nand, Scientist 'D'& H.O.O.*** *The efforts of Smt Rachna Bhatti, Scientist 'B' in scrutiny, processing and issuance of report is also highly significant.*

This ground water year book contains useful data for water year 2016-17 for all the planners and user agencies dealing with the development of ground water resources and it is hoped that it would be utilized fully for the real time management of ground water resources in the State.

Dated: 10.05.2018

Dharamshala

(10/5/18)

Vidya Nand
Scientist 'D'& H.O.O

GROUND WATER YEAR BOOK
HIMACHAL PRADESH
2016-2017
EXECUTIVE SUMMARY

- Central Ground Water Board, NHR has set up a network of 128 National Hydrograph Stations in the state of Himachal Pradesh. The monitoring commenced in the year 1969 with the establishment of 3 observation wells and since, then the number of monitoring station are being increased regularly so as to get the overall picture of ground water scenario in different hydrogeological set up of the state.

- Most of the area in Himachal Pradesh is hilly enclosing few small intermontane valleys. The traditional ground water structures under observation at present are dugwells and are mostly located in the valley areas only. Therefore, the ground water regime monitoring programme is concentrated mainly in valley areas of the state and some places in hard rock areas.

- All the 128 National Hydrograph Stations are located only in 7 districts out of the 12 districts in Himachal Pradesh. The reason being hilly terrain, hard approachability and insignificant number of structures available for monitoring.

- The average annual rainfall in the state varies from 600 mm to more than 2400 mm. The rainfall increases from south to north. Dharamshala in district Kangra, receives the 2nd highest rainfall of about 3000 mm in the Country.

- Water levels are being monitored four times in a year during the month of May, August, November and January. Water samples are collected during the month of May every year for chemical analysis of ground water quality.

- The depth to water level, recorded during May 2016 ranged between 0.36m (Mandi district) and 28.23 m bgl (Sirmaur district). Out of 96 stations monitored, the majority of 83 NHS (86.45%) recorded DTWL, in the range between 2 - 20 m bgl. 5 stations (5.20%), recorded shallow water levels, less than 2 m bgl and 8 stations (8.33%), recorded deep water levels, more than 20 m bgl in the state.

- The depth to water level recorded during August 2016 ranges between 0.18 m bgl (Kullu districts) to 27.40 m bgl.

- The depth to water level recorded during November 2016 ranged between 0.41 m bgl in Bahl valley (Mandi district) to 26.33 m bgl in Paonta valley (Sirmaur district).

- The depth to water level recorded during January 2017 ranged between 0.51m (Kangra district) to 27.90 m bgl (Sirmaur district) (Table-7).

- Monsoonal fluctuation of water level was analyzed for 94 stations for the period May 2016 – November 2016. A perusal of Table-8 shows that out of the 94 stations, 80 stations (85.10%) have shown rise in water level and remaining 14 stations (14.89%) have shown fall in water level.

- Out of the 82 stations analysed, 17 stations (20.73%) have shown rise in water level ranging from 0.12 (Sirmaur district) to 7.49 m (Kangra district), whereas 65 stations (79.26%) have shown fall ranging from 0.01m (Mandi district) to 6.52 m (Kangra district).

- Annual fluctuation data of water levels in May 2015 wrt May 2016 shows frequency distribution of rise and fall. Out of the 95 stations, 27 stations (28.42%) have shown rise in water level ranging from 0.03 m (Sirmaur district) to 6.06 m (Una district) whereas 68 stations (71.57%) have shown fall ranging from 0.08 m (Kullu district) to 9.32 m (Una district).

- Annual fluctuation of water level has been worked out by comparing DTW of November 2015 with November 2016. Out of the 93 stations, 27 stations (29.03%) have shown rise in water level ranging from 0.03m (Mandi district) to 2.34 m (Kangra district) whereas 66 stations (70.96%) have shown fall ranging from 0.02 m (Kangra district) to 11.34 m (Sirmaur district).

- Annual fluctuation of water level has been worked out by comparing depth to water level of January 2016 with January. Out of the 81 stations analysed, 33 stations (40.74%) have shown rise in water level ranging from 0.07 (Kangra district) to 6.99 m (Una district) whereas 48 stations (59.25%) have shown fall ranging from 0.05 (Kangra district) to 6.32 m (Kangra district).

- Decadal water level fluctuation has been worked out by comparing water level data of May 2016 with the average mean of 10 years water level data of May (2006-2015.A perusal of data shows that out of 95 stations analysed, 36 stations (37.89%) have shown rise and 59 stations (62.10%), have shown fall in water level. 30 stations (83.33%) are showing rise in water level between 0 to 2m, 3 stations (8.33%) between 2 to 4m. and 3 stations (8.33%), more than 4m.

- Decadal water level fluctuation has been worked out by comparing water level data of August 2016 with the average 10 years water level data of August (2006-2015). A perusal of data shows that out of 99 stations analysed, 38 stations (38%) have shown rise and 61 stations (61%), have shown fall in water level. 33 stations (86.84%) are showing rise in water level between 0 to 2m, 3 stations (7.89%) between 2 to 4m. and 2 stations (5.26%), more than 4m.

- Decadal water level fluctuation has been worked out by comparing water level data of November 2016 with the average water level data of November for 10 years (2006-2015). A perusal of data shows that out of 99 stations analysed, 39 stations (39.39%) have shown rise and 60 stations (60.60%), have shown fall in water level. 32 stations (82.05%) are showing rise in water level between 0 to 2m, 5 stations (12.82%) between 2 to 4m. and 2 stations (5.1%), more than 4m.

- Decadal water level fluctuation has been worked out by comparing water level data of January 2017 with the average water level data of January for 10 years (2007-2016). A perusal of data shows that out of 86 stations analysed, 37 stations (43.02%) have shown rise and 49 stations (56.97%), have shown fall in water level. 29 stations (78.37%) are showing rise in water level between 0 to 2m, 3 stations (8.10%) between 2 to 4m. and 5 stations (13.5%), more than 4m. Out of 49 stations, 37 stations (75.51%) show fall in water level between 0 to 2m, 10 stations (20.40%) between 2 to 4 m and 2 stations (4.08%) more than 4m.

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1.0 INTRODUCTION

Himachal Pradesh is located between the north latitude 30°22'40" & 33°12'40" and east longitude 75°47'55" & 79°04'20". It falls in Survey of India topographic sheets Nos. 52D, 52H, 52L, 53A, 53B, 53F, 53E and 53I and covers an area of 55,673 sq km. It is one of the predominantly hilly states in India, which lies in the western Himalayas. The length of Himachal Pradesh is about 355 km i.e. from northwestern part of Chamba to southeastern part of Kinnaur. The breadth of the state is about 270 km i.e. from western part of Una to northeast part of Lahaul and Spiti disrtict. The state is bounded by the state of Jammu & Kashmir in north, Punjab state in west, Haryana state in south and Uttrakhand state in southeast and shares an international border with China (Tibet) in northeast.

Administratively, the state is divided in 12 districts, 76 tehsils, 34 sub-tehsils and 75 blocks. There are 20,118 villages, 3,037 Gram Panchayats, 57 towns, 28 Nagar Panchayats and 21 Nagar Parishads including Municipal Corporations. Lahaul & Spiti is the largest and Hamirpur is the smallest district of the state with geographical area of 12,835 and 1,118 sq km respectively.

The state has a population of 68,64,602 persons (Census 2011) having an average population density of 128 person per sq km. The male population in the state is 34,81,873 persons and female population is 33,82,729. The rural and urban population in the state is 61,76,050 and 6,00,552 persons respectively. The density of population in the state varies from as low as 2 persons/sq.km in Lahaul and Spiti district to 406 persons/sq km in Hamirpur district as compared to the state average of 128 persons/sq km.

Himachal region presents an intricate mosaic of mountain ranges, hills and valleys with altitude ranging from 350 m to 6500 m amsl. The Dhauladhar range looks in supreme majesty over the Kangra valley while the Pir Panjal, the Great Himalaya and the Zanskar ranges guard over Chamba, Lahaul & Spiti, Kullu and Kinnaur districts. The mountain slopes are covered with forests and meadows. The valleys below are interspersed with numerous streams, fields and quiet homesteads. There is general increase in elevation from east to west and from south to north. The physiographic divisions from south to north are the Outer Himalayas also known as Siwaliks (350 to 1500 m amsl), the Lesser Himalayan Range (1500-5000 m amsl), Great Himalayan Range (5000 – 6000 m amsl) and Zanskar Range (> 6000 m amsl)

Himachal state has a unique distinction of having drainage systems of both the Indus and the Ganga basin. The major river systems of the region are the Chandra-Bhaga or the Chenab, the Ravi, the Beas, the Satluj and the Yamuna. The catchments of these rivers are fed by snow and rainfall,

and are protected by fairly extensive cover of natural vegetation. Major rivers of the Indus river basin are the Chenab, the Ravi, the Beas and the Satluj. The Yamuna is the only river contributing water to Ganga basin.

The southwestern monsoon contributes about 70% of rainfall during monsoon period from July to September and about 30% occurs during non-monsoon period due to western disturbances and in the form of thunderstorm. Generally, rainfall increases from south to north. Western disturbances also shower rainfall in winters. Beyond Kullu towards Lahaul & Spiti and Kinnaur, rainfall decreases due to rain shadow effect. Spiti is the driest area with 50 mm rainfall because of being enclosed by High Mountain from all sides. The average annual rainfall in the districts of the state varies from about 600 mm in Lahaul & Spiti to more than 2400 mm in Kangra.

Central Ground Water Board, under part of its national ground water monitoring programme has established a network of observation stations in the state for periodic monitoring of ground water level and water quality. The ground water regime monitoring programme commenced during the year 1969 when the erstwhile groundwater wing of Geological Survey of India established 3 stations in the State. At present there are 110 Ground Water Monitoring Station (GWMS) in Himachal Pradesh. The year wise increase in GWMS in the State is given in Table-1.

Table-1: Year wise increase in GWMS, Himachal Pradesh

Year	Total Number of Ground Water Monitoring Stations
1969-73	3
1974-77	19
1978	32
1979	34
1980	35
1981	68
1982	69
1983-88	71
1989	72
1990-2000	79
2000-2010	86
2011-2013	102
2015-2016	111
2016-2017	128

The ground water monitoring is being carried out by Northern Himalayan Region, Dharamshala, since 1996. All the 128 GWMS are dug wells and are located in 7 districts of Himachal Pradesh out of the 12 districts. The reason for not monitoring other districts is being the hard approachability due to terrain conditions and non- availability of ground water monitoring structures. The district wise

break up of Ground Water Monitoring Stations and their occurrence in different hydrogeological setup is given in Table-2.

Table-2: District wise GWMS & hydrogeological setup

S. No	District	Number of GWMS			
		Total	Valley Area Porous Formation (Quaternary)	Fissured Formation (Tertiary)	Fissured Formation (Proterozoic to Mesozoic)
1.	Hamirpur	4	4	-	-
2.	Kangra	46	31	15	-
3.	Kullu	4	4	-	-
4.	Mandi	9	9	-	-
5.	Sirmaur	17	15	2	-
6.	Solan	16	16	-	-
7.	Una	31	31	-	-
8.	Chamba	1	-	1	-
TOTAL		**128**	**110**	**18**	**-**

2.0 HYDROGEOLOGY

The major part of Himachal Pradesh is hilly and mountainous with few small intermontane valleys covering about 15% of the area. These valleys comprise of alluvial deposits, which form extensive aquifers and thus represent porous formations. Major valleys in the state are Indora-Nurpur and Kangra-Palampur valleys in district Kangra, Una valley in district Una, Balh valley in district Mandi, Nalagarh valley in district Solan and Paonta valley in district Sirmaur.

The Siwalik and Sirmaur group represent the Tertiary formation in the state. These two groups occur in the western part of the state and have northwest to southeast trend. The Siwalik comprises of boulder, conglomerate, sandstone and clay while, Sirmaur group comprises of shale, sandstone and clay. The primary porosity and permeability in the Tertiary formation is low to moderate and hence, these aquifers do not form high yielding aquifers.

The older rock formations of Proterozoic to Mesozoic eras constitute of igneous and metamorphic rocks like granite, gneiss, slate, schist, phyllite, quartzite etc. Because of their consolidated nature, these rock formations serve as poor aquifers. However, due to tectonic movements, they have been traversed by faults, thrust and joints, which have enhanced their ground water potential.

The quality of ground water in hard rocks and alluvial areas is by and large good and suitable for domestic and irrigational use. The distribution of the hydrogeological formations discussed above and their yield potential are given below in Table -3.

Table-3: Hydrogeological Formations and their Yield Potential, in Himachal Pradesh

Age	Rock Formation	Districts	Hydrogeological Characteristics
POROUS FORMATIONS			
Recent to sub Recent	Boulder, Cobble, Pebble, Sand, Silt, Clay,	Kangra, Una, Solan, Sirmaur, Mandi and Kullu	High Yield 30-75 m^3/hr
FISSURED FORMATIONS			
Tertiary	Boulder Conglomerate Sandstone, Clay	Kangra, Solan, Sirmaur Bilaspur, Una, Mandi, and Hamirpur .	Moderate to Low Yield < 30 m^3/hr
Proterozoic to Mesozoic	Shale, Slate, phyllite, Limestone, dolomite, Sandstone, Quartzite, Granite, Schist,	Lahaul & Spiti, Kinnaur, Chamba, Mandi, Simla, Kangra, Sirmaur, Solan, and Kullu	Moderate to Low Yield < 5 to 30 m^3/hr

2.1 Proterozoic to Mesozoic Formations

Older formations of Proterozoic to Mesozoic age are constituted by groups like Sundernagar group, Shali-Deoban-Largi group, Vaikrita group, Jutogh group, Simla group, Krol group, Tal group, Kuling group, Lilang group, Tandi group etc. These groups comprise of granites, gneisses, slates, schists, phyllites, quartzites etc. and occur in Kangra, Chamba, Lahaul & Spiti, Kinnaur, Simla, Sirmaur, Kullu and Solan districts. These rocks are dense and consolidated in nature therefore; they bear low primary porosity and permeability, thus forming poor yielding hard rock aquifers. Secondary porosities have developed due to the tectonic movements. Weathered, fractured and contact zones however, form potential ground water zones.

Groundwater in hard rocks area is either developed though bore wells or springs at favorable locations. Springs are the major ground water sources in these formations and its yield ranges from seepages to more than 25 lps and are utilized for both domestic and irrigation purposes. Weathered mantle in low topographic areas, also forms poor aquifers. In some areas, percolation wells are also constructed. *Bowris* are also constructed in oozing out spring zones, for collection of water to fulfill the domestic water needs. Number of hot water springs also occurs in these formations.

2.2 Tertiary Formations

The upper Tertiary formations ranging in age from Middle Miocene to Lower Pleistocene are represented by the rocks of Siwalik group and extend from northwest to southeastern part of the state. It comprises of great thickness of cobbles, pebbles, detritus rocks, clays and conglomerates. The Siwalik chain is widest in the valley of river Beas. On paleontological grounds the Siwalik are subdivided into three subgroups namely upper, middle and the lower Siwaliks.

The lower Tertiary formations ranging in age from Eocene to Lower Miocene are represented by the rocks of Sirmaur group. The Sirmaur group has also been sub-divided into three formations namely Kasauli, Dagshai and Subathu. The group comprises of shale, sandstone and clay. The Sirmaur group is separated by a fault from the Siwaliks.

Fracture zones and contact zones form important aquifers in the low topographic areas with poor to moderate yields. Yields of the tube wells are less than $30m^3$/hr constructed along the fault/ fracture/contact zones. These fractures or faults zones form potential ground water zones for development.

2.3 Quaternary Formations

The Quaternary formations occur either as major or minor valley fills/piedmont/fluvio-glacial deposits and alluvium. The major valley fill areas are Nurpur – Jawali – Nagrota Surian, Pragpur – Dadasiba, Palampur – Kangra valley fills in Kangra district; Shathlai and Sirkhad in Hamirpur district; Balh valley in Mandi district; Una valley in Una district; Nalagarh valley in Solan district; Paonta valley in Sirmaur district; Spiti valley in Lahaul & Spiti district. Ground water occurs under phreatic to semi-confined conditions in these deposits. In some of the valleys like Indora – Nurpur valley in Kangra district and Balh valley in Mandi district, confined aquifers are encountered.

The thickness of valley fills in Paonta, Una, Nalagarh, Nurpur and Andaura are generally more than 100 m whereas, in other areas its thickness is within 100 m. Groundwater occurs under unconfined to confined conditions. In general, depth to water level varies from 5 to about 60 m bgl. Artesian conditions also exist in lower and central part of Una valley, lower part of Nurpur, Andaura and Balh valley fills.

Ground water occurs under unconfined conditions in shallow valley fills areas developed along the river/streams. Discontinuous aquifers system is observed in Kangra, Sirmaur, Solan and Una districts. Depth to water level varies from < 2 to 20 m bgl. Ground water is developed through open dug wells, shallow and deep tube wells. The discharge of the tube wells varies up to 40 lps but generally ranges between 15 to 25 lps. There are about 8000 tube wells constructed including exploratory wells of CGWB in the valley fill deposits both for drinking and irrigation purpose. A large number of shallow boreholes fitted with hand pumps also exist in the state for developing groundwater.

3.0 GROUND WATER SCENARIO

The ground water level in the state is monitored regularly to have a review over the changes in ground water regime. The maps generated from these data help in identifying the areas, which are under water level rising and water level declining. With the help of these maps, suitable measures as per the demand of the area can be adopted for the sustainable ground water development. It also helps the planners to formulate the future strategy in various fields of ground water development.

For the purpose of presentation, the water levels and their changes are shown separately in alluvial and hard rock areas because of aquifer discontinuity. As discussed earlier, the major alluvial areas are Indura-Nurpur and Kangra-Palampur valley in district Kangra, Una valley in district Una, Balh valley in district Mandi, Nalagarh valley in district Solan and Paonta valley in district Sirmaur. In hard rock areas point values are given at places.

The water level is being monitored in the State four times in a year

1. May : 20th to 30th : represents water level of Pre-monsoon period
2. August : 20th to 30th : represents peak monsoon water level.
3. November : 1st to 10th : represents water level of Post-monsoon period.
4. January : 1st to 10th : represents the recession stage of water level

The data has been analyzed for each set of measurement and report has been prepared which include following maps to understand the groundwater regime in the area.

A.	Depth to water level maps	:	Water level scenario for the month in the area.
B.	Seasonal fluctuation maps	:	Water level fluctuation in comparison to Pre-monsoon.
C.	Annual fluctuation maps	:	Water level fluctuation in comparison to same month in the previous year.
D.	Decadal mean fluctuation maps	:	Water level fluctuation in the month of measurement with reference to the decadal average for the same month.

The depth to water level, seasonal fluctuation and annual fluctuation has been presented in Annexure-I, II and III. The decadal mean fluctuation has been tabulated in Annexure-IV. The ground water behavior in the seven districts of Himachal Pradesh has been discussed below.

3.1 Depth to Water Level

3.1.1 May 2016

The depth to water level, recorded during May 2016 (Annexure - I), ranged between 0.36m (Mandi district) and 28.23 m bgl (Sirmaur district) (Table-3). Out of 96 stations monitored, the majority of 83 NHS (86.45%) recorded DTWL, in the range between 2 - 20 m bgl. 5 stations (5.20%), recorded shallow water levels, less than 2 m bgl and 8 stations (8.33%), recorded deep water levels, more than 20 m bgl in the state.

A perusal of the DTWL map of May 2016 shows that the shallow water level area of less than 2m bgl, occurs in eastern part of Kangra Palampur valley mainly in Mandi district. 2-5 m bgl and 5-10 m bgl water level occupies in most of the monitoring area of all the valleys of Himachal Pradesh, water level 10-20m bgl in shown in major part of Kangra Palampur valley. Deeper water levels, between 20-40m bgl are shown in Northern part of Paonta valley, outer fringes of Nalagarh valley and whole south western part of Una valley.

Table-3: District wise number & % of NHS distribution, in different DWL of May 2016

Depth to Water Table
Distribution of Percentage of Observation Wells
2016/May

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0.0 - 2.0	2.0 - 5.0	5.0 - 10.0	10.0 - 20.0	20.0 - 40.0	> 40.0
HAMIRPUR	4	2.91	8.69	0	2 50.00%	2 50.00%	0	0	0
KANGRA	33	0.51	15.10	2 6.06%	18 54.55%	7 21.21%	6 18.18 %	0	0
KULLU	1	6.01	6.01	0	0	1 100.00%	0	0	0
MANDI	7	0.36	6.56	2 28.57%	4 57.14%	1 14.29%	0	0	0
SIRMAUR	10	2.33	28.23	0	1 10.00%	2 20.00%	6 60.00 %	1 10.00%	0
SOLAN	10	6.15	27.50	0	0	2 20.00%	3 30.00 %	5 50.00%	0
UNA	31	1.16	21.47	1 3.23%	13 41.94%	11 35.48%	4 12.90 %	2 6.45%	0
Total	96	0.36	28.23	5	38	26	19	8	0

3.1.2 August 2016

The depth to water level recorded during August 2016 (Annexure - I) ranges between 0.18 m bgl (Kullu districts) to 27.40 m bgl (Solan district) (Table-5). Out of the 99 stations monitored the majority of 63 stations (63.6%) recorded DTW in the range between 2-20 m bgl, 30 stations (30.1%) have recorded shallow water level less than 2 m bgl, and only 6 stations (6.1%) have shown, more than 20 m bgl in the state.

