



# Climate Change Impact on Sustainment in Godavari Districts of Andhra Pradesh, India

Dr. SIVANGI SURYANARAYANA RAJU\*

Professor of Chemistry and Associate Dean, Research & Innovation Cell  
Godavri Global University, Rajahmundry, Andhra Pradesh, India 533 296.

## ABSTRACT:

The climate change is one of the very typical issues, its impact now considered as common global issue by all the countries and looking for best controlling ways in view of future unpredictable situations. Though the problem recognised a few decades earlier, its present situational impact attracting immediate attention. Apart from human beings witnessing the adverse effects, all the plants, animals and other living beings are also not an exception. Several reports suggest climate change mostly depends on three important factors, population, environment, and utility of resources in diversified ways. Lead termination of green belts also reported as vital reason. Reports evidenced that huge variation found in average earth atmosphere prior to industrial era. East and West Godavri districts in the state of Andhra Pradesh in India have significant global identity because of its rich heritage, culture, climatic conditions, and as a profound supplier of food materials. These areas are very famous for agriculture and the quality of many products like rice, sugar cane, coconut. The aqua food cultivation made these districts wealthy enough. However, lot of changes are being observed in the typical maintenance of agriculture and other sustainment due to significant changes in seasonal weather conditions due to climate change. In view of this, it is also found at cases that people are migrating to other places for their sustainment. Typical investigations with important surveys carried out for the identification of observable impact of climate change in these areas and people. Possible scientific suggestions for mitigation of the issues were made.

## **Key words-**

Godavari Districts, Andhra Pradesh, India, Agri and Aqua Culture, Climate Change, Impact on Sustainment, Scientific Suggestions.

## **1. INTRODUCTION**

As per IPCC, the United Nations Intergovernmental Panel on Climate Change, continual emission of greenhouse gases from various sources is expected to enhance the atmospheric temperature to around 3.5°C by the end of 21<sup>st</sup> century (IPCC Report, 2018). As per the indications of RCP scenarios for India, it is estimated that temperature will increase by 1.7 °C to 4.78 °C by 2030 to 2080 and the precipitation is expected to increase from 1.2 to 11.3% (Agriculture Policy Inputs

handbook, 2017). These factors are expected to have huge impact in particular agricultural and water sectors and hence the issue now being considered as common global issue by all the countries and looking for best controlling ways to avoid future unpredictable adversity on human livelihoods, viz., food, fresh water, fresh air etc (Muralidhar et al. 2013). After numerous awareness programs viz., worldwide conferences, etc., considerable best practices are being implemented resulted a bit like 1.5°C fall in temperature. However, if the emissions are still controlled, it can even be more successful either by attaining 2 to 2.2°C by the end of 2030 (P Swarna Latha et al. 2023). Though the human beings facing huge impact and looking for safer ways, all the plants, animals and other living beings are also not an exception and hence sensitization is very much required (Habibullah S, 2022). Severe scorching temperature with heat waves, unexpected and sudden rain falls, unusual droughts, unseasonal cyclones, facing today throughout the globe are the reflections of climate change and Godavari districts also witnessed in recent times. Continual and long duration heat waves reflecting to fatal deaths in considerable number has become a significant problem. As climate has become so dynamic, drastic changes have been observing in the same period zones in different years (P Swarna Latha et al. 2023). Fluctuations on all time scales viz., monthly, yearly and decade wise are also being observed, significant variations also observed in different areas. The southern hemisphere found greater warmer than northern hemisphere (Jones et al. 1999). Reports are abundant on variations of atmospheric temperatures and rainfall (Ghosh et al 2016). The effective rainfall trend has also been found varied from area to area like east, west and central parts of the globe. (Ghosh et al. 2016). The variations in this context resulting on scarcity on food and quality water and hence urgent need is required to estimate these variations and identify best controlling methods to mitigate the issue. Different statistical and technical approaches are available for the detection of trends in rain fall and temperature etc. (Mazahar et al. 2019, Alasan et al. 2020). India is blessed with abundant of water resources. However, in view of unequal distribution of water, preference and security of water is also of so important for cultivation and other important needs. Water balance method has been found as one of the best ways to address the hydrology of any particular region ( Lakhera et al. 2016). Vulnerability to climate change in the state of Andhra Pradesh with respect to different districts was depicted in several cases.

