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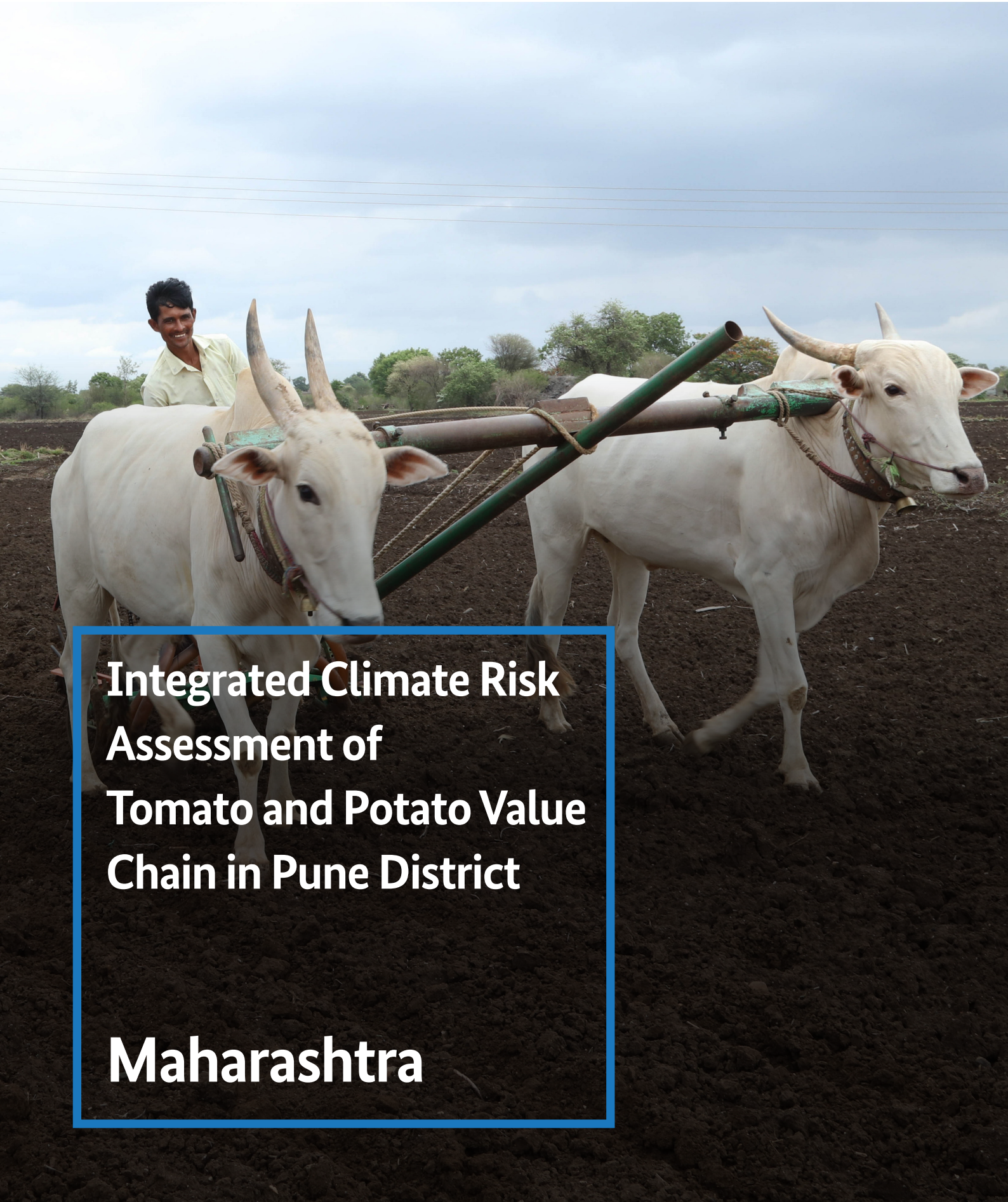

