
IMPACT OF CLIMATE CHANGE ON DROUGHT PRONE AREA OF MAHARASHTRA STATE IN INDIA –A CASE STUDY OF UPPER GODAWARI BASIN

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INTRODUCTION

About a quarter of India's drought-prone districts are in Maharashtra, with 73% of its geographic area classified as semi-arid. Several factors account for the languishing state of agriculture in Maharashtra. Heavy monocropping in some areas, limited value addition to support agribusinesses, a degrading resource base, excessive withdrawal of groundwater, and unfavourable market conditions. Furthermore, irrigation, which covers only 18% of the total agricultural area, is accessible mainly to larger farmers that have access to power and is widely used for the cultivation of sugarcane, a water-intensive cash crop. The drought proneness of the state is a critical additional stress factor that adversely affects productivity, livelihoods, and the rural economy. Ironically, the cultivated areas lie predominantly in drought-affected districts (Ahmednagar, Solapur, Nashik, Pune, Sangli, Satara, Aurangabad, Beed, Osmanabad, Dhule, Jalgaon, and Buldhana), which account for 60% of the net sown area. These areas lie in the rain shadow region east of the Sahayadri mountain ranges in Maharashtra and the adjacent Marathwada region. Aridity appears to be encroaching upon adjacent areas: districts that previously had moderately assured rainfall, such as Vidarbha, have been afflicted by declining and unpredictable rainfall with debilitating impacts on the local economy (box.1). Maharashtra experienced severe and successive years of drought in 1970-1974, 2000-2004 and 2012-2015. The state Employment Guarantee Scheme (EGS), a relief and rehabilitation program of state support was introduced in 1972 in response to a devastating drought. Large tracts of rain-fed agricultural land in the state have become unremunerative. The agrarian crisis has become acute; with signs of a breakdown of coping mechanisms among vulnerable groups whose exposure to drought appear to be increasing. For these reasons Maharashtra represents an important case for assessing the coping capacities of communities and the underlying vulnerabilities associated with droughts.

Box 1- Rainfall Distribution in Maharashtra- Maharashtra is divided into 35 districts split among five regions: Vidarbha (in the northeast), Marathwada (in the south-central region), Khandesh (in the northwest), the rain shadow region (extending from the northeast to the southeast between the coastal districts and Marathwada), and Konkan/Western Ghats (in the southwest, on the coast). There is a wide variation in the distribution of rainfall across the state, with the coastal belt, the Konkan region, receiving more than 2,000 millimetres annually, with the second highest rainfall being recorded in the Vidarbha region. Overall, rainfall in Maharashtra increases steadily towards the east and average rainfall in the easternmost districts is about 1,400 millimetres. The rain shadow and Marathwada regions are the drought-prone areas of the state, with an annual average rainfall of less than 600 millimetres. These regions are generally characterized by extreme aridity, hot climate, and acute deficiency in water availability. More recently areas in Vidarbha, which usually have reliable rainfall, have experienced variable and reduced precipitation.



Map 1-Location of study area showing Marathwada region in Maharashtra.

The Report by Vulnerability and Adaption Programme in Semi arid India (2009) – talks about two major climate changes. Firstly, the sixty percent population of India resides in rural regions whose livelihood is primarily based on climate sensitive natural resources with poor adaptive capacity. Secondly is the concerned associated with the biodiversity loss as around seventy percent of natural vegetation to adapt with the changing climate.

To Access the vulnerability in India the semi arid regions have been considered as they are very vulnerable. The climatic conditions were assessed and on that basis their climate projections and the impact on natural resources was calculated. To build response capacity and improve management of climate risks it included interventions for improved land and water management, energy conservation, promotion of best agronomic practices, introducing systems for improved weather based farming decisions and awareness creation.

OBJECTIVES OF THE STUDY-

1. To understand the changing scenario of Maharashtra with respect to climate change through rainfall, temperature.
2. To study the extreme weather events of flood and drought in Maharashtra.
3. To address the vulnerabilities to current water scarcity and climate change risks.
4. To study the Maharashtra Government's adaptation strategy, plans and programmes on water resources in the light of climate change.

