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Dry and wet spell probability analysis by Markov chain model for Sangli District (Maharashtra), India

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Abstract
It is important to understand the probability that the monsoon will start or end during a specific week. It is crucial to understand the risks involved with the crops and whether they are suitable for sowing or planting. In order to choose the sowing date, crop pattern, plan for protective irrigation, and conduct intercultural operations, it is also crucial to be aware of the probability that dry spells will occur during the critical parts of the crops. As a result, the probability distribution analysis was carried out in this study for various parameters influencing the drought, such as the SPI index and the onset and withdrawal of the monsoon, for various stations in the Sangli district. Hence, the present study entitled, "Dry and wet spell probability analysis by Markov chain model for Sangli District (Maharashtra), India". For this study rainfall data of 10 stations have been procured and used for the period of 1961-2021.

Keywords: Markov chain, probability, wet week, dry week

1. Introduction
Drought, has multiple definitions. For a farmer, a drought is a time when it is difficult to carry out regular farm tasks. Drought is caused by a prolonged lack of rainfall, which is characterised by a significant depletion of surface water, the cessation of spring flows, a decrease in groundwater storage, and the rapid depletion of reservoirs, lakes, streams, and river systems, according to hydrologists. When rainfall in a given area is significantly lower than average, in the eyes of a meteorologist, this is a situation. The agricultural scientist, on the other hand, believes that it happens when there is extreme water stress during the growing season due to insufficient soil moisture and rainfall to maintain optimal crop productivity throughout the growth season. The Sangli district in western Maharashtra has been chosen as the study location because it is susceptible to rainfall differences and has a large tract of rainfed land. "Crop yield, especially in a rainfed environment, is affected by the rainfall pattern. Simple criteria connected to sequential phenomena such as dry and wet spells could be used to analyse rainfall data in order to acquire specific information needed for crop planning and agricultural operations" (Reddy *et al*., 2008) [1]. "The Markov Chain probability model has been identified as an appropriate model for explaining the long-term frequency behaviour of wet and dry weather spells. In this model, the conditional probability has been acknowledged as fully justified in the analysis of weekly rainfall data. This model allows us to predict the likelihood of dry and wet weather within a given week. To keep crop output stable at a specific level, agriculture must be planned scientifically in order to make the best use of an area's rainfall pattern. This entails researching an area's dry and wet period sequences in order to take the appropriate actions to develop agricultural plans in rainfed areas." Farmers may benefit from scientific forecasts of wet and dry spells in order to increase productivity and cropping intensity, and thus their economic returns. "The Markov chain probability model has been used to determine the long-term frequency behaviour of wet and dry spells" (Victor and Sastry, 1979) [2], as well as the chance of daily precipitation occurrence. A drought contingency plan could be developed with the help of the region-by-region evaluations of the dry spell. Rainfall accumulation in the past and present is another element that affects when the monsoon arrives and departs. (Vanitha *et al*., 2017) [3]

2. Materials and Methods
2.1 Study Area
Sangli District is a district of Maharashtra state in west-central India.

It is situated between the latitude $16^0$5'N and $17^0$33'N and longitudinal of $73^0$41' East to $75^0$41' East. It is bounded by Satara district to the North, Bijapur district to the East, Kolhapur district to the South, and Ratnagiri district to the West. There are 10 tehsils in Sangli district *viz*, (1) Atpadi (2) Walwa (3) Jat (4) Kadegaon (5) Kavathemahankal (6) Khanapur (7) Miraj (8) Palus (9) Shirala and (10) Tasgaon.

2.2 Data and methods

The daily rainfall data of all tahsils in Sangli district will be collected from Department of Agricultural Meteorology, College of Agriculture, Pune, State Agriculture Department, Pune, India Meteorological Department, Pune, Downloaded from www.maharain.gov.in (www.krishi.maharashtra.gov.in) from January to December.

Microsoft office sub-module Microsoft-Excel-2010 is used for data analysis. The formulation and conditional statements were also executed in MS-excel. The DrinC (drought indices calculator) software developed at National Technical University of Athens is used for analysis of drought using Precipitation Deciles Index.

Table 1: The location of rain gauge station Geographical area location and availability of data

Sr. No	Name of tehsils	Area km^2	latitude	longitude	Period of year		No. of years
					From	To	
1	Atpadi	830.26	17.420°N	74.937°E	1982	2021	40
2	Jat	2196.05	17.059°N	75.212°E	1961	2021	61
3	Kavathemahankal	734.06	17.945°N	73.976°E	1982	2021	40
4	Kadegaon	575.68	17.296°N	74.331°E	1998	2021	24
5	Khanapur	727.25	17.264°N	74.708°E	1998	2021	24
6	Miraj	926.10	16.850°N	74.610°E	1982	2021	40
7	Palus	464.54	17.091°N	74.458°E	1998	2021	24
8	Shirala	639.09	17.015°N	74.116°E	1961	2021	61
9	Tasgaon	729.76	17.033°N	74.599°E	1961	2021	61
10	Walwa	772.83	16.494°N	74.230°E	1961	2021	61