# Integrated Climate Risk Assessment of Tomato and Potato Value Chain in Pune District

# Maharashtra

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Bengaluru, August 2023

# INTEGRATED CLIMATE RISK ASSESSMENT OF TOMATO AND POTATO VALUE CHAIN IN PUNE DISTRICT, MAHARASHTRA

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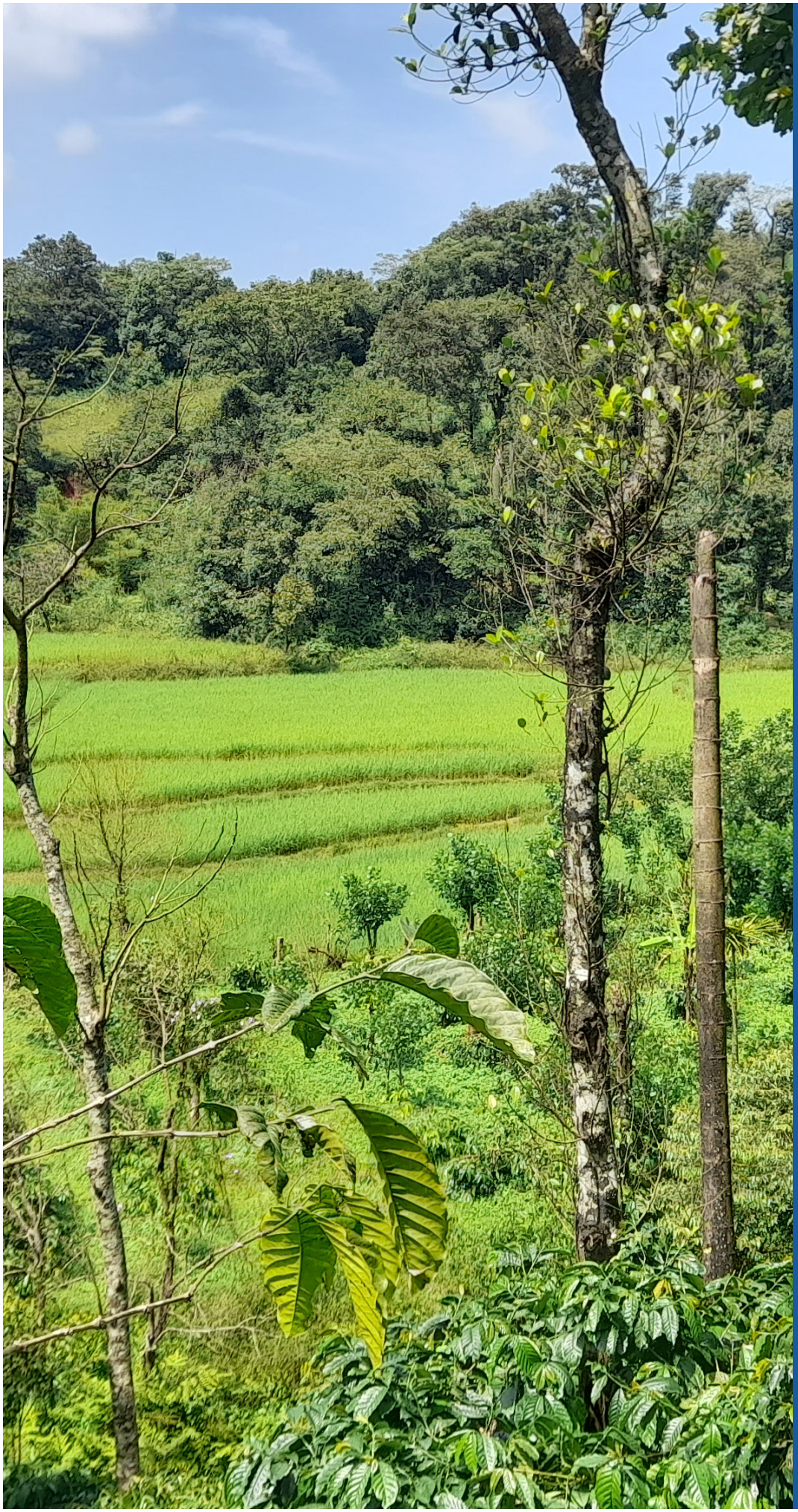

# EXECUTIVE SUMMARY

# 01

## Climate change has been recognised as one of the key challenges for India, with the agriculture sector being extremely vulnerable.

Smallholder farmers with high exposure to climate events are vulnerable to climate change and suffer the most due to their low resilience to such events.

Analysis of year-to-year rainfall variability in monsoon months and seasonal mean for 1951-2018 in Pune District did not show any significant trend; a slight increase was observed during 2010-18 during individual months and seasons as a whole. The variability in the number of rainy days was higher in July and August in the recent decade and shows a slightly decreasing tendency during the period of 1951 to 2018. Stakeholders on ground report unseasonal, heavy rains over the last few years. They also reported that the monsoon season seemed to shift, with delayed onset and delayed withdrawal becoming more pronounced. Rains also occurred throughout the year, affecting different crop seasons.

Extreme weather events in the region have been on the rise. Between 1970 and 2019, there was a 700% increase in drought events and a 600% increase in flood events in Maharashtra. While droughts affect crops and livestock, floods cause significant losses to all types of livelihood assets and standing crops. Increased monsoon rainfall is also likely to increase leaching of nitrates and adversely affect decomposition of organic matter. The projections for climate change for the region, which include Pune as well as a few other districts, indicate that the annual mean temperature is set to increase by 1.15-1.280C in the 2030s and 1.65-1.940C in the 2040s. In Pune District, the number of warm days per month is set to increase from the current 10% of the days in a season to 38% in the 2030s and 55% in the 2050s. The number of cold days in the winter season of three months is set to fall from 20% currently to 7% in the 2030s and 4% in the 2050s. The State Policy on Climate Change has classified Pune District as low in terms of vulnerability based on an analysis of exposure, sensitivity and adaptive capacity to climate change.

While vulnerability might be low for Pune District, it is highly sensitive to climate change. The changes in temperature and rainfall observed over the past few years and the projections clearly establish that productivity of crops, including tomato and potato, will be impacted.