HYPOTHESIS-

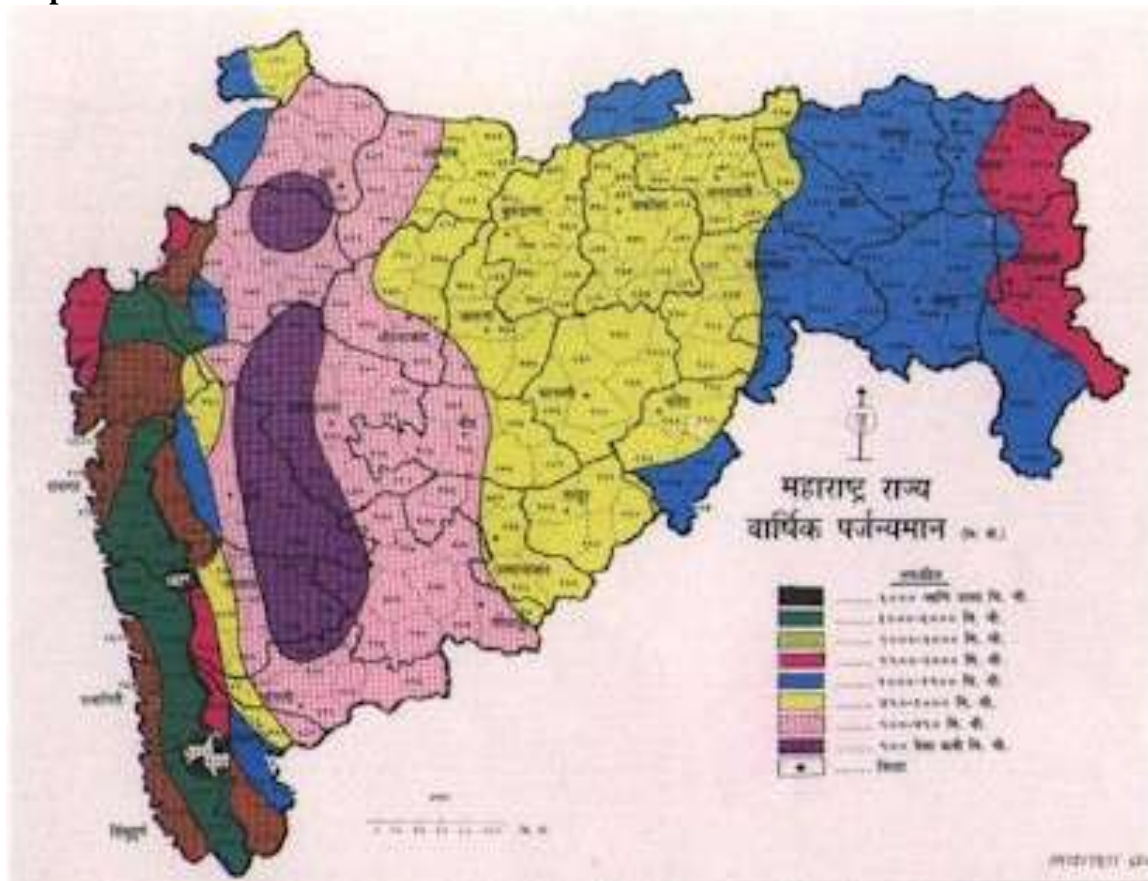
1. Extreme events like droughts and floods have increased in the state.
2. Nature of rainfall has changed with increase or decrease in precipitation in most of the districts in Maharashtra.

3. Heat waves in summer of longer duration are more intense and more frequent particularly in Marathwada and Vidarbha region.
4. Dependency on ground water has increased

RESEARCH METHODOLOGY- Source of data collection- The study has based on the secondary data and literature collected from research institutions, libraries and related government departments. For primary data collection survey was conducted in the Beed, Jalna, Aurangabad, Ahmadnagar and Nashik districts. The data was statistically analysed and is presented in the form of tables, maps, graphs.