A perusal of the DTW map for August 2016 indicates that the shallow water level area less than 2m bgl occurs in all the valleys of Himachal Pradesh, except Nalagarh and Paonta valley, mainly in Balh valley (Mandi district), all the valleys of Kangra district including Kangra Palampur valley and

Nurpur Indaura valley and eastern & central part of Una valley. 2-5m bgl and 5-10 m bgl water level is recorded in couple of pockets in almost all the valley areas. 10 -20 m bgl water level is recorded in pockets in Una Valley, eastern part of Paonta valley and in fringes of Nalagarh valley. Deeper water levels are found at some places in Nalagarh and Una valley.

Table-5:– Depth to water level - August 2016

2.1

Depth to Water Table
Distribution of Percentage of Observation Wells
2016/Aug

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0.0 - 2.0	2.0 - 5.0	5.0 - 10.0	10.0 - 20.0	20.0 - 40.0	> 40.0
HAMIRPUR	4	1.61	5.74	2 50.00%	1 25.00%	1 25.00%	0	0	0
KANGRA	34	0.19	6.70	16 47.06%	14 41.18%	4 11.76%	0	0	0
KULLU	2	0.18	5.16	1 50.00%	0	1 50.00%	0	0	0
MANDI	8	0.32	4.70	3 37.50%	5 62.50%	0	0	0	0
SIRMAUR	11	1.35	20.52	1 9.09%	4 36.36%	2 18.18%	3 27.27 %	1 9.09%	0
SOLAN	10	4.75	27.40	0	2 20.00%	1 10.00%	4 40.00 %	3 30.00%	0
UNA	30	0.46	21.62	7 23.33%	13 43.33%	4 13.33%	4 13.33 %	2 6.67%	0
Total	99	0.18	27.40	30	39	13	11	6	0

3.1.3 November 2016

The depth to water level recorded during November 2016 (Annexure - I) ranged between 0.41 m bgl in Bahl valley (Mandi district) to 26.33 m bgl in Paonta valley (Sirmaur district) (Table-6). Out of 99 stations monitored, the majority of 51 NHS (51%) recorded DTWL, in the range between 2 - 20 m bgl. 19 stations (19%), recorded shallow water levels, less than 2 m bgl and 6 stations (6.06%), recorded deep water levels, more than 20 m bgl in the State.

A perusal of the DTWL map for November 2016 shows that the shallow water level areas of less than 2 m observed in eastern part of Kangra Palampur valley and in pockets of all the valleys, except Nalagarh and Paonta valleys. Water level of 2-5m & 5-10 m bgl is observed in major part of Kangra Palampur valley, whole of Indaura-Nurpur valley, Balh valley, central part of Una Valley, Nalagargh valley Paonta valley respectively. 10-20 m bgl water level is shown in Una, Nalagah and Paonta valley only. Deeper water level more than 20m is confined mainly in eastern part of Paonta valley in Sirmaur district, southern part of Nalagarh valley of Solan district and small part of Una valley.

Table- 6: Depth to Water Level – November 2016

2.1

Depth to Water Table
Distribution of Percentage of Observation Wells
2016/Nov

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0.0 - 2.0	2.0 - 5.0	5.0 - 10.0	10.0 - 20.0	20.0 - 40.0	> 40.0
HAMIRPUR	4	2.68	7.74	0	2 50.00%	2 50.00%	0	0	0
KANGRA	33	0.49	9.80	8 24.24%	17 51.52%	8 24.24%	0	0	0
KULLU	2	0.98	7.31	1 50.00%	0	1 50.00%	0	0	0
MANDI	8	0.41	5.79	3 37.50%	3 37.50%	2 25.00%	0	0	0
SIRMAUR	12	2.00	26.33	1 8.33%	2 16.67%	2 16.67%	6 50.00 %	1 8.33%	0
SOLAN	9	3.85	25.95	0	1 11.11%	1 11.11%	4 44.44 %	3 33.33%	0
UNA	31	0.58	22.76	6 19.35%	10 32.26%	9 29.03%	4 12.90 %	2 6.45%	0
Total	99	0.41	26.33	19	35	25	14	6	0

3.1.4 January 2017

The depth to water level recorded during January 2017 (Annexure - I) ranged between 0.51m (Kangra district) to 27.90 m bgl (Sirmaur district) (Table-7). Out of 86 stations which are monitored, the majority of 65 NHS (75.58%) recorded DTW in the range between 2 - 20 m bgl. 16 stations (18.60%) recorded shallow water levels, less than 2 m bgl and 5 stations (5.81%) recorded deep water levels, more than 20 m bgl in the state.

A perusal of the DTW map of January 2017 shows that the shallow water level area occurs mainly in south eastern part of Kangra Palampur valley (Kangra district), southern part of Balh valley (Mandi district). 2-5 m bgl & 5-10m bgl water level is depicted in all the valleys of Himachal Prasesh. 10-20 m bgl water level occupies Paonta valley and small parts of Nalagarh and Una valley. Deeper water level, more than 20m are confined mainly in eastern part of Paonta valley, Nalagargh and at few places of Una valley.

Table- 7: Depth to Water Level – January 2017

2.1

Depth to Water Table
Distribution of Percentage of Observation Wells
2017/Jan

State : Himachal Pradesh

District	No. of Wells Analysed	Depth to Water Table (mbgl)		No. / Percentage of Wells Showing Depth to Water Table (mbgl) in the Range of					
		Min	Max	0.0 - 2.0	2.0 - 5.0	5.0 - 10.0	10.0 - 20.0	20.0 - 40.0	> 40.0
HAMIRPUR	3	1.94	8.22	1 33.33%	1 33.33%	1 33.33%	0	0	0
KANGRA	31	0.51	11.95	6 19.35%	20 64.52%	2 6.45%	3 9.68 %	0	0
KULLU	2	1.49	6.65	1 50.00%	0	1 50.00%	0	0	0
MANDI	8	0.61	7.09	3 37.50%	3 37.50%	2 25.00%	0	0	0
SIRMAUR	11	2.25	27.90	0	2 18.18%	3 27.27%	5 45.45 %	1 9.09%	0
SOLAN	5	4.40	24.30	0	1 20.00%	1 20.00%	1 20.00 %	2 40.00%	0
UNA	26	0.97	22.82	5 19.23%	9 34.62%	8 30.77%	2 7.69 %	2 7.69%	0
Total	86	0.51	27.90	16	36	18	11	5	0

3.2 Seasonal Water Level Fluctuation

To study the effect of monsoon and subsequent utilization for various needs like agriculture, irrigation and domestic etc, changes in water level are studied and are discussed below.

3.2.1 May 2016 to November 2016

Monsoonal fluctuation of water level was analyzed for 94 stations for the period May 2016 – November 2016. A perusal of Table-8 shows that out of the 94 stations, 80 stations (85.10%) have shown rise in water level and remaining 14 stations (14.89%) have shown fall in water level.

The minimum rise in water level of 0.01 m was observed in Hamirpur District and the maximum rise 9.58 m was noticed in Kangra District. Out of the 80 stations which have shown rise in water level, 57 stations (71.25%) show rise between the range of 0 to 2m, 14 stations (17.5%) between 2 to 4m and remaining 9 stations (11.25%) show rise more than 4m.

The minimum and maximum fall in water level of 0.02 m and 3.00 m was observed in Mandi and Solan District. Out of them 12 stations (85.71%) have shown fall between 0-2 m, 2 stations (14.28%) have shown fall between 2-4 m. No station has shown fall >4m.

A perusal of map for seasonal fluctuation shows a rise in water level in major part of Paonta valley, Nalagargh valley, Una valley, Balh valley and Kangra valley. Except a fall which is noticed in eastern part of Paonta valley and southern part of Balh valley.

Table-8: Monsoonal Fluctuation - May 2016 to November 2016

District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other

From Year: 2016/May - **To Year:** 2016/Nov

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.01	0.95	-	-	4 100.00%	0	0	0	0	0	4	0
KANGRA	32	0.02	9.58	2.07	2.07	17 53.13%	8 25.00 %	6 18.75%	0	1 3.13%	0	31	1
KULLU	1	-	-	1.30	1.30	0	0	0	1 100.0%	0	0	0	1
MANDI	7	0.07	0.77	0.02	0.65	3 42.86%	0	0	4 57.14%	0	0	3	4
SIRMAUR	10	0.33	4.31	0.32	1.62	5 50.00%	2 20.00 %	1 10.00%	2 20.00%	0	0	8	2
SOLAN	9	0.35	5.55	1.00	3.00	4 44.44%	1 11.11 %	2 22.22%	1 11.11%	1 11.11%	0	7	2
UNA	31	0.04	3.47	0.06	1.97	24 77.42%	3 9.68 %	0	4 12.90%	0	0	27	4
Total	94	0.35	0.77	0.00	3.00	57	14	9	12	2	0	80	14

3.3 Annual Water Level Fluctuation

Annual fluctuation in water level of GWMS during different monitoring periods were analysed and discussed below.

3.3.1 May 2015 to May 2016

Annual fluctuation of water level, has been worked out by comparing depth to water level of May 2015, with May 2016 and the data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-9.

Out of the 82 stations analysed, 17 stations (20.73%) have shown rise in water level ranging from 0.12 (Sirmaur district) to 7.49 m (Kangra district), whereas 65 stations (79.26%) have shown fall ranging from 0.01m (Mandi district) to 6.52 m (Kangra district).

Out of stations which have shown rise in water level, 15 stations (88.23%) show rise between the range of 0 to 2m, no station has shown rise between 2 to 4m and only 2 stations (11.76%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 51 stations (78.46) show fall between the range of 0 to 2m, 12 stations (18.46%) between 2 to 4m and remaining 2 stations (3.07%) show fall more than 4m.

A perusal of map of Annual Water Level Fluctuation for May 2015 to May 2016 shows fall in water level in majority of monitoring areas. Fall of 0-2m in shown in Nurpur Indora valley and Kangra Palampur valley of Kangra district, Nalagarh valley of Solan district and major part of Paonta valley of Sirmour district. Fall >4 m is noticed in small pockets. Rise in water level is noticed

in Kangra Palampur valley, Balh valley, and southern part of Nalagarh valley and at some places in Paonta valley.

Table-9: District wise number & % of NHS distribution in different Annual W/L Fluctuation Range (May 2015 - May 2016)

District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other

From Year: 2015/May - **To Year:** 2016/May

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	3	-	-	0.26	2.17	0	0	0	2 66.67%	1 33.33%	0	0	3
KANGRA	27	0.09	7.49	0.16	6.52	4 14.81%	0	1 3.70%	16 59.26%	5 18.52%	1 3.70%	5	22
KULLU	1	-	-	1.37	1.37	0	0	0	1 100.0%	0	0	0	1
MANDI	7	0.30	0.56	0.01	1.13	4 57.14%	0	0	3 42.86%	0	0	4	3
SIRMAUR	10	0.12	1.28	0.25	2.95	4 40.00%	0	0	5 50.00%	1 10.00%	0	4	6
SOLAN	9	0.20	6.30	0.10	5.70	2 22.22%	0	1 11.11%	3 33.33%	2 22.22%	1 11.11%	3	6
UNA	25	0.04	0.04	0.04	3.22	1 4.00%	0	0	21 84.00%	3 12.00%	0	1	24
Total	82	0.30	0.04	0.01	6.52	15	0	2	51	12	2	17	65

3.3.2 August 2015 to August 2016

Annual fluctuation data of water level is presented in Annexure – III and its frequency distribution of rise and fall is given in Table-10. Out of the 95 stations, 27 stations (28.42%) have shown rise in water level ranging from 0.03 m (Sirmaur district) to 6.06 m (Una district) whereas 68 stations (71.57%) have shown fall ranging from 0.08 m (Kullu district) to 9.32 m (Una district).

Out of stations which have shown rise in water level, 24 stations (88.89%) show rise between the range of 0 to 2m, 2 stations (7.40 %) between 2 to 4m and remaining 1 stations (3.70%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 45 stations (66.17%) show fall between the range of 0 to 2m, 19 stations (27.94%) between 2 to 4m and remaining 4 stations (5.89%) show fall more than 4m.

A perusal of map of Annual Water Level Fluctuation for August 2016 to August 2017 shows fall in water level in majority of monitoring areas except a rise in eastern part of Kangra Palampur valley, Bahl valley, in small pockets of Indora-Nurpur valley and in small patches of Una valley and Paonta valley. Majority of the area is showing water level fall in all the valleys, under monitoring area. The water level fall has been observed in whole of Nalagarh valley.

Table-10: Annual Fluctuation August 2015 - August 2016

District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other

From Year: 2015/Aug - **To Year:** 2016/Aug

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.40	0.70	0.21	0.97	2 50.00%	0	0	2 50.00%	0	0	2	2
KANGRA	32	0.05	2.00	0.14	4.49	13 40.63%	0	0	14 43.75%	4 12.50%	1 3.13%	13	19
KULLU	1	-	-	0.18	0.18	0	0	0	1 100.0%	0	0	0	1
MANDI	7	0.07	0.24	0.08	0.53	4 57.14%	0	0	3 42.86%	0	0	4	3
SIRMAUR	11	0.03	0.08	0.23	2.70	2 18.18%	0	0	5 45.45%	4 36.36%	0	2	9
SOLAN	10	-	-	0.35	7.30	0	0	0	4 40.00%	4 40.00%	2 20.00%	0	10
UNA	30	0.06	6.06	0.09	9.32	3 10.00%	2 6.67 %	1 3.33%	16 53.33%	7 23.33%	1 3.33%	6	24
Total	95	0.40	0.08	0.08	9.32	24	2	1	45	19	4	27	68

3.3.3 November 2015 to November 2016

Annual fluctuation of water level has been worked out by comparing DTW of November 2015 with November 2016 and data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-11. Out of the 93 stations, 27 stations (29.03%) have shown rise in water level ranging from 0.03m (Mandi district) to 2.34 m (Kangra district) whereas 66 stations (70.96%) have shown fall ranging from 0.02 m (Kangra district) to 11.34 m (Sirmaur district).

Out of stations which have shown rise in water level, 25 stations (92.59%) show rise between the range of 0 to 2m, 2 stations (7.40 %) between 2 to 4m and no station show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 54 stations (81.81%) show fall between the range of 0 to 2m, 10 station (15.15%) between 2 to 4m and remaining 2 stations (3.03%) show fall more than 4m.

A perusal of map of annual fluctuation of November 2015 to November 2016 showing fall in water levels in majority of valley areas. Una valley is completely under fall conditions. 0-2m fall is shown in major part of Paonta valley, more than 4m is observed in the small pocket of Una, Indora & Paonta valley. Similarly rise in water level 0-2m is noticed along the fringe areas of Kangra valley, complete area of Nalagargh valley and central part of Paonta valley.

Table-11: Annual Fluctuation -November 2015 to November 2016

District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other

From Year: 2015/Nov - **To Year:** 2016/Nov

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	3	0.22	0.22	0.85	0.94	1 33.33%	0	0	2 66.67%	0	0	1	2
KANGRA	30	0.05	1.30	0.02	4.20	12 40.00%	0	0	15 50.00%	2 6.67%	1 3.33%	12	18
KULLU	2	-	-	0.38	2.17	0	0	0	1 50.00%	1 50.00%	0	0	2
MANDI	8	0.03	0.18	0.09	0.72	3 37.50%	0	0	5 62.50%	0	0	3	5
SIRMAUR	12	0.35	1.65	0.07	11.34	4 33.33%	0	0	6 50.00%	1 8.33%	1 8.33%	4	8
SOLAN	7	2.10	2.10	0.45	3.75	0	1 14.29 %	0	4 57.14%	2 28.57%	0	1	6
UNA	31	0.04	2.34	0.27	3.88	5 16.13%	1 3.23 %	0	21 67.74%	4 12.90%	0	6	25
Total	93	2.10	0.18	0.02	11.34	25	2	0	54	10	2	27	66

3.3.4 January 2016 to January 2017

Annual fluctuation of water level has been worked out by comparing depth to water level of January 2016 with January 2017 and data is presented in Annexure – III and its frequency distribution in various rise and fall ranges is given in Table-12. Out of the 81 stations analysed, 33 stations (40.74%) have shown rise in water level ranging from 0.07 (Kangra district) to 6.99 m (Una district) whereas 48 stations (59.25%) have shown fall ranging from 0.05 (Kangra district) to 6.32 m (Kangra district).

Out of stations which have shown rise in water level, 28 stations (84.84%) show rise between the range of 0 to 2m, 3stations (9.09%) between 2 to 4m and remaining 2 stations (6.06%) show rise more than 4m.

Similarly, for the stations which have shown fall in water level, 41 stations (85.41%) show fall between the range of 0 to 2m, 5 stations (10.41%) between 2 to 4m and remaining 2 stations (4.16%) show fall more than 4m.

A perusal of map of annual fluctuation of January 2016 to January 2017 is showing fall & rise, about in same proportions. The fall in water level 0-2m is shown in Indora valley, and few places of Kangra Palampur valley, Balh valley, a part of Nalagargh valley, part of Una valley and a part of Paonta valley. Fall in water level, more than 4m is observed in the small pockets of Una valley only. Similarly rise in water level 0-2m is noticed in central & southern part of Kangra valley, southern part of Balh valley, southern part of Una valley and a small part of Paonta valley.

Table-12: Annual Fluctuation, January 2016 to January 2017

District Wise - Fluctuation and Frequency Distribution From Different Ranges from One Period to Other

From Year: 2016/Jan - **To Year:** 2017/Jan

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation (m)				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise		Fall		Rise			Fall			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	3	0.17	0.94	0.91	0.91	2 66.67%	0	0	1 33.33%	0	0	2	1
KANGRA	31	0.07	1.80	0.05	6.32	15 48.39%	0	0	14 45.16%	1 3.23%	1 3.23%	15	16
KULLU	1	-	-	0.99	0.99	0	0	0	1 100.0%	0	0	0	1
MANDI	7	0.67	0.67	0.13	0.91	1 14.29%	0	0	6 85.71%	0	0	1	6
SIRMAUR	11	0.54	6.01	0.13	2.00	6 54.55%	1 9.09 %	1 9.09%	3 27.27%	0	0	8	3
SOLAN	4	2.55	2.55	0.31	1.10	0	1 25.00 %	0	3 75.00%	0	0	1	3
UNA	24	0.04	6.99	0.09	4.64	4 16.67%	1 4.17 %	1 4.17%	13 54.17%	4 16.67%	1 4.17%	6	18
Total	81	2.55	0.67	0.05	6.32	28	3	2	41	5	2	33	48

3.4 Decadal Fluctuations

The decadal variations were analyzed considering the decadal average of water level and the water level for the respective period.

3.4.1 Decadal average of May (2006-2015) to May 2016

Decadal water level fluctuation has been worked out by comparing water level data of May 2016 with the average mean of 10 years water level data of May (2006-2015) and is presented in Annexure-IV and frequency distribution in various ranges is presented in Table -13.

A perusal of Table-13 shows that out of 95 stations analysed, 36 stations (37.89%) have shown rise and 59 stations (62.10%), have shown fall in water level. 30 stations (83.33%) are showing rise in water level between 0 to 2m, 3 stations (8.33%) between 2 to 4m. and 3 stations (8.33%), more than 4m.

Out of 59 stations, 47stations (79.66%) show fall in water level between 0 to 2m, 9 stations (15.25%) between 2 to 4 m and3 stations (5.08%) more than 4m.

A minimum rise in water level of 0.04 m was noticed in Kangra & Solan districts and the maximum rise of 9.97 m is noticed in Sirmaur district. Similarly, the minimum and maximum fall of 0.06 m is noticed in Una district & maximum fall of 9.61 m is noticed in Kangra district.

A perusal of map of Decadal Variation - Average of May (2006 - 2015) with May 2016 reveals fall less than 2m, in all the valleys of Kangra district, Mandi district, Sirmaur district, Solan district & Una district except at some places in Indaura valley and Nalagarh valley where fall is 2-4m. Rise of water level, is observed in all valleys under monitoring.

Table-13: District wise number & % NHS distribution in different Decadal W/L Fluctuation Range (May (2006 - 2015) with May 2016

District Wise - Fluctuation of Water Level with Mean and Selected Period

10 Years Mean (2006 May - 2015 May) - 2016/May

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.34	0.34	0.19	0.63	1 25.00 %	0	0	3 75.00%	0	0	1	3
KANGRA	32	0.04	7.92	0.30	9.61	12 37.50 %	2 6.25%	1 3.13%	14 43.75%	1 3.13 %	2 6.25%	15	17
KULLU	1	-	-	1.05	1.05	0	0	0	1 100.0%	0	0	0	1
MANDI	7	.00	2.20	0.04	0.04	5 71.43 %	1 14.29%	0	1 14.29%	0	0	6	1
SIRMAUR	10	0.16	9.97	0.47	3.11	4 40.00 %	0	1 10.00%	4 40.00%	1 10.00 %	0	5	5
SOLAN	10	0.04	4.73	1.08	4.90	1 10.00 %	0	1 10.00%	2 20.00%	5 50.00 %	1 10.00%	2	8
UNA	31	0.19	1.09	0.06	2.86	7 22.58 %	0	0	22 70.97%	2 6.45 %	0	7	24
Total	95	0.34	0.34	0.04	9.61	30	3	3	47	9	3	36	59

3.4.2 Decadal Average of August (2006 - 2015) to August 2016

Decadal water level fluctuation has been worked out by comparing water level data of August 2016 with the average 10 years water level data of August (2006-2015) and is presented in Annexure - IV and frequency distribution in various ranges is presented in Table -14.