Precise recent estimates of acreage under tomato and potato are not available for the district because these two crops, while important in certain locations, are not major crops. In 2016-17, Pune district witnessed tomato production over 18,560 hectares, producing 4.64 lakh tonnes. The production of tomato in Maharashtra was more than a million tonnes in 2019-20.

## Climate Change And Vulnerability To Climate Change

Field surveys indicate that farmers continue to suffer because of climate change. Tomato farmers, NGOs operating in the field, and the technical personnel from KVKs indicated that there is a loss of production arising from reduced yield. This is caused by higher temperatures, unseasonal rains, and heavy precipitation as well as a higher incidence of pests and diseases. The higher temperatures have given rise to new viruses and insects not previously seen in tomato crops. The changes in rainfall pattern have delayed the harvest of the onion crop, which precedes the summer tomato crop. The delayed planting of tomato results in tomato fruiting coinciding with monsoon rains, which affects productivity and crop quality. White fly infestation has been witnessed more than in the past. Fungus formation accompanied higher temperatures during the crop season. The whitefly and fungus problems require much more spraying of fungicides

and insecticides. Apart from the increase in cost of production, the crop suffers quality erosion with chemical residues from spraying. Intense precipitation close to harvest time causes damage to the plant crop and reduces produce quantity and quality. The recent years' phenomenon of rains throughout the year, i.e. for a few days every month, disrupts crop growth and harvesting. Green Innovation Centres for the Agriculture and Food Sectors (GIC) India, implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH had introduced organic cultivation and good agricultural practices that could address several aspects of the problems arising from temperature and rainfall variations.

Potato farmers asserted that the changes in temperature and rains have impacted productivity, which they say has seen a 50% decline. Bacterial blight has become an annual occurrence requiring spraying. Despite the spraying, crop quality suffers and is rendered unfit for remunerative buyers. The frequent rains reduce the window available for spraying of insecticides and fungicides, delaying remedial action, and leading to a loss of inputs. A major problem is that of heavy rains around harvest time, which results in the crop rotting in the field. The GIC India project has been enabling farmers to deal with vagaries of climate by introducing solutions from correct land preparation to harvesting and marketing, in the case of potato and tomato.

In general, farmers had difficulty in sourcing some of the organic inputs. Access to remunerative markets was also a longstanding problem, which in the recent past is being addressed through the FPOs established in the local areas.

# Climate hazards and vulnerability of stakeholder

Table 1: Climate hazards and vulnerability of stakeholders

| Issues - Tomato | Possible remedies |
|---|---|
| **Delayed onset of monsoons** | Proper crop planning including contingency planning; choice of varieties which might be suited to late planting; securing irrigation sources to facilitate 'on-schedule' planting |
| **Paucity of bio-inputs in local markets** | Bulk purchase in advance through the FPO; encouragement to local entrepreneurs for production of bio-fertilisers, with marketing done by FPOs |
| **Irregular rains** | Micro-irrigation installation with credit |
| **High temperature** | Mulching, increasing organic content of the soil and introducing resistant varieties |
| **Issues - Potato** | Possible remedies |
| **Timely technical advice** | Engage an agronomist at the FPO level so that dependence on external support is reduced to the minimum |
| **Access to finance** | Positioning FPO as an agent (BC) of a bank for credit support to all member farmers |
| **Access to markets** | Use FPO as an aggregator – either for executing an order from a large buyer or as a procuring institution for marketing by itself (either as an agent of buyers or on own account); explore tie-ups with major buyers and processors |

# Recommendations

FPOs should be empowered to continue providing advisory and other services to farmer groups to ensure the longevity of sustainable farming. FPOs should, based on the membership and demand for services, engage an agronomist to provide these services and support in a timely manner, instead of relying on other sources such as government departments, KVKs, and NGOs.

Soil- and water-related services should become user fee-based so that FPCs can deliver to all members sustainably. FPOs can buy equipment and engage trained personnel to operate the equipment on a service fee-basis; all the farmer households will then be able to hire the equipment and avail the services as per their needs. Mechanisation of potato cultivation can make a large difference; laser levellers, rotovators, and potato planters, among others, should be available through custom hiring centres that can be set up in FPOs.

More capacity-building of FPOs for establishing input linkages, market facilitation, and loan access for members. FPOs should be able to buy inputs in bulk in advance of the season and either go on to sell it to members or tie up with other credible input sellers. Some of the larger FPOs would be able to become direct dealers of input companies.

Urban compost was found in some of the project areas; the wider use of urban compost should be facilitated through FPCs. There is a need to coordinate with the government entities that are behind the urban compost units and ensure a steady and reliable supply.

Despite adoption of good agricultural practices that reduce the severity of climate change impacts, not all farmers and crops in all seasons produce a positive return. Farmer-friendly climate change adaptive agriculture should focus not only on specific crops but also on any viable crop. For example, in Pune District, vegetable crops, soybean and sugar beet are seen as better alternatives. Advisory to farmers should focus on the best sustainable agricultural outcomes in terms of income, rather than focusing on one or two crops.

