

Change in trend of Rainfall Pattern Affecting Natural Ground Water Recharge and Agriculture in Uttar Pradesh

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All India Rainfall Distribution (mm)

Year	Monsoon Season (June-Sept)			Over all rainfall (June-May)		
	Actual	Normal	%Departure	Actual	Normal	%Departure
1992-93	831	899	-8	1092	1176	-7
1993-94	902	909	-1	1184	1193	-1
1994-95	999	907	10	1297	1191	9
1995-96	905	905	0	1155	1189	-3
1996-97	928	906	2	1195	1190	0
1997-98	927	909	2	1292	1198	8
1998-99	945	904	5	1276	1199	6
1999-00	867	903	-4	1184	1197	-1
2000-01	834	902	-8	1044	1196	-13
2001-02	826	901	-8	1120	1196	-6
2002-03	737	912	-19	981	1205	-19
2003-04	947	903	5	1278	1197	7
2004-05	780	893	-13	1086	1197	-9
2005-06	879	893	-1	1185	1197	-1
2006-07	887	892	-1	1133	1196	-5
2007-08	937	892	5	1180	1195	-1
2008-09	873	892	-2	1075	1196	-10
2009-10	690	892	-23	973	1196	-19
2010-11	913	893	2	1212	1192	2

Broad region wise Monsoon (June - September) Rainfall distribution (mm)

Year	North-west India			Central India			South Peninsula			North-east India		
	A	N	%D	A	N	%D	A	N	%D	A	N	%D
2005	552.1	611.6	-10	1094.9	993.2	10	808.9	722.6	12	1140.9	1430.7	-20
2006	573.7	611.6	-6	1152.2	993.9	16	684.6	722.6	-5	1177.6	1427.3	-17
2007	520.8	611.6	-15	1073.8	993.9	8	907.3	722.6	26	1485.9	1427.3	4
2008	651.7	611.6	7	956.9	993.9	-4	692.5	722.6	-4	1346.0	1427.3	-6
2009	392.1	611.6	-36	794.8	993.9	-20	693.0	722.6	-4	1037.7	1427.3	-27
2010	688.2	613.0	12	1027.9	991.5	4	853.6	722.9	18	1175.8	1436.2	-18

A :Actual

N: Normal

D: Departure

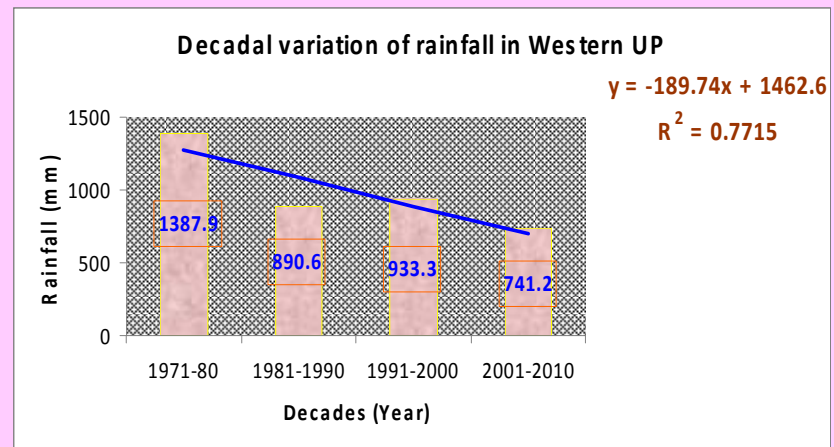
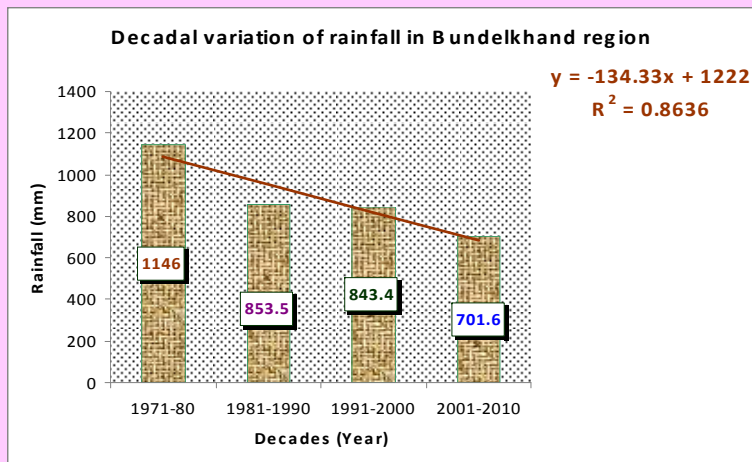
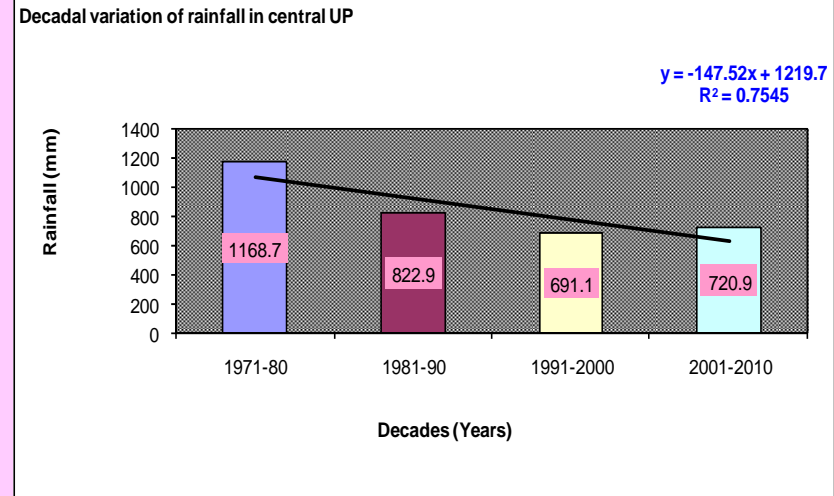
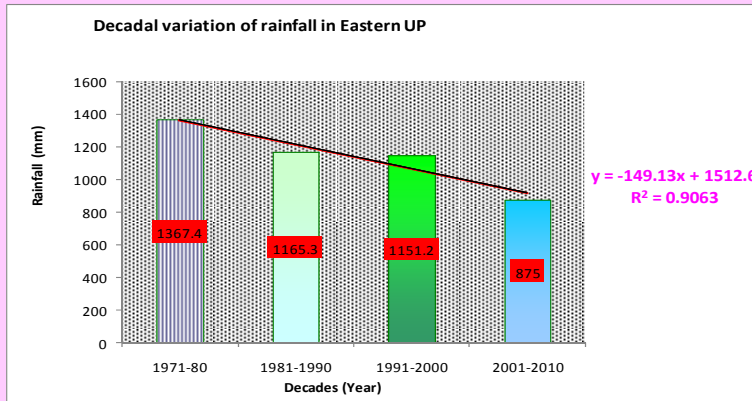
Decadal trend of rainfall distribution in U.P.