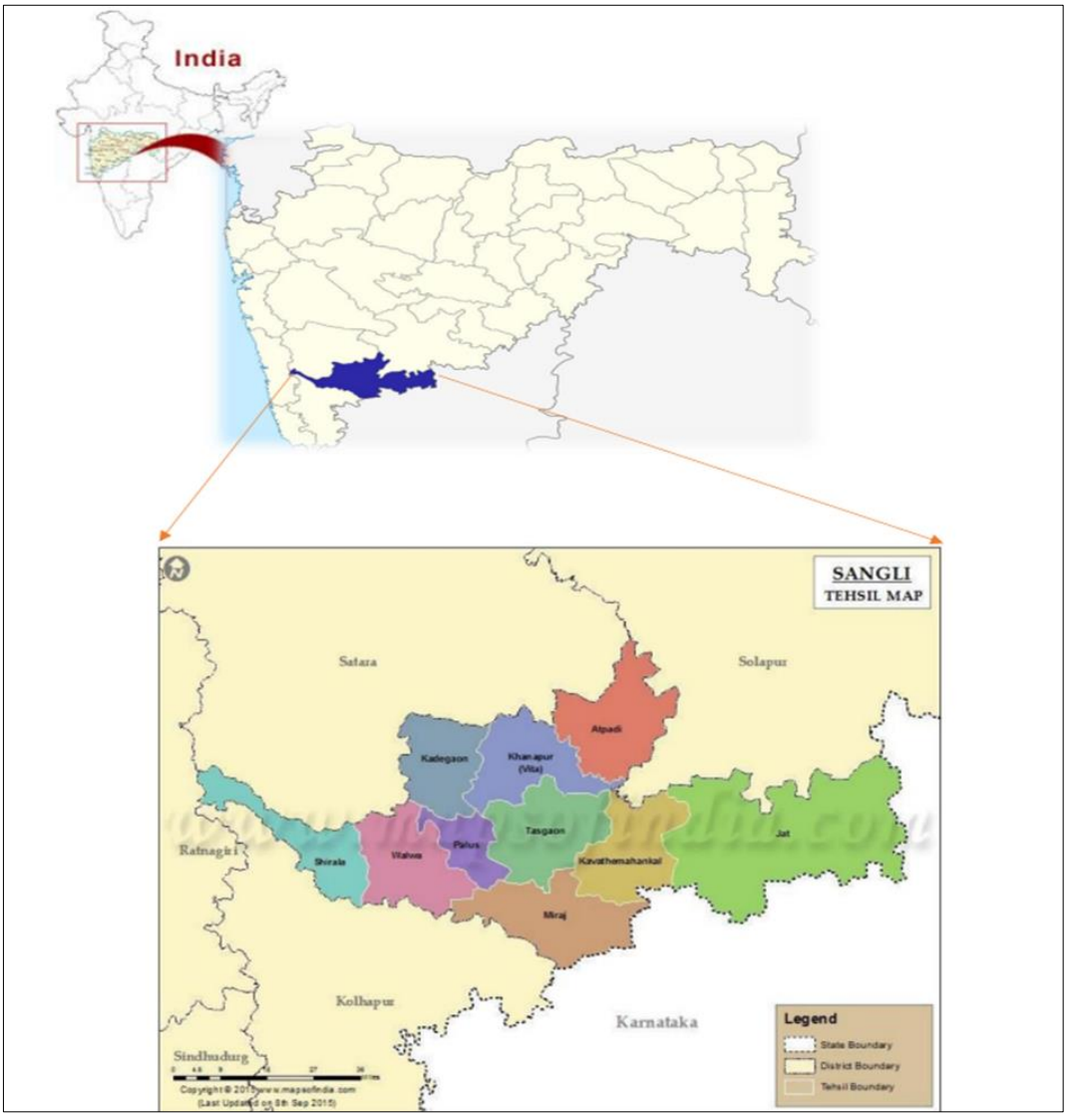


Fig 1: Location map of Sangli district

2.3 Markov Chain Probability Model for Dry and Wet Spell Analysis

The success or failure of crops particularly under rainfed conditions is closely linked with the rainfall patterns. Simple criterion related to sequential phenomena like a dry and wet spell was used for analysing rainfall data to obtain specific information needed for crop planning and for carrying out agricultural operations including protective irrigations. It is always useful to ascertain the probability of sequential events like a wet week following another wet week or a dry week following a wet or dry week during the crop growing season. This is the basis for the analysis of rainfall for a dry spell and wet spell using the Markov-Chain process, which is described in this section.

Rainfall of 20 mm per week was considered adequate for all the growth stages of all the crops grown. Thus, if in a given week the rainfall received was less than 20mm, that week was designated as a dry week and vice versa Pandharinath, (1991). Based on this criterion each week was categorized as a dry week and wet week and respective probabilities were calculated as follows:

2.3.1 Initial Probability of Dry and Wet Weeks

Based on historical data of weekly rainfall and following the above-mentioned criteria of dry and wet week, the initial probabilities can be calculated as:

$P(D) = F(D)/N$

$P(W) = F(W)/N$

Where,
P_D= Probability of the week is dry
P_W= Probability of the week being wet
F_D= Number of dry weeks
F_W= Number of wet week
N= Number of years of data

2.3.2 Conditional Probability of Dry and Wet Weeks

$P(D/D) = F(DD)/F(D)$
$P(W/W) = F(WW)/F(W)$
$P(W/D) = 1-P(D/D)$

$P(D/W) = 1-P(W/W)$

where,
P_{DD}= Probability (conditional) of a dry week preceded by a dry week
P_{WW}= Probability (conditional) of a wet week preceded by a wet week
P_{WD}= Probability (conditional) of a wet week preceded by a dry week
P_{DW}= Probability (conditional) of a dry week preceded by a wet week
F_{DD}= Number of dry weeks preceded by another dry week
F_{WW}= Number of wet weeks preceded by another wet week

2.3.3 Markov chain model

The model assumes that the transition probability for a given week depends on the weather (dry or wet) of its previous week. Under such a model the following relations hold
$P(Wi) = 1–P(Di)$
$P(Wi/ Di-1) = 1-P(Di/Di-1)$
$P(Di/ Wi-1) = P(Di) -P(Di-1) P(Di/Di-1)$ and
$P(Wi/ Wi-1) = 1-P(Di/Wi-1)$

Where
$P(Di/Wi-1)$ is the transition probability that i^{th} week is dry given that (i-1) the week is wet and the other definitions automatically follow. It is interesting to note that only the initial probability the i^{th} week of a year is dry, P (Di) and the transition probability of i^{th} week that it is dry provided previous week is dry,
P (Di/Di-1), need to be calculated from the original data and the other probabilities are easily obtained by substitution.