Soil quality indicators based on carbon levels need to be measured periodically to monitor the efficacy of suggested agricultural practices.

Plastic mulch, while effective, is still not a completely organic solution. Some farmers have used sugarcane stalks successfully. Similar organic mulching solutions need to be explored.

Chosen crops varieties do not always perform in the local area, despite following all recommended practices. On-farm performance of selected varieties needs to be established before taking up full-scale adoption of the varieties.

# BACKGROUND

# 02

# In Pune District, 45% of the population is engaged in agricultural livelihoods. Small farmers form 81% of farm households and operate 43% of the cultivated area in the district.

The major crops of the district are jowar, paddy, sugarcane, maize, soybean, groundnut, sorghum, and wheat. Onion, potato, tomato, chilli, and brinjal are the vegetable crops commonly seen. The major horticulture crops are grapes, guava, mango, sapota, and banana. There is also a significant floricultural practice, with rose and marigold being dominant.

Table 2: Agricultural production in the district (2020-21)

| | Area (00 ha) | Production (00 tonnes) | Yield (kg/ha) |
|---|---|---|---|
| **Total cereals** | 3534.6 | 5456.58 | 1543.76 |
| **Total pulses** | 1139.31 | 877.5 | 770.21 |
| **Total food-grains** | 4673.9 | 6334.09 | 1355.2 |
| **Total oilseeds** | 562.7 | 1086.19 | 1930.32 |

Extreme weather events in the region have been on the rise. Between 1970 and 2019, there was a 700% increase in drought events and a 600% increase in flood events in Maharashtra. While droughts affect crops and livestock, floods cause significant losses to all types of livelihood assets and standing crops. Increased monsoon rainfall is also likely to increase leaching of nitrates and adversely affect decomposition of organic matter. The projections for climate change for the region, which include Pune as well as a few other districts, indicate that the annual mean temperature is set to increase by 1.15-1.280C in the 2030s and 1.65-1.940C in the 2040s. In Pune District, the number of warm days per month is set to increase from the current 10% of the days in a season to 38% in the 2030s and 55% in the 2050s. The number of cold days in the winter season of three months is set to fall from 20% currently to 7% in the 2030s and 4% in the 2050s. The State Policy on Climate Change has classified Pune District as low in terms of vulnerability based on an analysis of exposure, sensitivity, and adaptive capacity to climate change.

While vulnerability might be low for Pune District, it is highly sensitive to climate change. The changes in temperature and rainfall observed over the past few years and the projections clearly establish that productivity of crops, including tomato and potato, will be impacted.

Precise recent estimates of acreage under tomato and potato are not available for the district because these two crops, while important in certain locations, are not major crops. In 2016-17 Pune District grew tomato over 18,560 hectares, producing 4.64 lakh tonnes. The production of tomato in Maharashtra was more than a million tonnes in 2019-20.

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Smallholder farmers with high exposure to climate events are vulnerable to climate change and suffer the most due to their low resilience to such events. Adaptation options must be developed for these farmers in the face of the increasing intensity, frequency, and variety of climate risks. This will require consideration of agriculture value chains, their vulnerabilities, and their adapta-tion potentials. These adaptation options build sustainable resilience by creating assets and insti-tutional linkages for farmers.

The aim of this document is to provide a comprehensive climate risk assessment and specific recommendations for managing both the current and future risks of the tomato and potato value chains in the Pune District of Maharashtra. It is based on the Climate Risk Management (CRM) Framework developed by developed by GIZ projects ‘Global Programme on Risk Assessment and Management for Adaptation to Climate Change’ and ‘Climate Change Adaptation in Rural Areas of India’, commissioned by German Federal Ministry for Economic Cooperation and Development (BMZ), in collaboration with KPMG India and IIASA, and published by National Institute of Disaster Management, and is an outcome of the desk review and the field survey conduct-ed on climate hazards (their nature, frequency, intensity, risk and magnitude) vis-à-vis resilience capacity (sensitivity) of tomato and potato value chain participants to determine their relative vul-nerability to climate change. The past trends and future projections for climate change were studied from the State Strategy and Action Plan for Climate Change and the Climate Change and Environment Action Plan of Pune District. This report is strongly informed by the experiences and information shared by stakeholders during the field visit.

Under GIZ India, this is supported by the Indo-German development cooperation projects 'Green Innovation Centres for the Agriculture and Food Sector - India (GIC India)', 'Climate Adaptation and Finance in Rural India (CAFRI).' GIC India is part of a larger global programme under the Special Initiative "Transformation of Agricultural and Food Systems" by the German Federal Ministry for Economic Cooperation and Development (BMZ).

# CLIMATE CHANGE IN PUNE DISTRICT

# 03

## 3.1 Precipitation and Rainfall

Pune District lies in the leeward side of Sahyadri Range, part of the Western Ghats. The climate type is tropical monsoon. The chance of wet days in Pune varies very significantly throughout the year. A 'wet day' is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The wetter season lasts 4.1 months, from June 2 to October 7, with a greater than 33% chance of a given day being a wet day. The month with the greatest number of wet days in Pune is July, with an average of 20.1 days with at least 0.04 inches of precipitation. The drier season lasts 7.9 months, from October 7 to June 2. The month with the fewest wet days in Pune is January, with an average of 0.2 days with at least 0.04 inches of precipitation.