## 2. CASE STUDY AREA

For the present study, East and West Godavari districts in the state of Andhra Pradesh in India have been chosen which are situated in eastern and western delta basins of famous river Godavri. The latitude of the East Godavari district is 17.83333 and longitude is 18.83333. The total area of the East Godavari is 10807 sq.km having population density of 477 per sq.km. However, the latitude of west Godavari district is 17.00000 and longitude is 81.1666. As per the census data of 2011, the total population of the study area is 90,91,262, where 75.1% of lives in the urban area and 25.49% lives in rural area of the specified districts. The heritage, culture, the attractive greenery, geographical advantage, and sculpture attracts lot more pilgrims throughout the world irrespective of seasons (Handbook of Statistics Andhra Pradesh, 2020). Both the districts are famous in production of good quality of paddy, wheat, and other agriculture products like, coconut, peanuts, maize, sugarcane, cashew, tobacco and so on. Further, these districts stand as main sources for many fruits and vegetables export to different parts of the world as well to various states in India. For the last few decades, these districts got international recognition for aqua culture incurred with huge profits (Swarnalatha et al. 2023). Further, these areas have better connectivity to any place in India via different modes of transport and hence it has become favorite place to stay for general public. These two districts found to have a greater number of open ground water sources viz., bores and open wells apart from ponds, lakes and coastal backwaters as prime sources for many purposes include agriculture.

### 3. MATERIALS AND METHODS

All the necessary geographical information of the study area was obtained from official district information handbooks of Andhra Pradesh and corresponding district administrative authorities. Further, the relevant meteorological information was obtained from India Meteorological Department, Cyclone Warning Centre, Visakhapatnam Amaravathi in the state of Andhra Pradesh and Meteorological center, Hyderabad, state of Telangana. The detailed data analysis was carried out for a period of 13 years from 2010 to 2023 to verify the climate change with respect to temperature variations, rain fall trend, monthly precipitation, and humidity percent. As the area chosen for study is not so vulnerable for deep fogs, foggy content was not given priority in the study. However, the snow fall content was included in precipitation data in the corresponding seasonal periods. For pictorial representations, tabulations, argument submissions and trend designs Microsoft Office 2019 was extensively used.

### 4. RESULTS AND DISCUSSIONS

#### 4.1 Trend of Temperature

The maximum temperature recorded of each year under study and the average maximum and minimum temperatures recorded in different years from 2010 to 2013 are presented in Table 1 and pictorially represented in Figure 1. The data also provided with no. of days of rain fall in the corresponding years and notable observations found. From Table 1 and Figure 1, the data reveals the highest temperature crossed 45°C in 6 different years during the span of observed 13 years. A maximum temperature of 47°C in the year 2012, 47.2°C in the year 2015, 46.8°C was observed in the year 2023. Interestingly, there was a notable decrease in temperature found in 2011, where the same kind of observation was not found elsewhere. It is also to be noted that there is at least minimum 0.1 °C variation from year to year where in the average maximum temperature found in 2000 was 32.9 °C and it was 33.9 °C in 2023. It was confirmed with the factual informative data that hot weather conditions have become increased year by year in the second half of this decade when compared to the first half of the decade. It is also observed from the data that the total no. of rainy days found less in the specified mentioned period, where the observed temperatures were maximum. Further, it is to be noted from the data that the year 2020 was recorded with lowest maximum temperature of 32.9 °C during the entire period of study where better rains were observed. The most suspected reason assumed in this context is that frequent and long period lockdowns imposed by the State and Central governments due to covid pandemic. No vehicular exhaust and not functioning of industries contributed to a better extent in pollution free environment.

#### 4.2 Trend in Precipitation and Humidity

The average precipitation along with humidity values in every month of each year of the study was presented in Table 2. The average maximum recorded temperatures are pictorially represented in Figure 2. From Table 2 and Figure 2, it is clear the obvious fact, the precipitation found more in more humidity periods. Table 1 also reflects the details of number of days of rainfall and graphical representation of the same is in Figure 3. As Figure 3 shows, during the 13 years of study period, there is no specific trend and the rainy days ranges from 50 (minimum) in 2011, 2014 to 91 (maximum) in 2020. However, all the period of study found either surplus or deficient when compared to the normal rain trend as per the reports of survey ( A Sravani et al. 2024 ).