CASE STUDIES- Two case studies were conducted covering rural as well as urban area. First study was conducted to find out the farmers respond to climate change in rural area of Maharashtra. For this Beed, Aurangabad, Ahamadnagar were covered from drought prone areas of the state. A questionnaire was prepared to collect the primary data. Second study was conducted in the Beed Latur Aurangabad cities. Urban area to study the urbanisation, water crisis and its management.

Map of Annual Rainfall distribution of Maharashtra State-



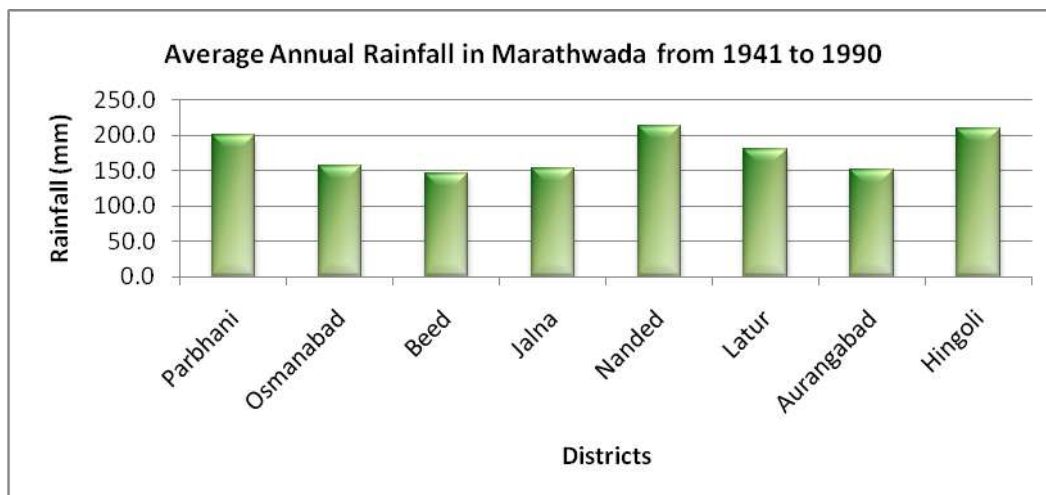
2. Characteristics of Study Area

a. Climate and Geography –

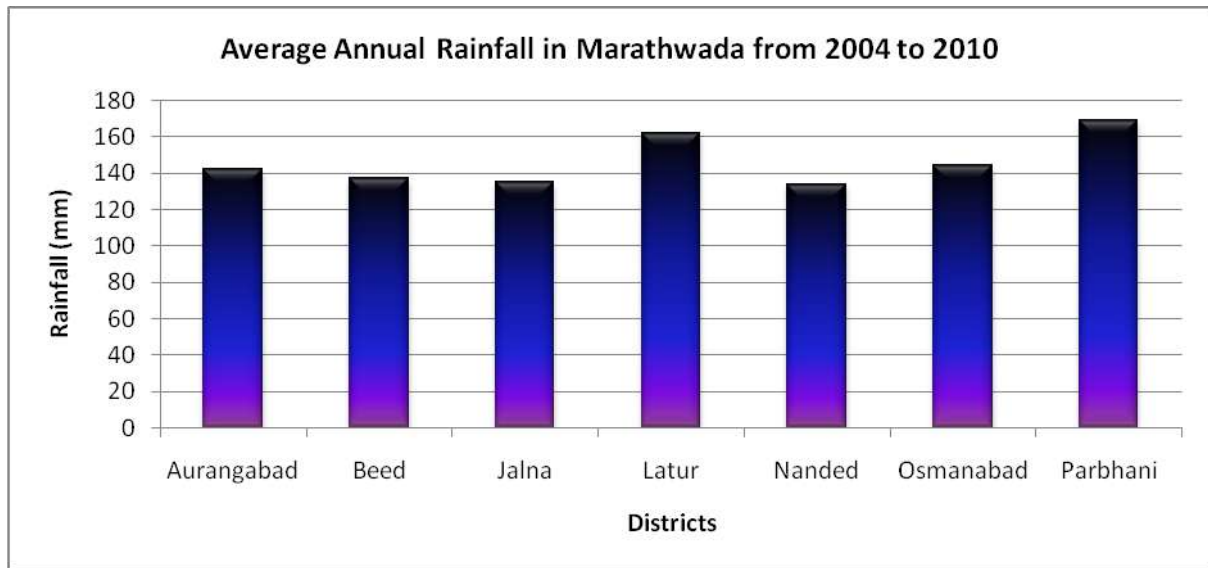
The two drought-prone districts of Nashik and Ahmednagar, located in the Godavari basin, were chosen from Western Region. Though both districts are located in drought-prone zones, they are substantially different: Nashik is located closer to the higher rainfall