The mean monsoon rainfall is about 970 mm, with 10 to 14 rainy days in a month and about 50 days of good rainfall during the season.

Table 3: Temperature and rainfall parameters in the district

| Particulars | Values |
|---|---|
| Lowest precipitation | February – 1 mm |
| Highest precipitation | July 185mm |
| Mean monsoon rainfall | 970 mm |
| Highest temperature ever recorded | 43°C |
| Lowest temperature ever recorded | 4.6°C |
| Average maximum temperature (April) | 38°C |
| Average minimum temperature (January) | 15°C |
| Area affected by excessive rainfall | Yes, some areas in some periods |

The year-to-year rainfall variability in monsoon months and the seasonal mean for 1951-2018 over Pune District does not show any significant trend; however, a slight increase is observed in the past decade during both individual months and the season as a whole. It has been observed that the variability in the number of rainy days is higher in July and August in the recent decade and shows a slightly decreasing tendency during the period of 1951 to 2018 for the month of July and August. During winter, the state receives about 14 cm of rainfall. This rainfall, though small in amount, is of utmost significant for agriculture.

The projections for climate change for Pune region, including a few more districts apart from Pune itself, indicate that the annual mean temperature is set to increase by 1.15 to 1.28°C in the 2030s and 1.65 to 1.94°C in the 2040s. In Pune District, the number of warm days per month is set to increase from the current 10% of the days in a season to 38% in the 2030s and 55% in the 2050s. The number of cold days in the three-month winter season is set to fall from 20% currently to 7% in the 2030s and 4% in the 2050s.The Climate Change Policy of the Government of Maharashtra has classified Pune District as low in terms of vulnerability based on an analysis of exposure, sensitivity and adaptive capacity to climate change.