YEAR	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	TOTALL
1971-72- 1980-81	144.6	403.6	345.2	246.7	41.6	5.5	5.6	17.3	20.9	10.9	8.5	29.8	1280.1
1981-82- 1990-91	92.1	289.2	237.1	185.5	35.8	3.9	11.0	13.6	15.6	9.9	9.8	20.4	923.8
1991-92- 2000-01	94.6	226.3	287.9	169.9	30.7	5.3	8.5	12.6	12.3	4.9	5.5	14.6	872.9
2001-02- 2010-11	90.7	225.8	194.6	148.6	22.7	2.3	2.5	7.3	14.7	6.4	4.1	17.7	737.4
Average (1971- 2010-11)	105.5	286.2	266.2	187.6	32.7	4.3	6.9	12.7	15.9	8.0	7.0	20.6	957.3
1980-81 - 2010-11	93.9	253.8	245.2	168.7	29.5	3.7	7.5	11.5	13.8	7.2	6.3	17.8	859.0
Normal	95.0	280.9	275.6	178.3	35.8	4.9	6.8	17.6	19.9	10.2	7.3	15.1	947.4

Monthly average rainfall (mm) received during last decade in U. P.

Year	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APRIL	MAY	TOTAL
2001-02	182	268	150	96	51	1	0	13	28	1	1	21	812
2002-03	39	70	224	224	14	0	4	13	36	2	7	4	639
2003-04	83	266	231	277	4	0	11	24	1	0	14	21	931
2004-05	111	164	200	90	42	0	0	15	16	13	2	7	660
2005-06	53	285	173	152	17	0	2	0	0	12	5	27	727
2006-07	93	245	106	64	6	1	1	0	38	28	2	21	606
2007-08	76	231	176	101	5	0	1	2	1	0	5	25	622
2008-09	229	340	242	99	10	3	0	1	2	2	4	12	945
2009-10	22	151	200	139	72	9	3	3	13	0	0	12	623
2010-11	21	239	234	239	13	9	2	6	12	3	0	29	807
Average	91	226	194	148	23	2	2	8	15	6	4	18	737
Normal	95	281	276	178	36	5	7	18	20	10	7	15	947

Long term decline in rainfall under different regions of U. P.



Rate of decrease of rainfall in different zones are in the order of Western UP>Eastern UP>Central UP>Bundelkhand region

Source: Tripathi, Padmakar (2012), NDUAT, Faizabad

Long Term Periodicity of occurrence of drought

Sl No.	Frequency	Meteorological Divisions
1	Once in 2½ years	W.Rajasthan, Realayaseema, Telengana, Haryana, Chandigarh and Delhi
2	Once in 3 years	E. Rajasthan, Gujarat, Jammu & Kashmir, Tamilnadu, W. Uttar Pradesh
3	Once in 4 years	Uttarakhand, Vidarbha, North interior, Karnataka
4	Once in 5 years	Bihar, E. U.P., W. Bengal, Jharkhand, Kerla, Odisha, W. Madhya Pradesh, Madhya Maharashtra, Coastal Andhra Pradesh
5	Once in 15 years	North East States

Source : ICAR Annual Report 2010-11. pp 76

Rate of Ground Water decline in Uttar Pradesh

Sl. No.	Rate of decline in Groundwater (cm/year)	Number of Blocks
1.	1 - 10	296
2.	10- 20	102
3.	20 - 30	37
4.	30 - 40	11
5.	40 - 50	4
6.	>50	11
	Total	461

Source: State Ground Water Department, Uttar Pradesh

Sl. No.	District	Average rate of decline (cm/Year)
1.	Lucknow	73
2.	Kanpur	45
3.	Agra	40
4.	Varanasi	23
5.	Aligarh	40
6.	Gaziabad	22
7.	Mathura	36