Table 1: Annual maximum recorded temperature, maximum/minimum average temperature &amp; total number of rain days during 2000 to 2023

S.No.	Year	Maximum Recorded Temperature (°C)	Maximum Avg. Temperature(°C)	Minimum Avg. Temperature(°C)	Total No. of Rainy Days
1	2010	45.0	33.2	24.7	88
2	2011	39.9	33.5	24.0	50
3	2012	47.0	33.8	24.2	88
4	2013	46.0	33.4	24.2	81
5	2014	43.0	33.8	24.4	50
6	2015	47.2	34.0	24.3	63
7	2016	45.0	33.8	24.5	58
8	2017	43.0	33.5	24.5	55
9	2018	40.8	33.4	24.4	63
10	2019	43.0	33.4	25.0	81
11	2020	42.5	32.9	24.3	91
12	2021	41.0	33.2	24.2	76
13	2022	41.8	33.1	24.3	83
14	2023	46.8	33.9	24.4	60

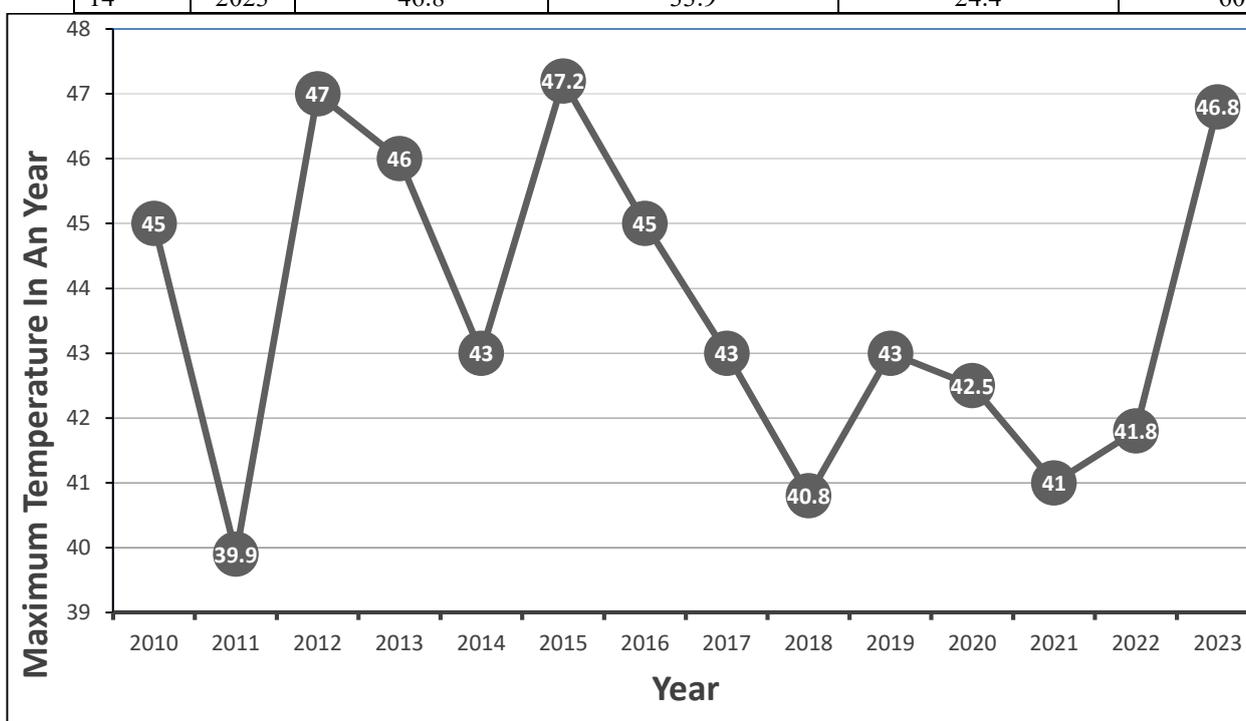


Figure 1: Variation of maximum recorded temperature in different years

### 4.3 Observations of Impact on Agriculture

The regions under study, East and Godavri Districts situated in Andhra Pradesh are highly known for production of many agricultural products and in particular paddy in both the crop seasons, *kharif and rabi*. As mostly the climatic conditions and soil capacity of these districts are highly compatible, huge production of quality agricultural products and contributes in better for export every year from these areas is well noted. As per the reports of Agricultural department, state of Andhra Pradesh, approximately, 15 lakh tone of rice is being produced every year from these areas. Apart from rice, many other grains like wheat, maize, etc., vegetables and fruit production and export to different areas India and also to abroad is well noticed. Aquaculture is another important farming in these districts and got wealthy and international recognition in the production of prawn and fish products (Giri S et al. 2021).