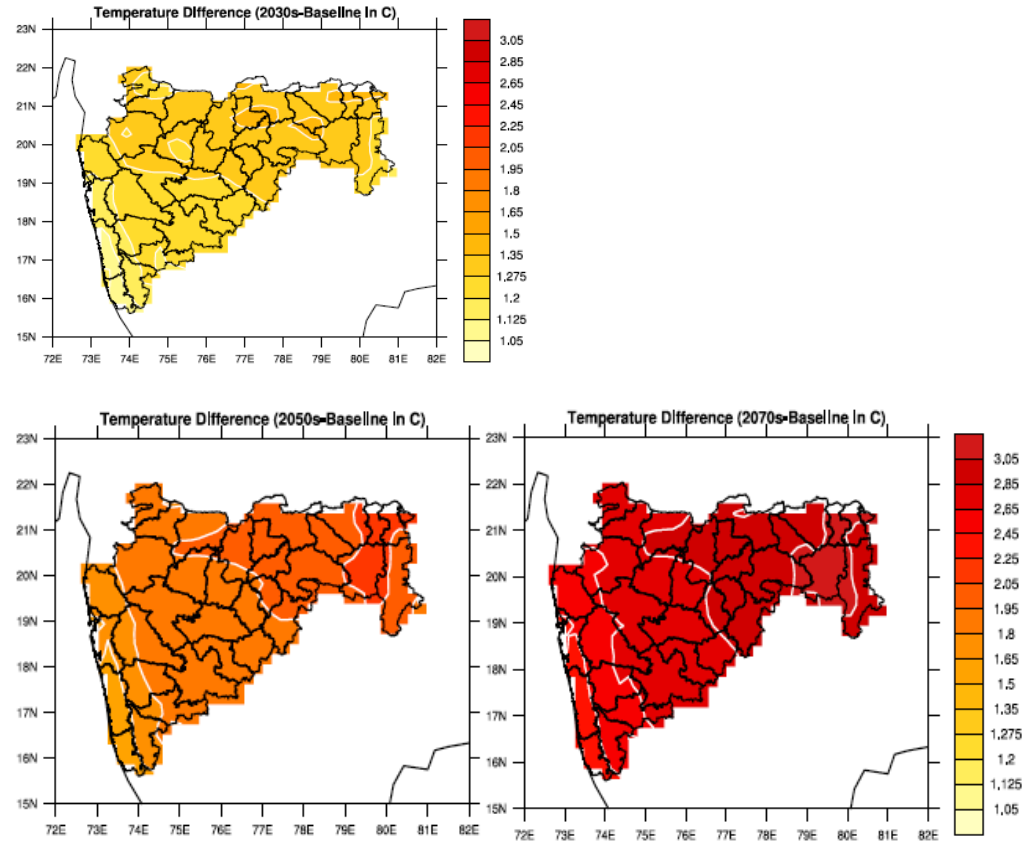


Figure 1: Temperature projection for Maharashtra State

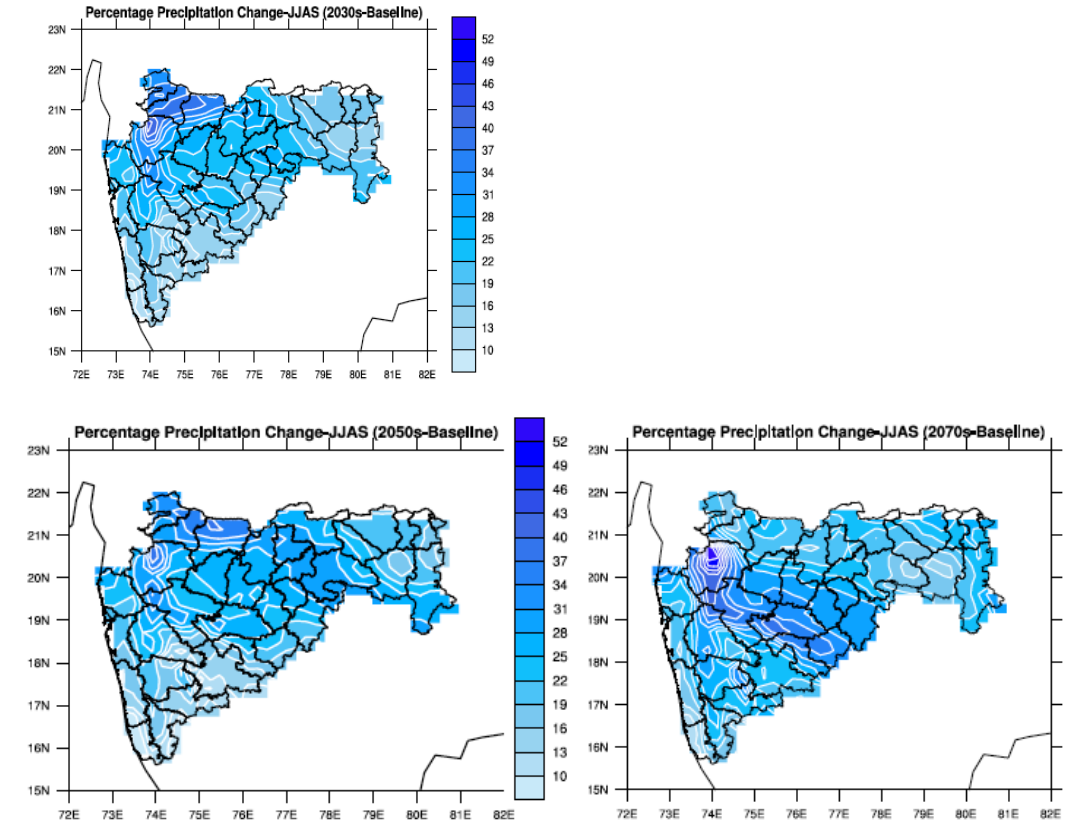


Figure 2: Rainfall projection for Maharashtra State

## 3.2 Extreme Weather Events

Extreme weather events in the districts have been on the rise. Between 1970 and 2019, there was a 700% increase in drought events and a 600% increase in flood events in Maharashtra. While droughts affect crops and livestock, floods cause significant losses to all types of livelihood assets and standing crops. Increased monsoon rainfall is also likely to increase the leaching of nitrates and adversely affect decomposition of organic matter. Major flooding events in recent years impacted agriculture, resulting in crop losses, damage to infrastructure, and loss of human lives.

## 3.3 Impact Of Climate Change

- **Floods**: Increase in warming, erratic rainfall, and rainfall changes will lead to more frequent floods and water yield in major rivers by 2030. Over the last few years, cyclones have devastated Maharashtra, a phenomenon not witnessed earlier. The recurrence of such events cause damage to crops and lives.
- **Drought**: Despite good rainfall, the number of dry days is set to increase, along with a rise in temperature that will affect a number of crops. Dryland crops and rainfed agriculture can come under severe stress because of the concentration of precipitation and extended dry spells.
- **Loss of infrastructure**: High-intensity rainfall will result in landslides, erosion, flooding, and environmental changes with severe threat to infrastructures.
- **Impact on agriculture**: With increasing temperatures, the productivity of crops like jowar, bajra, and pulses is predicted to decline. Irrigated cash crops such as sugarcane, tomato, onion, and maize will also suffer productivity losses. Field reports indicate that new viruses and insects, and new challenges to crops are arising due to higher temperatures; these tendencies will be further amplified.

# 3.4 Vulnerability To Climate Change

## 3.4.1 State-Level Vulnerability To Climate Change

The state action plan has recognised the vulnerability of the state to climate change and has identified the districts that are likely to be most impacted. While Pune is not very vulnerable, it is very sensitive to climate change (see Table 7).