Western Ghat region and is the more fertile and moist area. It receives an average annual rainfall of about 1,000 millimetres, and only 25% of its area is fully affected by drought. In contrast, the district of Ahmednagar is arid and lies in the scarce rainfall zone like Marathwada region. The district is hot and dry with an average annual rainfall of 579 millimetres, the lowest in the state. In both districts agriculture is the primary source of income. Reflecting agroclimatic conditions, there are great differences in average incomes between the districts. Large and medium farmer households are more dependent on agricultural sources of income, draw much higher incomes, and own more assets than their marginal and landless counterparts. MARATHWADA region has been reeling under drought condition since 2012. It is in a part of the scanty rainfall area of Central Maharashtra. The region coincides with the Aurangabad Division of Maharashtra. It includes districts of Aurangabad, Jalna, Beed, Osmanabad, Nanded, Latur, Parbhani and Hingoli. Out of these eight districts, five are the worst affected, namely Beed, Jalna, Parbhani, Nanded and Osmanabad. Marathwada region has a population of about 1.87 crore and geographical area of 64.5 thousand sq.km. The region had faced several droughts in the past. Droughts have occurred in the years 1899, 1918, 1972, 1987, 2004 and 2012 onwards. The 1972 drought is in the recent past; which people still remember. In 1972, food and fodder were the main concerns, but now drinking water is more important. It is multi-dimensional drought. Global climatic situation is also playing in the process, which was not so acute 50 years before.

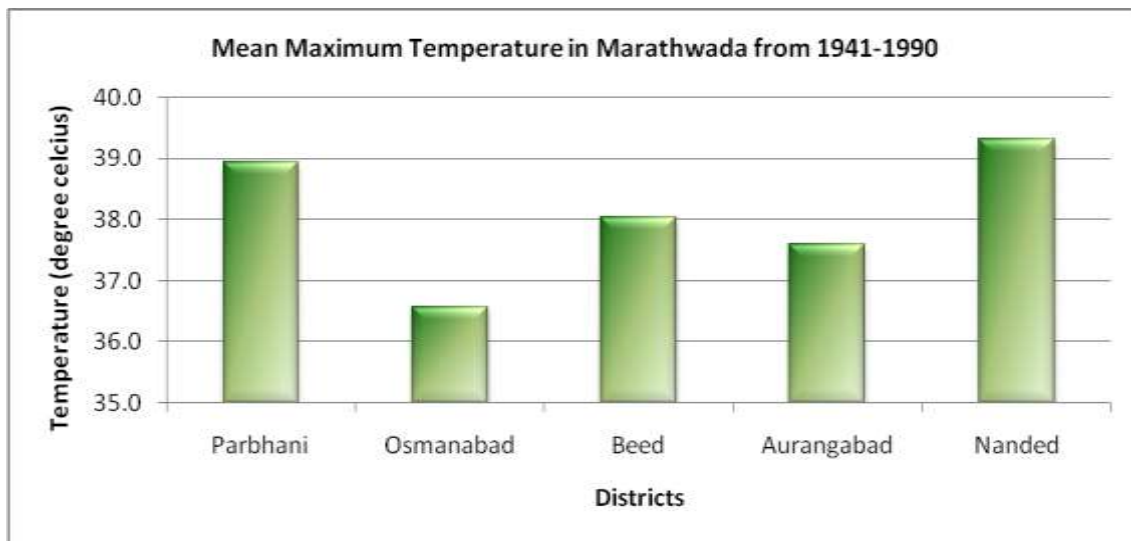
CLIMATE of MARATHWADA-



Graph 1: Graph showing average annual rainfall in districts of Marathwada for a period of 50 years from 1941 to 1990