Table:2: Annual average precipitation &amp; humidity during 2000 to 2023

S.No.	Month	Precipitation(mm)	Humidity (%)
1	January	2.1	71
2	February	7.3	71
3	March	4.3	72
4	April	22.4	72
5	May	48.4	70
6	June	90.0	73
7	July	184.2	80
8	August	134.1	80
9	September	172.8	82
10	October	187.8	78
11	November	111.0	75
12	December	14.8	73

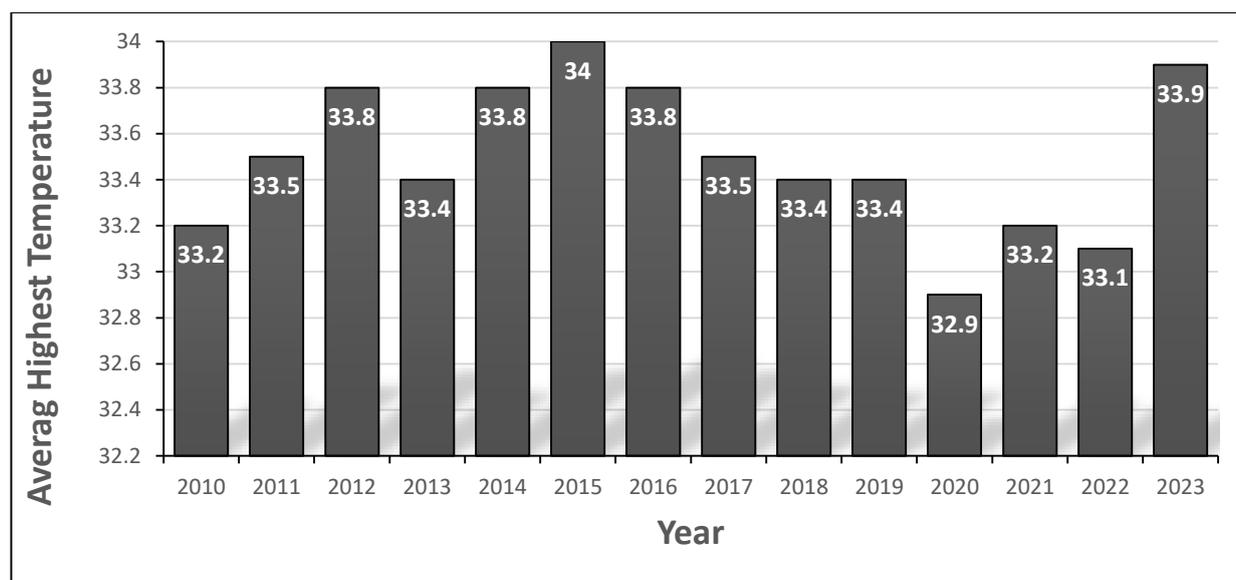


Figure 2: Average maximum recorded temperature in different years

As a matter of fact, the agriculture is highly sensible to cyclones, heatwaves, floods and other calamities ( Nahib Akthar Siddiqi et al. 2016). The observed variations in temperature change, inconsistency in rain fall etc. especially during this decade continuously posing impact on the conditions of the field activities. The farmers must be able to adapt the situations to mitigate the issues any to be raised which was not found all the times. Several researchers revealed the facts of many unending issues continuously faced by the farmers (Tripathi A et al. 2016) . Several problems associated with aquaculture farmers in draught as well as flood times was identified. Optimal maintain of DO in ponds is very important for aqua farmers. Reports available regarding the inconvenience in the maintaining of optimal DO level in draught times and fish escape / transfer situations from one pond to another in the period of floods ( Adikari S. 2018 ). However, the efforts were unsuccessful at extraneous situations. In the lateral period of study, the abnormality was observed and hence found severe problems for regular periodic cultivation by the aqua farmers too as in the case of paddy farmers. Severe unseasonal rainfall due to heavy and repeated cyclones, unexpected draught found responsible for contaminated landfill resulted in the hampering of the soil or aqua pond qualities. The studies reveal that on an average, each 1 rise in temperature reduces the income by 109 Rs. per hectare. Aquaculture debts found more even (Singh N P et al. 2014). These unfavorable conditions reflects the de cultivation attitude among middle level farmers and highly illiterate people reflected in frequent crop holidays and migration of the people to urban areas for their sustainment observed.

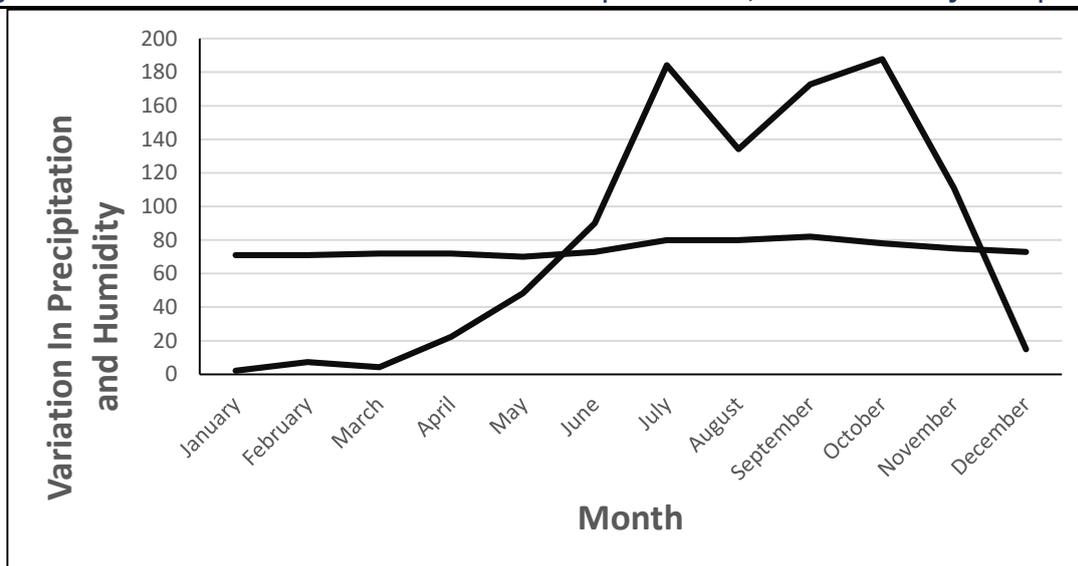


Figure 3: Representation of annual average total precipitation (mm) & ( % ) in Different Years

## 5. ADAPTING PRACTICES FOR MITIGATION

Rapid expansion of industrial sector in view of current generation life style, deforestation, highway encroachments count to the climate change were well understood and priorities are now in function for ecofriendly product development and utility. The technologies like IOT, Artificial Intelligence, 3D Printing, Robotics are extending towards agricultural sector to reduce the human struggle in view of this climate change (King A , 2017 ). Compulsory advancement in green belt in the areas of educational organizations, industries are at regular practice. The east and west Godavari districts also started adapting the concept of natural farming, emphasizes nature and biodiversity to mitigate the impact of unconditional weather situations. Farmers in one region found successful by using the combined product of cow urine, jaggery and a few more organic materials which together act as of barriers of bad weather apart from being in the lines of pesticides. The experimentation proved that the natural farming provides more water storage capacity for soil and provides more healthy and strong roots for the plants (Awanindra Kumar Tiwari, 2023) The sensitization programs by eminent agricultural scientists are expected to build more confidence for uninterrupted cultivate situations also counts for sustainable environment.

## 6. CONCLUSIONS

The rich heritage, culture, climatic conditions and as a typical profound supplier of food materials, East and West Godavri districts in the state of Andhra Pradesh in India got global recognition. Apart from its production of rice, sugar cane, coconut, the remarkable aquaculture made these districts wealthy enough. A study with effective evidences has been carried out on the impact of climate change on the agriculture, aquaculture in these areas for the last 13 years. The correlation between the recorded temperatures and rainfall were also discussed. Typical variations in the maintenance of agriculture and other sustainment due to seasonal weather conditions due to climate change situations are discussed which includes migration of people and crop holidays for sustainment. Typical investigations with important surveys carried out for the identification of observable impact of climate change in these areas and people. Possible scientific suggestions for mitigation of the issues were made. Improvement findings with integration of technology and the effective implementation of organic farming found considerably positive results in mitigating the impact of unfavourable conditions.

## 7. ACKNOWLEDGMENTS

The author is pleased to acknowledge India Meteorological Department, Cyclone Warning Centre, Amaravati and Visakhapatnam, state of Andhra Pradesh and Meteorological center, Hyderabad, state of Telangana for extending their support, Agricultural Departments, East and West Godavari Districts, Andhra Pradesh, India for providing necessary important data.