Source: State Ground Water Department, Uttar Pradesh

Categorization of blocks on the basis of level of groundwater development

Type	Number of Blocks			
	31.3.2000	31.3.2004	31.3.2008	31.3.2012
Over Exploited	22 (critical added)	37	76	76
Critical	-	13	25	32
Semi-critical	53	88	117	107
Safe	745	682	602	605

Region wise blocks under different categories

Area	According to 31-3-2004			According to 31-3-2008		
	Over-exploited	Critical	Semi-critical	Over-exploited	Critical	Semi-critical
Bundelkhand	-	-	2	0	3	4
Central	1	2	19	0	5	17
Eastern	1	1	15	11	6	49
Western	35	10	52	65	11	4
Total	37	13	88	76	25	117

Deteoriating Ground Water Quality

Contaminants	Districts affected (in part)
Salinity (EC > 3000 μS/cm at 25 ° C)	Agra, Hathras, Mathura,
Fluoride (>1.5 mg/l)	Agra, Aligarh, Etah, Firozabad, Jaunpur, Kannauj, Mahamaya Nagar, Mainpuri, Mathura, Maunath Bhanjan
Chloride (> 1000 mg/l)	Mathura, Agra
Iron (>1.0 mg/l)	Azamgarh, Balia, Balrampur, Etawah, Fatehpur, Gazipur, Gonda, Hardoi, Kanpur Dehat, Kanpur Nagar, Lakhimpur, Lalitpur, Mau, Siddartnagar, Unnao
Nitrate (>45 mg/l)	Agra, Aligarh, Allahbad, Ambedkar Nagar, Auraiyya, Badaun, Baghpat, Balrampur, Banda, Barabanki, Bareilly, Basti, Bijnour, Bulandsahar, Chitrakoot, Etah, Etawa, Fatehpur, Firozabad, GB Nagar, Ghaziabad, Ghazipur, Hamirpur, Hardoi, Jaunpur, Jhansi, Kannauj, Kanpur Dehat, Lakhimpur, Mahoba, Mathura, Meerut, Moradabad, Muzaffarnagar, Raibarelli, Rampur, Sant Ravidas Nagar, Shajahanpur, Sitapur, Sonbhadra, Sultanpur, Unnao
Arsenic (>0.05 mg/l)	Agra, Aligarh, Balia, Balrampur, Gonda, Gorakhpur, Lakhimpur Kheri*, Mathura, Muradabad

Source: Central Ground Water Board

Area, production and productivity of rice as influenced by rainfall

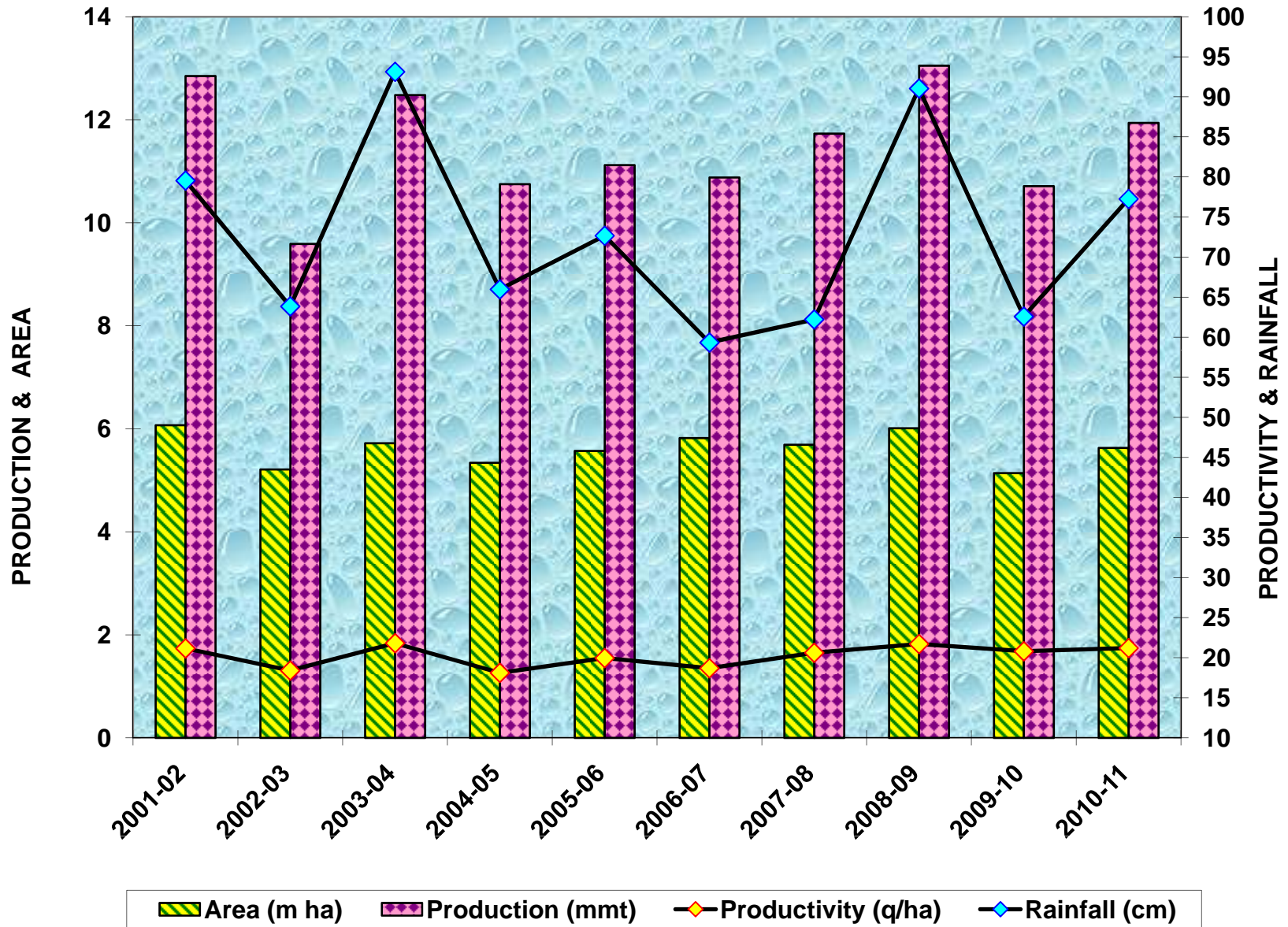
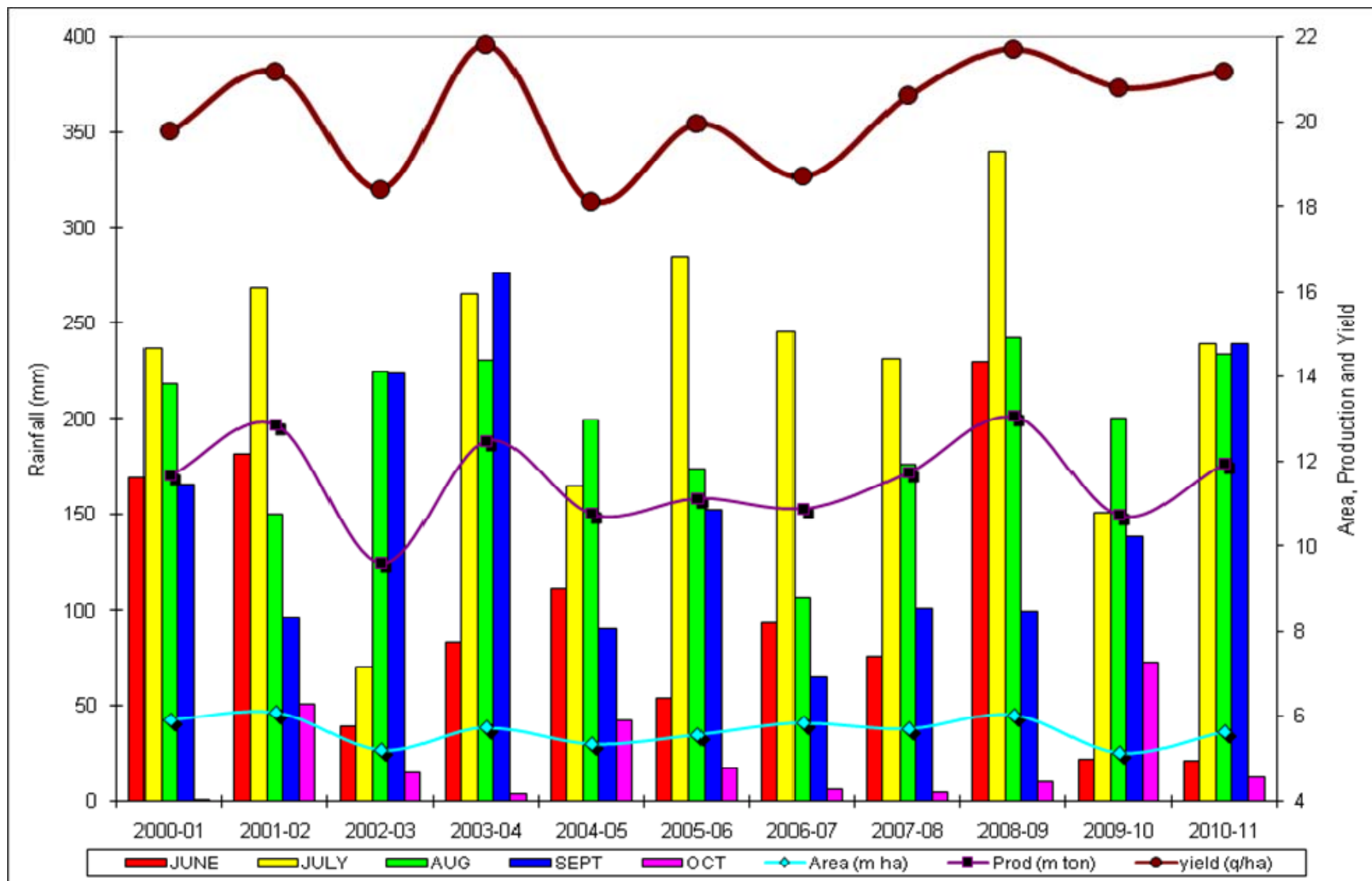


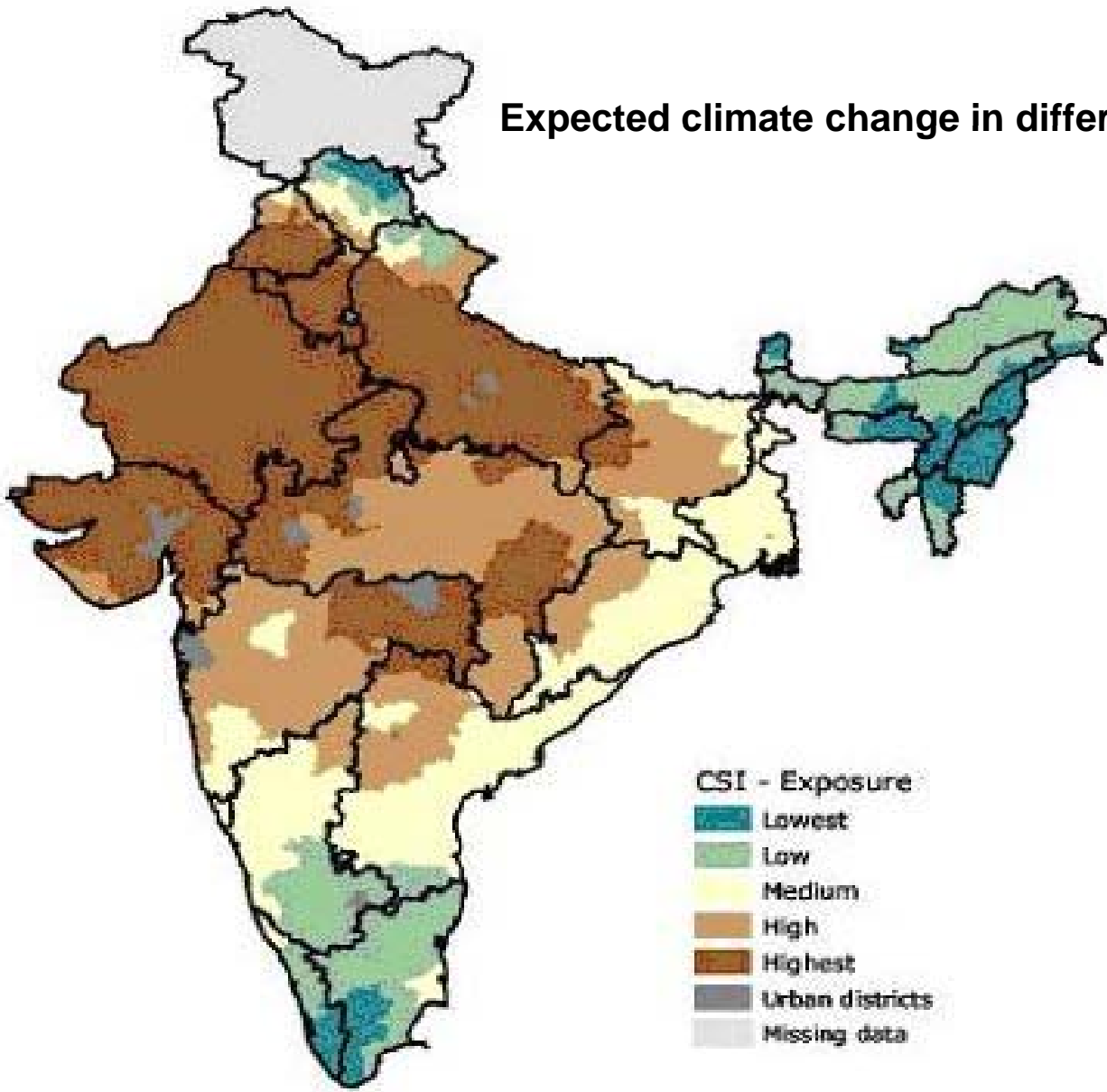
Figure 7. Effect of rainfall distribution on area, production and yield of rice



Districts falling under different productivity category (Rice)

YEAR	<15 q/ha	15-20 q/ha	20-25 q/ha	>25 Q/ha	Rainfall (cm)
2002-03	8	20	36	6	63.86
2003-04	6	19	34	11	93.13
2004-05	19	19	22	10	65.98
2005-06	9	25	28	8	72.67
2006-07	15	26	21	8	59.34
2007-08	10	25	26	9	62.21
2008-09	6	21	32	11	91.05
2009-10	11	17	32	11	62.58

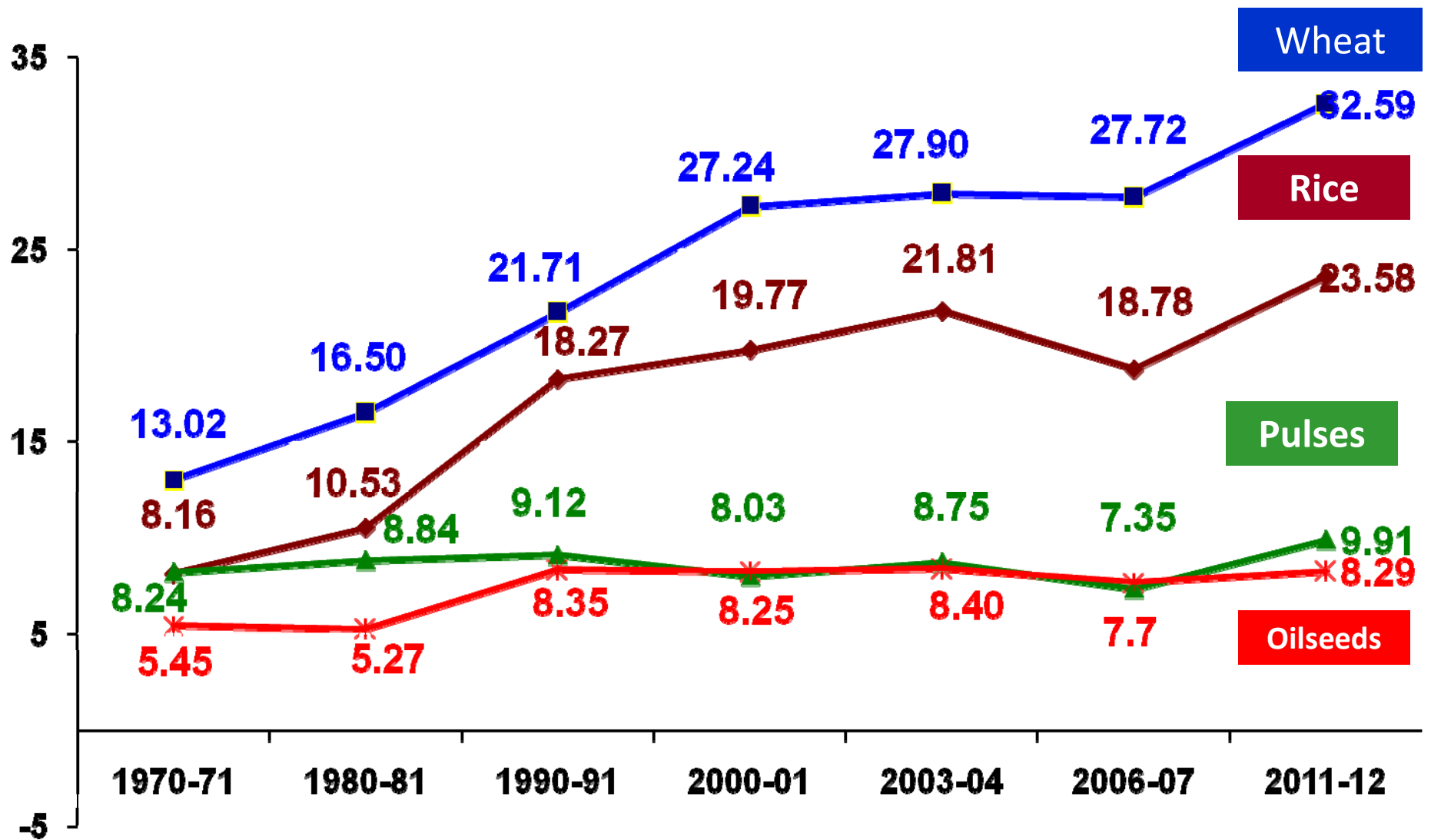
Expected climate change in different regions

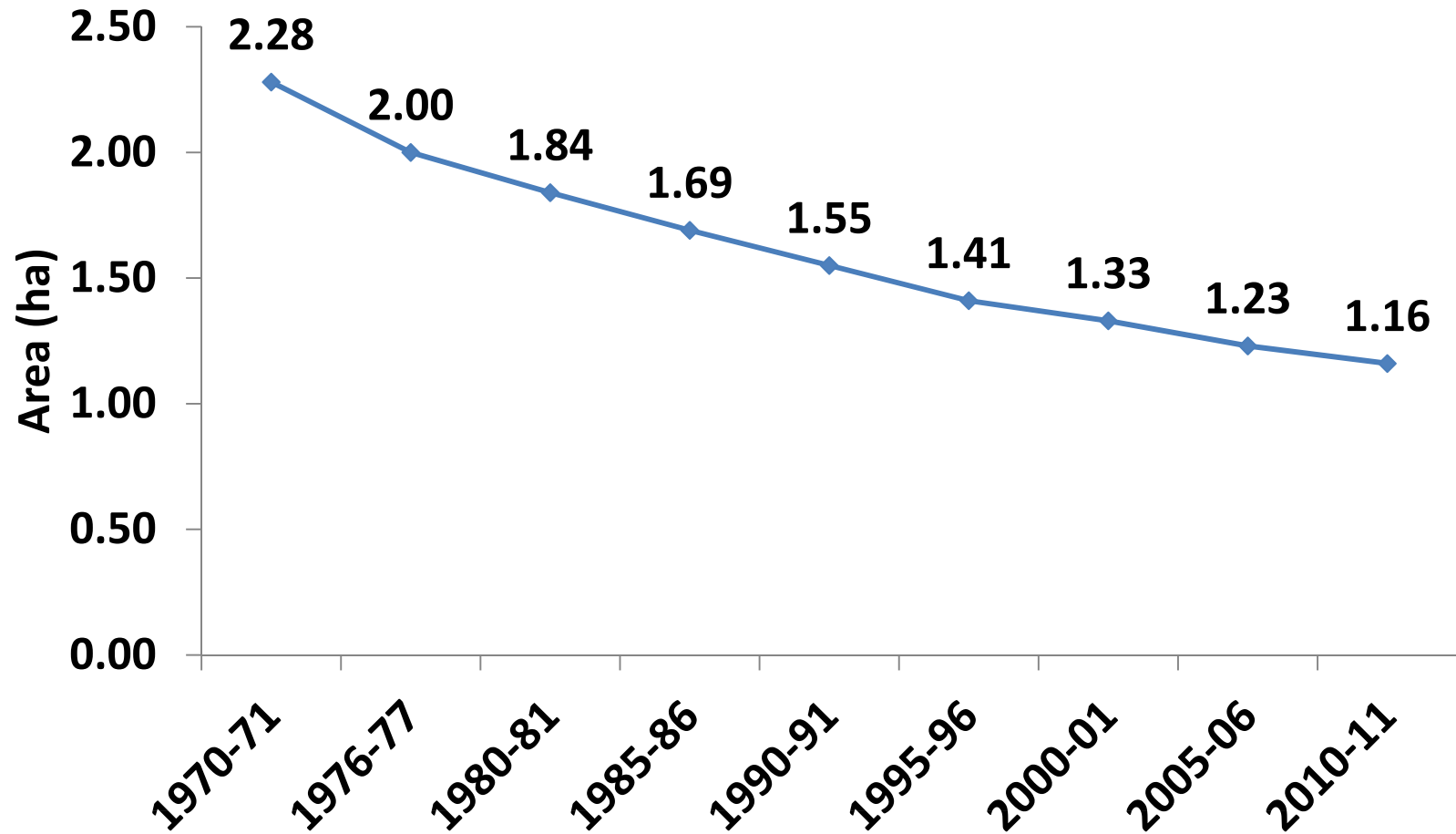


Contribution of Uttar Pradesh in Agriculture Production of India

Crops	Production (lakh metric tons)		% Share
	India	U.P.	
Food Grains (2011-12)	2574	517	<u>20</u>
Wheat (2011-12)	939	317	<u>34</u>
Rice (2011-12)	1043	140	<u>13</u>
Pulses (2011-12)	172	24	<u>14</u>
Sugar Cane (2011-12)	3577	1255	<u>35</u>
Potato (2009-10)	366	134	<u>37</u>
Vegetable (2009-10)	1093	255*	16
Milk (2009-10)	1125	202	18

Productivity of Major Crops (q/ha)

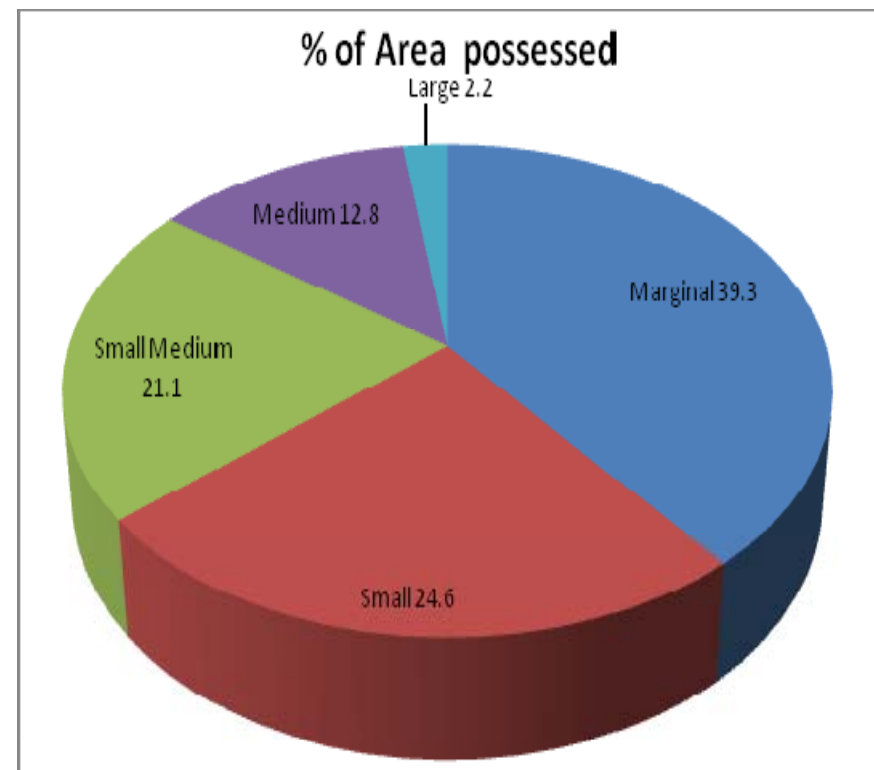
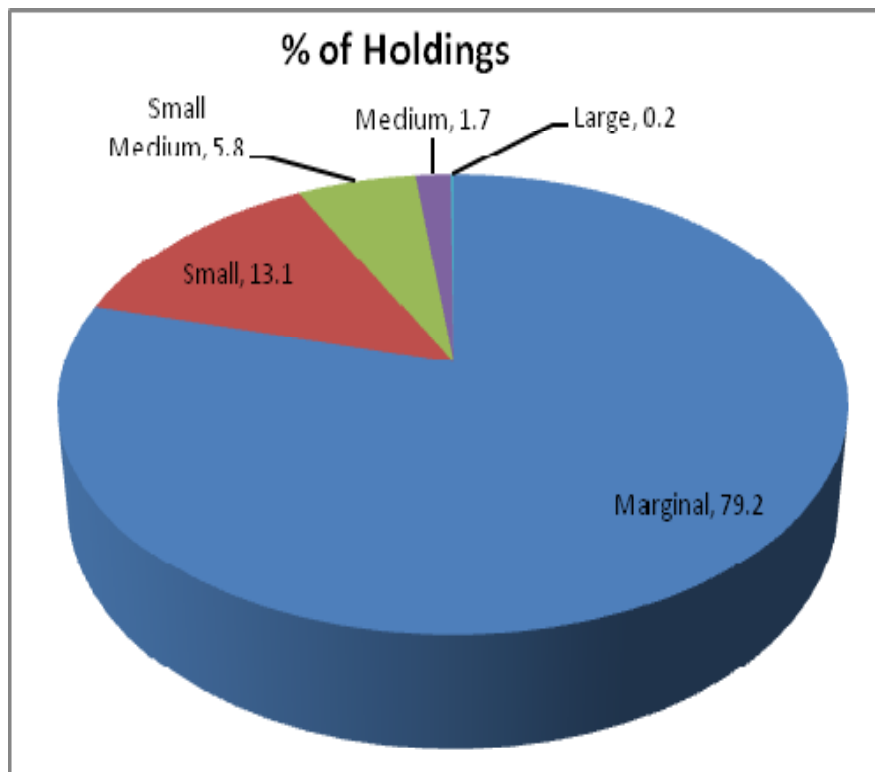




Declining average size of land holding in India

Source: Agricultural Statistics at A Glance, Department of Agriculture and Cooperation, Govt. of India

Size wise operational holdings and area occupied by different farm groups.



Source: Agricultural statistics at a glance 2011-12

Suggestions

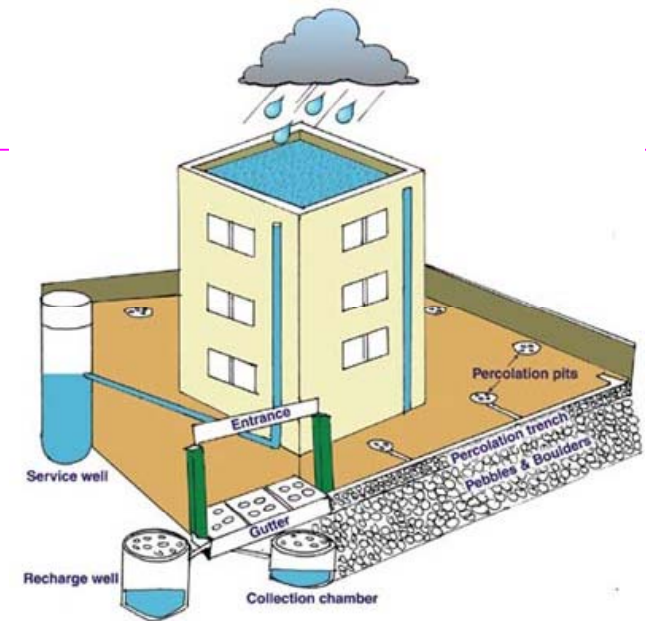
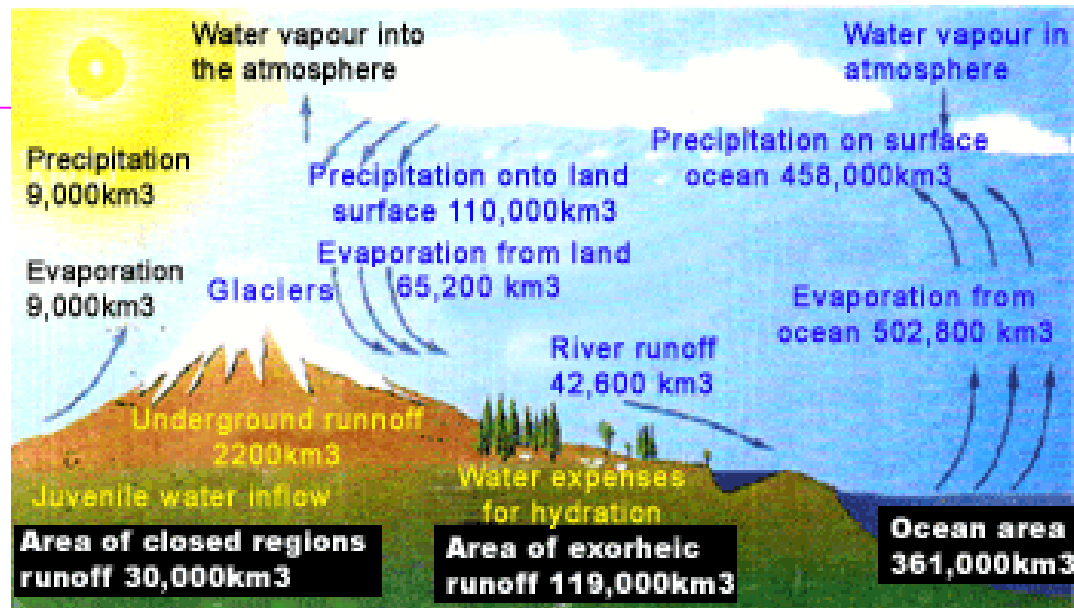
1. Establishment of climate change and agriculture cell

- **To collect and compile data and other information on climate change and agriculture to enhance the current understanding of the subject.**
- **To build capacity in different government departments/agencies through trainings, seminars, exposure visits etc. to effectively address various dimensions of climate change and agriculture.**
- **To assess the vulnerability of agriculture to climate change and develop strategies to address them effectively.**
- **To coordinate and monitor the programmes to be implemented by different organisations**

- 2. Identification of Vulnerable areas and assessing Vulnerability**
- 3. Establishment of Climate Field Schools (CFS)**
- 4. Rain Water Harvesting to Recharge Ground Water**
- 5. Promotion of Carbon Sequestration Agricultural Practices**
 - i. Use of organic manures**
 - ii. Soil Management Practices**
 - iii. Farming system approach for diversifying incomes and livelihoods**
 - iv. Diversification of cropping systems and promotion of stress tolerant crop varieties**
 - v. Popularization of aerobic rice cultivation methods**
 - vi. Popularisation of Agro-forestry**

Rain Water Harvesting?.

- Rain Water Harvesting RWH- process of collecting, conveying & storing water from rainfall in an area – for beneficial use.
- **Storage – in tanks, reservoirs, underground storage-groundwater**
- **Hydrological Cycle**



Thank you