3. Results and Discussion

3.1 Variation of Annual Rainfall in Sangli District

Table 2 shows that the Sangli district received 632.6 mm of rainfall on average each year. It ranged from 432.8 mm in Palus to 1111.3 mm at Shirala. (Anonymous, 2013)

Table 2: Tehsil wise annual rainfall variation in Sangli district

Tehsil	Maximum Rainfall		Minimum Rainfall		Mean Rainfall (mm)	S.D. (mm)	C.V. (%)
	Rainfall (mm)	Year	Rainfall (mm)	Year			
Sangli District							
Atpadi	1073	2020	141	2018	427.7	202.8	47.4
Jat	1102	1975	221.4	1983	615.6	214.7	34.9
Kadegaon	1035.8	2020	142.2	2002	597.3	247.3	41.4
Kavathemahankal	958.3	2020	134.2	1985	504.1	195.6	38.8
Khanapur	912	1998	364	2011	655	184.9	28.2
Miraj	1105.9	1991	296.8	1986	597.2	190	31.8
Palus	980.9	2021	134	2000	432.8	213.9	49.4
Shirala	1981.9	2021	481.8	2002	1111.3	287	25.8
Tasgaon	1108.8	2020	231.4	1972	639.8	203.8	31.9
Walwa	1412.6	2005	291	2003	745.2	252	33.8
District average					632.6	219.2	36.3

3.2 Markov-Chain Initial and Conditional Probabilities of Dry and Wet Weeks

Using the "Weather Cock" software created by CRIDA, Hyderabad, the initial and conditional probabilities of dry and wet weeks at a threshold limit of 20 mm of precipitation during the crop growth period (MW 23 to 43) are calculated for various tehsils in the Sangli district.

3.2.1 Probability Distribution of Atpadi Tehsil

The initial probability of getting a wet week, P(W), varies from 10 to 60 per cent, and the initial probability of having a dry week, P(D), ranges from 40 to 90 per cent. In contrast,

during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The probability of a wet week, or P(W), are found in 39 and 40 MWs. The conditional probability of wet and dry weeks, namely, wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D) and wet weeks preceded by another dry week P(W/D), ranges from 0 to 62 per cent, 38 to 100 per cent, 42 to 91 per cent, and 09 to 58 per cent, respectively. The probability of a dry week followed by another dry week P(D/D) is greater than 50 per cent in the MWs 23 to 39, and 41 to 43. The greater probability of being a dry week preceded by another dry week P(D/D) was observed in 26, 27, 30, 31, and 32 MWs.

3.2.2 Probability Distribution of Jat Tehsil

The initial probability of getting a wet week, P(W), varies from 21 to 64 per cent, and the initial probability of having a dry week, P(D), ranges from 44 to 79 per cent. In contrast, during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The probability of a wet week, or P(W), are found in 23, 37 to 40 MWs. The conditional probability of wet and dry weeks, namely, wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D) and wet weeks preceded by another dry week P(W/D), ranges from 14 to 69 per cent, 25 to 86 per cent, 40 to 85 per cent, and 15 to 60 per cent, respectively. The probability of a dry week followed by another dry week P(D/D) is greater than 50 per cent in the MWs 24 to 37, and 40 to 43. The greater probability of being a dry week preceded by another dry week P(D/D) was observed in 27, 29, 42 and 43 MWs.

3.2.3 Probability Distribution of Kadegaon Tehsil

The initial probability of getting a wet week, P(W), varies from 08 to 63 per cent, and the initial probability of having a dry week, P(D), ranges from 38 to 63 per cent. In contrast, during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The probability of a wet week, or P(W), is found in 29, 37, 39, 40 and 41 MWs. The conditional probability of wet and dry weeks, namely wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D), and wet weeks preceded by another dry week P(W/D) ranges from 25 to 78 per cent, 22 to 75 per cent, 29 to 100 per cent, and 0 to 71 per cent, respectively. The probability of a dry week followed by another dry week P(D/D) is greater than 50 per cent in the 25, 26, 27, 30 to 38 and 40 to 43 MWs. The greater probability of being a dry week preceded by another dry week P(D/D) was observed in 33, 42 and 43 MWs.

3.2.4 Probability Distribution of Kavathemahankal Tehsil

The initial probability of getting a wet week, P(W), varies from 10 to 64 per cent, and the initial probability of having a dry week, P(D), ranges from 36 to 90 per cent. In contrast, during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The probability of a wet week, or P(W), is found in 39 and 40 MWs. The conditional probability of wet and dry weeks, namely wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D), and wet weeks preceded by another dry week P(W/D) ranges from 0 to 72 per cent, 28 to 100 per cent, 43 to 88 per cent, and 13 to 57 per cent, respectively. The probability of a dry week followed by another dry week (PDD) is greater than 50 per cent in the 23 to 38 and 40 to 43 MWs. The greater probability of being a dry week preceded by another dry week P(D/D) was observed in 33, 34, 35 and 43 MWs.

3.2.5 Probability Distribution of Khanapur Tehsil

The initial probability of getting a wet week, P(W), varies from 13 to 67 per cent, and the initial probability of having a dry week, P(D), ranges from 33 to 88 per cent. In contrast, during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The probability of a wet week, or P(W), is found in 23, 29, 36,38, 39, 40 and 41 MWs. The conditional probability of wet and dry weeks, namely wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D), and wet weeks preceded by another dry week P(W/D) ranges from 0 to 75 per cent, 25 to 100 per cent, 20 to 100 per cent, and 0 to 80 per cent, respectively. The probability of a dry week followed by another dry week P(D/D) is greater than 50 per cent in the 26, 27, 28, 30 to 35, 42 to 43 MWs. The greater probability of being a dry week preceded by another dry week P(D/D) was observed in 33 and 43 MWs.

3.2.6 Probability Distribution of Miraj Tehsil

The initial probability of getting a wet week, P(W), varies from 20 to 68 per cent, and the initial probability of having a dry week, P(D), ranges from 33 to 80 per cent. In contrast, during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The probability of a wet week, or P(W), is found in 29, 39, 40 and 41 MWs. The conditional probability of wet and dry weeks, namely wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D), and wet weeks preceded by another dry week P(W/D) ranges from 15 to 84 per cent, 16 to 82 per cent, 24 to 81 per cent, and 19 to 76 per cent, respectively. The probability of a dry week followed by another dry week P(D/D) is greater than 50 per cent in the 24 to 28, 30 to 38 and 40 to 43 MWs. The greater probability of being a dry week preceded by another dry week P(D/D) was observed in 27, 42 and 43 MWs.

3.2.7 Probability Distribution of Palus Tehsil

The initial probability of getting a wet week, P(W), varies from 04 to 46 per cent, and the initial probability of having a dry week, P(D), ranges from 54 to 88 per cent. In contrast, during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The conditional probability of wet and dry weeks, namely wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D), and wet weeks preceded by another dry week P(W/D) ranges from 0 to 80 per cent, 20 to 100 per cent, 53 to 100 per cent, and 0 to 47 per cent, respectively. The probability of a dry week followed by another dry week P(D/D) is greater than 50 per cent in between 23 to 43 MWs. The greater probability of being a dry week preceded by another dry week (PDD) was observed in

27, 33, 34, 36 and 43 MWs.

3.2.8 Probability Distribution of Shirala Tehsil

The initial probability of getting a wet week, P(W), varies from 18 to 80 per cent, and the initial probability of having a dry week, P(D), ranges from 20 to 82 per cent. In contrast, during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The probability of a wet week, or P(W), is found in 38 to 41 MWs. The conditional probability of wet and dry weeks, namely wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D), and wet weeks preceded by another dry week P(W/D) ranges from 29 to 80 per cent, 16 to 71 per cent, 19 to 86 per cent, and 14 to 81 per cent, respectively. The probability of a dry week followed by another dry week P(D/D) is greater than 50 per cent in between 23, 28, 35, 36, 37, 40 to 43 MWs. The greater probability of being a dry week preceded by another dry week P(D/D) was observed in 36 to 42 and 43 MWs.

3.2.9 Probability Distribution of Tasgaon Tehsil

The initial probability of getting a wet week, P(W), varies from 30 to 64 per cent, and the initial probability of having a dry week, P(D), ranges from 36 to 80 per cent. In contrast, during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The probability of a wet week, or P(W), is found in 29, 38, 39 and 40 MWs. The conditional probability of wet and dry weeks, namely wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D), and wet weeks preceded by another dry week P(W/D) ranges from 23 to 74 per cent, 26 to 77 per cent, 47 to 86 per cent, and 14 to 53 per cent, respectively. The probability of a dry week followed by another dry week (PDD) is greater than 50 per cent in between 23, 25 to 38, 41 to 43 MWs. The greater probability of being a dry week preceded by another dry week (PDD) was observed in 33, 35, 36 and 43 MWs.

3.2.10 Probability Distribution of Walwa Tehsil

The initial probability of getting a wet week, P(W), varies from 26 to 57 per cent, and the initial probability of having a dry week, P(D), ranges from 43 to 74 per cent. In contrast, during the remaining weeks of the crop growth period, the probability of a dry week, or P(D), is greater than 50 per cent. The probability of a wet week, or P(W), is found in 23, 24, 27, 29, 30, 31, 32, 38 and 40 MWs. The conditional probability of wet and dry weeks, namely wet weeks preceded by another wet week P(W/W), dry weeks preceded by another wet week P(D/W), dry weeks preceded by another dry week P(D/D), and wet weeks preceded by another dry week P(W/D) ranges from 30 to 80 per cent, 20 to 70 per cent, 36 to 86 per cent, and 14 to 64 per cent, respectively. The probability of a dry week followed by another dry week (PDD) is greater than 50 per cent in between 23, 35 and 43 MWs. The greater probability of being a dry week preceded by another dry week P(D/D) was observed in 33, 34 and 42 MWs. As a result, crops in the *Kharif* season will face increased moisture stress throughout these weeks.

Crops will therefore encounter less moisture stress during these weeks of the *Kharif* season. Since there are more opportunities for water collection in these MWs, the given tehsil should take the appropriate measures to harvest water now in order to utilise it later when it is dry.

Table 3: Probability Distribution for the period of 1961-2021 of different stations of Sangli district during 23-43 MWs

Atpadi						
	Initial Probability (%)		Conditional probability (%)			
MW	P(W)	P(D)	P(W/W)	P(D/W)	P(D/D)	P(W/D)
23	56	44	44	56	40	60
24	30	70	26	74	67	33
25	25	75	17	83	72	28
26	33	67	40	60	70	30
27	21	79	25	75	80	20
28	34	66	69	31	75	25
29	21	79	29	71	83	18
30	31	69	38	62	71	29
31	25	75	26	74	76	24
32	23	77	27	73	78	22
33	21	79	14	86	77	23
34	34	66	38	62	67	33
35	30	70	43	57	78	23
36	33	67	44	56	72	28
37	52	48	75	25	59	41
38	62	38	69	31	45	55
39	64	36	68	32	43	57
40	54	46	59	41	55	45
41	49	51	58	42	61	39
42	33	67	47	53	81	19
43	23	77	40	60	85	15

Jat						
	Initial Probability (%)		Conditional probability (%)			
MW	P(W)	P(D)	P(W/W)	P(D/W)	P(D/D)	P(W/D)
23	56	44	44	56	40	60

24	30	70	26	74	67	33
25	25	75	17	83	72	28
26	33	67	40	60	70	30
27	21	79	25	75	80	20
28	34	66	69	31	75	25
29	21	79	29	71	83	18
30	31	69	38	62	71	29
31	25	75	26	74	76	24
32	23	77	27	73	78	22
33	21	79	14	86	77	23
34	34	66	38	62	67	33
35	30	70	43	57	78	23
36	33	67	44	56	72	28
37	52	48	75	25	59	41
38	62	38	69	31	45	55
39	64	36	68	32	43	57
40	54	46	59	41	55	45
41	49	51	58	42	61	39
42	33	67	47	53	81	19
43	23	77	40	60	85	15

Kadegaon

	Initial Probability (%)		**Conditional probability (%)**			
MW	**P(W)**	**P(D)**	**P(W/W)**	**P(D/W)**	**P(D/D)**	**P(W/D)**
23	50	50	50	50	50	50
24	38	63	25	75	50	50
25	42	58	56	44	67	33
26	38	63	60	40	79	21
27	29	71	44	56	80	20
28	38	63	71	29	76	24
29	63	38	78	22	47	53
30	38	63	53	47	89	11
31	46	54	67	33	67	33
32	38	63	55	45	77	23
33	17	83	33	67	93	7
34	33	67	50	50	70	30
35	38	63	63	38	75	25
36	38	63	33	67	60	40
37	54	46	78	22	60	40
38	42	58	54	46	73	27
39	63	38	50	50	29	71
40	58	42	73	27	67	33
41	54	46	64	36	60	40
42	21	79	31	69	91	9
43	8	92	40	60	100	0

Kavathemahankal

	Initial Probability (%)		**Conditional probability (%)**			
MW	**P(W)**	**P(D)**	**P(W/W)**	**P(D/W)**	**P(D/D)**	**P(W/D)**
23	44	56	71	29	72	28
24	28	72	24	76	68	32
25	31	69	36	64	71	29
26	28	72	42	58	78	22
27	23	77	27	73	79	21
28	26	74	11	89	70	30
29	26	74	30	70	76	24
30	31	69	40	60	72	28
31	18	82	17	83	81	19
32	23	77	43	57	81	19
33	10	90	0	100	87	13
34	18	82	25	75	83	17
35	15	85	29	71	88	13
36	33	67	17	83	64	36
37	44	56	62	38	65	35
38	46	54	47	53	55	45
39	64	36	72	28	43	57

40	54	46	60	40	57	43
41	46	54	52	48	61	39
42	41	59	56	44	71	29
43	18	82	19	81	83	17

Khanapur						
	Initial Probability (%)		**Conditional probability (%)**			
MW	**P(W)**	**P(D)**	**P(W/W)**	**P(D/W)**	**P(D/D)**	**P(W/D)**
23	58	42	63	38	44	56
24	50	50	29	71	20	80
25	46	54	42	58	50	50
26	33	67	45	55	77	23
27	29	71	25	75	69	31
28	42	58	71	29	71	29
29	54	46	60	40	50	50
30	42	58	54	46	73	27
31	46	54	70	30	71	29
32	42	58	64	36	77	23
33	13	88	20	80	93	7
34	29	71	0	100	67	33
35	33	67	71	29	82	18
36	54	46	50	50	44	56
37	42	58	62	38	82	18
38	58	42	70	30	50	50
39	58	42	43	57	20	80
40	67	33	57	43	20	80
41	67	33	75	25	50	50
42	33	67	38	63	75	25
43	13	88	38	63	100	0

Palus						
	Initial Probability (%)		**Conditional probability (%)**			
MW	**P(W)**	**P(D)**	**P(W/W)**	**P(D/W)**	**P(D/D)**	**P(W/D)**
23	42	58	67	33	67	33
24	42	58	40	60	57	43
25	25	75	20	80	71	29
26	33	67	50	50	72	28
27	21	79	38	63	88	13
28	29	71	60	40	79	21
29	42	58	43	57	59	41
30	33	67	50	50	79	21
31	42	58	75	25	75	25
32	33	67	50	50	79	21
33	4	96	13	88	100	0
34	13	88	0	100	87	13
35	21	79	33	67	81	19
36	29	71	80	20	84	16
37	29	71	29	71	71	29
38	38	63	57	43	71	29
39	38	63	22	78	53	47
40	46	54	67	33	67	33
41	46	54	45	55	54	46
42	21	79	18	82	77	23
43	13	88	40	60	95	5

Miraj						
	Initial Probability (%)		**Conditional probability (%)**			
MW	**P(W)**	**P(D)**	**P(W/W)**	**P(D/W)**	**P(D/D)**	**P(W/D)**
23	50	50	50	50	50	50
24	38	63	40	60	65	35
25	40	60	40	60	60	40
26	35	65	31	69	63	38
27	23	78	29	71	81	19
28	30	70	44	56	74	26
29	53	48	58	42	50	50

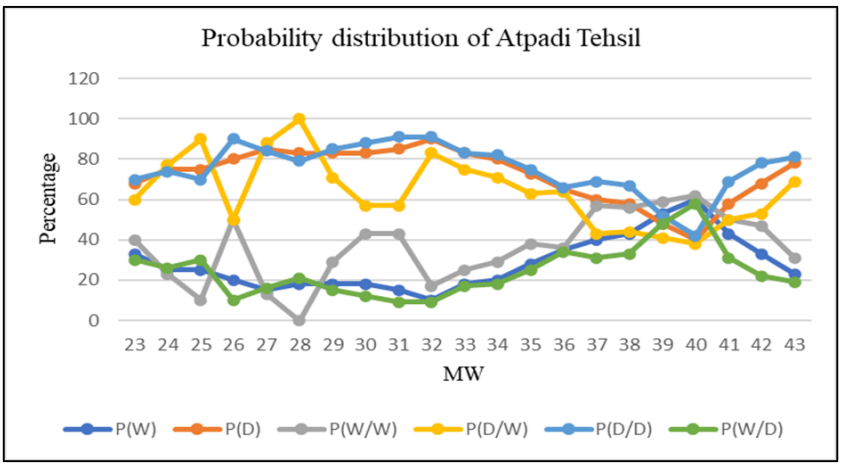
30	43	58	52	48	68	32
31	45	55	59	41	65	35
32	38	63	50	50	73	27
33	28	73	33	67	76	24
34	33	68	36	64	69	31
35	25	75	31	69	78	22
36	33	68	50	50	73	27
37	23	78	15	85	74	26
38	48	53	67	33	58	42
39	63	38	47	53	24	76
40	68	33	84	16	60	40
41	53	48	59	41	62	38
42	28	73	33	67	79	21
43	20	80	18	82	79	21

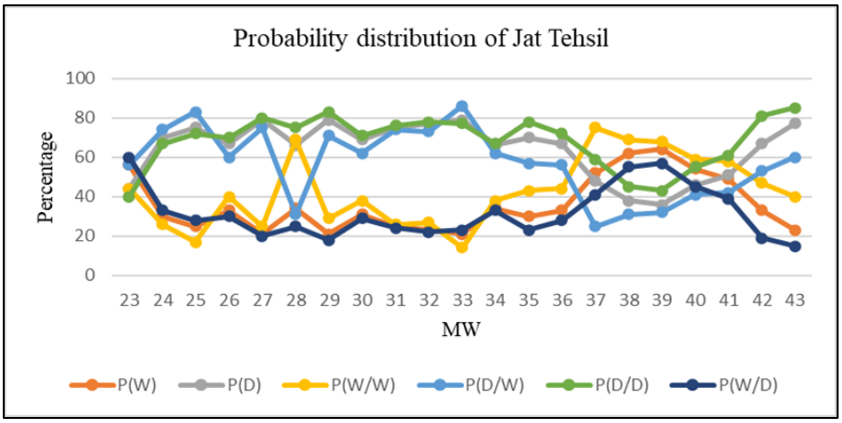
SShirala						
	Initial Probability (%)		**Conditional probability (%)**			
MW	**P(W)**	**P(D)**	**P(W/W)**	**P(D/W)**	**P(D/D)**	**P(W/D)**
23	48	52	68	32	67	33
24	62	38	66	34	41	59
25	70	30	79	21	43	57
26	72	28	72	28	28	72
27	72	28	80	20	47	53
28	69	31	77	23	53	47
29	74	26	76	24	32	68
30	80	20	80	20	19	81
31	72	28	76	24	42	58
32	77	23	84	16	41	59
33	64	36	66	34	43	57
34	59	41	64	36	50	50
35	51	49	58	42	60	40
36	51	49	74	26	73	27
37	33	67	32	68	67	33
38	56	44	55	45	44	56
39	57	43	62	38	48	52
40	51	49	63	37	65	35
41	51	49	45	55	43	57
42	28	72	35	65	80	20
43	18	82	29	71	86	14

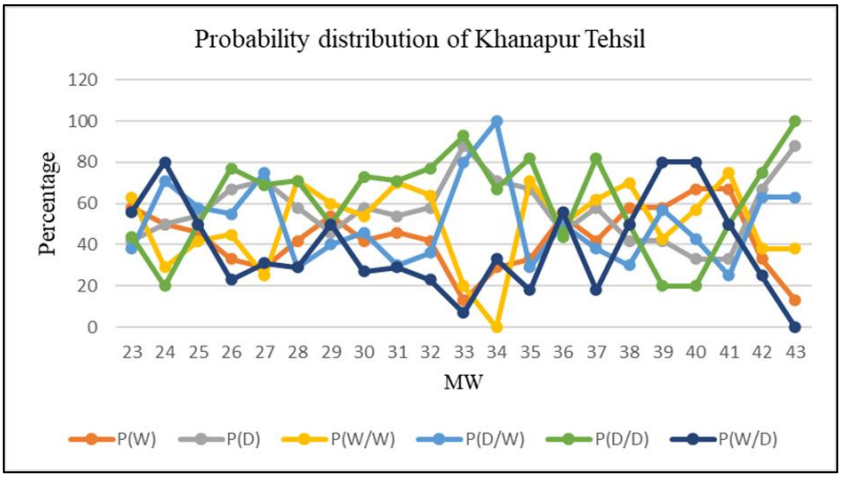
Tasgaon						
	Initial Probability (%)		**Conditional probability (%)**			
MW	**P(W)**	**P(D)**	**P(W/W)**	**P(D/W)**	**P(D/D)**	**P(W/D)**
23	48	52	48	52	53	48
24	44	56	34	66	47	53
25	34	66	37	63	68	32
26	33	67	38	62	70	30
27	43	57	45	55	59	41
28	31	69	23	77	63	37
29	56	44	74	26	52	48
30	41	59	47	53	67	33
31	51	49	60	40	56	44
32	43	57	55	45	70	30
33	20	80	23	77	83	17
34	28	72	42	58	76	24
35	28	72	53	47	82	18
36	30	70	59	41	82	18
37	46	54	56	44	58	42
38	56	44	64	36	52	48
39	57	43	62	38	48	52
40	64	36	74	26	50	50
41	46	54	46	54	55	45
42	28	72	32	68	76	24
43	20	80	35	65	86	14

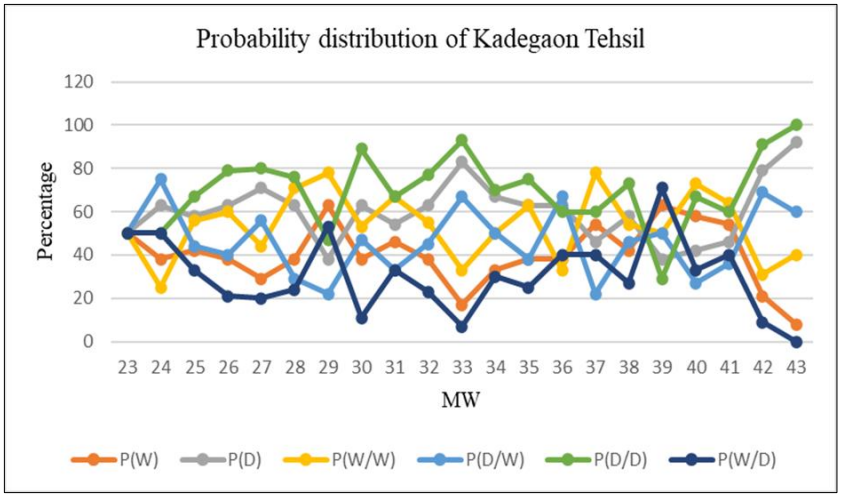
Walwa

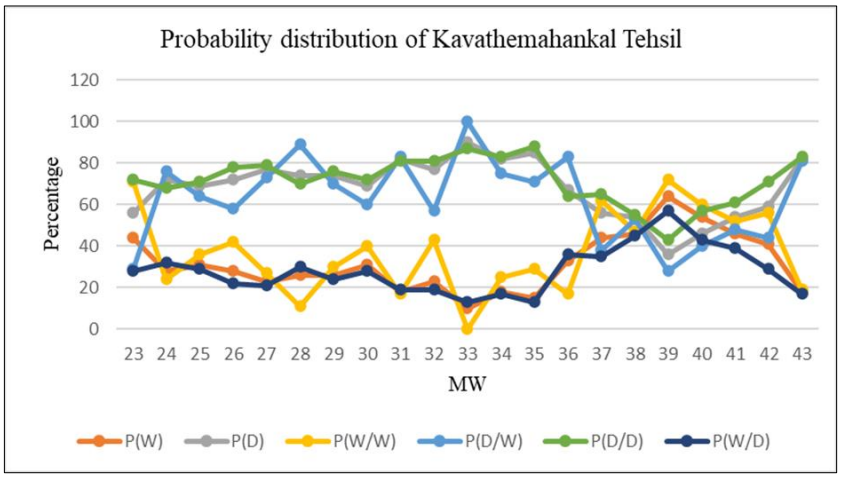
	Initial Probability (%)		Conditional probability (%)			
MW	**P(W)**	**P(D)**	**P(W/W)**	**P(D/W)**	**P(D/D)**	**P(W/D)**
23	54	46	80	20	54	46
24	56	44	48	52	36	64
25	46	54	53	47	63	37
26	41	59	46	54	64	36
27	54	46	76	24	61	39
28	48	52	52	48	57	43
29	57	43	62	38	47	53
30	54	46	66	34	62	38
31	54	46	64	36	57	43
32	52	48	58	42	54	46
33	30	70	44	56	86	14
34	34	66	61	39	77	23
35	33	67	43	57	73	28
36	30	70	30	70	71	29
37	33	67	39	61	70	30
38	52	48	75	25	59	41
39	49	51	63	38	66	34
40	56	44	67	33	55	45
41	43	57	41	59	56	44
42	26	74	35	65	80	20
43	33	67	50	50	73	27

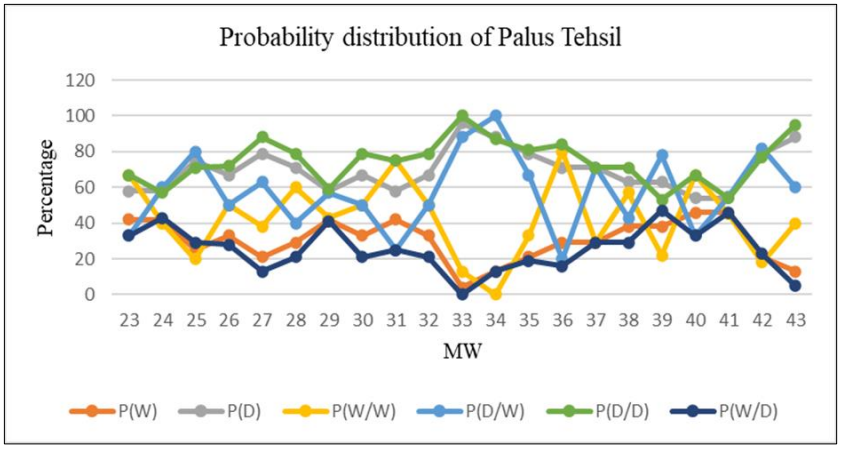





Probability distribution of Khanapur Tehsil
Percentage
120
100
80
60
40
20
0
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43
MW
P(W) P(D) P(W/W) P(D/W) P(D/D) P(W/D)