## REFERENCES-

- [1] IPCC, 2018. Summary for Policymakers. In: Global warming of 1.5°C, World Meteorological Organization, Geneva, Switzerland.
- [2] Agriculture Handbook, 2017. Climate change and adoption in agriculture and water sectors: technology and policy inputs, Andhra Pradesh State, India.
- [3] Muralidhar et al, 2013. Climate change and coastal aqua culture in west Godavari district in Andhra Pradesh: Impact, vulnerability, adaptations and mitigations for resilience, *J Agrometeorol*, 15: 116 – 122.
- [4] Swarna Latha P et al, 2023. Assessment of climate change in west Godavari district of Andhra Pradesh, India using water balance approach, *J Geosciences Research*, 8 (1): 12-17.
- [5] Habibullah S et al, 2022. Impact of climate change on biodiversity loss: global evidence. *Environ Sci Pollut Res*, 29: 1073–1086.
- [6] Jones P D et al, 1999. Surface air temperature and its changes over 150 years *Rev. Geophys*, 37(2): 173-199.
- [7] Ghosh S et al, 2016. Indian monsoon rainfall : implication of contrasting trends in spatial variability of rainfall over peninsular India, *Quart. J. R Meteorol. Soc.*, 147(747): 2197-2211.
- [8] Mazhar F and Rehaman A , 2019. Assessing temperature variations in Punjab and Pakistan using Mann-Kendal trend analysis and inverse distance weighting (IDW) for spatial interpolation. *Europe. online. Jour. Nat. Soci. Sci.*, 8 (4), 717-726.
- [9] Alashan S, 2020. Combination of modified Mann-Kendal method and sen innovative trend analysis. *Engineer. rep.:* e12131,1-13.
- [10] N S Praveen Kumar et al, (2018). *Int J of Curr Micro and App Sci.* :7(11), 495-502.
- [11] Lakhera N, 2016. Water base study of Beas river, Himachal Pradesh, using ARCGIS technique, *Proceedings of National Civil Conference-Innovation for Sustainability*, 9-10 September.
- [12] *Handbook Statistics of Andhra Pradesh*, 2020.
- [13] Swarna Pragathi et (2023). *Aquaculture and economic development in coastal areas: The Case of Andhra Pradesh, India.*, Springer, Cham. [https://doi.org/10.1007/978-3-031-21644-2\\_24](https://doi.org/10.1007/978-3-031-21644-2_24).
- [14] Singh N P et al, 2014. Economic impact of climate change on agriculture in SAT India: An empirical analysis of impacts in Andhra Pradesh using ricardian approach. In: Behnassi, M, Ramachandran G Shelat K, Syomiti Muteng'e M, (eds) *Vulnerability of Agriculture, Water and Fisheries to Climate Change*. Springer, Dordrecht. [https://doi.org/10.1007/978-94-017-8962-2\\_5](https://doi.org/10.1007/978-94-017-8962-2_5).
- [15] Md Masroor et al, 2020. Exploring climate variability and its impact on drought occurrence: Evidence from Godavari Middle sub-basin, India, *Weather and Climate Extremes*, 30.
- [16] Sravani A et al, 2024. Analysis of historical and future rainfall projections in lower Godavari basin: *Int J of Env, and Climate Change*, 14(2).
- [17] DawT M, Giri S, Hazra S, et al, 2022. Economic incentives drive the conversion of agriculture to aquaculture in the Indian Sundarbans: Livelihood and environmental implications of different aquaculture types. *Ambio* 51, 1963–1977.
- [18] Shabbir Alam Md and Nahib Akhtar Siddiqui, 2016. Climate sensitivity of Indian agriculture: *Int J App Bus and*

Econ Res. 14(6) : 4293-4303.

- [19] Tripathi A et al, 2016. Paradigms of climate change impacts on some major food sources of the world: a review on current knowledge and future prospects. *Agric Ecosyst Environ.* 216:356–373.
- [20] Adikari S et al, 2018. *J of Fis. Sci. Com.*, 12(1).
- [21] King A ,Technology, 2017. The future of agriculture: *Nature* 544, S21–S23.
- [22] Awanindra Kumar Tiwari, 2023. The role of organic farming in achieving agricultural sustainability: *Environmental and Socio Economic Impacts, Acta Biology Forum.*, 29 to 32.

