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FARMERS' PERCEPTIONS ON IMPACT OF CLIMATE CHANGE ON WATER RESOURCES: A STUDY IN NAGAPATTINAM DISTRICT, TAMIL NADU

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ABSTRACT

There is a growing concern on impact of climate change on water resources. One may observe the over rainfall, flash flood and extreme weather events consequent upon climate change. At the same time occurrence of drought, delayed rainfall, monsoon failure and desertification is the major impact of climate change on water resources. This paper deals with impact of climate change on water resources on the basis of perceived experience of the farmers in Nagapattinam district of Tamil Nadu. It outlines the 30 impact indicators of climate change on water resources. This paper makes an analysis based on farm households' educational, caste and family size status. This paper concludes with some interesting findings along with policy implications.

KEYWORDS: *climate change, water resources, monsoon, drought, adaptation, water management*

INTRODUCTION

In order to minimize the adverse impacts of climate change on water resources and attaining its sustainable development and management, there is a need for developing rational adaptation strategies. In India the distribution of rainfall is highly non-uniform both in terms of time and space. As a result water is required to be stored and utilized for meeting the demands of different sectors throughout the year. Efficient water management requires sustainable development of the available surface and ground water resources and their optimal utilizations. Although specific regional effects in this regard are still uncertain, climate change is expected to lead to an intensification of the global hydrological cycle and can have major impacts on regional water resources, affecting both ground and surface water supply. In its Fourth Assessment Report, the IPCC suggests that average temperatures will climb 1.56 to 5.44°C in south Asia by 2099. Dry season rainfall will drop by 6 to 16 per cent, while wet season rains will increase by 10 to 31 per cent. Such shifts in temperature and precipitation patterns could carry major repercussions for India's freshwater resources and food production. Rising surface temperatures appear to be contributing to melting of snow and ice pack in the Himalaya, thus threatening the water supplies on which hundreds of millions of people depend. As per IPCC analysis India could suffer from outright water stress – annual availability of less than 1,000 cubic meters per capita – by 2025, and gross water availability could fall as much as 37 percent by mid-century. In addition to the implications for drinking water and sanitation, this could

considerably diminish crop yields in the region. Temperature increase of as little as 0.5 to 1.5°C might trim yield potentials for Indian wheat and maize by 2 to 5 per cent. For greater warming, above 2.5 degrees centigrade, the losses in non-irrigated wheat and rice yields in south Asia could cut net farm level revenues by 9 to 25 per cent. Even under the most conservative climate change scenarios, net cereal production for south Asian countries is expected to tumble by at least 4 to 10 per cent. Where some parts of India will face shrinking water supplies, others will face rising seas. Average global sea levels are projected to rise at a rate of 2 to 3 mm per year over the coming 100 years. Low end scenarios estimate sea levels in Asia will be, a minimum, 40 cm higher by the end of the 21st century. The IPCC calculates that this would expose from 13 million to 94 million people to flooding, with about 60 per cent of this total in South Asia. In India, sea level rise of 100 cm would inundate 5,763 km3 of the country's landmass. Because of their high population density, susceptibility to coastal flooding and saltwater intrusion from sea level rise, and exposure to storm surges, the IPCC has specifically designated several of India's low-lying coastal river deltas-the Ganges (shared with Bangladesh), the Godavari, the Krishna, and the Mahanadi- as particular "hotspots" of climate change vulnerability. Based on this background, a study has been conducted with respect to impact of climate change on water resources on the basis of perceived experience of the farm households in Nagapattinam district of Tamil Nadu.

METHODS AND MATERIALS

This study is conducted in Nagapattinam district Tamil Nadu. Out of the total 11 blocks in Nagapattinam district, 6 blocks viz Kollidam block, Nagapattinam block, Kuttalam block, Kilvelur block, Thalainayar block and Vedharanyam block are selected. From each block 75 farm household are selected as a sample. In total 450 farm household are selected under stratified random sampling method. The data relating to Impact of Climate Change on Water Resources are collected from the respondents with the help of interview schedule method. The collected data relating to 5 point rating scale are converted into mean score value. The data interpretation is done with the help of average and anova two way analysis.

IMPACT OF CLIMATE CHANGE ON WATER RESOURCES

This section deals with respondents' rating on impact of climate change on water resources. It can be assessed with the help of 30 factors on a 5 point rating scale. These include decline in ground water quality, occurrence of acid rain, flood damages the infrastructure, decline in average rainfall, change in ocean wave length and ocean currents, increase in precipitation, water shortage for agriculture, improving retention scheme against flood damage, shortage of clean drinking water, occurrence of erratic rain fall, increase in ground water recharge, occurrence of unseasonal rainfall, occurrence of high level evaporation, sea level rise in low laying area, increase in runoff, decline in fish population, natural retention of flood water, decline in ground water tables, frequent intrusion of sea water in to the land surface, increase in drought frequency, lower river flows, delayed monsoon rains, water stress on water intensive crops, increase in irrigation water need due to crop production, decreases in average number of rainy days per year, increase in risk of flood, rapid drying of wells and water bodies, decline in soil humidity, irrigation infrastructure damage due of flash floods and decline in hydropower production.

Table 1 Block Wise Respondents' Rating on Impact of Climate Change on Water Resources

Variables	Kollidam block	Nagapattinam block	Kuttalam block	Kilvelur	Thalainayar	Vedharanyam	Total
Increase in precipitation	3.98	4.06	3.82	3.27	3.63	3.15	3.68
Increase in ground water recharge	3.66	3.78	3.30	2.85	3.23	2.73	3.26
Increase in runoff	3.29	3.41	3.00	2.59	2.96	2.47	2.96
Increase in drought frequency	2.89	3.01	2.62	2.40	2.55	2.28	2.62
Increase in risk of flood	2.46	2.58	2.31	2.16	2.28	2.04	2.30
Decline in ground water quality	4.02	4.08	4.01	4.07	4.06	3.96	4.05
Lower river flows	2.84	2.96	2.57	2.35	2.50	2.23	2.57
Water shortage for agriculture	3.96	4.08	3.60	3.15	3.53	3.03	3.56
Decline in fish population	3.23	3.35	2.93	2.58	2.94	2.46	2.91
Increase in irrigation water need due to crop production	2.57	2.69	2.42	2.27	2.39	2.15	2.41
Occurrence of acid rain	4.00	4.12	3.95	3.96	4.05	3.84	3.99
Decline in hydropower production	2.22	2.34	1.96	1.98	2.04	1.86	2.05
Flood damages the infrastructure	3.99	4.07	3.92	3.80	4.01	3.68	3.93
Improving retention scheme against flood damage	3.87	3.99	3.51	3.06	3.44	2.94	3.47
Natural retention of flood water	3.17	3.29	2.87	2.52	2.88	2.40	2.85
Occurrence of erratic rain fall	3.73	3.85	3.37	2.92	3.30	2.80	3.33
Occurrence of unseasonal rainfall	3.53	3.65	3.23	2.82	3.16	2.70	3.19
Decline in ground water tables	3.12	3.24	2.82	2.47	2.79	2.35	2.80
Shortage of clean drinking water	3.80	3.92	3.44	2.99	3.37	2.87	3.40
Frequent intrusion of sea water in to the land surface	3.06	3.18	2.75	2.51	2.63	2.39	2.74
Delayed monsoon rains	2.79	2.91	2.53	2.30	2.45	2.18	2.52
Decline in average rainfall	4.00	4.12	3.85	3.70	3.95	3.58	3.88
Decreases in average number of rainy days per years	2.51	2.63	2.36	2.21	2.33	2.09	2.35
Rapid drying of wells and water bodies	2.40	2.52	2.25	2.10	2.22	1.98	2.24
Occurrence of high level evaporation	3.43	3.55	3.13	2.72	3.06	2.60	3.09
Water stress on water intensive crops	2.64	2.76	2.49	2.34	2.46	2.22	2.48
Decline in soil humidity	2.30	2.42	2.18	2.03	2.17	1.91	2.17
Irrigation infrastructure damage due of flash floods	2.30	2.42	2.05	1.98	2.09	1.86	2.11
Sea level rise in low laying area	3.37	3.49	3.07	2.66	3.00	2.54	3.03
Change in ocean wave length and ocean currents	3.99	4.06	3.86	3.44	3.73	3.32	3.76
Average	3.22	3.34	3.01	2.76	2.96	2.62	2.99

Source: Computed from primary data

ANOVA					
Source of Variation	***SS***	***df***	***MS***	***F***	***F crit***
Variation due to Climate Change on water resources	63.49719	29	2.189558	160.2681	1.545812
Variation due to blocks	11.73438	5	2.346877	171.7833	2.276603
Error	1.980967	145	0.013662		
Total	77.21254	179			

Data presented in table 1 indicate the village wise respondents' rating on impact of climate change on water resources. It could be noted that out of the 30 impacts of climate change on water resources, the respondents rate the decline in ground water quality as their first level observed impact of climate change on water resource and it is evident from their secured mean score of 4.05 on a 5 point rating scale. Occurrence of acid rain is rated at second level impact of climate change on water resource and it is estimated from the respondents' secured mean score of 3.99 on a 5 point rating scale. The respondents rate the third level impact of climate change on water resources by citing the event of flood damages the infrastructure. It is evident from their secured mean score of 3.93 on a 5 point rating scale. The respondents rate the fourth level impact of climate change on water resources by citing the incidents of decline in average rainfall and it is observed from the respondents' secured mean score of 3.88 on a 5 point rating scale. Changes in ocean wave length and ocean currents is rated at fifth level impact of climate change on water resources and it could be known from the respondents' secured mean score of 3.76 on a 5 point rating scale.

The respondents rate the increase in precipitation as their sixth level observed impact of climate change on water resources and it is revealed from their secured mean score of 3.68 on a 5 point rating scale. Water shortage for agriculture is rated at seventh level impact of climate change on water resources and it observed from the respondents' secured mean score of 3.56 on a 5 point rating scale. The respondents cite the impact of climate change on water resources by the way of improving retention scheme against flood damage and it is their eighth level rating. It is evident from their secured mean score of 3.47 on a 5 point rating scale. The respondents report the ninth level impact of climate change on water resources by citing the event of shortage of clean drinking water as per their secured mean score of 3.40 on a 5 point rating scale. Occurrence of erratic rain fall is rated at tenth level impact of climate change on water resources and it is evident from the respondents' secured mean score of 3.33 on a 5 point rating scale.

The respondents rate the increase in ground water recharge as their eleventh level impact of climate change on water resources and it could be known from their secured mean score of 3.26 on a 5 point rating scale. Occurrence of unseasonal rainfall is rated at twelfth level impact of climate change on water resources and it is reflected from the respondents' secured mean score of 3.19 on a 5 point rating scale. The respondents report the thirteenth level impact of climate change on water resources by citing the event of occurrence of high level evaporation. It is evident from their secured mean score of 3.09 on a 5 point rating scale. The respondents observe the fourteenth level impact of climate change on water resources by citing the event of sea level rise in low laying area and it is clear from their secured mean score of 3.03 on a 5 point rating scale. Increase in runoff is rated at fifteenth level observed impact of climate change on water resources as per the respondents' secured mean score of 2.96 on a 5 point rating scale.

The respondents rate the decline in fish population as their sixteenth level observed impact of climate change on water resources and it is revealed from their secured mean score of 2.91 on a 5 point rating scale. Natural retention of flood water is rated at seventeenth level impact of climate change on water resources and it is revealed from the respondents' secured mean score of 2.85 on a 5 point rating scale. The respondents visualize the impact of climate change on water resources by citing the event of decline in ground water tables and it is evident from their eighteenth level observation. It is known from their secured mean score of 2.80 on a 5 point rating scale. The respondents rate the nineteenth level impact of climate change on water resources by citing the event of frequent intrusion of sea water in to the land surface as per their secured mean score of 2.74 on a 5 point rating scale. Increase in drought frequency is rated at twentieth level impact of climate change on water resources, and it is known from the respondents' secured mean score of 2.62 on a 5 point rating scale.

The respondents rate the lower river flows as their twenty first level observed impact of climate change on water resources and it could be known from their secured mean score of 2.57 on a 5 point rating scale. Delayed monsoon rains is rated at twenty second level impact of climate change on water resources and it is reflected from the respondents' secured mean score of 2.52 on a 5 point rating scale. The respondents report the twenty third level impact of climate change on water resources by citing the event of water stress on water intensive crops. It is evident from their secured mean score of 2.48 on a 5 point rating scale. The respondents observe the twenty fourth level impact of climate change on water resources by citing the need for increase in irrigation water need due to crop production and it is clear from their secured mean score of 2.41 on a 5 point rating scale. Decreases in average number of rainy days per year is rated at twenty fifth level observed impact of climate change on water resources as per the respondents'

secured mean score of 2.35 on a 5 point rating scale.

The respondents rate the increase in risk of flood as their twenty sixth level observed impact of climate change on water resources and it is revealed from their secured mean score of 2.30 on a 5 point rating scale. Rapid drying of wells and water bodies is rated at twenty seventh level impact of climate change on water resources and it is revealed from the respondents' secured mean score of 2.24 on a 5 point rating scale. The respondents visualize the impact of climate change on water resources by citing the incidence of decline in soil humidity and it is evident from their twenty eighth level observation. It is known from their secured mean score of 2.11 on a 5 point rating scale. The respondents rate the twenty ninth level impact of climate change on water resources by citing the situation of irrigation infrastructure damage due of flash floods as per their secured mean score of 2.11 on a 5 point rating scale. Decline in hydropower production is rated at thirtieth level impact of climate change on water resources, and it is known from the respondents' secured mean score of 2.05 on a 5 point rating scale.

The farmers of Nagapattinam block rank the first position in their overall observed impact of climate change on water resources. It is evident from their secured means score of 3.34 on a 5 point rating scale. The farmers of Kollidam block record the second position in their overall reported impact of climate change on water resources. It is evident from their secured means score of 3.22 on a 5 point rating scale. The farmers of Kuttallam block register the third position in their overall observed impact of climate change on water resources. It is revealed from their secured mean score of 3.01 on a 5 point rating scale. The farmers of Kilvelur block occupy the fourth position in their overall visualized impact of climate change on water resources. It is evident from their secured mean score of 2.96 on a 5 point rating scale. The farmers of Thalainayar block hold the fifth position in their overall rated impact of climate change on water resources and it is evident from their secured mean score of 2.76 on a 5 point rating scale. The farmers of Vedharanayam block slip down to the last position in their overall reported impact of climate change on water resources and it is evident from their secured means score of 2.62 on a 5 point rating scale.

The anova two way model is applied for further discussion. The computed anova value 160.26 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the overall observed impact of climate change on water resources is statistically identified as significant as per the rating of the respondents'. In another point, the computed anova value 171.78 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the blocks is statistically identified as significant as per the respondents rating on impact of climate change on water resources.

Table 2 Education Wise Respondents' Rating on Impact of Climate Change on Water Resources

variables	Primary level	Secondary level	Higher secondary level	Degree level	Total
Increase in precipitation	3.21	3.57	3.88	4.04	3.68
Increase in ground water recharge	2.79	3.17	3.36	3.72	3.26
Increase in runoff	2.53	2.90	3.06	3.35	2.96
Increase in drought frequency	2.34	2.49	2.68	2.95	2.62
Increase in risk of flood	2.10	2.22	2.37	2.52	2.30
Decline in ground water quality	4.02	4.04	4.07	4.08	4.05
Lower river flows	2.29	2.44	2.63	2.90	2.57
Water shortage for agriculture	3.09	3.47	3.66	4.02	3.56
Decline in fish population	2.52	2.88	2.99	3.29	2.91
Increase in irrigation water need due to crop production	2.21	2.33	2.48	2.63	2.41
Occurrence of acid rain	3.90	3.99	4.01	4.06	3.99
Decline in hydropower production	1.92	1.98	2.02	2.28	2.05
Flood damages the infrastructure	3.74	3.95	3.98	4.05	3.93
Improving retention scheme against flood damage	3.00	3.38	3.57	3.93	3.47
Natural retention of flood water	2.46	2.82	2.93	3.23	2.85
Occurrence of erratic rain fall	2.86	3.24	3.43	3.79	3.33
Occurrence of unseasonal rainfall	2.76	3.10	3.29	3.59	3.19
Decline in ground water tables	2.41	2.73	2.88	3.18	2.80
Shortage of clean drinking water	2.93	3.31	3.50	3.86	3.40
Frequent intrusion of sea water in to the land surface	2.45	2.57	2.81	3.12	2.74
Delayed monsoon rains	2.24	2.39	2.59	2.85	2.52
Decline in average rainfall	3.64	3.89	3.91	4.06	3.88
Decreases in average number of rainy days per years	2.15	2.27	2.42	2.57	2.35
Rapid drying of wells and water bodies	2.04	2.16	2.31	2.46	2.24
Occurrence of high level evaporation	2.66	3.00	3.19	3.49	3.09
Water stress on water intensive crops	2.28	2.40	2.55	2.70	2.48
Decline in soil humidity	1.97	2.11	2.24	2.36	2.17
Irrigation infrastructure damage due of flash floods	1.92	2.03	2.11	2.36	2.11
Sea level rise in low laying area	2.60	2.94	3.13	3.43	3.03
Change in ocean wave length and ocean currents	3.38	3.67	3.92	4.05	3.76
Average	2.68	2.91	3.07	3.30	2.99

Source: Computed from primary data

ANOVA					
Source of Variation	***SS***	***df***	***MS***	***F***	***F crit***
Variation due to Climate Change on water resources	43.38207	29	1.495933	126.4419	1.597822
Variation due to educational level	6.052403	3	2.017468	170.5239	2.709402
Error	1.029297	87	0.011831		
Total	50.46377	119			

Table 2 presents data on the education wise respondents' rating on impact of climate change on water resources. The degree level educated respondents rank the first position in their overall observed impact of climate change on water resources and it is evident from their secured mean score of 3.30 on a 5 point rating scale. The higher secondary level educated respondents record the second position in their overall reported impact of climate change on water resources and it is revealed from their secured mean score of 3.07 on a 5 point rating scale. The secondary level educated respondents register the third position in their overall rated impact of climate change on water resources and it is reflected from their secured mean score of 2.91 on a 5 point rating scale. The primary level educated respondents come down to the last position in their overall witnessed impact of climate change on water resources and it is estimated from their secured mean score of 2.68 on a 5 point rating scale.

The anova two way model is applied for further discussion. The computed anova value 126.44 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the overall reported impact of climate change on water resources is statistically identified as significant as per the rating of the respondents. In another point, the computed anova value 170.52 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the educational groups is statistically identified as significant as per the respondents rating on impact of climate change on water resources.

Table 3 Farm Wise Respondents' Rating on Impact of Climate Change on Water Resources

Variables	Marginal farmers	Small farmers	Medium farmers	Large farmers	Total
Increase in precipitation	4.07	3.97	3.50	3.17	3.68
Increase in ground water recharge	3.79	3.45	3.10	2.70	3.26
Increase in runoff	3.42	3.15	2.83	2.44	2.96
Increase in drought frequency	3.02	2.77	2.42	2.25	2.62
Increase in risk of flood	2.59	2.46	2.15	2.01	2.30
Decline in ground water quality	4.09	4.06	4.01	3.98	4.05
Lower river flows	2.97	2.72	2.37	2.20	2.57
Water shortage for agriculture	4.09	3.75	3.40	3.00	3.56
Decline in fish population	3.36	3.08	2.81	2.43	2.91
Increase in irrigation water need due to crop production	2.70	2.57	2.26	2.12	2.41
Occurrence of acid rain	4.07	4.10	3.92	3.87	3.99
Decline in hydropower production	2.35	2.11	1.91	1.83	2.05
Flood damages the infrastructure	4.05	4.07	3.88	3.71	3.93
Improving retention scheme against flood damage	4.00	3.66	3.31	2.91	3.47
Natural retention of flood water	3.30	3.02	2.75	2.37	2.85
Occurrence of erratic rain fall	3.86	3.52	3.17	2.77	3.33
Occurrence of unseasonal rainfall	3.66	3.38	3.03	2.67	3.19
Decline in ground water tables	3.25	2.97	2.66	2.32	2.80
Shortage of clean drinking water	3.93	3.59	3.24	2.84	3.40
Frequent intrusion of sea water in to the land surface	3.19	2.90	2.50	2.36	2.74
Delayed monsoon rains	2.92	2.68	2.32	2.15	2.52
Decline in average rainfall	4.07	4.00	3.82	3.62	3.88
Decreases in average number of rainy days per years	2.64	2.51	2.20	2.06	2.35
Rapid drying of wells and water bodies	2.53	2.40	2.09	1.95	2.24
Occurrence of high level evaporation	3.56	3.28	2.93	2.57	3.09
Water stress on water intensive crops	2.77	2.64	2.33	2.19	2.48
Decline in soil humidity	2.43	2.30	2.04	1.92	2.17
Irrigation infrastructure damage due of flash floods	2.33	2.20	1.96	1.93	2.11
Sea level rise in low laying area	3.50	3.22	2.87	2.51	3.03
Change in ocean wave length and ocean currents	4.06	4.01	3.60	3.35	3.76
Average	3.35	3.15	2.85	2.61	2.99

Source: Computed from primary data

ANOVA					
Source of Variation	*SS*	*df*	*MS*	*F*	*F crit*
Variation due to Climate Change on water resources	43.23077	29	1.490716	99.38902	1.597822
Variation due to farm size	9.749729	3	3.24991	216.6779	2.709402
Error	1.304896	87	0.014999		
Total	54.2854	119			

Table 3 presents data on the farm wise respondents' realization on impact of climate change on water resources. The marginal farmer respondents rank the first position in their overall observed impact of climate change on water resources and it is evident from their secured mean score of 3.35 on a 5 point rating scale. The small farmer respondents record the second position in their overall visualized impact of climate change on water resources and it is reflected from their secured mean score of 3.15 on a 5 point rating scale. The medium farmer respondents register the third position in their overall witnessed impact of climate change on water resources and it is evident from their secured mean score of 2.85 on a 5 point rating scale. The large farmer respondents come down to the last position in their overall reported impact of climate change on water resources and it is estimated from their secured mean score of 2.61 on a 5 point rating scale.

The anova two ways model is applied for further discussion. The computed anova value 99.38 is greater than its tabulated value at 5 per cent level significance. Hence, the variation among the overall observed impact of climate change on water resources is statistically identified as significant as per the rating of the respondents. In another point, the computed anova value 216.67 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the farm groups is statistically identified as significant as per the respondents rating on adopted impact of climate change on water resources.

Table 4 Caste Wise Respondents' Rating on Impact of Climate Change on Water Resources

Variables	Forward caste	Backward caste	Most backward caste	Scheduled caste	Total
Increase in precipitation	3.97	3.87	3.60	3.27	3.68
Increase in ground water recharge	3.69	3.35	3.20	2.80	3.26
Increase in runoff	3.32	3.05	2.93	2.54	2.96
Increase in drought frequency	2.92	2.67	2.52	2.35	2.62
Increase in risk of flood	2.49	2.36	2.25	2.11	2.30
Decline in ground water quality	4.08	4.06	4.02	4.00	4.05
Lower river flows	2.87	2.62	2.47	2.30	2.57
Water shortage for agriculture	3.99	3.65	3.50	3.10	3.56
Decline in fish population	3.26	2.98	2.91	2.53	2.91
Increase in irrigation water need due to crop production	2.60	2.47	2.36	2.22	2.41
Occurrence of acid rain	4.07	4.02	4.00	3.87	3.99
Decline in hydropower production	2.25	2.02	2.00	1.93	2.05
Flood damages the infrastructure	4.04	3.97	3.91	3.81	3.93
Improving retention scheme against flood damage	3.90	3.56	3.41	3.01	3.47
Natural retention of flood water	3.20	2.92	2.85	2.47	2.85
Occurrence of erratic rain fall	3.76	3.42	3.27	2.87	3.33
Occurrence of unseasonal rainfall	3.56	3.28	3.13	2.77	3.19
Decline in ground water tables	3.15	2.87	2.76	2.42	2.80
Shortage of clean drinking water	3.83	3.49	3.34	2.94	3.40
Frequent intrusion of sea water in to the land surface	3.09	2.80	2.60	2.46	2.74
Delayed monsoon rains	2.82	2.58	2.42	2.25	2.52
Decline in average rainfall	4.00	3.90	3.89	3.72	3.88
Decreases in average number of rainy days per years	2.54	2.41	2.30	2.16	2.35
Rapid drying of wells and water bodies	2.43	2.30	2.19	2.05	2.24
Occurrence of high level evaporation	3.46	3.18	3.03	2.67	3.09
Water stress on water intensive crops	2.67	2.54	2.43	2.29	2.48
Decline in soil humidity	2.33	2.20	2.14	2.02	2.17
Irrigation infrastructure damage due of flash floods	2.36	2.10	2.06	1.90	2.11
Sea level rise in low laying area	3.40	3.12	2.97	2.61	3.03
Change in ocean wave length and ocean currents	4.06	3.81	3.70	3.45	3.76
Average	3.27	3.05	2.94	2.70	2.99

Source: Computed from primary data

ANOVA					
Source of Variation	***SS***	***df***	***MS***	***F***	***F crit***
Variation due to Climate Change on water resources	43.31033	29	1.49346	137.1531	1.597822
Variation due to caste status	5.140383	3	1.713461	157.3571	2.709402
Error	0.947342	87	0.010889		
Total	49.39806	119			

Table 4 presents data on the caste wise respondents' overall reported impact of climate change on water resources. The forward caste respondents rank the first position in their overall observed impact of climate change on water resources and it is evident from their secured mean score of 3.27 on a 5 point rating scale. The backward caste respondents record the second position in their overall reported impact of climate change on water resources and it is learnt from their secured mean score of 3.05 on a 5 point rating scale. The most backward caste respondents register the third position in their overall visualized impact of climate change on water resources and it is revealed from their secured mean score of 2.94 on a 5 point rating scale. The schedule caste respondents come down to the last position in their overall witnessed impact of climate change on water resources as per their secured mean score of 2.70 on a 5 point rating scale.

The anova two ways model is applied for further discussion. The computed anova value 137.15 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the overall reported impact of climate change on water resources is statistically identified as significant. In another point, the computed anova value 157.35 is greater than its tabulated value at 5 percent level significance. Hence, the variation among the caste groups is statistically identified as significant as per the respondents rating on adopted impact of climate change on water resources.

Table 5 Family Size Wise Respondents' Rating on Impact of Climate Change on Water Resources

Variables	Large	Medium	Small	Total
Increase in precipitation	3.35	3.69	3.99	3.68
Increase in ground water recharge	2.93	3.29	3.47	3.26
Increase in runoff	2.67	3.02	3.17	2.96
Increase in drought frequency	2.48	2.61	2.79	2.62
Increase in risk of flood	2.24	2.34	2.48	2.30
Decline in ground water quality	4.08	4.05	4.02	4.05
Lower river flows	2.43	2.56	2.74	2.57
Water shortage for agriculture	3.23	3.59	3.77	3.56
Decline in fish population	2.66	3.00	3.10	2.91
Increase in irrigation water need due to crop production	2.35	2.45	2.59	2.41
Occurrence of acid rain	4.09	4.01	3.90	3.99
Decline in hydropower production	2.06	2.10	2.13	2.05
Flood damages the infrastructure	3.88	4.07	4.09	3.93
Improving retention scheme against flood damage	3.14	3.50	3.68	3.47
Natural retention of flood water	2.60	2.94	3.04	2.85
Occurrence of erratic rain fall	3.00	3.36	3.54	3.33
Occurrence of unseasonal rainfall	2.90	3.22	3.40	3.19
Decline in ground water tables	2.55	2.85	2.99	2.80
Shortage of clean drinking water	3.07	3.43	3.61	3.40
Frequent intrusion of sea water in to the land surface	2.59	2.69	2.92	2.74
Delayed monsoon rains	2.38	2.51	2.70	2.52
Decline in average rainfall	3.78	4.01	4.02	3.88
Decreases in average number of rainy days per years	2.29	2.39	2.53	2.35
Rapid drying of wells and water bodies	2.18	2.28	2.42	2.24
Occurrence of high level evaporation	2.80	3.12	3.30	3.09
Water stress on water intensive crops	2.42	2.52	2.66	2.48
Decline in soil humidity	2.11	2.23	2.35	2.17
Irrigation infrastructure damage due of flash floods	2.06	2.15	2.22	2.11
Sea level rise in low laying area	2.74	3.06	3.24	3.03
Change in ocean wave length and ocean currents	3.52	3.79	4.03	3.76
Average	2.82	3.03	3.16	2.99

Source: Computed from primary data

ANOVA					
Source of Variation	***SS***	***df***	***MS***	***F***	***F crit***
Variation due to Climate Change on water resources	31.3944	29	1.082566	104.2046	1.662901
Variation due to family size	1.798247	2	0.899123	86.54695	3.155932
Error	0.602553	58	0.010389		
Total	33.7952	89			

Data presented in table 5 indicate the family size wise respondents' rating on impact of climate change on water resources. The small family size respondents' rank the first position in their overall observed impact of climate change on water resources as per their secured mean score of 3.16 on a 5 point rating scale. The medium family size respondents record the second position in their overall realization on impact of climate change on water resources as per their secured mean score of 3.03 on a 5 point rating scale. The large family size respondents come down to the last position in their overall reported impact of climate change on water resources as per their secured mean score of 2.82 on a 5 point rating scale.

The anova two way model is applied for further discussion. At one point, the computed anova value 104.20 is greater than its tabulated value at 5 per cent level significance. Hence the variation among the reported impact t of climate change on water resources is statistically identified as significant. In another point, the computed anova value 86.54 is greater than its tabulated value at 5 per cent level significance. Hence, the variation among the family size groups is statistically identified as significant.

CONCLUSION

It could be seen clearly from the above discussion that the respondents' rate the high level impact of climate change on water resources by citing the events of decline in ground water quality, occurrence of acid rain, flood damages the infrastructure, decline in average rainfall, change in ocean wave length and ocean currents, increase in precipitation and water shortage for agriculture as per their secured mean score above 3.50 on a 5 point rating scale. The respondents' rate the moderate level impact of climate change on water resources by stating the event of improving retention scheme against flood damage, shortage of clean drinking water, occurrence of erratic rain fall, increase in ground water recharge, occurrence of unseasonal rainfall, occurrence of high level evaporation, sea level rise in low laying area, increase in runoff, decline in fish population, natural retention of flood water, decline in ground water tables, frequent intrusion of sea water in to the land surface, increase in drought frequency, lower river flows and delayed monsoon rains as per their secured mean score in the range of 2.50 to 3.50 on a 5 point rating scale. The respondents' report the low level impact of climate change on water resources by indicating the events of water stress on water intensive crops, increase in irrigation water need due to crop production, decrease in average number of rainy days per year, increase in risk of flood, rapid drying of wells and water bodies, decline in soil humidity, irrigation infrastructure damage due of flash floods and decline in hydropower production as per their secured mean score below 2.50 on a 5 point rating scale. It could be observed that the farmers of Nagapattinam block rank the first position in their overall reported impact of climate change on water resources, farmers of Kollidam block the second, farmers of Kuttalam block the third, farmers of Kilvelur block the fifth and farmers of Vedharanyam block the last.

The result of education wise analysis reveals that the degree level educated respondents rank the first position in their overall observed impact of climate change on water resources, higher secondary level educated respondents' the second, secondary level educated respondents' the third and primary level educated respondents' the last. The high level realized impact of climate change on water resources depends on high level educational attainment. It is due to possession of acquired knowledge about the climate change indicators and their consequences in contrast to the low level educated respondents.

The result of farm size wise analysis reveals that the marginal farmer respondents rank the first position in their overall reported impact of climate change on water resources, small farmer respondents the second, medium farmer respondents the third and large farmer respondents the last. In general, marginal farmers and small farmers face a lot of problems consequent upon impact of climate change on water resources in contrast to the medium farmers and large farmers. It is due to poor socio-economic status inhibit the marginal farmers and smalls farmers to diversify their occupation and also their livelihood opportunities.

The result of caste wise analysis reveals that the forward caste respondents rank the first position in their overall observed impact of climate change on water resources, backward caste respondents' the second, most backward caste respondents' the third and scheduled caste respondents' the last. The high caste farmers are more aware of overall impact of climate change on water resources, due to possession of high level educational and economic status in contrast to the low caste farmers. The result of family size wise analysis reveals that the small family size respondents rank the first position in their overall reported impact of climate change on water resources, medium family size respondents' the second and large family size respondents' the last. The large family size farmers' with low socio-economic status are unable to aware to overall impact of climate change on water resources in contrast to the small family size and medium family size group farmers.

SUGGESTIONS

The findings of the present study leans to the following policy implications.

1. In order to avoid the water shortage, there is a need to develop rain water harvesting mechanism among the farm households by the way of imparting awareness training programme.
2. The wastage of surplus rainwater during monsoon season can prevented through development of water storage service by the way of recycyling process.
3. The famers should be motivated to cultivate drought resistant variety of crops and necessary crop variety to be introduced through genetic engineering and biotechnology.
4. The government should encourage the research towards developing crops to be grown in changing climate scenario.
5. Efforts should be made to develop public awareness on coping mechanism to overcome the negative impact of climate on life support system.

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