Graph 2: Graph showing average annual rainfall in districts of Marathwada for a period of 50 years from 2004-2010



Graph 3: Graph showing mean maximum temperature in districts of Marathwada for a period of 50 years from 1941 to 1990

Generally, drought is a period of below average precipitation in a given region, resulting in prolonged shortage in its water supply, in all levels namely atmospheric, surface or groundwater. A drought condition in any region including Marathwada region occurs when there is less than 50 per cent of average rainfall for consecutive periods. The region is under the influence of southwest monsoon. When southwest monsoon reaches in western coast in the month of June, massive rainfall occurs in the western coast of Maharashtra (2,500 mm to 3,000 mm). Rainfall decreases from west to east. When it reaches Marathwada region, the average rainfall becomes 750 mm.

The data also reveals that Nanded district of Marathwada has the highest mean temperature at 39.3 degrees Celsius, followed by Parbhani (39 degrees Celsius). However, mean maximum temperature of Beed (38.1) and Aurangabad (37.6) is slightly lower than the above two districts. There, Osmanabad district shows the lowest mean maximum temperature i.e. 36.6 degrees Celsius. All the districts of Marathwada are affected from drought, as the average rainfall in 2014 and 2015 is 44 per cent below normal rainfall. The problem intensified after serious crop damage due to hailstorm in Marathwada and Vidarbha in 2013.

b. NATURAL WATER DISTRIBUTION OF MARATHWADA REGION

Marathwada is a landlocked region. The entire region is drained by the Godavari River and its tributaries such as Purna, Shivna, Dudhna, Vedganga, Sindhphana, and Bindusara are the main rivers in the region. Except Godavari, no other is a perennial river. These rivers carry very little water as the summer approaches. Major dams in Godavari basin are Bhandardara in Ahmednagar, Jayakwadi Stage 1 in Aurangabad, Upper Dudhna in Jalna, and Lower Dudhna in Parbhani, Sindhphana and Bendsura in Beed, Majira in Latur, and Ujjani in Aurangabad, etc. All the reservoirs receive water during rainy season. Due to the failure of monsoon, many reservoirs are dry. No water can be supplied until next monsoon.

Along with surface water, underground water resource has also been affected. The water crisis in Marathwada has pushed thousands towards the underground borewell industry. It is draining the underground water and posing ecological challenge. There is severe depletion in groundwater level in all the talukas. Highest depletion has taken place in Hingoli (-4.35m), followed by Osmanabad (-4.13m), Parbhani (-2.87m), Latur (-2.52m), Nanded (-1.60m), Aurangabad (-0.94m) and Beed (-0.34m). It is reported that at least 10,000 new bores came into existence. This extraction of underground water ultimately would lead to ecological disaster. Primarily, farmers were using shallow groundwater. They were dependent on wells. With the acute shortage of rainwater in 2012-13, most of the wells went dry. Many check dams became dysfunctional. Live storage of reservoirs of Manjara, Manzalgoan, Terena, Purana were at zero level in August 2015.

REVIEW OF LITERATURE-

The review covers books, research articles, reports and popular articles on the research topics. The main topics covered the review are : Climate Change , Vulnerability, Adaptation and Extreme Events.

CONSEQUENCES OF DROUGHT CONDITION IN MARATHWADA

Farmers' suicide: Because of this severe drought situation continuing for last four years, Marathwada became the graveyard of farmers. Total number of suicides in January 2016 crossed 1,000, every week 25 to 30 farmers are committing suicide. This should be treated as the national epidemic.

Agriculture is worst affected: Jowar and Bajra, along with other kharif crops, were completely wiped out in 2013 when monsoon failed. Along with the food crops, fruits (horticulture) also are affected. Jalna, which is known for being the biggest producer of sweet lime, has been the worst hit in the drought. Sweet limes grow in about 55,000 ha in Jalna. In 2015, there was no cultivation of sweet lime at all. Sweet lime plants require five years to bear fruits. Thus, the hard work of farmers for years together was in vain.

Two important cash crops in Marathwada namely cotton and sugarcane are also severely affected. Cotton is not water intensive crop as it can be cultivated in the dry area. In fact, 90 dry days are required before germination of cotton flowers. However, misfortune of the farmer began with the introduction of B.T. cotton. The capital input for cultivation increased for the farmers but the crop failed successively. Loan burden remained on the shoulder of the farmers. Sugarcane is a water intensive crop, planted in water deficient area. Marathwada has 70 sugar mills. Total water required for Marathwada for sugarcane cultivation is 4,300 million cubic metres. This requirement is double the storage capacity of the largest dam of Godavari. Just crushing of cane will require 17 million cubic metres water, which is enough to provide drinking water to 15.85 lakh people until next monsoon.

Intensification of water politics of Maharashtra: The problems faced by drought situation in Marathwada are due to not only natural factors but also lack of appropriate political intervention. Powerful political parties played all tricks to grab local water resource. In many cases, dam water through channels has been diverted to the particular field belonging to a powerful minister. It is the false pretension of political leaders that there is no drinking water for the resident population.

Improper distribution of water resources unknowingly has created havoc for both the sections of population for example Nashik and Ahmednagar district, which are enjoying sufficient water supply throughout the year from Sahyadri region. In these districts there is good production of various crops like onion, sugarcane, grapes, etc. As a result there is always excess supply, the products are not getting even the minimum retail price. This demand and supply gap has harmed the interest of farmers of particular area. Due to this situation, where the farmers are not able to sell their produce even at minimum prices, they are incurring abundant losses. All this has created a negative impact on the daily subsistence of the farmers. Sometime they are forced to sell onion and tomato at 50 paise each per kg, which actually would have accounted for Rs. 6 per kg and Rs. 8 per kg for onion and tomato respectively. Frustration on this level has forced some of the farmers in Marathwada region to commit suicide. Hence, improper distribution of water supply has not only affected the poor farmers, but even the general population get the pinch of this situation. This frustration has caused the farmers in Marathwada to agitate against the Government by demonstrating through road blockage and other means.

Consequence of drought on cattle: Apart from the people, it is the cattle that are affected by the problem. Average cattle need more than 100 rupees per day fetching them approximately 15 kg of grass and fodder. However, at present it is only 60 rupees' fodder per cattle the government has sanctioned and out of that, 50 per cent is thrashed to the godowns of the higher authorities.

Suggestions and Recommendations

There is no proper water management policy in Maharashtra. To combat with the situation many measures need to be undertaken.

Stopping westward water diversion from Bhima basin to Konkan: The region suffers from complete lack of water management policy. It is a very big irony that water is transferred from water deficit area of Bhima Basin to surplus area of Konkan region. The hydropower stations of Khopoli, Bhivpuri, Bhira has more than 136.64 MCM of water till July 2015. Other dams associated with above project namely Mulshi, Andre, Walve, Shiravda, Thokanwada and Vadivde are storing 620 MCM of water. The water stored in Tata dam rightfully belongs to Bhima basin. If it is released, it can directly come to Ujjani reservoir and can supply water to Beed, Osmanabad in Marathwada region through pipeline, which is already in place for drinking water. Further, from Bhima-Sina link tunnel water can flow from Sina river basin, and can be used for drinking purpose in Solapur and Marathwada region. This redistribution of water is within the power of the state government. The Maharashtra government should implement it without further delay.

Government adopts Policy to promote micro irrigation and piped water supply: PIPED WATER supply systems will be used more extensively in Maharashtra to carry dam water to farms.

Regulations needed for sugarcane production and introduction of low capital investment crops: It is well known that the sugarcane cultivation and crushing in Marathwada region is a large stake of certain politicians. Strict restrictions to be imposed for any sort of water lifting and stealing for sugarcane field and factory. No new sugarcane factories to be permitted. Sugarcane requires 4,300 MCM of water for the entire season, which leads to problem of water shortage for other uses. Demand for water for sugarcane should be curbed to preserve it for drinking purpose. As a long-term proposal less water consuming crops like oil seed, pulses to be considered for introduction.