A perusal of Table-14 shows that out of 99 stations analysed, 38 stations (38%) have shown rise and 61 stations (61%), have shown fall in water level. 33 stations (86.84%) are showing rise in water level between 0 to 2m, 3 stations (7.89%) between 2 to 4m. and 2 stations (5.26%), more than 4m.

Out of 61 stations, 53 stations (86.88%) show fall in water level between 0 to 2m, 5 stations (8.19%) between 2 to 4 m and 3 stations (4.91%) more than 4m.

A minimum rise in water level of 0.01m was noticed in Kangra district and the maximum rise of 9.46 m is noticed in Sirmaur district. Similarly, the minimum and maximum fall of 0.01 m is noticed in Kangra district & maximum fall of 1.03 m is also noticed in Solan district.

A perusal of map Decadal Average of August (2006 - 2015) to August 2016 shows fall in water level in western part of Paonta valley of Sirmaur district, northern & central part of Nalagargh valley of Solan district, southern part of Una valley of Una district, some part of Balh valley of Mandi district and north western part of Kangra valley of K

angra district. Similarly rise in water level is noticed in Balh valley of Mandi district, northern part of Una valley in Una district and part of Kangra valley of Kangra district.

Table-14: Decadal Fluctuation August (2006-2015) to August 2016

District Wise - Fluctuation of Water Level with Mean and Selected Period

10 Years Mean (2006 Aug - 2015 Aug) - 2016/Aug

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	0.04	0.48	0.11	0.31	2 50.00 %	0	0	2 50.00%	0	0	2	2
KANGRA	34	0.01	8.48	0.01	3.82	15 44.12 %	1 2.94%	1 2.94%	16 47.06%	1 2.94 %	0	17	17
KULLU	2	1.05	1.05	0.65	0.65	1 50.00 %	0	0	1 50.00%	0	0	1	1
MANDI	8	0.13	2.41	0.04	0.43	3 37.50 %	1 12.50%	0	4 50.00%	0	0	4	4
SIRMAUR	11	0.50	9.46	0.04	3.28	2 18.18 %	0	1 9.09%	7 63.64%	1 9.09 %	0	3	8
SOLAN	10	0.28	1.17	1.03	7.95	3 30.00 %	0	0	3 30.00%	2 20.00 %	2 20.00%	3	7
UNA	30	0.04	3.31	0.26	6.51	7 23.33 %	1 3.33%	0	20 66.67%	1 3.33 %	1 3.33%	8	22
Total	99	0.48	1.05	0.01	7.95	33	3	2	53	5	3	38	61

3.4.3 Decadal average of November (2006-2015) to November 2016

Decadal water level fluctuation has been worked out by comparing water level data of November 2016 with the average water level data of November for 10 years (2006-2015) and is presented in Annexure - IV and frequency distribution in various ranges in Table 15.

A perusal of Table-15 shows that out of 99 stations analysed, 39 stations (39.39%) have shown rise and 60 stations (60.60%), have shown fall in water level. 32 stations (82.05%) are showing rise in water level between 0 to 2m, 5 stations (12.82%) between 2 to 4m. and 2 stations (5.1%), more than 4m.

Out of 60 stations, 45 stations (75%) show fall in water level between 0 to 2m, 13 stations (21.67%) between 2 to 4 m and 2 stations (3.33%) more than 4m.

A minimum rise in water level of 0.05 m was noticed in Kangra district and the maximum rise of 9.00 m is noticed in Sirmaur district. Similarly, the minimum and maximum fall of 0.01 m is noticed in Una district & maximum fall of 9.63 m is also noticed in Sirmaur district.

A perusal of map of Decadal average of November (2006-2015) to November 2016 reveals water level fall less than 2m.in central part of Kangra - Palampur valley & Nurpur Indaura valley of Kangra district, major part of Una valley, central part of Balh valley, a couple of places in Paonta valley and northern part of Nalagargh valley.. The fall between 2 to 4 m was noticed in, northern part

of Nalagargh valley. Similarly, rise is noticed in all the valleys from 0-2 m except in major part of nallagah valley, where rise is 2- 4m.

Table-15: Decadal Fluctuation November (2006-15) to November 2016

District Wise - Fluctuation of Water Level with Mean and Selected Period

10 Years Mean (2006 Nov - 2015 Nov) - 2016/Nov

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	4	-	-	0.14	1.04	0	0	0	4 100.0 %	0	0	0	4
KANGRA	33	0.05	8.33	0.04	2.47	16 48.48 %	2 6.06%	1 3.03%	13 39.39%	1 3.03 %	0	19	14
KULLU	2	0.62	0.62	2.19	2.19	1 50.00 %	0	0	0	1 50.00 %	0	1	1
MANDI	8	0.09	3.85	0.09	0.34	3 37.50 %	1 12.50%	0	4 50.00%	0	0	4	4
SIRMAUR	12	0.08	9.00	0.37	9.63	3 25.00 %	0	1 8.33%	4 33.33%	3 25.00 %	1 8.33%	4	8
SOLAN	9	1.34	3.83	0.31	6.84	2 22.22 %	1 11.11%	0	3 33.33%	2 22.22 %	1 11.11%	3	6
UNA	31	.00	2.78	0.01	3.59	7 22.58 %	1 3.23%	0	17 54.84%	6 19.35 %	0	8	23
Total	99	0.62	1.34	0.01	9.63	32	5	2	45	13	2	39	60

3.4.4 Decadal average of January (2007-2016) to January 2017

Decadal water level fluctuation has been worked out by comparing water level data of January 2017 with the average water level data of January for 10 years (2007-2016) and is presented in Annexure - IV and frequency distribution in various ranges is presented in Table -15.

A perusal of Table-15 shows that out of 86 stations analysed, 37 stations (43.02%) have shown rise and 49 stations (56.97%), have shown fall in water level. 29 stations (78.37%) are showing rise in water level between 0 to 2m, 3 stations (8.10%) between 2 to 4m. and 5 stations (13.5%), more than 4m. Out of 49 stations, 37 stations (75.51%) show fall in water level between 0 to 2m, 10 stations (20.40%) between 2 to 4 m and 2 stations (4.08%) more than 4m.

A minimum rise in water level of 0.06 m was noticed in Hamirpur district and the maximum rise of 1.28 m is noticed in Solan district. Similarly, the minimum and maximum fall of 0.07 m is noticed in Mandi district & maximum fall of 8.54 m is noticed in Solan district.

A perusal of map for Decadal average of January (2007-2016) to January 2017 reveals fall in water level 0-2m in a part of Kangra Palampur valley of Kangra district, A small part of Balh valley, all of Paonta valley except its central part, northern part of Nalagargh valley and major part of Una

valley. More than 4m water level fall is observed in only at a place in Una & Nalagarh valley. Rise of water level 0-2m is noticed in all valleys.

Table –15: Decadal Fluctuation January (2007-2016) to January 2017

District Wise - Fluctuation of Water Level with Mean and Selected Period

10 Years Mean (2007 Jan - 2016 Jan) - 2017/Jan

State : Himachal Pradesh

District Name	No. of Wells	Range of Fluctuation				No. of Wells/Percentage Showing Fluctuation						Total No. of Wells	
		Rise (m)		Fall (m)		Rise (m)			Fall (m)			Rise	Fall
		Min	Max	Min	Max	0 to 2	2 to 4	>4	0 to 2	2 to 4	>4		
HAMIRPUR	3	0.06	0.20	1.11	1.11	2 66.67 %	0	0	1 33.33%	0	0	2	1
KANGRA	31	0.09	7.56	0.17	3.70	17 54.84 %	1 3.23%	1 3.23%	10 32.26%	2 6.45 %	0	19	12
KULLU	2	0.37	0.37	0.84	0.84	1 50.00 %	0	0	1 50.00%	0	0	1	1
MANDI	8	0.08	2.13	0.07	0.60	2 25.00 %	1 12.50%	0	5 62.50%	0	0	3	5
SIRMAUR	11	0.47	8.09	0.16	2.70	3 27.27 %	0	2 18.18%	4 36.36%	2 18.18 %	0	5	6
SOLAN	5	1.28	1.91	1.12	8.54	2 40.00 %	0	0	2 40.00%	0	1 20.00%	2	3
UNA	26	0.12	34.50	0.26	4.20	2 7.69 %	1 3.85%	2 7.69%	14 53.85%	6 23.08 %	1 3.85%	5	21
Total	86	0.20	1.28	0.07	8.54	29	3	5	37	10	2	37	49

Annexure-I

Depth to water level of May2016, August2016, Nov 2016 & Jan 2017

State	Himachal Pradesh						
District	**Hamirpur**	**Latitude**	**Longitude**	**Dtw May16**	**Dtw Aug16**	**Dtw Nov16**	**Dtw Jan17**
1	Bagnalla	31.78	76.34	6.04	4.11	6.03	
2	Bijari	31.52	76.53	3.03	1.61	2.71	1.94
3	Galore	31.61	76.47	2.91	1.91	2.68	2.44
4	Kangu	31.69	76.42	8.69	5.74	7.74	8.22
District	**Kangra**						
5	Andaura	32.13	75.69	3.41	0.67	2.26	2.31
6	Bandh	32.01	76.23	2.64	0.19		3.83
7	Barota	32.03	75.72	6.93	3.48	4.19	4.29
8	Basa Bazira	32.19	75.99	8.50	6.70	8.30	
9	Bhalad	32.19	75.99	4.28	0.28	1.21	2.14
10	Bhali	32.18	75.95	5.70	1.15	1.55	1.70
11	Bharmar	31.8	76.33	15.10	5.67	9.80	11.95
12	Bharoli	32.29	75.87	12.99	3.86	6.13	9.72
13	Bod	32.11	76.41	3.65	1.40	2.75	2.49
14	Chakban Ambari	32.15	75.69	4.29	3.61	4.23	4.32
15	Channaur	32.16	76.99	3.11	2.09	5.18	2.53
16	Darkati	31.88	76.22	2.58	0.67	1.36	1.97
17	Dehra Gopipur	31.93	76.28	5.43	2.91	3.98	4.38
18	Dehrian	31.79	76.3	2.03	1.07	1.31	1.93
19	Hardogri	31.97	75.9	4.58	3.52	3.12	3.66
20	Jassur	32.28	75.84	4.49	3.75	3.65	3.85
21	Jwalaji	31.88	76.32	11.72	0.96	2.14	
22	Kangra	32.1	76.27	12.43	5.14	7.46	11.66
23	Kathgarh	32.12	75.64	4.59	2.61	4.12	4.24
24	Kotla	32.24	76.04	2.95	1.15	1.25	2.45
25	Manjgram	32.23	76.17	1.30	0.45	0.90	1.20
26	Mao	32.27	76.02	3.99	0.41	1.34	1.99
27	Mohtli	32.22	75.67	4.73	1.88	2.72	3.13
28	Nagrota	32.11	76.37	0.00	6.24	8.83	
29	Old Kangra	32.09	76.26	5.41	4.84	3.09	4.28
30	Olherian	32.08	75.65	4.07	2.83	2.96	3.34
31	Pandtehr	32.04	76.64	0.51	0.42	0.49	0.51
32	Panjpir	32.28	75.79	4.81	2.10	3.80	4.25
33	Paprola	32.05	76.63	12.78	4.66	9.44	10.98
34	Rait	32.19	76.21	10.76	4.65	7.95	9.60
35	Raja-ka-talab	32.21	75.92	4.40	1.90	3.25	4.65
36	Rakar	31.78	76.24	5.98	1.38	3.12	3.14
37	Takipur	32.03	76.25	7.94	0.62	2.63	4.03
38	Thali	32.25	75.72	4.10	2.50	2.55	2.60
District	**Kullu**						
39	Gadauri	31.91	77.13	6.01	5.16	7.31	6.65
40	Kullu	31.96	77.12	0.00	0.18	0.98	1.49
District	**Mandi**						
41	Bahangrotu	31.61	76.92	6.56	4.70	5.79	5.65
42	Gagal	31.63	76.96	2.01	1.64	1.94	1.99

		Latitude	Longitude	Dtw May16	Dtw Aug16	Dtw Nov16	Dtw Jan17
43	GUTKAR	31.66	76.95	0.00	3.39	5.63	7.09
44	Jarl	31.56	76.9	0.36	0.38	0.41	0.61
45	Jhiri	31.83	77.17	4.25	2.95	4.83	4.43
46	Kaned	31.58	76.91	0.62	0.32	1.27	1.62
47	Lohara	31.59	76.95	3.69	3.14	3.47	3.49
48	Ratti	31.6	76.9	4.01	3.31	4.03	4.06
District	**Sirmaur**						
49	Ajiwala	30.47	77.59	6.42	3.41	4.69	
50	Akkawala	30.52	77.29	10.84	11.30	12.46	5.53
51	Badripur	30.44	77.62	0.00	9.30	19.08	11.50
52	Dhaulakuan	30.45	77.64	5.98	0.00	4.62	4.99
53	Kala-Amb	30.5	77.22	16.75	13.30	15.20	15.60
54	Khodawala	30.49	77.73	15.05	11.47	15.37	15.12
55	Kiyarda	30.48	77.55	11.01	2.70	6.70	9.41
56	Kolar	30.55	77.43	13.03	3.93	10.47	10.95
57	Nayagaon	30.49	77.52	0.00	4.95	11.60	11.94
58	Shambuwala	30.53	77.32	10.57	7.80	6.70	8.90
59	Shibpur	30.48	77.67	28.23	20.52	26.33	27.90
60	Trilokpur	30.54	77.21	2.33	1.35	2.00	2.25
District	**Solan**						
62	Barotiwala	30.9	76.84	27.50	23.48	23.05	24.30
63	Barun	31.15	76.64	22.95	27.40	25.95	
64	Bhagheri	31.16	76.62	21.60	21.41	20.10	22.25
65	BHATOLI	31.17	76.61	13.00	14.00	14.00	
66	Dhabota	31.09	76.63	13.25	13.25	12.90	12.96
67	Jagatpur	31.16	76.68	21.40	19.95	15.85	
68	Khera-chak	31.01	76.72	6.95	4.80	5.50	6.10
69	Mahadev	31.11	76.68	14.15	13.68	13.68	
70	Panjahra	31.15	76.67	27.00	0.00		
71	Phalahi	31.15	76.61	6.15	4.75	3.85	4.40
District	**Una**						
72	Amb	31.68	76.12	6.49	3.76	5.55	6.34
73	Babehr	31.79	75.82	4.93	1.31	1.92	3.68
74	Bawal	31.55	76.31	3.28	1.04	1.24	1.46
75	Bhadsali	31.48	76.17	15.52	14.72	15.22	
76	Bhangana	31.62	76.2	2.66	0.65	0.82	
77	Daulatpur	31.78	76	8.79	7.83	8.26	8.99
78	Dharampur	31.45	76.23	3.88	3.03	3.59	3.72
79	Gagret	31.66	76.06	8.82	8.19	8.28	
80	Ghaneri	31.7	76	9.51	6.62	8.83	9.72
81	Guglahar	31.56	76.13	4.61	3.08	4.04	4.52
82	Ishapur	31.5	76.18	3.19	2.56	2.86	3.14
83	Jankaur	31.43	76.27	5.39	4.57	4.96	4.17
84	Jawar	31.74	76.2	1.16	0.00	0.96	0.97
85	Jhalera	31.49	76.24	5.92	5.06	5.48	
86	Khanpur	31.38	76.31	6.99	3.99	5.86	5.99
87	Khwaja	31.5	76.23	2.92	1.78	2.22	2.29
88	Kuluwal	31.48	76.21	4.86	3.89	4.72	
89	Kuthera Jaswala	31.6	76.12	8.78	4.77	7.63	8.72
90	Lalehri	31.37	76.25	12.66	10.68	11.83	4.43

		Latitude	Longitude	Dtw May16	Dtw Aug16	Dtw Nov16	Dtw Jan17
91	Loharli	31.59	76.13	4.91	3.07	3.34	
92	Mawa Kalan	31.75	76	21.47	20.44	22.07	22.30
93	Mubarikpur	31.7	76.07	5.85	4.47	5.91	6.43
94	Nangran	31.4	76.29	5.72	4.97	5.12	5.37
95	Panjawar	31.55	76.15	13.49	13.63	15.01	15.99
96	Panoh	31.54	76.2	3.40	1.63	2.48	2.69
97	Raipur Marwadi	31.8	75.98	17.26	17.09	17.22	18.81
98	Rajli Panjal	31.54	76.4	4.05	0.46	0.58	1.02
99	Santokhgarh	31.36	76.31	5.48	4.28	4.86	5.06
100	Singhnei	31.69	76.03	20.79	21.62	22.76	22.82
101	Tahliwala	31.34	76.27	2.37	0.61	1.64	1.62
102	Una	31.47	76.26	3.61	2.59	2.18	2.97

NDC
Faridabad

Annexure-II

Monsoonal Fluctuation of - Pre and post for 2016

State	**Himachal Pradesh**			
District	**Hamirpur**	**Latitude**	**Longitude**	**Monsoon fl (may16-Nov16**
1	Bagnalla	31.78	76.34	0.01
2	Bijari	31.52	76.53	0.32
3	Galore	31.61	76.47	0.23
4	Kangu	31.69	76.42	0.95
District	**Kangra**			
5	Andaura	32.13	75.69	1.15
6	Bandh	32.01	76.23	-
7	Barota	32.03	75.72	2.74
8	Basa Bazira	32.19	75.99	0.20
9	Bhalad	32.19	75.99	3.07
10	Bhali	32.18	75.95	4.15
11	Bharmar	31.8	76.33	5.30
12	Bharoli	32.29	75.87	6.86
13	Bod	32.11	76.41	0.90
14	Chakban Ambari	32.15	75.69	0.06
15	Channaur	32.16	76.99	-2.07
16	Darkati	31.88	76.22	1.22
17	Dehra Gopipur	31.93	76.28	1.45
18	Dehrian	31.79	76.3	0.72
19	Hardogri	31.97	75.9	1.46
20	Jassur	32.28	75.84	0.84
21	Jwalaji	31.88	76.32	9.58
22	Kangra	32.1	76.27	4.97
23	Kathgarh	32.12	75.64	0.47
24	Kotla	32.24	76.04	1.70
25	Manjgram	32.23	76.17	0.40
26	Mao	32.27	76.02	2.65
27	Mohtli	32.22	75.67	2.01
28	Old Kangra	32.09	76.26	2.32
29	Olherian	32.08	75.65	1.11
30	Olherian	32.08	75.65	-
31	Pandtehr	32.04	76.64	0.02
32	Panjpir	32.28	75.79	1.01
33	Paprola	32.05	76.63	3.34
34	Rait	32.19	76.21	2.81

State	Himachal Pradesh			
		Latitude	Longitude	Monsoon fl (may16-Nov16
35	Raja-ka-talab	32.21	75.92	1.15
36	Rakar	31.78	76.24	2.86
37	Takipur	32.03	76.25	5.31
38	Thali	32.25	75.72	1.55
District	**Kullu**			
39	Gadauri	31.91	77.13	-1.30
40	Kullu	31.96	77.12	-
District	**Mandi**			
41	Bahangrotu	31.61	76.92	0.77
42	Gagal	31.63	76.96	0.07
43	GUTKAR	31.66	76.95	-
44	Jarl	31.56	76.9	-0.05
45	Jhiri	31.83	77.17	-0.58
46	Kaned	31.58	76.91	-0.65
47	Lohara	31.59	76.95	0.22
48	Ratti	31.6	76.9	-0.02
District	**Sirmaur**			
49	Ajiwala	30.47	77.59	1.73
50	Akkawala	30.52	77.29	-1.62
51	Dhaulakuan	30.45	77.64	1.36
52	Badripur	30.44	77.62	-
53	Kala-Amb	30.5	77.22	1.55
54	Khodawala	30.49	77.73	-0.32
55	Kiyarda	30.48	77.55	4.31
56	Kolar	30.55	77.43	2.56
57	Nayagaon	30.49	77.52	-
58	Shambuwala	30.53	77.32	3.87
59	Shibpur	30.48	77.67	1.90
60	Trilokpur	30.54	77.21	0.33
District	**Solan**			
61	Barotiwala	30.9	76.84	4.45
62	Barun	31.15	76.64	-3.00
63	Bhagheri	31.16	76.62	1.50
64	BHATOLI	31.17	76.61	-1.00
65	Dhabota	31.09	76.63	0.35
66	Jagatpur	31.16	76.68	5.55
67	Khera-chak	31.01	76.72	1.45
68	Mahadev	31.11	76.68	0.47
69	Panjahra	31.15	76.67	-

State	**Himachal Pradesh**			
		Latitude	**Longitude**	**Monsoon fl (may16-Nov16**
70	Phalahi	31.15	76.61	2.30
District	**Una**			
71	Amb	31.68	76.12	0.94
72	Babehr	31.79	75.82	3.01
73	Bawal	31.55	76.31	2.04
74	Bhadsali	31.48	76.17	0.30
75	Bhangana	31.62	76.2	1.84
76	Daulatpur	31.78	76	0.53
77	Dharampur	31.45	76.23	0.29
78	Gagret	31.66	76.06	0.54
79	Ghaneri	31.7	76	0.68
80	Guglahar	31.56	76.13	0.57
81	Ishapur	31.5	76.18	0.33
82	Jankaur	31.43	76.27	0.43
83	Jawar	31.74	76.2	0.20
84	Jhalera	31.49	76.24	0.44
85	Khanpur	31.38	76.31	1.13
86	Khwaja	31.5	76.23	0.70
87	Kuluwal	31.48	76.21	0.14
88	Kuthera Jaswala	31.6	76.12	1.15
89	Lalehri	31.37	76.25	0.83
90	Loharli	31.59	76.13	1.57
91	Mawa Kalan	31.75	76	-0.60
92	Mubarikpur	31.7	76.07	-0.06
93	Nangran	31.4	76.29	0.60
94	Panjawar	31.55	76.15	-1.52
95	Panoh	31.54	76.2	0.92
96	Raipur Marwadi	31.8	75.98	0.04
97	Rajli Panjal	31.54	76.4	3.47
98	Santokhgarh	31.36	76.31	0.62
99	Singhnei	31.69	76.03	-1.97
100	Tahliwala	31.34	76.27	0.73
101	Una	31.47	76.26	1.43

- data not available

Annual Fluctuation of May 2015- May 2016, August 2015- August 2016 November 2015- November 2016 and January 2016- January 2017

State	**Himachal Pradesh**						
District	**Hamirpur**	**Latitude**	**Longitude**	**Annual fl may (15-16)**	**Annual fl Aug (15-16)**	**Annual fl Nov (15-16)**	**Annual fl Jan (16-17)**
1	Bagnalla	31.78	76.34	0.00	0.70	0.00	0.00
2	Bijari	31.52	76.53	-1.12	-0.97	-0.94	0.17
3	Galore	31.61	76.47	-0.26	-0.21	0.22	0.94
4	Kangu	31.69	76.42	-2.17	0.40	-0.85	-0.91
District	**Kangra**						
5	Andaura	32.13	75.69	-0.66	1.16	-0.03	0.30
6	Bandh	32.01	76.23	0.89	2.00	0.00	-0.62
7	Barota	32.03	75.72	-0.35	-0.15	-0.02	1.01
8	Basa Bazira	32.19	75.99	-	1.10	-4.20	-
9	Bhalad	32.19	75.99	-2.63	0.16	0.28	-0.38
10	Bhali	32.18	75.95	-3.70	-0.15	0.05	0.95
11	Bharmar	31.8	76.33	-2.85	0.90	0.35	0.40
12	Bharoli	32.29	75.87	-6.52	-1.69	-2.98	-6.32
13	Bod	32.11	76.41	-0.80	-0.45	-0.36	0.76
14	Chakban Ambari	32.15	75.69	0.31	-1.01	0.32	0.33
15	Channaur	32.16	76.99	-0.25	0.47	-2.80	0.13
16	Darkati	31.88	76.22	-0.16	0.14	0.63	0.46
17	Dehra Gopipur	31.93	76.28	-0.80	-0.51	-1.46	-1.67
18	Dehrian	31.79	76.3	-0.44	-0.14	1.30	1.14
19	Hardogri	31.97	75.9	-0.81	-2.92	-1.98	-2.09
20	Jassur	32.28	75.84	-0.89	0.75	-0.55	1.80
21	Jwalaji	31.88	76.32	0.00	-0.44	0.00	0.00
22	Kangra	32.1	76.27	-0.38	-2.24	-0.06	-1.11
23	Kathgarh	32.12	75.64	0.00	0.34	-0.38	-0.42
24	Kotla	32.24	76.04	-0.58	-0.65	0.97	0.14
25	Manjgram	32.23	76.17	0.15	0.00	-0.05	0.17
26	Mao	32.27	76.02	0.00	0.17	-0.15	0.96
27	Mohtli	32.22	75.67	-1.48	0.00	0.38	0.33
28	Old Kangra	32.09	76.26	7.49	-4.49	0.31	0.07
29	Olherian	32.08	75.65	-1.07	-0.42	-0.46	-0.59
30	Olherian	32.08	75.65	0.00	0.00	0.00	0.00
31	Pandtehr	32.04	76.64	0.09	0.28	0.06	-0.06
32	Panjpir	32.28	75.79	-0.51	-0.25	0.20	-0.05
33	Paprola	32.05	76.63	-2.73	-0.36	-	-1.13

State	Himachal Pradesh						
		Latitude	Longitude	Annual fl may (15-16)	Annual fl Aug (15-16)	Annual fl Nov (15-16)	Annual fl Jan (16-17)
34	Rait	32.19	76.21	-1.31	-2.75	0.79	-0.47
35	Raja-ka-talab	32.21	75.92	-0.85	-0.70	-0.95	-0.52
36	Rakar	31.78	76.24	-	-0.75	-1.05	-0.99
37	Takipur	32.03	76.25	-3.25	0.08	-0.49	-1.64
38	Thali	32.25	75.72	0.00	0.05	-0.03	-0.05
District	**Kullu**						
39	Gadauri	31.91	77.13	-1.37	-	-2.17	-0.99
40	Kullu	31.96	77.12	-	-	-0.38	-
District	**Mandi**						
41	Bahangrotu	31.61	76.92	-1.13	-0.53	-0.47	-0.23
42	Gagal	31.63	76.96	0.30	0.21	0.18	0.67
43	GUTKAR	31.66	76.95	-	-0.53	-0.11	-0.64
44	Jarl	31.56	76.9	0.34	-0.08	0.03	-0.19
45	Jhiri	31.83	77.17	-0.86	0.21	-0.72	-0.32
46	Kaned	31.58	76.91	0.44	0.24	-0.24	-0.91
47	Lohara	31.59	76.95	0.56	0.07	-0.09	-0.13
48	Ratti	31.6	76.9	-0.01	0.00	0.07	-
District	**Sirmaur**						
49	Ajiwala	30.47	77.59	-0.90	-0.51	0.35	-
50	Akkawala	30.52	77.29	0.48	-0.41	-0.71	6.01
51	Dhaulakuan	30.45	77.64	1.28	-	-0.52	2.03
52	Badripur	30.44	77.62	-	-2.36	-11.34	0.84
53	Kala-Amb	30.5	77.22	-2.95	-2.60	-2.85	-2.00
54	Khodawala	30.49	77.73	-0.25	0.08	-0.07	-0.43
55	Kiyarda	30.48	77.55	0.21	-0.23	-0.99	0.54
56	Kolar	30.55	77.43	-0.51	-2.38	0.52	1.88
57	Nayagaon	30.49	77.52	0.00	-0.93	-0.19	1.27
58	Shambuwala	30.53	77.32	-0.37	-2.70	0.75	0.60
59	Shibpur	30.48	77.67	0.12	0.03	1.65	0.82
60	Trilokpur	30.54	77.21	-0.53	-0.53	-0.31	-0.13
District	**Solan**						
61	Barotiwala	30.9	76.84	0.00	-1.38	-23.05	2.55
62	Barun	31.15	76.64	6.30	-3.35	-3.75	-
63	Bhagheri	31.16	76.62	-2.30	-4.01	-2.30	-
64	BHATOLI	31.17	76.61	-0.10	-3.40	-14.00	-
65	Dhabota	31.09	76.63	0.20	-0.50	-0.45	-0.31
66	Jagatpur	31.16	76.68	-3.40	-7.30	-1.65	0.00
67	Khera-chak	31.01	76.72	-0.30	-0.65	-0.65	-0.35
68	Mahadev	31.11	76.68	-0.80	-3.48	-1.18	-

State	Himachal Pradesh						
		Latitude	Longitude	Annual fl may (15-16)	Annual fl Aug (15-16)	Annual fl Nov (15-16)	Annual fl Jan (16-17)
69	Panjahra	31.15	76.67	-5.70	-	-	-
70	Phalahi	31.15	76.61	0.25	-2.10	2.10	-1.10
District	**Una**						
71	Amb	31.68	76.12	-	-0.87	-1.96	-1.83
72	Babehr	31.79	75.82	-1.14	-0.09	0.75	-0.41
73	Bawal	31.55	76.31	-1.19	0.48	0.75	1.48
74	Bhadsali	31.48	76.17	-	-0.76	-0.98	-
75	Bhangana	31.62	76.2	-	0.06	0.82	-
76	Daulatpur	31.78	76	-	-1.56	-1.32	-1.61
77	Dharampur	31.45	76.23	-0.94	-1.02	-1.07	-0.71
78	Gagret	31.66	76.06	0.04	-1.75	-1.15	-
79	Ghaneri	31.7	76	-1.20	-2.25	-1.39	-
80	Guglahar	31.56	76.13	-0.77	-0.57	-0.56	-1.20
81	Ishapur	31.5	76.18	-0.80	3.69	-0.80	-0.95
82	Jankaur	31.43	76.27	-1.07	-2.78	-1.95	-0.79
83	Jawar	31.74	76.2	-0.28	-	0.04	0.04
84	Jhalera	31.49	76.24	-	-1.59	-1.00	-
85	Khanpur	31.38	76.31	-3.10	-1.02	-0.44	-0.18
86	Khwaja	31.5	76.23	-0.73	-0.72	-0.28	0.45
87	Kuluwal	31.48	76.21	-0.49	-1.13	-1.41	-1.58
88	Kuthera Jaswala	31.6	76.12	-3.22	0.35	-1.52	6.99
89	Lalehri	31.37	76.25	-2.06	-9.32	-0.87	-
90	Loharli	31.59	76.13	-1.27	-2.41	-0.85	-
91	Mawa Kalan	31.75	76	-0.10	-2.75	-1.64	-2.34
92	Mubarikpur	31.7	76.07	-0.47	-1.95	-2.70	-2.66
93	Nangran	31.4	76.29	-0.86	-1.04	-0.63	-0.68
94	Panjawar	31.55	76.15	-0.82	-2.76	-3.14	-3.48
95	Panoh	31.54	76.2	-1.28	-0.92	-0.54	0.09
96	Raipur Marwadi	31.8	75.98	-0.32	-2.10	-3.48	-4.64
97	Rajli Panjal	31.54	76.4	-1.05	2.31	2.34	2.75
98	Santokhgarh	31.36	76.31	-0.60	-0.60	-0.27	-0.26
99	Singhnei	31.69	76.03	-0.04	-3.13	-3.88	-3.14
100	Tahliwala	31.34	76.27	0.00	6.06	-0.44	-0.09
101	Una	31.47	76.26	-0.75	-1.40	0.14	-0.12

- data not available

Annexure-IV

Decadal mean Fluctuation May (2006-2015 with May 2016), August (2006-2015 with Aug 2016) November (2006-2015 with Nov 2016) January 2007-2016 with Jan 2017)

State	Himachal Pradesh						
District	**Hamirpur**	**Latitude**	**Longitude**	**Decadal fl may(2006-2015)wrt May 16**	**Decadal fl Aug(2006-2015)wrt Aug16**	**Decadal fl Nov(2006-2015)wrt Nov16**	**Decadal fl Jan(2007-2016)wrt Jan17**
1	Bagnalla	31.78	76.34	0.33	0.48	-1.06	-
2	Bijari	31.52	76.53	-0.63	0.04	-0.34	0.06
3	Galore	31.61	76.47	-0.19	-0.11	-0.14	0.20
4	Kangu	31.69	76.42	-0.63	-0.31	-0.22	-1.11
District	**Kangra**						
5	Andaura	32.13	75.69	1.48	2.42	1.59	1.81
6	Bandh	32.01	76.23	0.63	0.68	-	-3.50
7	Barota	32.03	75.72	-0.64	-0.57	-0.04	1.17
8	Basa Bazira	32.19	75.99	0.00	-0.99	-2.47	-
9	Bhalad	32.19	75.99	-0.57	0.55	0.19	-0.47
10	Bhali	32.18	75.95	-3.69	0.12	0.14	0.52
11	Bharmar	31.8	76.33	-0.50	0.55	0.42	-1.13
12	Bharoli	32.29	75.87	-4.05	0.36	-0.95	-3.66
13	Bod	32.11	76.41	-0.50	-0.29	-0.15	0.17
14	Chakban Ambari	32.15	75.69	0.12	-0.17	0.05	0.41
15	Channaur	32.16	76.99	0.84	0.66	-1.92	0.87
16	Darkati	31.88	76.22	-0.30	0.31	0.23	0.35
17	Dehra Gopipur	31.93	76.28	-0.47	0.20	-0.20	-0.34
18	Dehrian	31.79	76.3	0.35	0.07	0.53	0.09
19	Hardogri	31.97	75.9	0.26	-0.40	-0.04	-0.17
20	Jassur	32.28	75.84	2.23	-0.66	2.30	2.27
21	Jwalaji	31.88	76.32	-9.64	-0.37	-1.07	-
22	Kangra	32.1	76.27	0.26	0.42	1.22	-1.91
23	Kathgarh	32.12	75.64	-0.66	0.10	-1.08	-0.72
24	Kotla	32.24	76.04	-0.70	-0.89	0.36	0.13
25	Manjgram	32.23	76.17	0.33	-0.04	0.18	0.18
26	Mao	32.27	76.02	1.03	0.42	0.37	0.70
27	Mohtli	32.22	75.67	8.15	8.48	8.71	7.99
28	Old Kangra	32.09	76.26	0.00	-1.07	2.84	-
29	Olherian	32.08	75.65	3.39	-3.82	0.53	0.37
30	Olherian	32.08	75.65	-0.43	-0.06	-0.17	-0.52

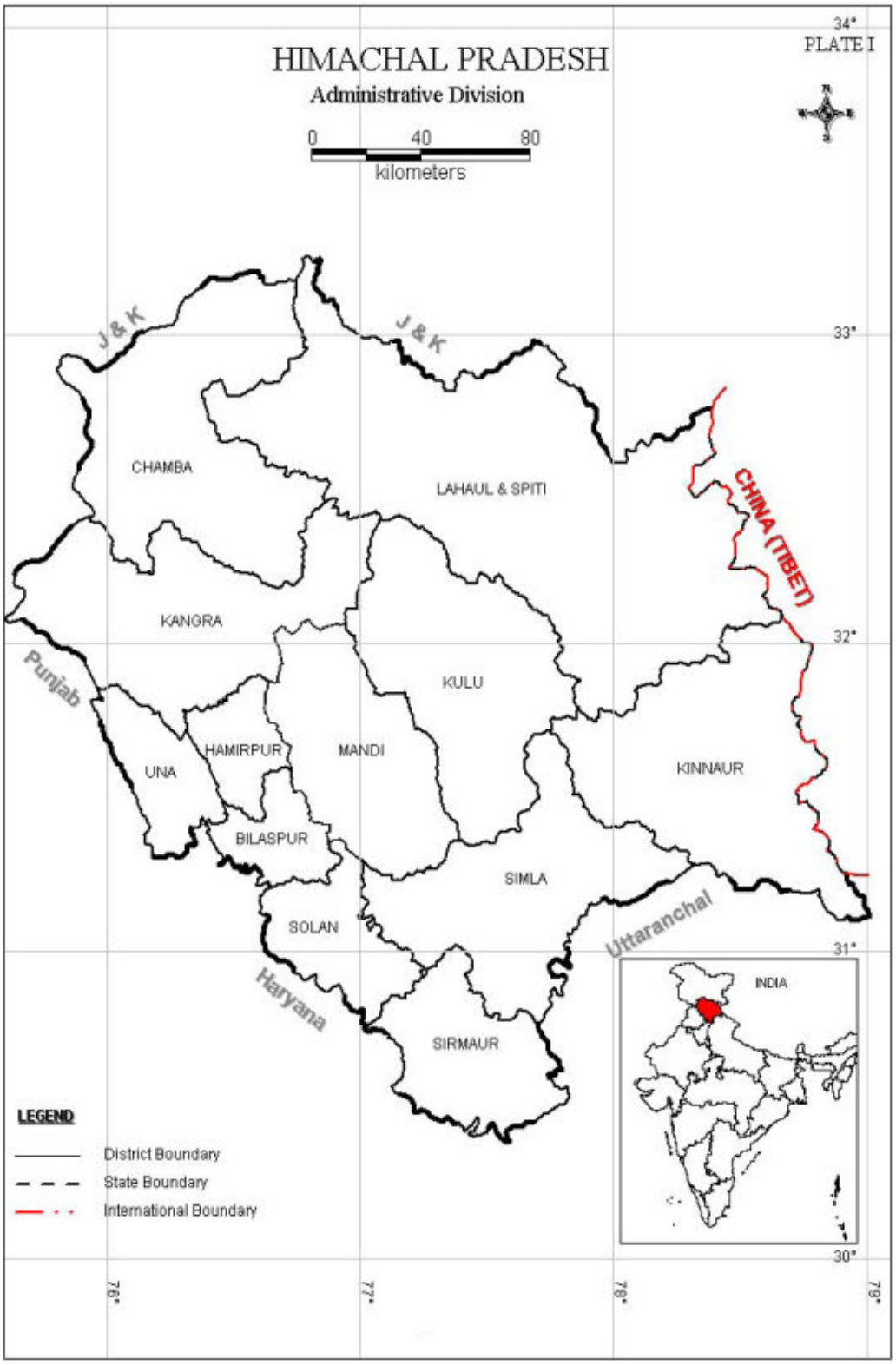
		Latitude	Longitude	Decadal fl may(2006-2015)wrt May 16	Decadal fl Aug(2006-2015)wrt Aug16	Decadal fl Nov(2006-2015)wrt Nov16	Decadal fl Jan(2007-2016)wrt Jan17
31	Pandtehr	32.04	76.64	0.52	-0.01	0.06	0.14
32	Panjpir	32.28	75.79	-0.46	-0.19	-0.81	-0.91
33	Paprola	32.05	76.63	0.46	1.79	1.01	0.25
34	Rait	32.19	76.21	-1.16	-0.43	0.06	-0.62
35	Raja-ka-talab	32.21	75.92	-0.51	-0.56	-0.44	-1.08
36	Rakar	31.78	76.24	0.38	-0.21	0.21	0.24
37	Takipur	32.03	76.25	-1.31	0.27	0.45	0.64
38	Thali	32.25	75.72	-1.44	0.01	0.18	0.09
District	**Kullu**						
39	Gadauri	31.91	77.13	-1.02	-0.65	-2.16	-0.81
40	Kullu	31.96	77.12	-	1.05	0.61	0.39
District	**Mandi**						
41	Bahangrotu	31.61	76.92	0.45	-0.43	0.02	0.75
42	Gagal	31.63	76.96	-0.04	-0.42	-0.35	-0.17
43	GUTKAR	31.66	76.95	0.00	-0.16	-0.02	-0.28
44	Jarl	31.56	76.9	0.30	-0.04	0.10	-0.07
45	Jhiri	31.83	77.17	2.20	2.41	3.27	1.76
46	Kaned	31.58	76.91	1.26	0.43	0.20	-0.21
47	Lohara	31.59	76.95	0.35	0.22	0.12	0.13
48	Ratti	31.6	76.9	0.01	0.13	-0.12	-0.11
District	**Sirmaur**						
49	Ajiwala	30.47	77.59	-0.40	-0.04	0.25	5.87
50	Akkawala	30.52	77.29	0.87	-0.28	-1.02	0.58
51	Dhaulakuan	30.45	77.64	1.96	0.00	-0.37	0.89
52	Badripur	30.44	77.62	0.00	-1.68	-9.63	0.00
53	Kala-Amb	30.5	77.22	-3.04	-3.28	-2.17	-2.40
54	Khodawala	30.49	77.73	0.75	0.50	-1.48	-0.77
55	Kiyarda	30.48	77.55	-0.76	-0.16	-0.93	-0.97
56	Kolar	30.55	77.43	9.97	9.46	9.00	8.59
57	Nayagaon	30.49	77.52	0.00	-0.54	-2.37	-0.07
58	Shambuwala	30.53	77.32	-0.32	-1.35	2.03	0.45
59	Shibpur	30.48	77.67	-0.54	0.67	-2.00	-2.25
60	Trilokpur	30.54	77.21	0.17	-0.33	0.88	-0.32
District	**Solan**						
61	Barotiwala	30.9	76.84	-3.31	1.17	3.83	1.91
62	Barun	31.15	76.64	4.80	0.26	1.42	0.00
63	Bhagheri	31.16	76.62	-4.75	-7.16	-6.90	-8.39

		Latitude	Longitude	Decadal fl may(2006-2015)wrt May 16	Decadal fl Aug(2006-2015)wrt Aug16	Decadal fl Nov(2006-2015)wrt Nov16	Decadal fl Jan(2007-2016)wrt Jan17
64	BHATOLI	31.17	76.61	-1.09	-2.88	-3.87	-
65	Dhabota	31.09	76.63	-1.07	-1.58	-1.56	-
66	Jagatpur	31.16	76.68	-3.52	-7.90	-0.02	-
67	Khera-chak	31.01	76.72	-2.15	-1.18	-1.52	-1.90
68	Mahadev	31.11	76.68	-2.46	-3.80	-3.20	-
69	Panjahra	31.15	76.67	-3.05	-	-	-
70	Phalahi	31.15	76.61	0.04	0.62	1.92	1.28
District	**Una**						
71	Amb	31.68	76.12	0.96	1.77	-0.97	-0.93
72	Babehr	31.79	75.82	-0.91	0.09	0.42	-0.39
73	Bawal	31.55	76.31	-1.71	0.04	0.00	0.21
74	Bhadsali	31.48	76.17	-0.06	-0.26	-1.26	-
75	Bhangana	31.62	76.2	-0.45	0.14	0.13	-
76	Daulatpur	31.78	76	-0.87	-1.25	-1.96	-0.72
77	Dharampur	31.45	76.23	-0.60	-0.46	-0.92	-1.10
78	Gagret	31.66	76.06	-0.56	-1.64	-1.12	-
79	Ghaneri	31.7	76	-1.73	-1.32	-3.12	-2.55
80	Guglahar	31.56	76.13	-0.71	-0.52	-1.09	-1.18
81	Ishapur	31.5	76.18	0.53	0.37	0.03	-0.33
82	Jankaur	31.43	76.27	-0.84	-2.31	-1.70	-0.91
83	Jawar	31.74	76.2	0.70	0.00	0.34	0.10
84	Jhalera	31.49	76.24	-0.51	-0.49	-1.11	0.00
85	Khanpur	31.38	76.31	-2.86	-1.07	-1.78	-1.70
86	Khwaja	31.5	76.23	-0.65	-0.95	-0.59	-0.67
87	Kuluwal	31.48	76.21	-0.30	-0.66	-1.00	0.00
88	Kuthera Jaswala	31.6	76.12	-2.01	0.54	-1.46	-2.23
89	Lalehri	31.37	76.25	-0.54	-1.14	-1.11	6.95
90	Loharli	31.59	76.13	-1.38	-1.23	2.78	-
91	Mawa Kalan	31.75	76	-1.03	-1.94	-2.24	-2.60
92	Mubarikpur	31.7	76.07	0.17	-0.31	-2.10	-2.25
93	Nangran	31.4	76.29	-0.59	-0.96	-0.52	-0.39
94	Panjawar	31.55	76.15	-0.67	-1.90	-3.22	-3.35
95	Panoh	31.54	76.2	-0.41	-0.47	0.12	-0.42
96	Raipur Marwadi	31.8	75.98	-1.09	-6.51	-3.59	-4.20
97	Rajli Panjal	31.54	76.4	0.82	1.77	0.89	2.17

		Latitude	Longitude	Decadal fl may(2006-2015) wrt May 16	Decadal fl Aug(2006-2015) wrt Aug16	Decadal fl Nov(2006-2015) wrt Nov16	Decadal fl Jan(2007-2016) wrt Jan17
98	Santokhgarh	31.36	76.31	-0.67	-0.57	-0.50	-0.27
99	Singhnei	31.69	76.03	0.27	-1.58	-2.95	-2.07
100	Tahliwala	31.34	76.27	0.60	3.31	-0.22	-0.32
101	Una	31.47	76.26	-0.47	-1.18	0.04	-0.26

- data not available

NDC Faridabad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Administrative Division
PLATE I
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32°
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77°
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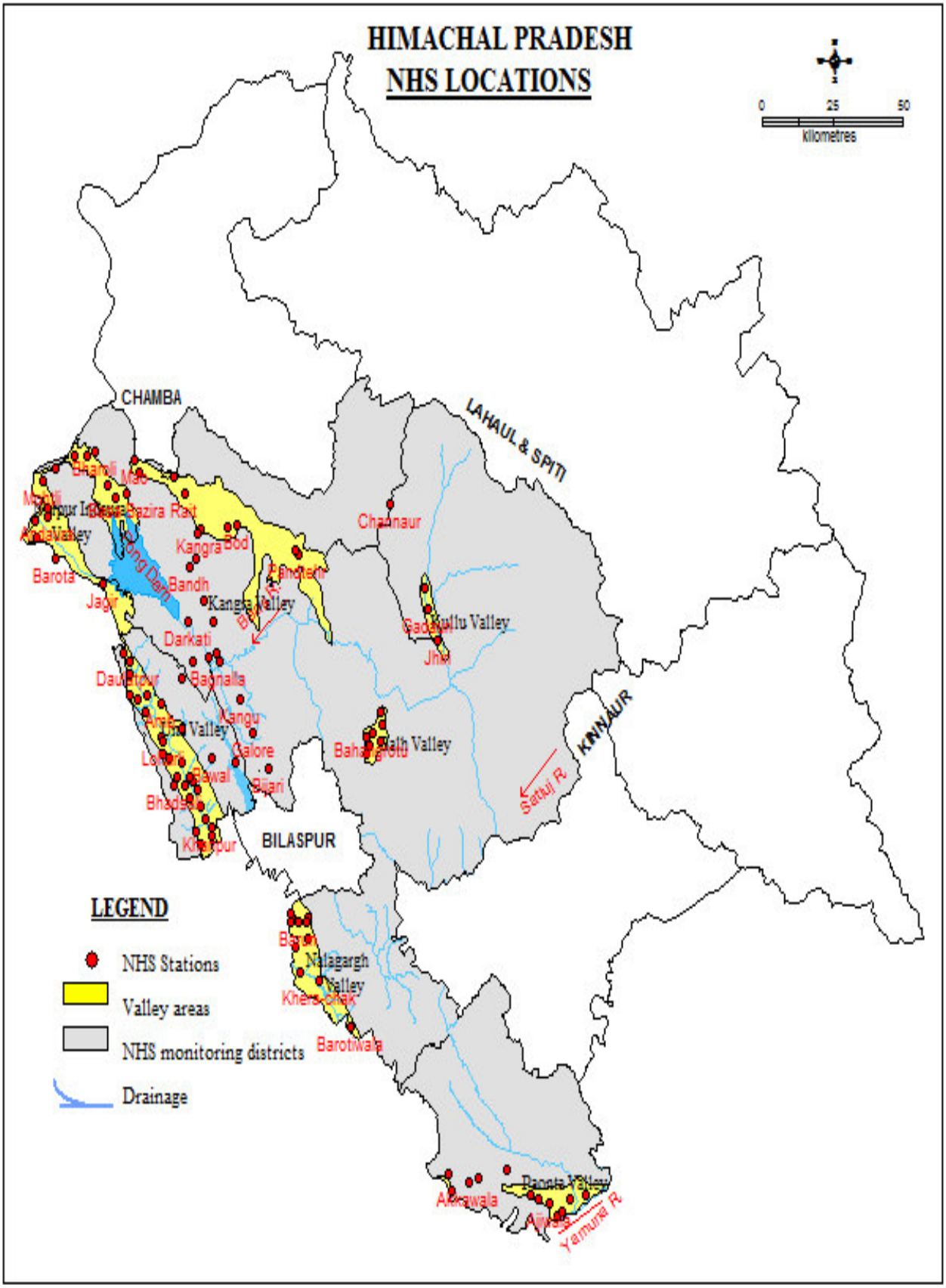
79°
J & K
J & K
CHAMBA
LAHAUL & SPITI
CHINA (TIBET)
KANGRA
Punjab
KULU
HAMIRPUR
MANDI
UNA
KINNAUR
BILASPUR
SIMLA
SOLAN
Uttaranchal
Haryana
SIRMAUR
INDIA
LEGEND
District Boundary
State Boundary
International Boundary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NHS LOCATIONS
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25
50
kilometres
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LAHAUL & SPITI
KINNAUR
BILASPUR
Bhamli
Mab
Bazira Rait
Kangra
Bod
Barota
Jagir
Bandh
Kangra Valley
Darkati
Bagnalla
Kangu
Galore
Bawal
Bijari
Bhadsali
Khairpur
Chaunaur
Kullu Valley
Jhiri
Satluj R.
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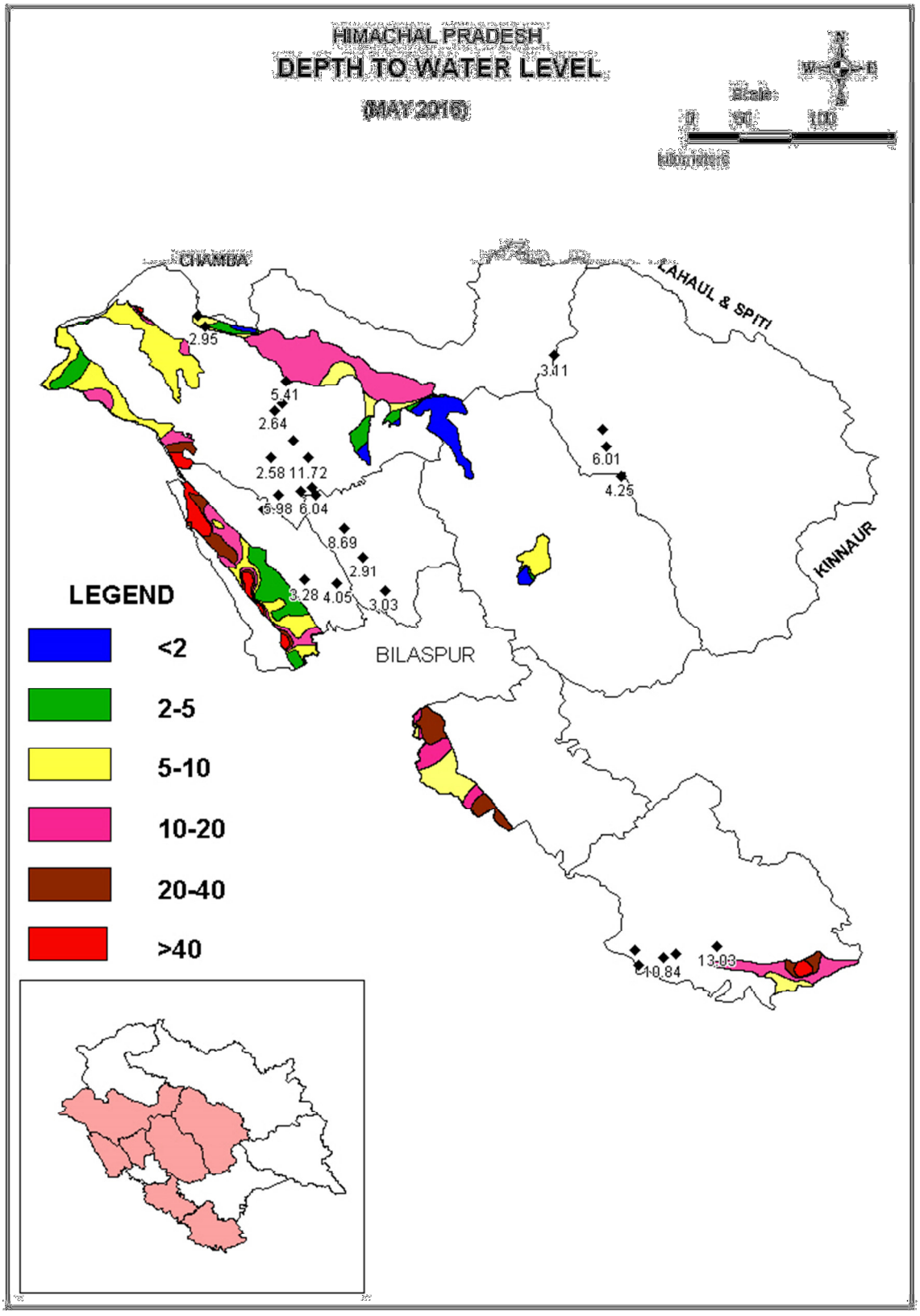
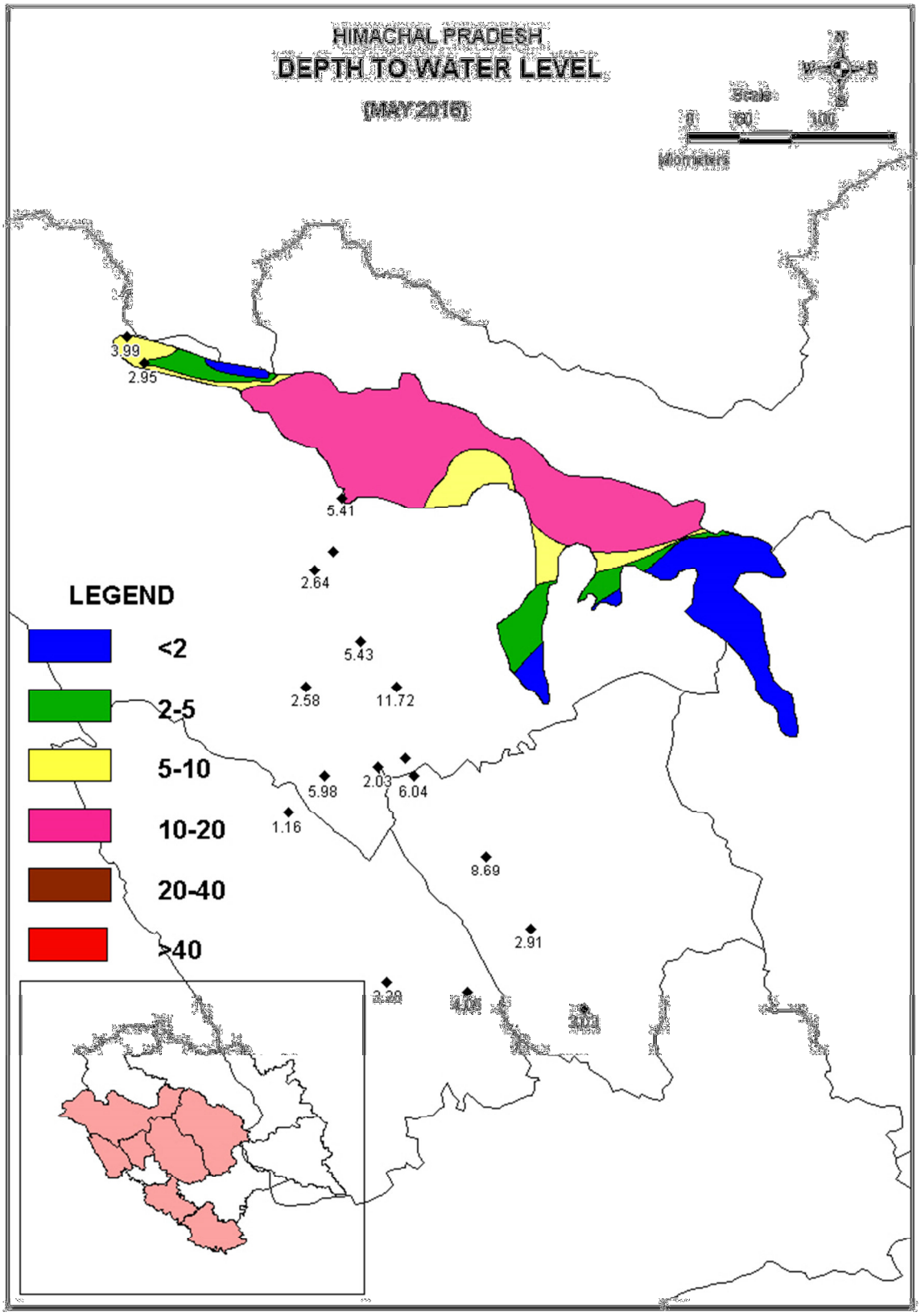
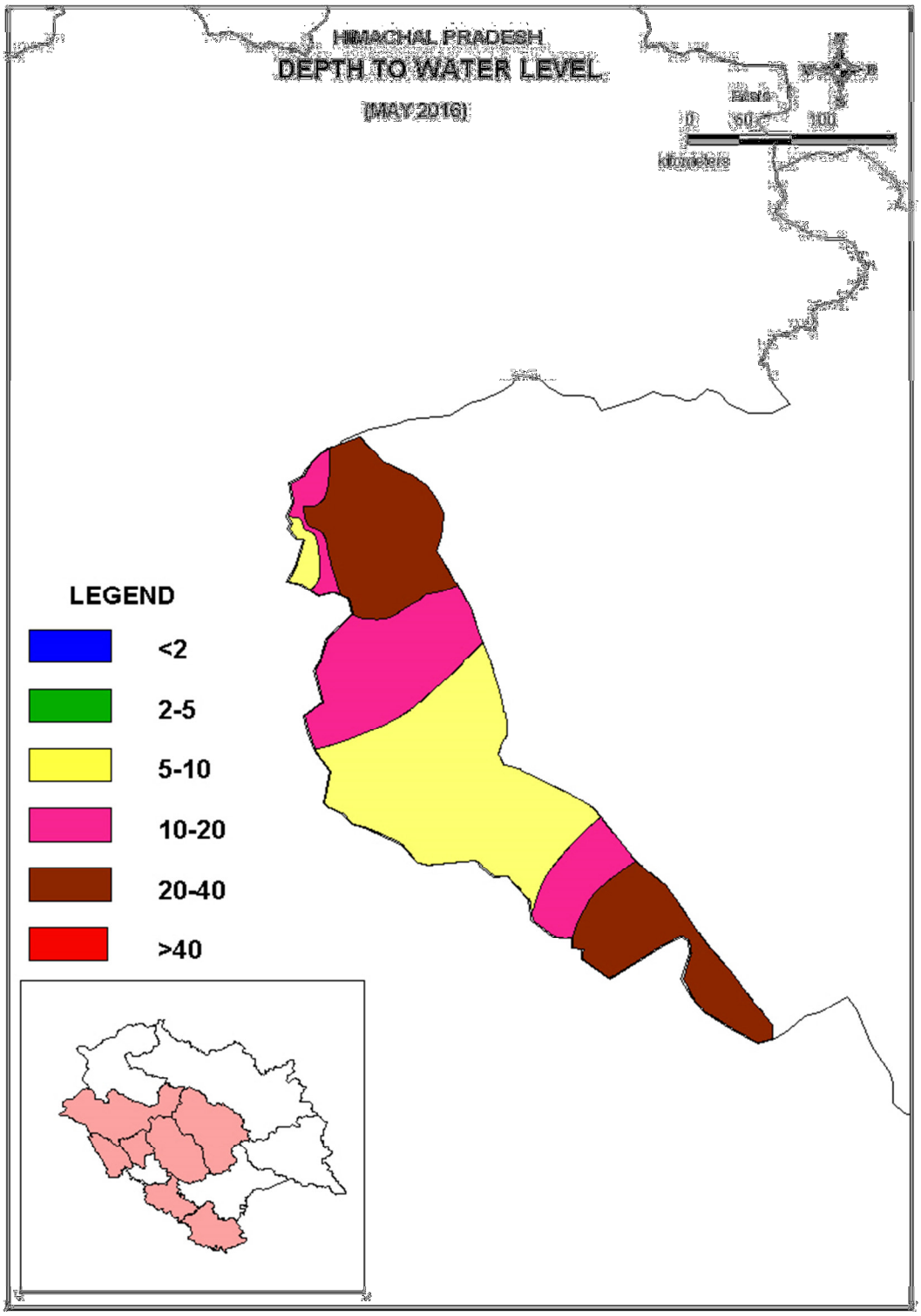
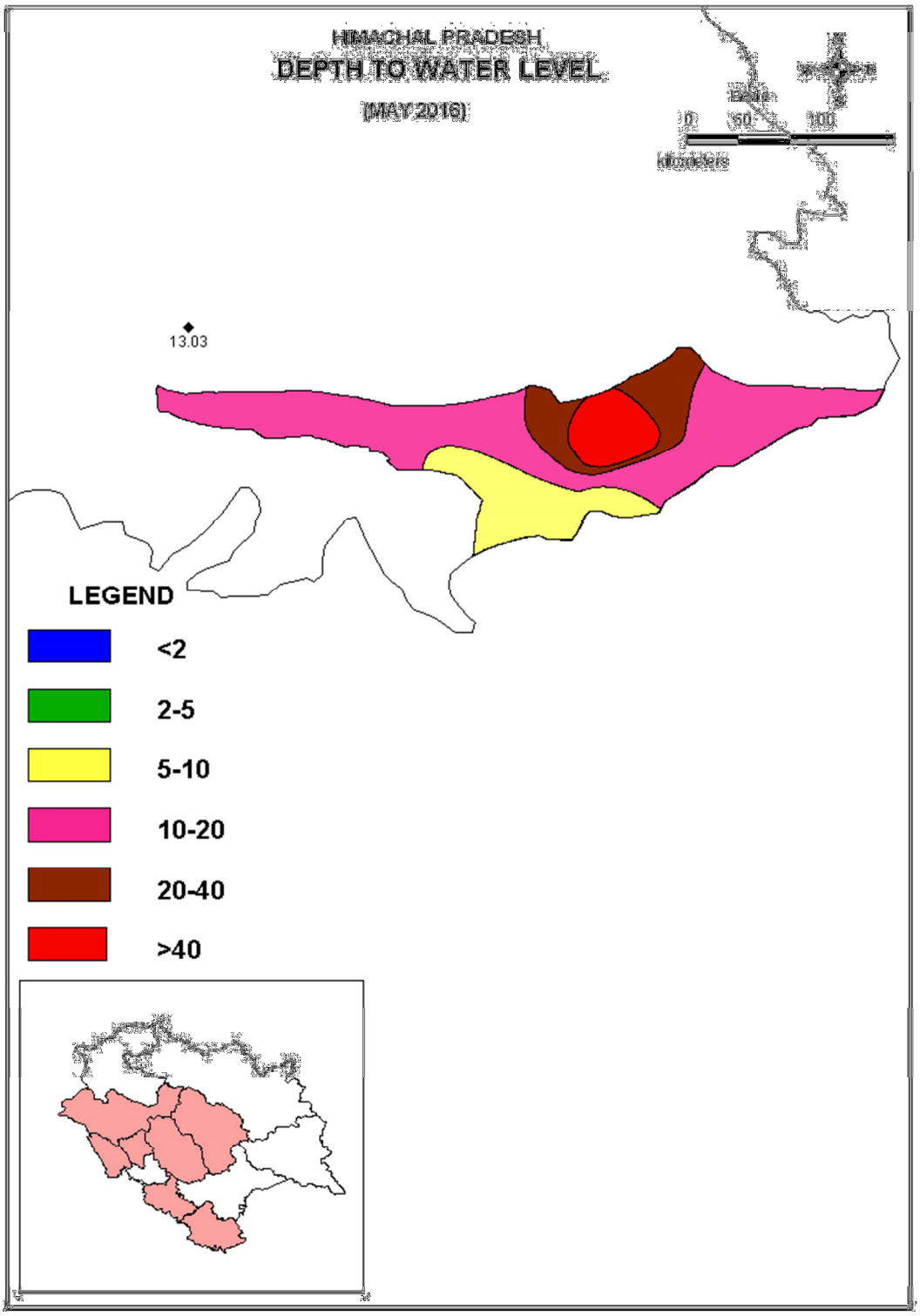
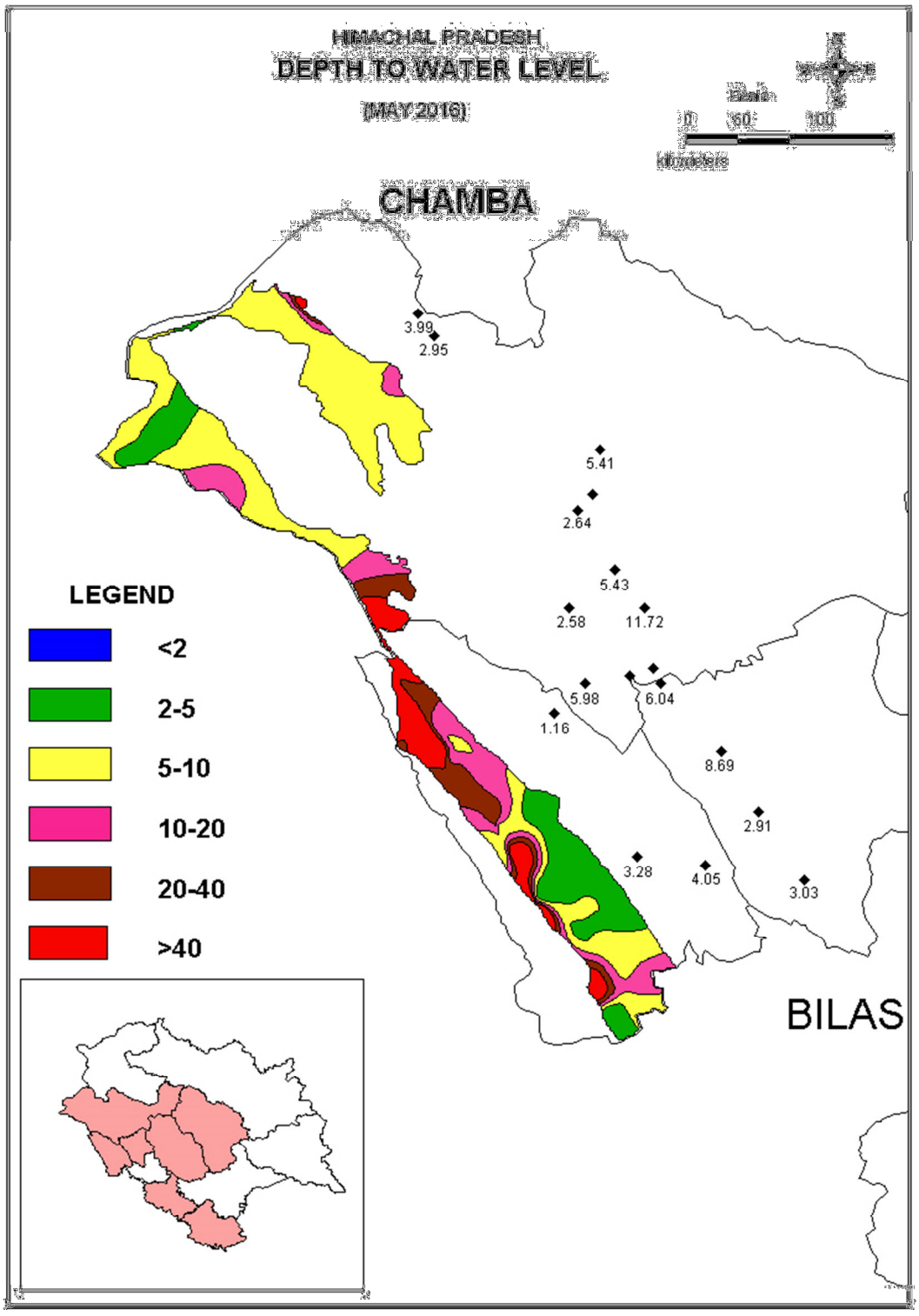
Barotiwala
Paonta Valley
Yamuna R.
LEGEND
NHS Stations
Valley areas
NHS monitoring districts
Drainage

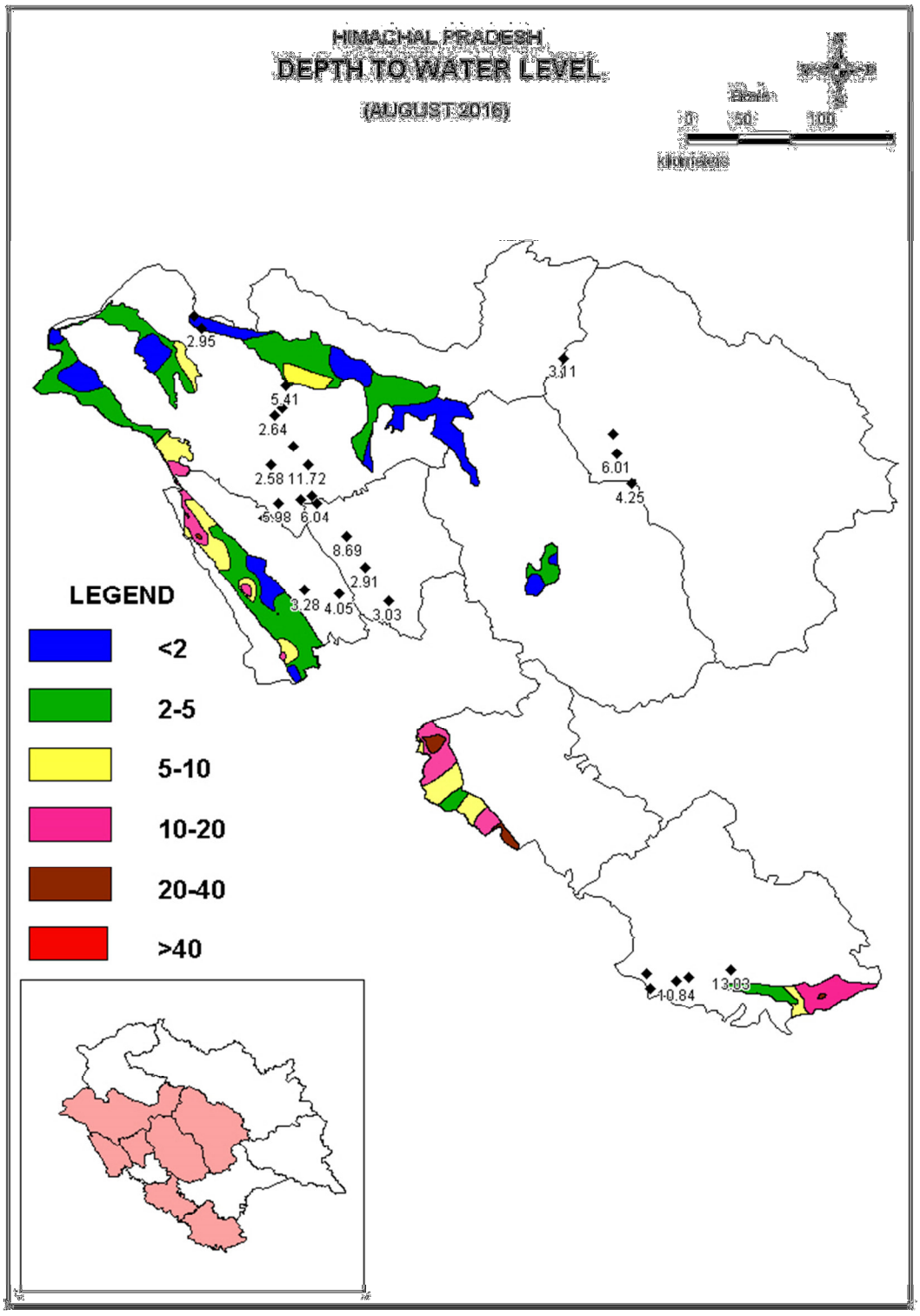

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(MAY 2016)
Scale:
0
50
100
CHAMBA
LAHAUL & SPITI
KINNAUR
BILASPUR
2.95
5.41
2.64
2.58
11.72
5.98
6.04
8.69
2.91
3.28
4.05
3.03
3.11
6.01
4.25
10.84
13.03
LEGEND
<2
2-5
5-10
10-20
20-40
>40

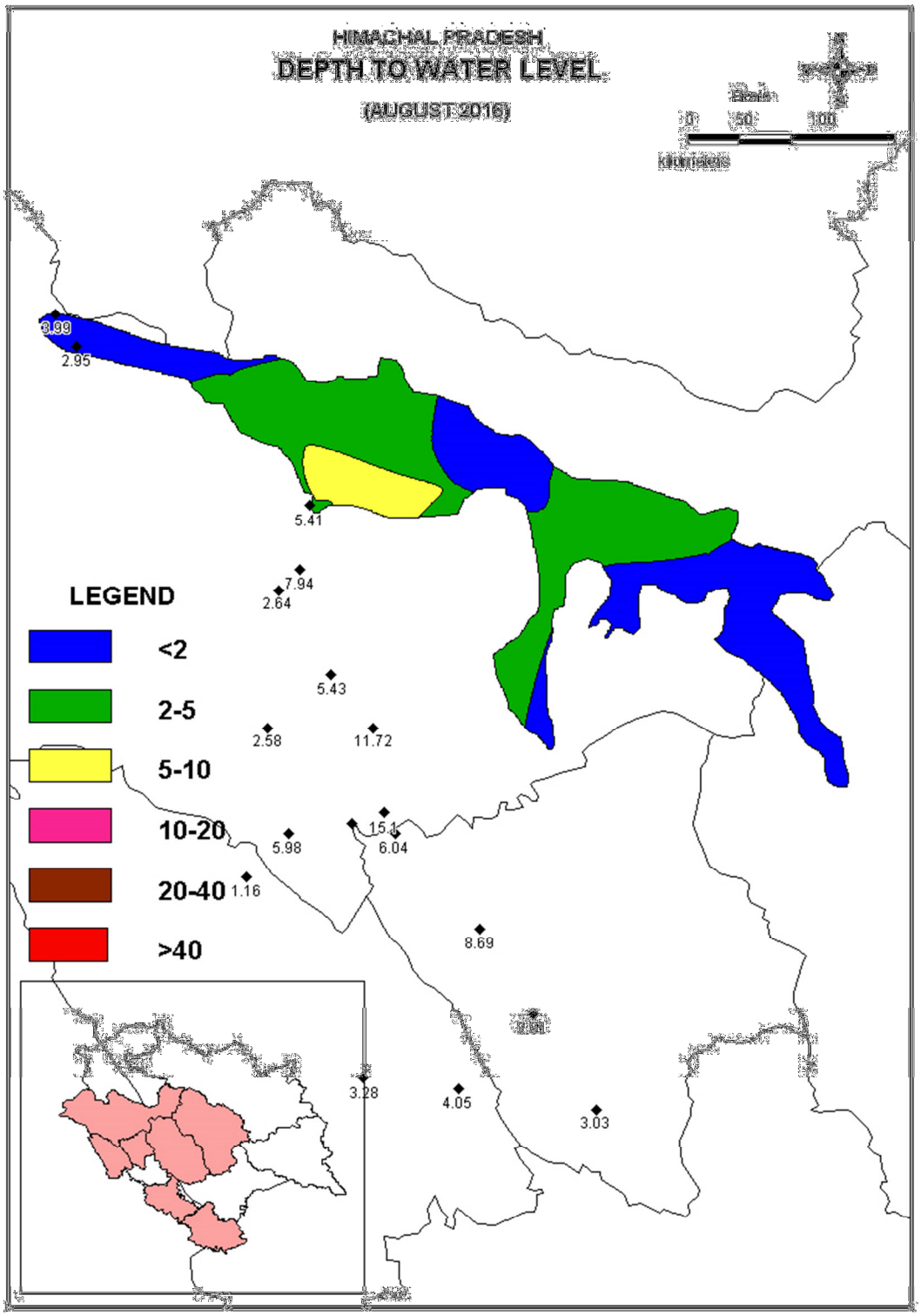

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(MAY 2016)
Scale
0
50
100
Kilometers
N
W
E
S
3.99
2.95
5.41
2.64
5.43
2.58
11.72
5.98
2.03
6.04
1.16
8.69
2.91
LEGEND
<2
2-5
5-10
10-20
20-40
>40

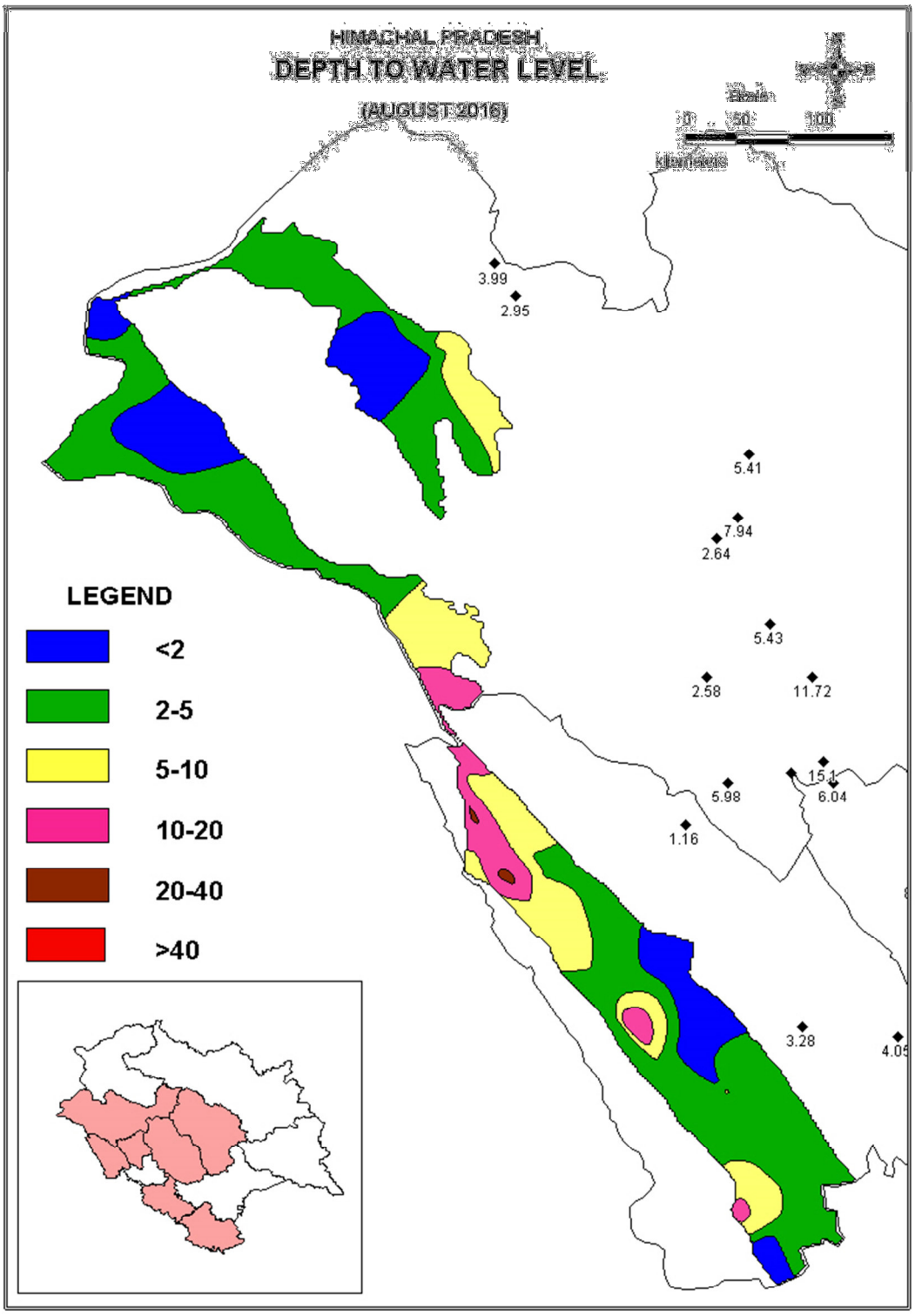

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(MAY 2016)
LEGEND
<2
2-5
5-10
10-20
20-40
>40

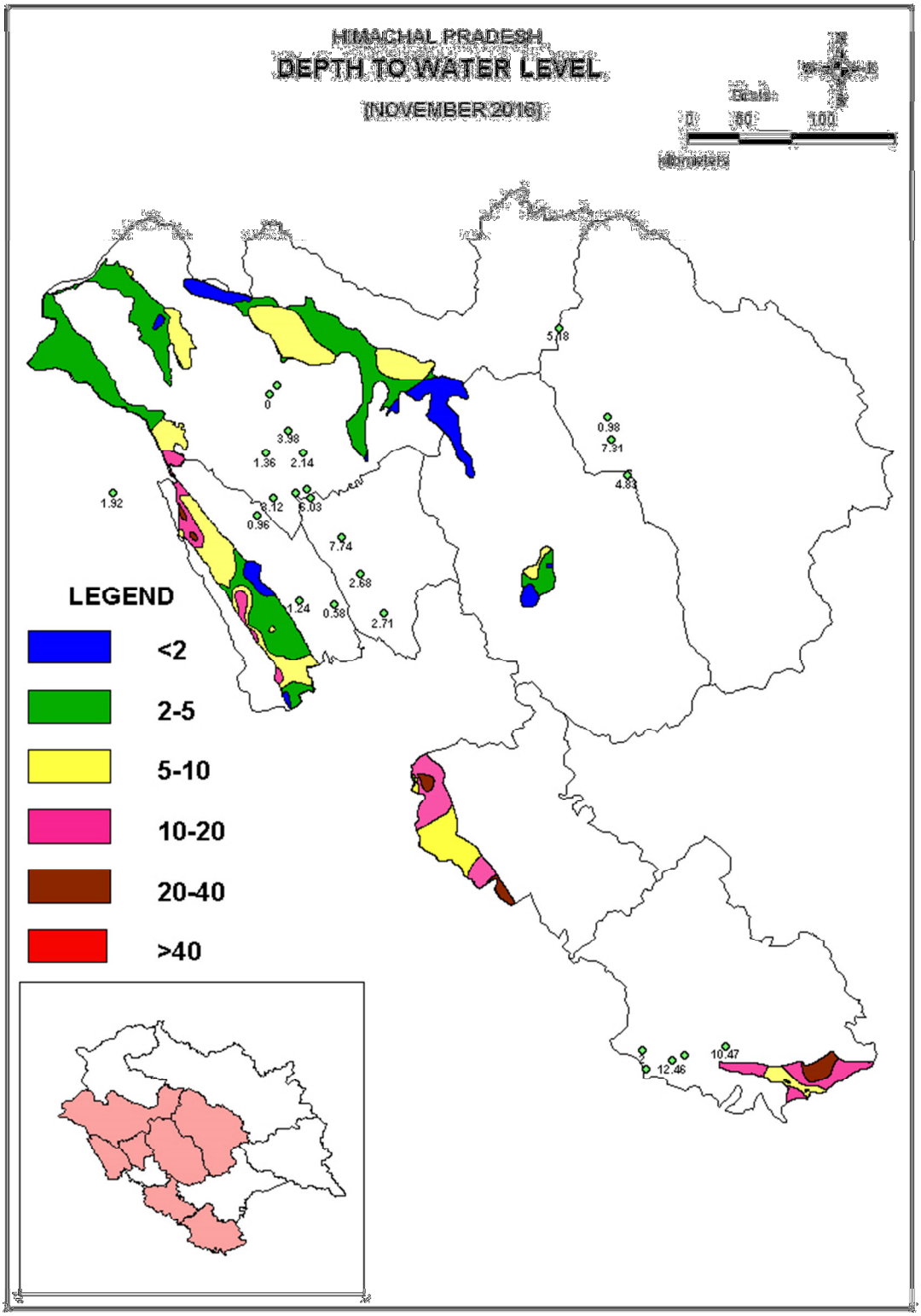

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(MAY 2016)
0
50
100
Kilometers
13.03
LEGEND
<2
2-5
5-10
10-20
20-40
>40

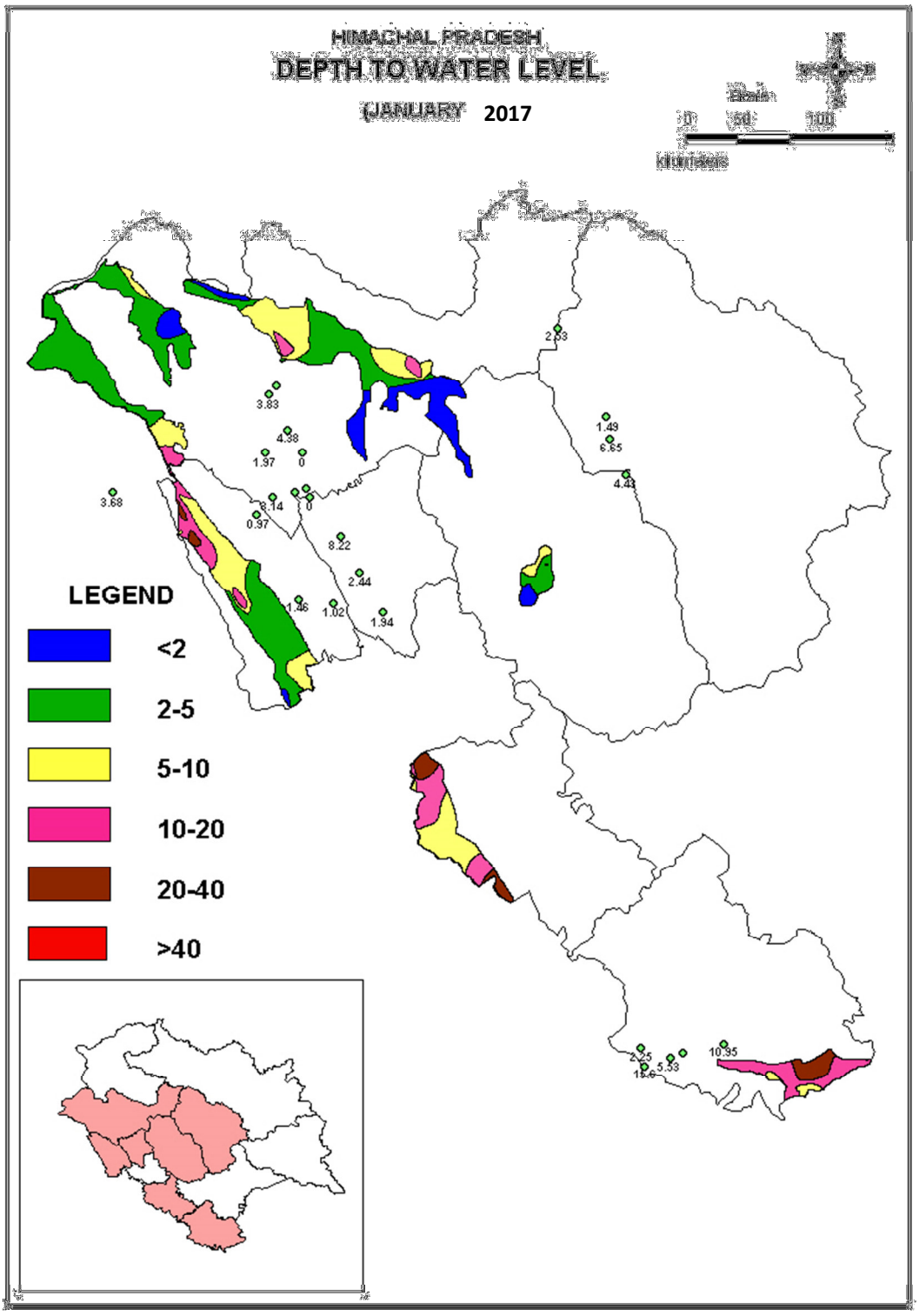

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(MAY 2016)
0
50
100
Kilometers
CHAMBA
3.99
2.95
5.41
2.64
5.43
2.58
11.72
5.98
6.04
1.16
8.69
2.91
3.28
4.05
3.03
BILAS
LEGEND
<2
2-5
5-10
10-20
20-40
>40

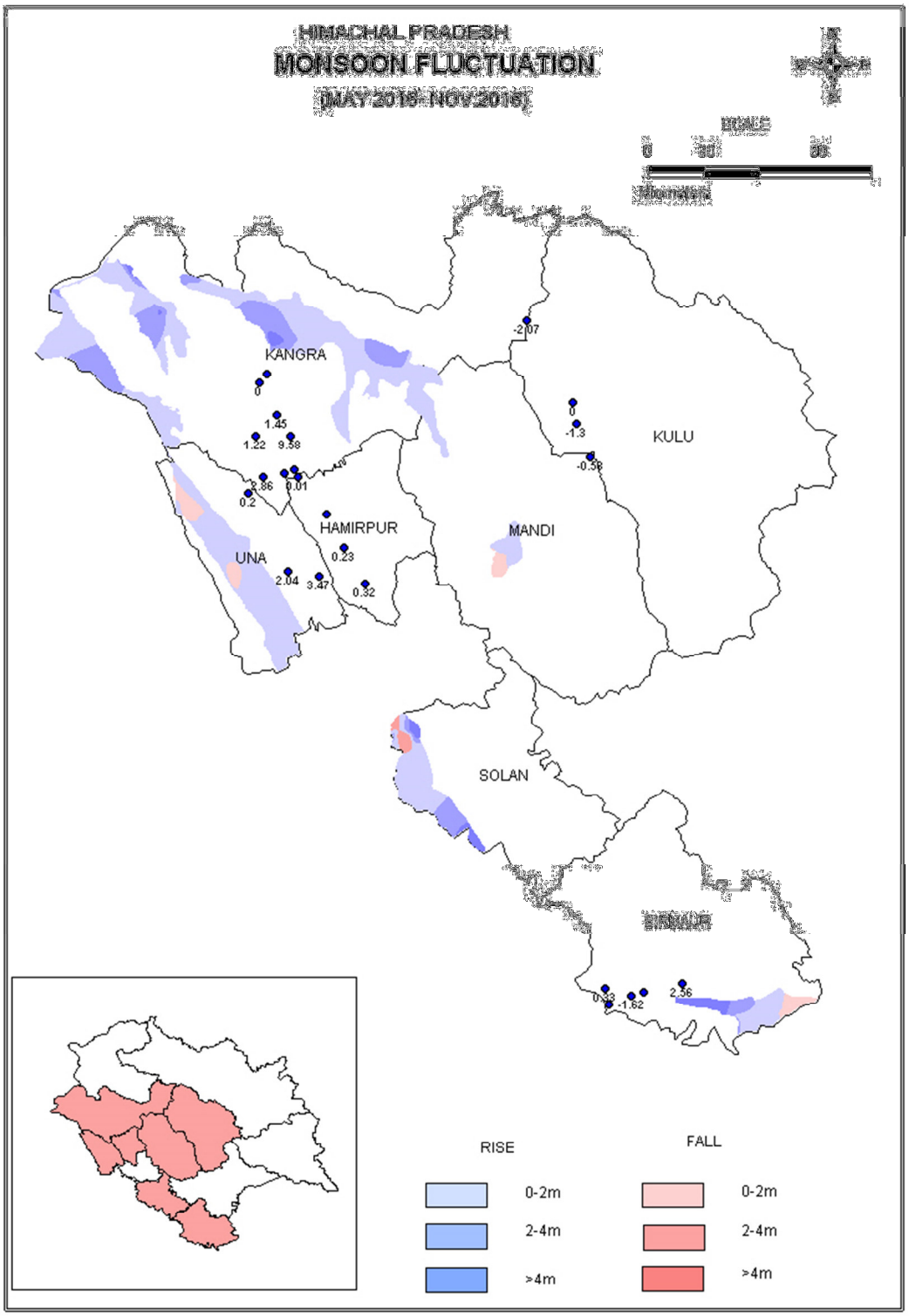

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(AUGUST 2016)
0
50
100
Kilometers
2.95
5.41
2.64
2.58
11.72
5.98
6.04
8.69
2.91
3.28
4.05
3.03
3.11
6.01
4.25
10.84
13.03
LEGEND
<2
2-5
5-10
10-20
20-40
>40

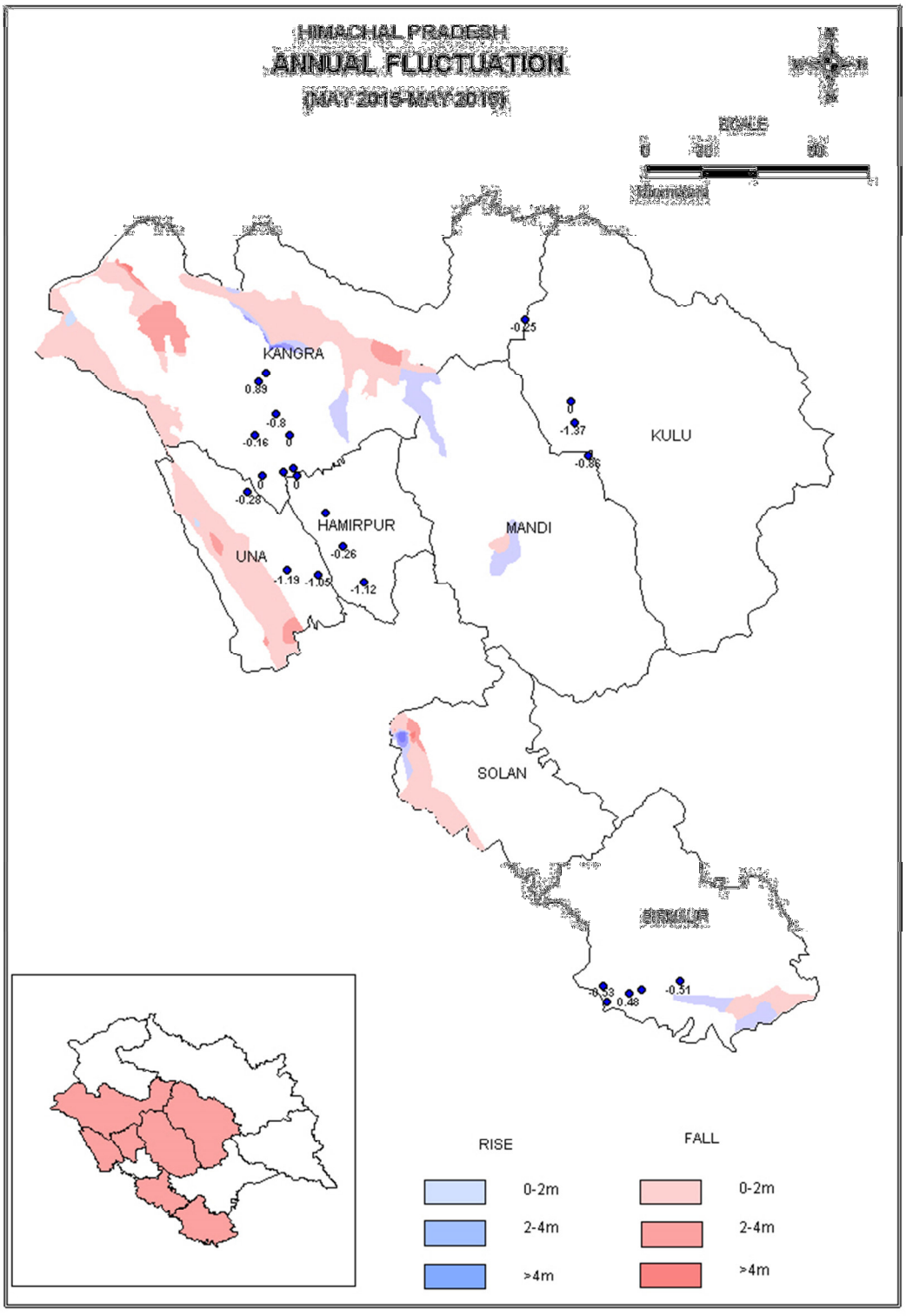

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(AUGUST 2016)
0
50
100
Kilometers
3.99
2.95
5.41
7.94
2.64
5.43
2.58
11.72
15.1
6.04
5.98
1.16
8.69
3.28
4.05
3.03
LEGEND
<2
2-5
5-10
10-20
20-40
>40

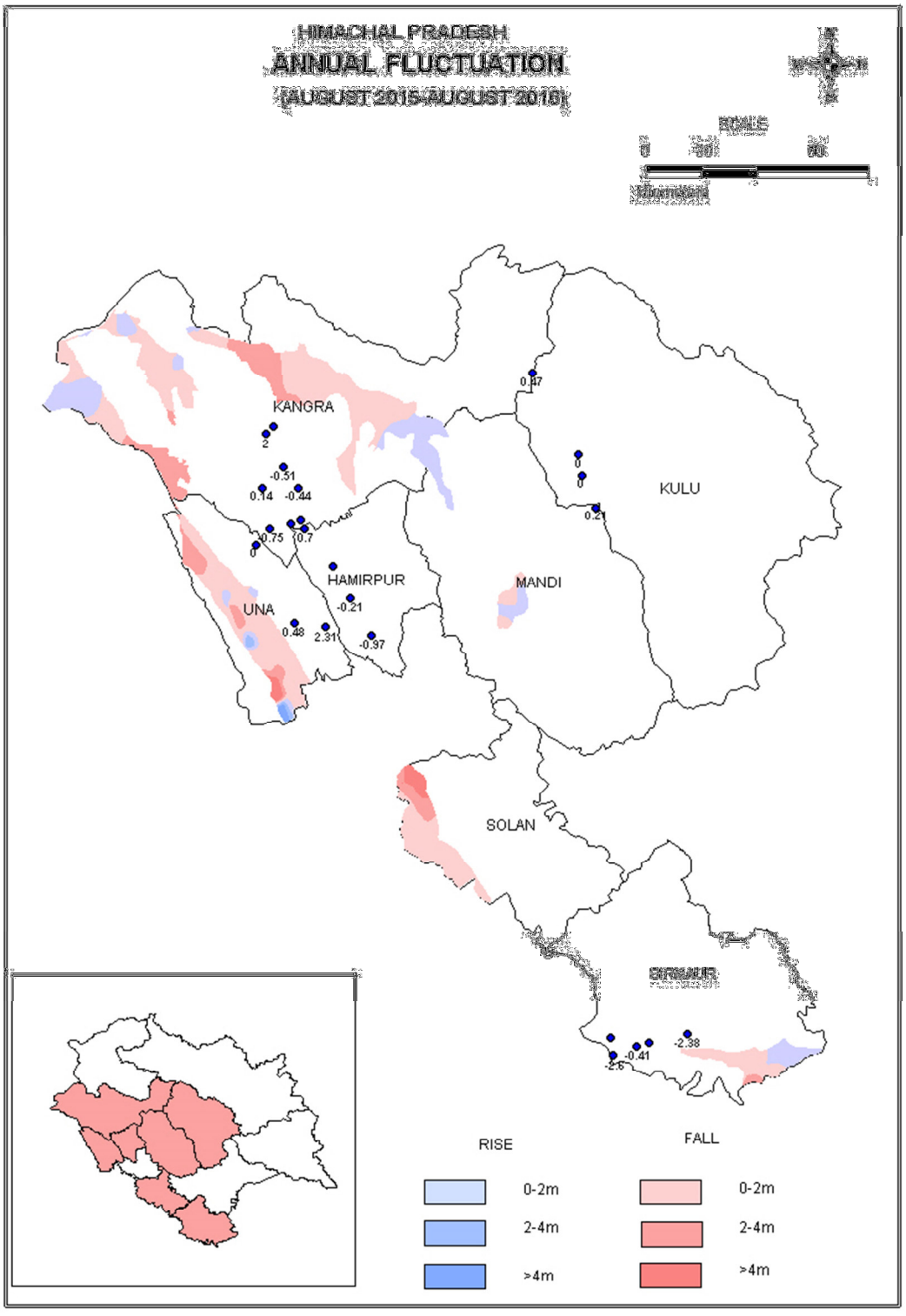

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(AUGUST 2016)
0
50
100
Kilometers
3.99
2.95
5.41
7.94
2.64
5.43
2.58
11.72
15.1
6.04
5.98
1.16
3.28
LEGEND
<2
2-5
5-10
10-20
20-40
>40

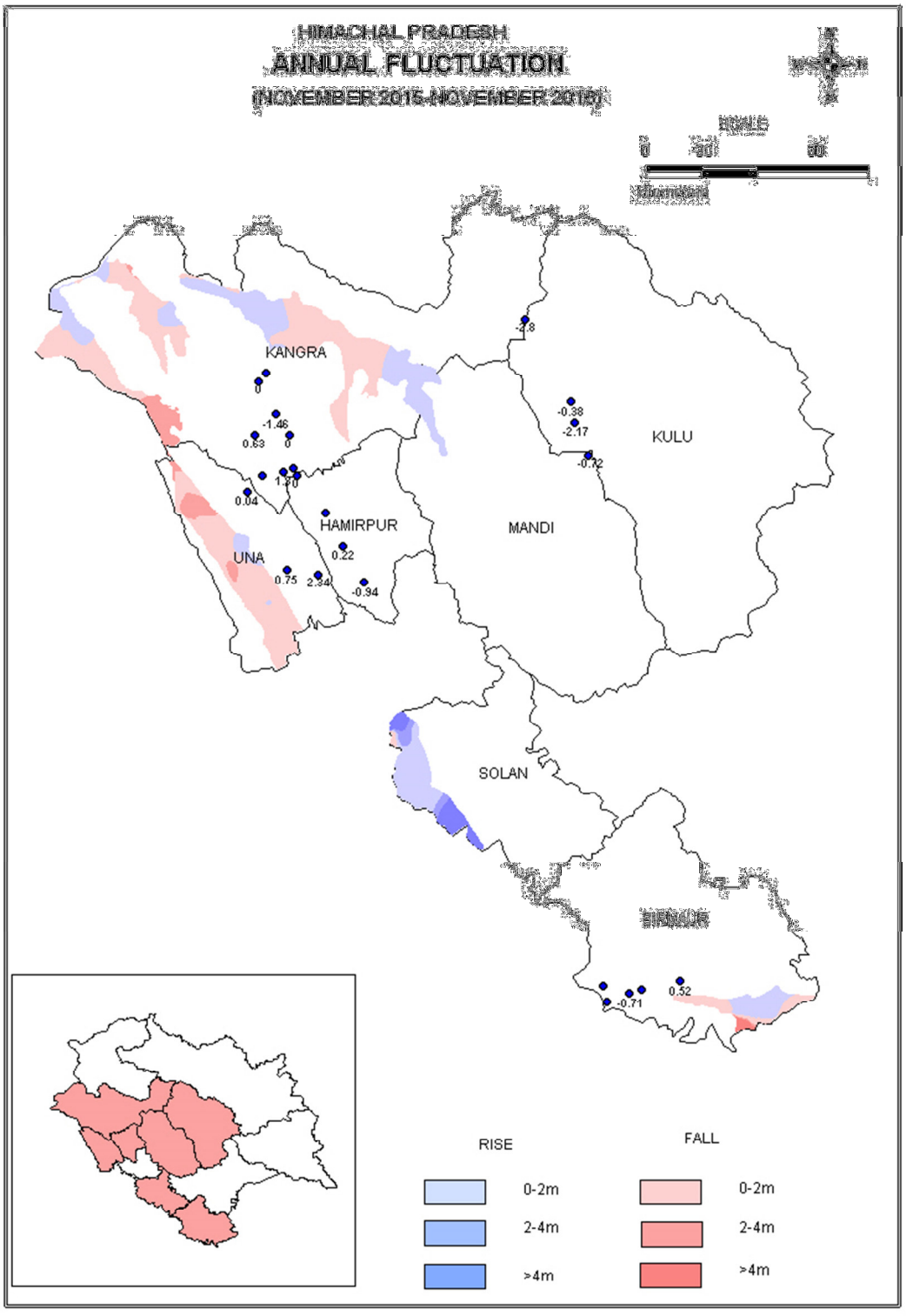

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(NOVEMBER 2016)
Scale
0
50
100
Kilometers
LEGEND
<2
2-5
5-10
10-20
20-40
>40
5.18
0
3.98
1.36
2.14
1.92
3.12
6.03
0.96
7.74
2.88
1.24
0.38
2.71
0.98
7.31
4.83
10.47
12.46

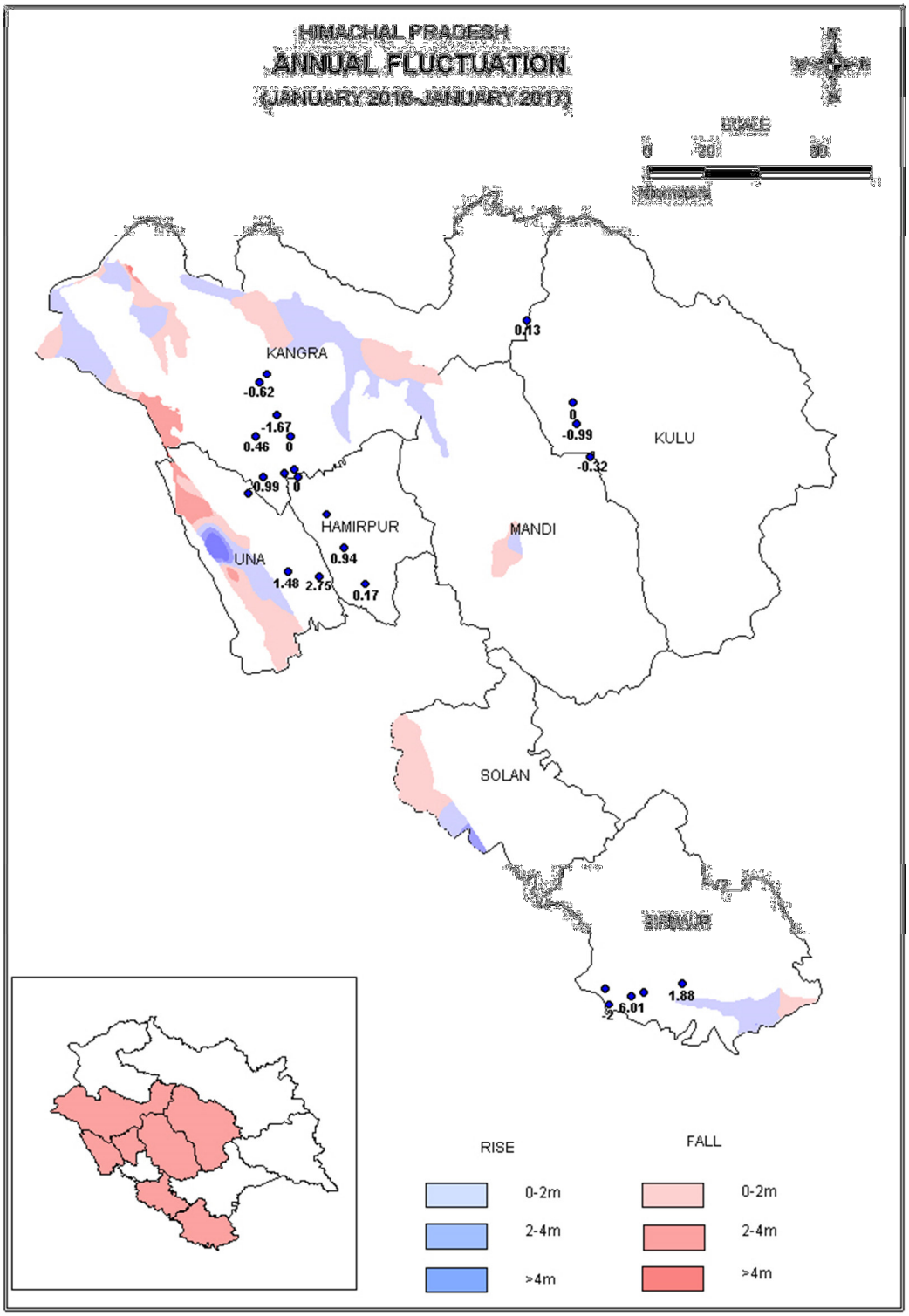

HIMACHAL PRADESH
DEPTH TO WATER LEVEL
(JANUARY 2017
Scale
0 50 100
Kilometers
LEGEND
<2
2-5
5-10
10-20
20-40
>40
3.83
4.38
1.97
0
3.68
0.97
8.22
2.44
1.46
1.02
1.94
2.53
1.49
6.65
4.43
2.25
5.53
10.95

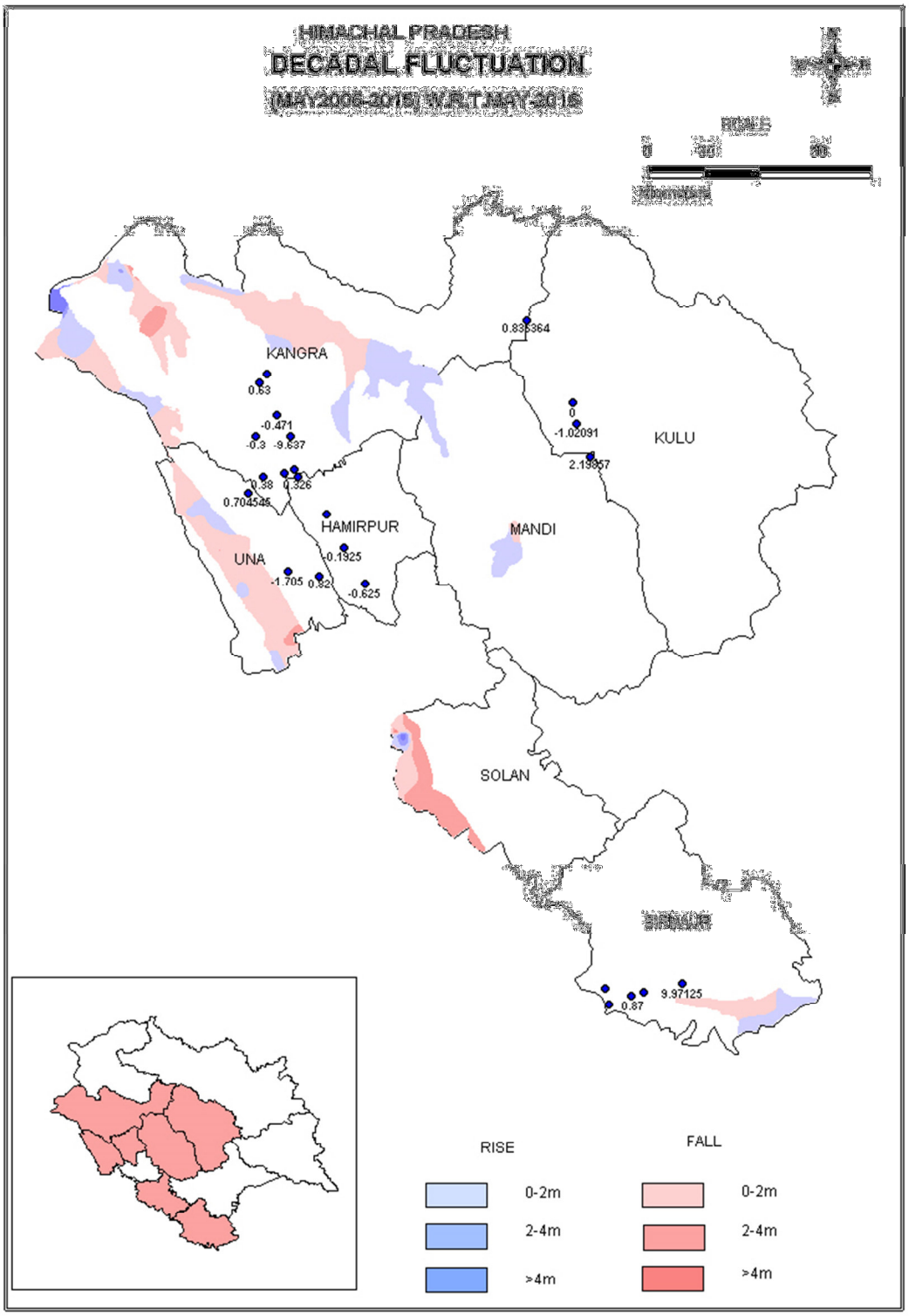

HIMACHAL PRADESH
MONSOON FLUCTUATION
(MAY 2016- NOV 2016)
KANGRA
KULU
MANDI
HAMIRPUR
UNA
SOLAN
SIRMAUR
-2.07
0
1.45
1.22
9.38
2.86
0.01
0.2
0.23
2.04
3.47
0.32
-1.3
-0.38
0.38
-1.62
2.36
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m

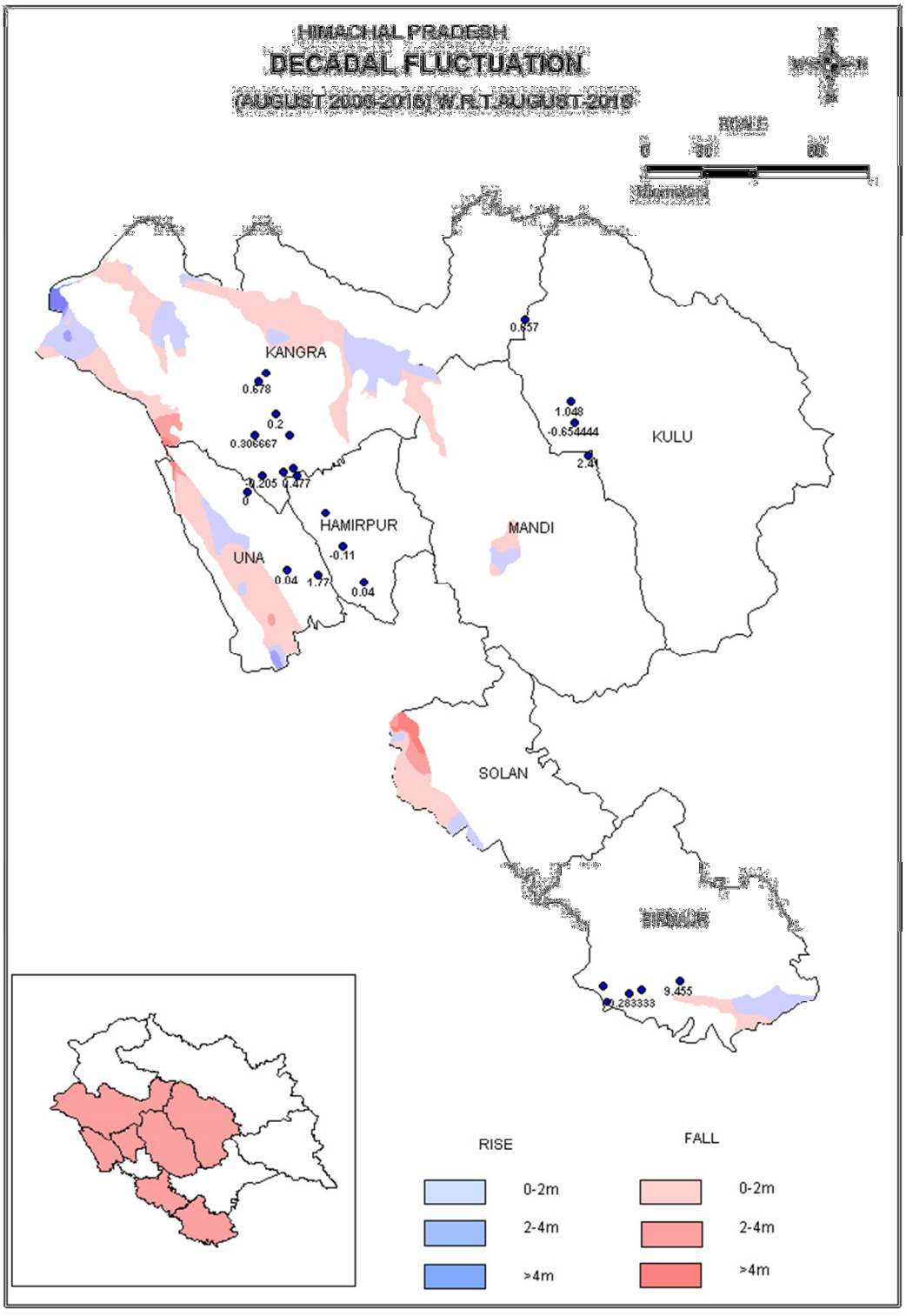

HIMACHAL PRADESH
ANNUAL FLUCTUATION
(MAY 2015-MAY 2016)
KANGRA
HAMIRPUR
UNA
MANDI
KULU
SOLAN
SIRMAUR
0.89
-0.8
-0.16
-0.28
-0.26
-1.19
-1.05
-1.12
-0.25
-1.37
-0.31
0.48
RISE
0-2m
2-4m
>4m
FALL
0-2m
2-4m
>4m

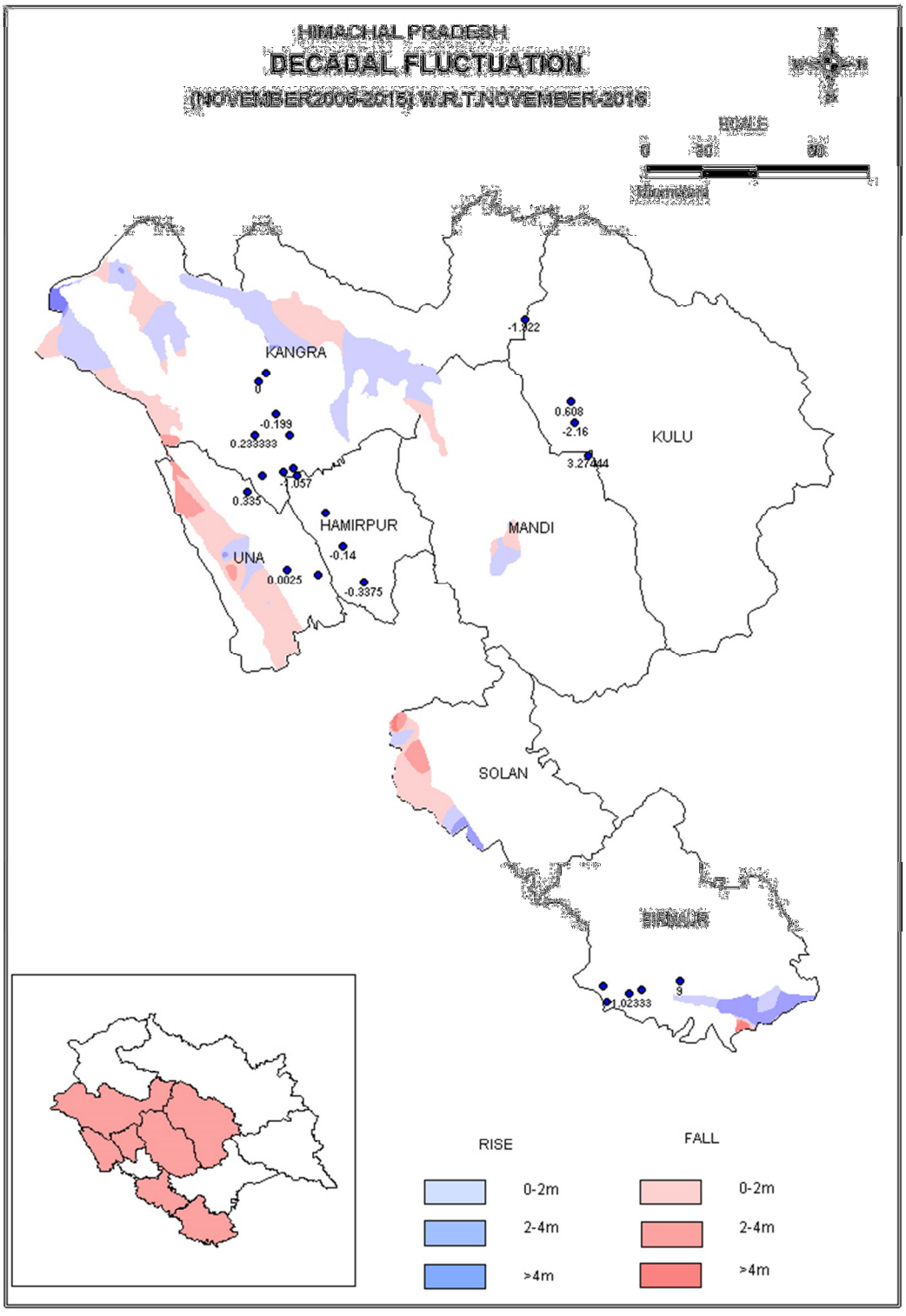

HIMACHAL PRADESH
ANNUAL FLUCTUATION
(AUGUST 2015-AUGUST 2016)
KANGRA
KULU
MANDI
HAMIRPUR
UNA
SOLAN
SIRMAUR
0.47
2
-0.31
0.14
-0.44
0
0.21
-0.75
0.7
-0.21
0.48
2.31
-0.97
-2.38
-0.41
-2.6
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m

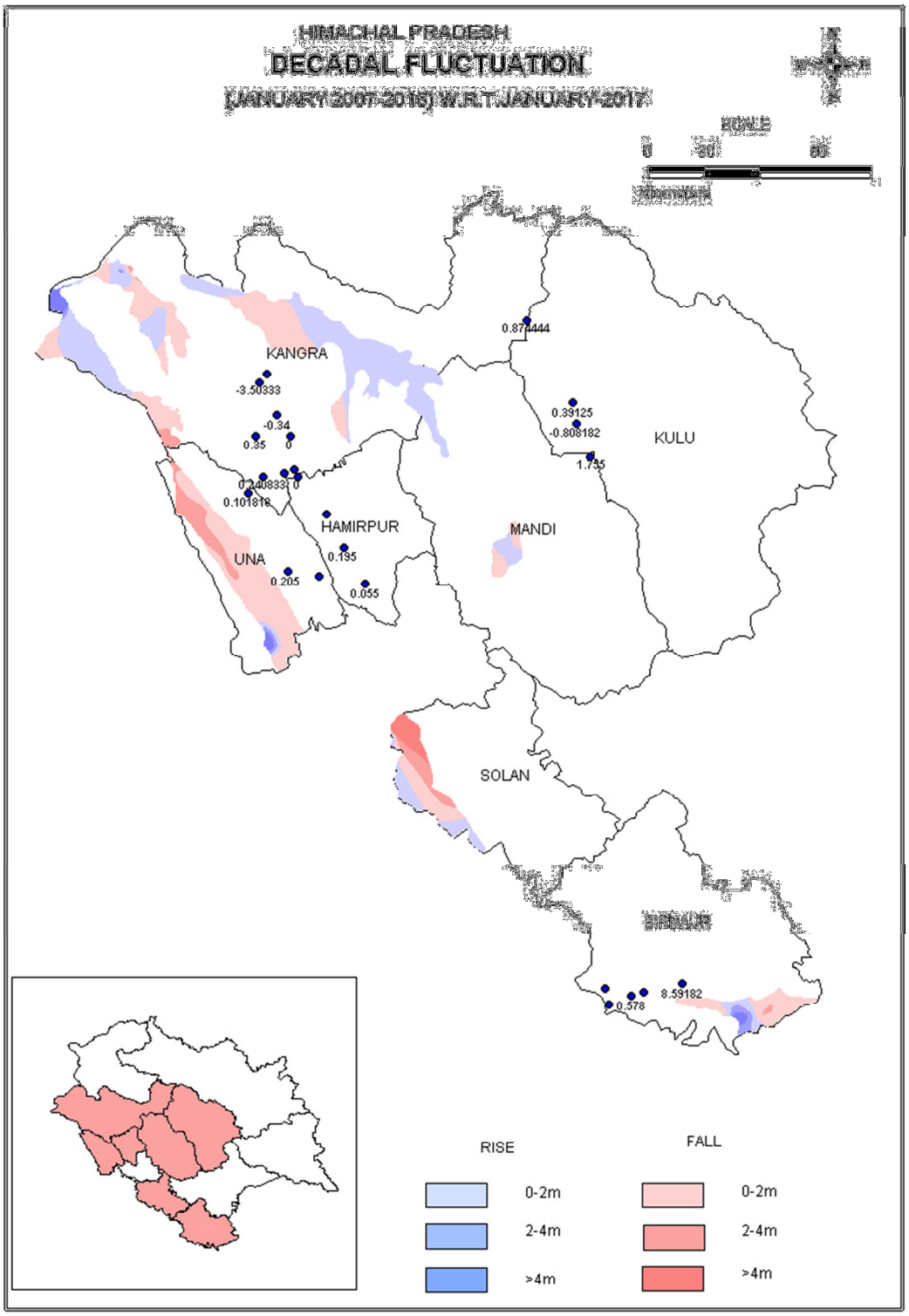

HIMACHAL PRADESH
ANNUAL FLUCTUATION
(NOVEMBER 2015-NOVEMBER 2016)
KANGRA
KULU
MANDI
HAMIRPUR
UNA
SOLAN
-2.8
0
-1.46
0.53
0
1.30
0.04
-0.38
-2.17
-0.72
0.22
0.75
2.34
-0.94
0.52
-0.71
RISE
0-2m
2-4m
>4m
FALL
0-2m
2-4m
>4m


HIMACHAL PRADESH
ANNUAL FLUCTUATION
(JANUARY 2016-JANUARY 2017)
SCALE
0
30
60
KANGRA
HAMIRPUR
UNA
MANDI
KULU
SOLAN
SIRMOUR
0.13
-0.62
-1.67
0.46
0
-0.99
0
0
-0.99
-0.32
0.94
1.48
2.75
0.17
1.88
-6.01
-2
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m


HIMACHAL PRADESH
DECADAL FLUCTUATION
KANGRA
HAMIRPUR
UNA
MANDI
KULU
SOLAN
SIRMAUR
0.63
-0.471
-0.3
-9.837
0.38
0.326
0.704545
-0.1925
-1.705
0.82
-0.625
0.835364
0
-1.02091
2.13857
9.97125
0.87
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m


HIMACHAL PRADESH
DECADAL FLUCTUATION
(AUGUST 2006-2015) W.R.T AUGUST 2016
SCALE
0
30
60
KANGRA
HAMIRPUR
UNA
MANDI
KULU
SOLAN
SIRMAUR
0.857
0.678
0.2
0.305667
1.048
-0.654444
2.41
0.205
0.477
-0.11
0.04
1.77
0.04
9.455
0.283333
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m


HIMACHAL PRADESH
DECADAL FLUCTUATION
(NOVEMBER2006-2015) W.R.T.NOVEMBER-2016
KANGRA
KULU
MANDI
HAMIRPUR
UNA
SOLAN
SIRMAUR
-1.322
0.608
-2.16
3.27444
-0.199
0.233333
-1.057
0.335
-0.14
0.0025
-0.3375
1.02333
RISE
0-2m
2-4m
>4m
FALL
0-2m
2-4m
>4m


HIMACHAL PRADESH
DECADAL FLUCTUATION
(JANUARY 2007-2016) W.R.T JANUARY-2017
KANGRA
HAMIRPUR
UNA
MANDI
KULU
SOLAN
SIRMOUR
-3.50333
-0.34
0.35
0
0.240833
0
0.101818
0.195
0.205
0.055
0.874444
0.39125
-0.808182
1.735
0.578
8.59182
RISE
FALL
0-2m
2-4m
>4m
0-2m
2-4m
>4m