Probability distribution of Kadegaon Tehsil
Percentage
120
100
80
60
40
20
0
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43
MW
P(W) P(D) P(W/W) P(D/W) P(D/D) P(W/D)


Probability distribution of Kavathemahankal Tehsil
Percentage
120
100
80
60
40
20
0
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43
MW
P(W) P(D) P(W/W) P(D/W) P(D/D) P(W/D)


Probability distribution of Palus Tehsil
Percentage
120
100
80
60
40
20
0
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43
MW
P(W) P(D) P(W/W) P(D/W) P(D/D) P(W/D)

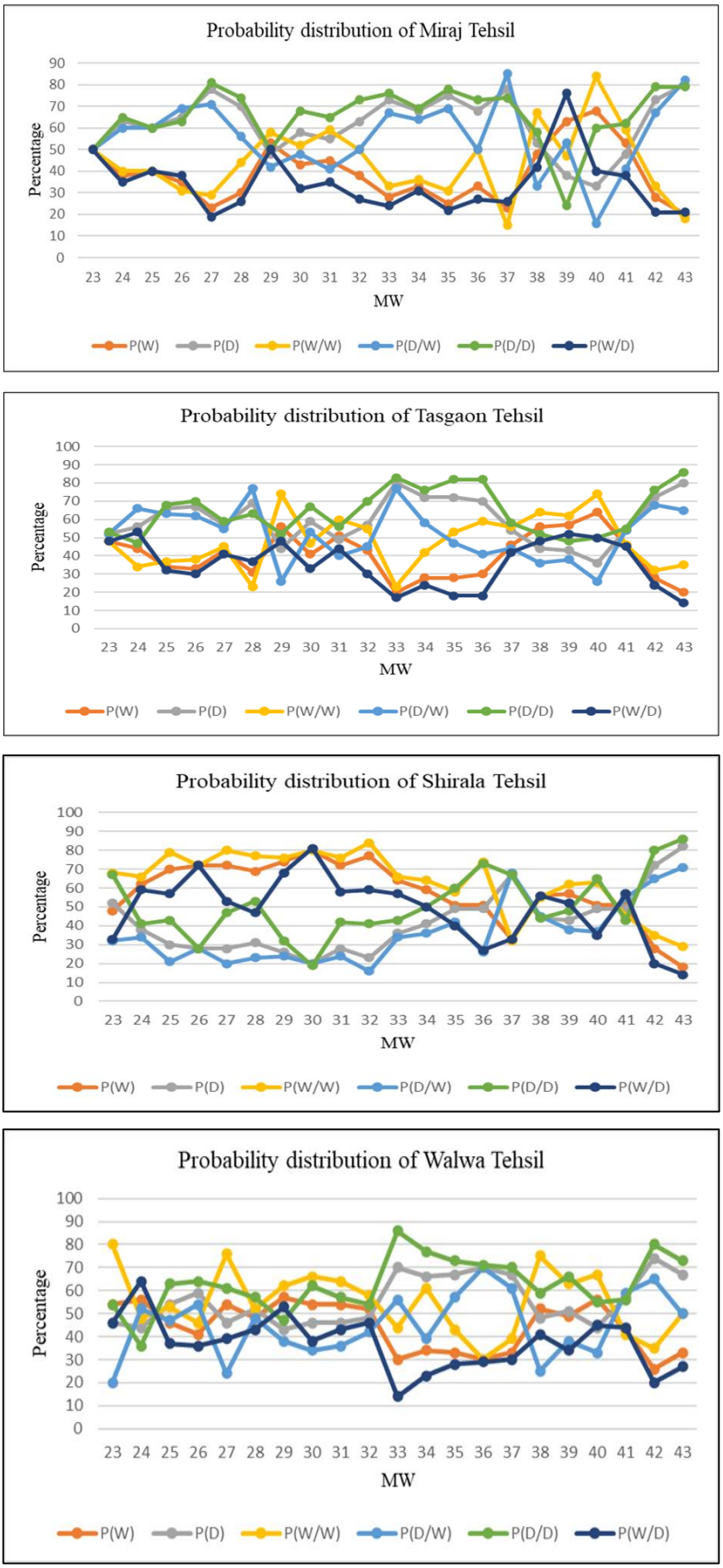


Fig 2: Probability Distribution of different stations of Sangli district during 23-43 Meteorological Weeks

4. Conclusions

Atpadi tehsil has a higher probability of a wet week, or P(W), which is found in the 39 and 40 MWs. For, the Jat tehsil probability of at least 20 mm of rainfall is found in the 23, 37, and 40 MWs. In Kadegaon tehsil, the probability of a wet week, or P(W), is found in the 29, 37, 39, 40, and 41 MWs. Chances of rainwater harvesting are higher in the 39 and 40 MWs for Kavathemahankal tehsil. The probability of a wet week, or P(W), is found in the 23, 29, 36, 38, 39, 40, and 41 MWs for Khanapur tehsil. For, Miraj tehsil probability of at least 20 mm of rainfall is found in the 29, 39, 40, and 41 MWs. The probability of a wet week, or P(W), is found in the 38 to 41 MWs for Shirala tehsil. The chances of rainwater harvesting are higher in the 29, 38, 39, and 40 MWs for Tasgaon tehsil. For, a Walwa tehsil probability of at least 20 mm of rainfall is found in the 23, 24, 27, 29, 30, 31, 32, 38, and 40 MWs. Chances of rainwater harvesting are null in the case of Palus tehsil because the probability of a wet week, or P(W), is not found in any MW.

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6. References

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