Marathwada as such has a vast land as open space. This land can be widely used as grassland, so that the industries such as dairy products, fodder and compost factories can develop extensively with very low investments. This may help to improve marginal profits of the farmers. The political capture of water in dry region like Marathwada region is not only shocking, but also a criminal activity. Maharashtra politicians are raising voice for bailing out the sugarcane industries. In this circumstance, the government should give some relief keeping in focus the long-term issues related to water management.

Social awareness needs to be created: In Marathwada, as there is limited facility for credit delivery system and official lending pattern, the poor farmers have no other alternative but to depend on the Mahajans (private moneylenders). This system needs to be socially tackled by the political parties, women's organisations, youth forum and students. They

have to come together to build social resistance against such type of loan. In addition, medical aid to be given to the farmers, while they are in depression.

Watershed development and enhancement of underground water resources: That drought situation of Marathwada region is not only because of the erratic distribution of monsoon rain but also associated with lack of water governance, poor implementation of watershed development projects, non-judicious use of irrigational water. The stake of the politicians makes the situation worse.

Finally, to tackle this situation, several political measures should be undertaken. Scientific dry farming with introduction of less water intensive crops like oilseeds and pulses to be taken as one of the main task. Marathwada region has tremendous potential for horticulture development such as sweet lime, pomegranate, etc. Sugarcane crushing is to be stopped and finally to be shifted from this area to the nearby area. Industries like beer, distilled water need to be shifted in peripheral area. Steps should be taken to introduce integrated marketing system to avoid exploitation by intermediary. With judicious water management, the area can be turned into a successful grassland farming area.

Maharashtra Government's adaptation strategy, plans and programmes on water resources in the light of climate change.-

Government of Maharashtra takes initiatives-

1. The government aims to increase the capital investment in agricultural sector to make it sustainable. Until view the issues faced by agriculture in Maharashtra in long term and with perspective of welfare schemes, limit the sector to aid, assistance and rehabilitation, the real issues before the farmers will never end. What is the problem when we look at perennial agriculture in Maharashtra? The true inhibition is that the lack of productivity. In terms of productivity Maharashtra is among the lowest five states in majority of crops. Government's entire capital investment is to the extent of Rs.31,000 crore. Out of this Rs.31,000 crore ,Rs.19,000 crore is the capital investment in agricultural sector. Therefore government is taking efforts to enhance this investment and make agriculture sustainable.
2. Maharashtra has taken up climate resilient agriculture in alliance with the World Bank. World Bank was earlier only assisting us for the huge work such as roads and building construction. This the first time government has gone to the World Bank with an innovative project to enhance investment in the agriculture sector. Government began right from soil improvement and went on to create end-to -end programme addressing factors such as better water use efficiency, micro-irrigation system, cropping pattern and post harvest technology further up to market linkage. In the first stage government decided to bring the transformation to 5,000 villages for which a project of Rs.7, 000 crore has been prepared. The World Bank is helping on this and has already started the project.

Government has suggested a vital project through the budget, where the government will provide all its schemes if 20 farmers get together with a total land of 100 acres. A marginal farmer does not have the resources to go for mechanisation. A single farmer cannot go for all these. However, if all the money is provided to community agriculture along with government schemes to enhance productivity, the farmers will be able to reap the benefit.

3. Jalyukta Shivar Abhiyan (water shed campaign) brings water security to farmers and curbs climate change- Jalyukta Shivar was successful because peoples participation and scientific approach taken by the government. At the core government placed the development of water shed. The objective is to make Maharashtra a drought-free state by 2019. It proposes a framework for village level water balance calculation which includes estimation of crop-water requirements, drinking water stress etc. Jalyukta Shivar promotes an integration and coordination between various government agencies and programme during planning and implementation levels and stresses on peoples participation as one of the key objectives. The programme aims to make 5,000 villages free of water scarcity every year. This transformation has been possible with concentrated efforts towards developing water sheds, improving ground water levels, de-silting and decentralizing water sources and increasing the area under irrigation. This programme involves deepening and widening of streams, construction of cement and earthen stop dams work on lakes and digging of farm ponds.

This programme has been focus primarily on over exploited villages in water shade, tanker feeded villages. District collector is responsible for selection of villages, approval of the plan and implementation of the work.

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