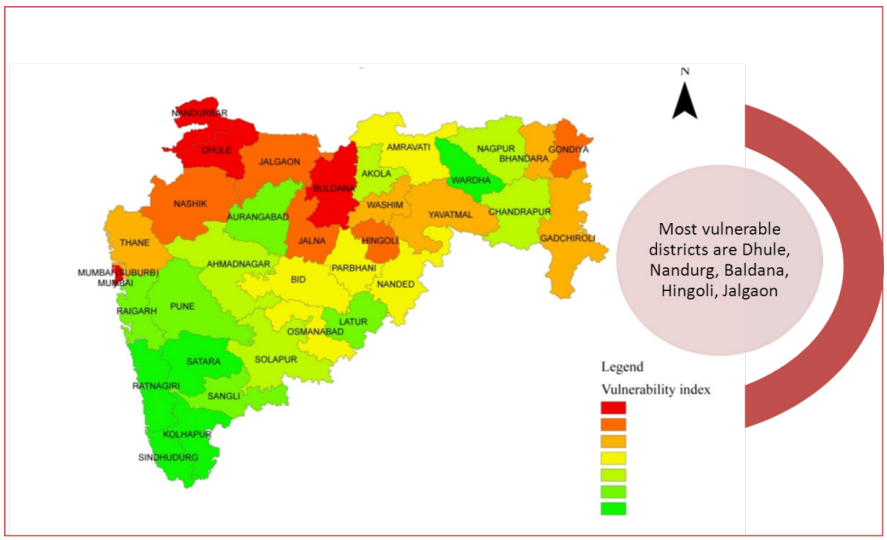


Figure 3: Climate change – Macro-level vulnerability index for Maharashtra

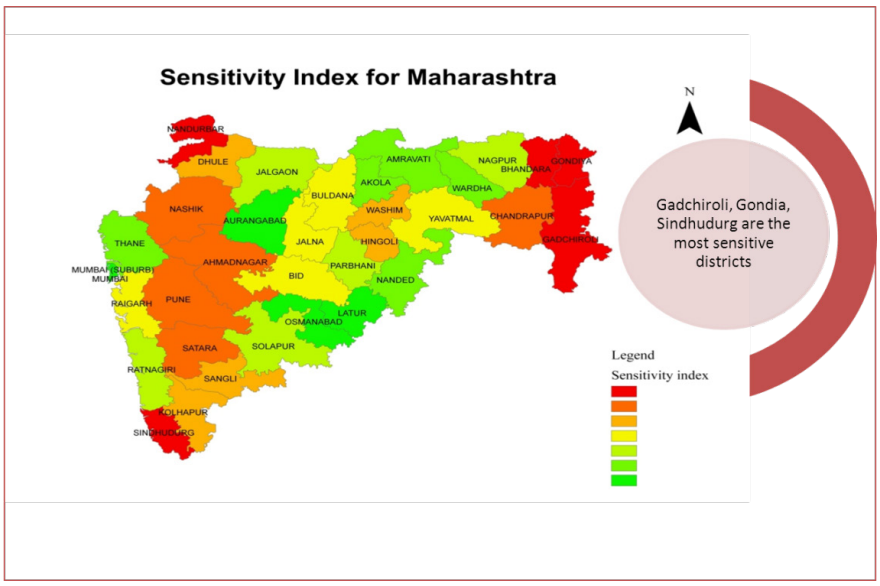


Figure 4: Climate change – Sensitivity Index for Maharashtra

Table 4: Comparative vulnerability of different districts in Maharashtra with regard to climate change

| District Name | Exposure | Sensitivity | Adaptive capacity | Vulnerability index |
|---|---|---|---|---|
| Ahmednagar | 20 | 26 | 9 | 20 |
| Akola | 4 | 6 | 11 | 21 |
| Amravati | 13 | 8 | 20 | 16 |
| Aurangabad | 12 | 1 | 13 | 27 |
| Bhandara | 19 | 30 | 10 | 11 |
| Bid | 24 | 16 | 22 | 14 |
| Buldhana | 8 | 17 | 32 | 3 |
| Chandrapur | 23 | 28 | 6 | 22 |
| Dhule | 2 | 19 | 29 | 2 |
| Gadchiroli | 27 | 33 | 14 | 10 |
| Gondia | 18 | 31 | 15 | 8 |
| Hingoli | 15 | 21 | 31 | 5 |
| Jalgaon | 1 | 13 | 26 | 4 |
| Jalna | 17 | 18 | 30 | 7 |
| Kolhapur | 32 | 20 | 8 | 30 |
| Latur | 28 | 2 | 17 | 24 |
| Nagpur | 21 | 9 | 12 | 23 |
| Nanded | 25 | 5 | 28 | 15 |
| Nandurbar | 5 | 29 | 33 | 1 |
| Nashik | 6 | 24 | 25 | 6 |
| Osmanabad | 29 | 3 | 27 | 17 |
| Parbhani | 22 | 10 | 18 | 18 |
| Pune | 26 | 25 | 7 | 28 |
| Raigad | 7 | 14 | 5 | 26 |
| Ratnagiri | 11 | 12 | 2 | 32 |
| Sangli | 33 | 23 | 16 | 25 |
| Satara | 31 | 27 | 3 | 33 |
| Sindhudurg | 16 | 32 | 1 | 31 |
| Solapur | 30 | 11 | 23 | 19 |
| Thane | 3 | 4 | 21 | 12 |
| Wardha | 14 | 7 | 4 | 29 |
| Washim | 9 | 22 | 24 | 9 |
| Yavatmal | 10 | 15 | 19 | 13 |

## 3.4.2 Climate Hazard Types That Affect Tomato And Potato Cultivation

Pune is susceptible to many biophysical and hydrological events and hazards triggered by climate change such as an increasing occurrence of hailstorms, floods during the rainy season, and drought-like conditions during summers.

**Hailstorms**: Hailstorms are rare but have hit the state in early summer months over the past few years. Hailstorms destroy standing crops and delay farming operations, due to which farmers incur heavy losses.

**Floods**: The passage of several rivers through the district makes many parts of the district prone to floods. Insufficient drainage and inadequate preparation of land for tilling lead to stagnation of water for long durations and affect crops, especially potato before harvest.

**Drought**: The district is prone to drought due to high temperatures. Farmers often face drought-like conditions in the summer when plants become stunted and there are increased pest attacks.

## 3.4.3 Hazard Calendar

The table below maps out the seasonal occurrence of hazards due to climate elements, i.e. variability in temperature and precipitation, in Pune.

Table 5: Hazard calendar in Pune District

| # | Hazards | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | High rainfall | | | | | | ** | *** | *** | * | | | |
| 2 | Drought | | | ** | *** | | | | | | | | |
| 3 | Flooding | | | * | * | | | | | | | | |
| 4 | Pest attack and water scarcity | | | * | ** | *** | *** | | | | | | |
| 5 | Loss of critical infrastructure | | | | | | | * | * | | | | |
| 6 | Human ailments | | | | | | | ** | ** | | | | |
| 7 | Post-harvest losses due to temperature/ rainfall | | | | | | ** | ** | ** | * | | | |

Note: number of stars depict the intensity of any hazard (0-4) where 4 means very high intensity.

# 3.5 Vulnerability Assessment Of Value Chain Stakeholders

## 3.5.1 Farmers' Perception Of Climate Hazards

Table 6: Hazard calendar in Pune District

| Hazard type | Climate events in the region that lead to hazard | Intensity/ severity of hazard ranking<br>0-nil, 5-very high | Frequency of hazard in the past<br>1- low, 4-very high | Risk of hazard happening again<br>0-nil, 5-very high | Overall rating of hazard – multiplication of columns (2*3*4) |
|---|---|---|---|---|---|
| Column No. | 1 | 2 | 3 | 4 | 5 |
| Hailstorms | Rising temperature and thunderstorm | 2 | 2 | 2 | 8 |
| Drought | No Rainfall | 3 | 3 | 3 | 27 |
| Soil erosion | Heavy rainfall | 4 | 2 | 2 | 16 |
| Flooding | Heavy Rainfall | 2 | 2 | 2 | 8 |
| Pest and disease | Climate variabilities | 2 | 3 | 3 | 18 |
| Post-harvest losses | High temperature | 2 | 2 | 2 | 8 |

## 3.5.2 Impact of hazards on farmers

- Most of the farmers in the district are small landholders and have limited financial capital to meet the risk and its impact.
- Tomato and potato crops are irrigated by water harvesting structures, canals and ground water. Farmers gave a high rating to drought conditions in the district because of the non-availability of water for irrigation, especially during the summer season.
- High intensity rains and hailstorms destroy crops and cause economic losses.
- Hailstorms and high intensity rains also impact the health of the human population and their livestock.

## 3.6 Resilience And Adaptive Capacity

The adaptive capacity of the value chain actors depends upon their natural capital. The findings of the assessment show that climate change-induced hazards cause significant economic losses to value chain participants. Specifically, the impact of three prioritised hazards – drought, landslides and hailstorms – result in varying degrees of losses of physical and financial assets to different value chain participants (discussed as part of impact assessment).

Smallholder farmers are limited in their adaptive capacity because of their small landholdings, poor economic and social status, and lack of access to and control over physical and financial resources. The Government of India and Government of Maharashtra have several programs and schemes to support smallholder farmers. However, most of the farmers are unable to avail of these facilities and schemes because of their remote location, lack of information, and the difficulties involved in dealing with government agencies. Wholesalers, transporters, retailers and agri-input providers, on other the hand, experience less impact on their businesses and wellbeing because of their more stable economic condition.

Table 7: Climate change vulnerability assessment of VCPs

| Value Chain Participant (VCP) and Type of hazard | Availability of capital (score 1 for low and 5 for high) | | | | Average capital score (Resilience Score) |
|---|---|---|---|---|---|
| | Social capital (social resources for collective action) | Natural capital (Land, water, soil, biodiversity etc.) | Financial and economic capital | Human capital and resources | |
| Farmer | 2 | 2 | 1 | 1 | 1.5 |
| Wholesalers | 1 | 1 | 5 | 3 | 2.5 |
| Retailer | 1 | 1 | 3 | 3 | 2 |
| