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Impact of Drought on Water Resources and Agriculture in Karnataka

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ABSTRACT

Drought is one of the most disastrous among the different natural hazards, as it inflicts untold miseries on the human society. According to National Commission on Agriculture (1976), there are three types of drought namely; Meteorological drought, Hydrological drought, and Agricultural drought (www.nrsc.gov.in). Agriculture is the first sector to be affected by drought. Present study aimed to study impact of drought on water resources, agriculture and on farm output loss in Karnataka. Karnataka is one of the most often drought affected state in India, it experienced one such drastic drought season in kharif 2012. Ramanagra district was affected most and least was Dakshina Kannada. Drought affected the water reservoirs of the state, Malaprabha and Kabini were most affected. Cereals and Oilseed crops were affected most in agricultural crops; overall sowing area was reduced by half of the target. Effective watershed development and afforestation programmes are essential in the state, as it is an established fact that state is frequently haunted by the drought.

Key words: *Drought, Rainfall, Reservoirs, Karnataka*

INTRODUCTION

Drought is one of the most disastrous among the different natural hazards, as it inflicts untold miseries on the human society. Its beginning is difficult to be precisely identified because of lack of sharp distinction from non-drought dry spells. As a disaster, it is experienced only after it has occurred. It is generally a natural and recurrent climatic phenomenon that is manifested in various forms and may cause significant impacts and consequences in the environment, on humans, and other living subjects on the earth. Insufficient precipitation over an extended period of time is the key sign of a drought. Also some other elements of the hydrologic cycle (that reflect the lack of water supply) may indicate the presence of drought. For instance, infiltrated precipitation is the natural water supply to the soil, a persistent deficit in soil moisture is also an obvious indicator of drought. Likewise, since precipitation becomes excess surface runoff and eventually stream flow, lower flow in streams and rivers is also a sign of water supply anomaly and drought.

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Furthermore, depleted water storage in the form of snowpack, reservoirs and lakes, and groundwater levels may also be indications of drought. In general, drought gives an impression of water scarcity due to insufficient precipitation, high evapo-transpiration, and over-exploitation of water resources or combination of these parameters. Drought is a situation in which there is a prolonged deficiency of rainfall over a wide area resulting in serious depletion of soil moisture and consequent poor agricultural production and general water shortage, resulting in low incomes and great public suffering and distress.According to National Commission on Agriculture (1976), there are three types of drought namely; Meteorological drought, Hydrological drought, and Agricultural drought (www.nrsc.gov.in). Agriculture is the first sector to be affected by drought. Within the agricultural sector, marginal and small farmers are more vulnerable to drought because of their dependence on rain fed agriculture and related activities. As a consequence, they face much greater relative loss of assets, thus widening disparities between small and large farmers. Also, as unemployment increases purchasing power decreases- credits shrink and the cost of credit increases. Consequently, the vulnerable segments are either forced to migrate, work at lower wages or live in near hunger conditions. Pressure and fear of losing social status due to drought induced poverty forces farmers to take drastic steps like suicides. We often talk about impacts of drought as either direct or indirect, because drought impacts can cause a chain reaction of events that lead to additional drought impacts. International Crops Research Institute for Arid and Semi-Arid tropics (ICRISAT) classifies effects of droughts as direct and indirect effects (www.vasat.icrisat.org).

Direct effects:

Direct effects are those that are caused by the drought itself. Some examples could be:

- Lower water level and availability
- Reduced crop productivity
- Less of fodder for livestock

Indirect effects:

Indirect effects are result of direct effects.

Examples are:

- Shortage of water for drinking and industry
- Food shortage and increased commodity prices
- Unemployment

In general there are some very critical economic effects of drought like reduced production of food and allied food products, decreased availability of dairy and livestock products, loss to industries directly dependent on agricultural production (e.g. machinery and fertilizer manufacturers, food processors, dairies etc.,), cost of water transport or transfer, cost of new or supplemental water resource development, increased commodity prices, revenue losses to state, and local governments, increased demand for monetary assets and increased interest rates, reduction of economic development and decrease of gross national product and economic growth.

MATERIAL AND METHODS

Secondary data pertaining to the extent of rainfall deviation, crop loss and drought affected area of the Karnataka state during 2012 was collected from Directorate of Economics and Statistics, Bengaluru and Karnataka State Natural Disaster Management Centre, Bengaluru. The data collected were analyzed using trend analysis and simple tabular techniques.

RESULTS AND DISCUSSION

Drought incidence can be confirmed with the variations in the rainfall of any area and is the simple key indicator of drought or flood situations. Table 1 depicts rainfall pattern of Karnataka over the past years and indicate number of drought years in the state (1985-2012). The normal rainfall in the state is 1,165 mm, rainfall showed a deficit of about 13 per cent (1,026 mm) in the study period in Karnataka. The state received highest rainfall in 2005 (1,467.30 mm), followed by 2009 (1,412.40 mm), 2010 (1,359.70 mm), 2006 (1,247.80 mm) and in 2011, (1,359.70mm).

Lowest rainfall was recorded in the year 1990 (770.10 mm) followed by 1985 (785.50 mm), 2002 (802.70 mm), 1989 (825.40 mm), and 1994 (830.60 mm). There are about 2 moderate drought years (≥ -25%) and 16 normal drought (0 ≥ -20%) years. Even though there were many deviations in the annual rainfall, the state witnessed an impressive increased positive trend (16.90) over the years (1985-2012).The State depends upon South-West Monsoon for its normal agriculture activities in any year and failure of the monsoon leads to have disastrous impact on drinking water tables for animals and agriculture. Table 2 represents the rainfall observed during the South-West Monsoon of 2012. It can be observed that the average actual (618 mm) rainfall in the state deviated by -26 per cent over the normal (835 mm) during 2012. It can also be seen that entire state was affected from the shortage of rainfall. Among total 30 districts, Ramangara (-54 mm), Chamarajanagara (-51 mm), Bangalore Urban (-49 mm), Dharwad (-47 mm) and Gadag (-46 mm) were the top five district affected. And top five districts with less effect were Dakshina Kannada (-15 mm), Uttara Kannada (-18 mm), Shimoga (-18 mm), Bidar (-18 mm) and Kolar (-19 mm). Similar results were obtained by Sharma and he showed that Sindagi as worst affected taluk in the year 2000 in Karnataka. Similar findings were noticed by Biradar and Sridhar[4] state received annual rainfall of 876 mm in 2003 as against the normal value of 1139 mm and that less by 23 per cent compared to normal rainfall and thus the state was under deficit category. Chamarajnagar was severely affected by drought, Gadag affected moderately and Gulbarga was less affected. The position of reservoir levels from 1st June 2012 to 30th September 2012 (South-West Monsoon) with respect to their maximum levels, increase or decrease in reservoirs level during 17 weeks period under consideration, comparison of water levels with 15 years average level and the balance reservoir level (RL) to reach their respective full levels which describe extent of severity of drought in the state are given in Table 3.Linganamakki, Supa, Varahi are three main hydel power generation reservoirs in the western coast of the State. During the South-West Monsoon, the levels in Linganamakki reservoir by the end of the season was less by 0.79 feet compared to the 15 years average level and also less by 10.10 feet compared to its full reservoir level. In Supa reservoir during the season, water level by the end of the season was less by 4.51 feet compared to the 15 years average level and also less by 60.15 feet compared to its FRL. Varahi reservoir level at the end of September was more by 1.38 feet compared to the 15 years average level and but less by 13.19 feet compared to the FRL. Harangi reservoir level by the end of the September or by the end of monsoon season was less by 4.29 feet compared to the 15 years average level and also less by -7.84 feet compared to the FRL. In Hemavathi reservoir level increased by 3.4 feet compared to the 15 years average level butwas less by 10.01 feet compared to its FRL. The K.R.S reservoir witnessed lesser reservoir level at the end of September by 8.29 feet compared to the 15 years average level and less by 15.30 feet compared to its FRL. In Kabini, reservoir level observed was lesser by 6.67 feet compared to the 15 years average and also less by 10.74 feet compared to the FRL. After the water resources are affected, drought advances to make agricultural activities disappear and Karnataka is the state where agriculture field is still gambling with monsoon for its upliftment. In Karnataka major agriculture activities are in full swing *kharif* season to their maximum because of South-West Monsoon. The sowing is done normally in June and in first half of the July, and will be completed by the end July. Crop-wise targeted area and actual area sown in Karnataka during *Kharif* 2012 is presented in Table 4.Of the total targeted area of 74.7 lakh ha, only 47 per cent was covered until end of July 2012 where sowing area done on the maximum area in Karnataka. The total actual area sown consisted of 8 lakh ha irrigated and about 27 lakh rain fed. Cereals covered 39 per cent area (13.74 lakh ha) against the target of 34.89 lakh ha targeted area in 2012. The area

covered less when compared to the area sown in the previous year (18.75 lakh ha) and the normal area (22.30 lakh ha) to be covered by the end of July. Pulses were sown in only 53 per cent area (8.44 lakh ha) against the 15.96 lakh ha targeted area. Thus area covered by this decreased when compared with area sown in 2011 (9.26 lakh ha) and normal area (11.16 lakh ha) to be covered by the end of July. Oilseeds covered an area about 39 per cent (5.23 lakh ha) to the total targeted area (13.38 lakh ha) during 2012. Commercial crops occupied about 7.79 lakh ha (74%) area compared to the targeted area (10.46 lakh ha) during 2012. It was less when compared to the area covered by the previous year *kharif* season (8.43 lakh ha) and the area covered was more when compared to the area to be covered (6.05 lakh ha) by the end of the July. Anonymous[2] it was reported that in India food production was dropped in 2002 because of drought. Food grain production dipped by 29 MT to 183 MT, from 212 mt in 2001. Over 18 mha of cropped area was left unsown during the *kharif* season. *Kharif* season is the main season where all the farmers cultivate land. Average crop loss in terms of area and value loss to the small and marginal farmers and other than small and marginal farmers is presented in the Table 5. Failure of monsoon to set within time during *khari f* 2012, resulted reduction in the area sown to 35.22 lakh ha from the targeted area 74.70 lakh ha across different farm categories. In the area sown, about 16.21 lakh ha was exposed to dry spell where more than 50 per cent crop yield was reduced. In case of crop value loss, total damage was up to ₹ 48,599.87 lakhs in the state across the different farm categories. Crop loss was calculated at the rate of 2,000/ha in case of agricultural crops and 6000/ha for farmers with horticultural crops. Small and marginal farmers suffered to the tune of ₹ 43,433.26 lakh from the 11,34,726 ha area and other than small and marginal farmers suffered to the extent about₹ 51,66.61 by the 4,86,274 ha.

Table 1: Rainfall pattern of Karnataka (*in mm*)

Sl. No	Year	Rainfall	Deviation from normal rainfall	% Deviation
1	1985	785.50	-241.21	-23.49
2	1986	901.20	-125.51	-12.22
3	1987	917.20	-109.51	-10.67
4	1988	987.80	-38.91	-3.79
5	1989	825.40	-201.31	-19.61
6	1990	770.10	-256.61	-24.99
7	1991	894.30	-132.41	-12.90
8	1992	1000.70	-26.01	-2.53
9	1993	989.10	-37.61	-3.66
10	1994	830.60	-196.11	-19.10
11	1995	956.10	-70.61	-6.88
12	1996	1017.10	-9.61	-0.94
13	1997	938.60	-88.11	-8.58
14	1998	1079.60	52.89	5.15
15	1999	884.10	-142.61	-13.89
16	2000	1039.60	12.89	1.26
17	2001	847.80	-178.91	-17.43
18	2002	802.70	-224.01	-21.82
19	2003	950.90	-75.81	-7.38
20	2004	1183.40	156.69	15.26
21	2005	1457.30	430.59	41.94
22	2006	1247.80	221.09	21.53
23	2007	1151.90	125.19	12.19
24	2008	1202.50	175.79	17.12
25	2009	1412.40	385.69	37.57
26	2010	1359.70	332.99	32.43
27	2011	1206.50	179.79	17.51
28	2012	1108.10	81.39	7.93
AVERAGE		**1026.71**		
NORMAL		**1165.00**		
TREND		**781.72+16.90x**		

Source: ARC section, DES Bengaluru 2013.

Table 2: District wise Rainfall pattern during South-West Monsoon (*kharif* 2012)

(in mm)

SI. No.	District	Normal	Actual	Percentage Deviation
1	Ramanagara	433	200	-54
2	Chamarajanagara	317	155	-51
3	Bangalore urban	457	235	-49
4	Dharwad	499	266	-47
5	Gadag	382	205	-46
6	Mandya	297	159	-46
7	Bangalore rural	445	245	-45
8	Mysore	377	210	-44
9	Bellary	361	205	-43
10	Haveri	496	288	-42
11	Bagalkot	351	216	-39
12	Koppal	374	226	-39
13	Bijapur	428	272	-36
14	Raichur	450	289	-36
15	Yadgir	592	394	-33
16	Kodagu	2333	1595	-32
17	Belgaum	601	431	-28
18	Gulbarga	608	437	-28
19	Tumkur	360	260	-28
20	Chikkaballapura	399	291	-27
21	Davanagere	362	265	-27
22	Udupi	4460	3241	-27
23	Hassan	689	546	-21
24	Chikkamagalur	1239	1003	-19
25	Chitradurga	276	223	-19
26	Kolar	387	314	-19
27	Bidar	683	562	-18
28	Shimoga	1869	1528	-18
29	Uttara Kannada	2374	1953	-18
30	Dakshina Kannada	3441	2921	-15
	State	**835**	**618**	**-26**

Source: Karnataka State Natural Disaster Management Centre, Bengaluru

Table 3: Major reservoir levels in the State by the end of September 2012

SI. No.	Name of the Reservoir	Full Reservoir Level (FRL)*	Average RL as on 30 September	R.L. as on 30.09.2012	R.L. of 2012 compared to the Average R.L.	Balance R.L. as on 30.09.2012
(a) Hydel power Generation Reservoirs (Western Coast)						
1	Linganamakki	1819.00	1809.69	1808.90	-0.79	-10.10
2	Supa	1859.39	1803.75	1799.24	-4.51	-60.15
3	Varahi	1950.00	1935.43	1936.81	1.38	-13.19
(b) Reservoirs of Cauvery Basin						
4	Harangi	2859.00	2855.45	2851.16	-4.29	-7.84
5	Hemavathi	2922.00	2908.59	2911.99	3.40	-10.01
6	K.R.S	124.80	117.79	109.50	-8.29	-15.30
7	Kabini	2284.00	2279.93	2273.26	-6.67	-10.74
(c) Reservoirs of Krishna Basin						
8	Bhadra	2158.00	2150.83	2144.83	-6.00	-13.17
9	Tungabhadra	1633.00	1630.85	1631.67	0.82	-1.33
10	Ghataprabha	2175.00	2170.01	2168.70	-1.31	-6.30
11	Malaprabha	2079.50	2069.22	2059.84	-9.38	-19.66
12	Alamatti	1704.81	1704.24	1703.60	-0.64	-1.21
13	Narayanapur	1615.00	1612.33	1613.56	1.23	-1.44

(*In feet, above mean sea level)

Table 4: Targeted area and area sown by the end of July during kharif in Karnataka (2012-13)

Sl. No.	Crops	Targeted area	Area sown (2012)			% Coverage to the targeted area	Area sown in 2011	Normal coverage by end of July	% of Normal coverage
			Irrigated	Rain fed	Total				
1	Cereals	34.89	2.56	11.18	13.74	39.00	18.75	22.30	62.00
2	Pulses	15.96	0.19	8.26	8.44	53.00	9.26	11.16	76.00
3	Food grains	50.85	2.74	19.44	22.18	44.00	28.02	33.47	66.00
4	Oilseeds	13.38	0.27	4.97	5.23	39.00	7.61	13.18	40.00
5	Commercial Crops	10.46	5.05	2.74	7.79	74.00	8.43	6.05	129.00
Total		**74.70**	**8.07**	**27.15**	**35.22**	**47.00**	**44.06**	**52.70**	67.00

Source: Karnataka State Natural Disaster Management Centre, Bengaluru

Table 5: Amount dispersed by state Government for coping with drought in Karnataka

Farmers	Targeted Area (lakh ha)	Area Sown (lakh ha)	Area Affected by Dry Spell (lakh ha)	Agriculture area where crop loss is >50% (in ha)	Total assistance Pursued (₹in lakh)
Small and Marginal Farmers	74.70	35.22	16.21	11.34	5,166.61
Medium and Large Farmers				4.86	43,433.30
Total				16.20	48,599.91
					Total **Loss 486 Crores**

Source: Karnataka State Natural Disaster Management Centre, Bengaluru

CONCLUSION

Rainfall of Karnataka varied between 770.10 mm in and 1457.30 mm in and it followed a positive trend (781.72+16.90). Out of 30 districts Karnataka, Chamarajanagra district received lowest (155 mm) and Udupi received highest rainfall (3,241 mm) in 2012. Ramangara and Dakshina Kannada districts experienced highest (-54 %) and lowest (-15 per cent) per cent deviation in rainfall, respectively. During kharif 2012 only 47 per cent of cultivated land in the state was sown as against a target of 74.70 lakh ha. In 2012 kharif the total estimated amount of loss in the state was of the order of about ₹ 486 crore. The opportunities for irrigating drought hit Karnataka state need to be fully exploited by competing the ongoing irrigation projects. Effective watershed development and afforestation programmes are essential in the district, as it is an established fact that state is frequently haunted by the drought. Crop compensation provided by the Government according to NDRF norms must be revised upward by at least 3 folds from the existing norms (₹ 3,000/ha Rain fed and ₹ 6,000/ha Irrigation crops).

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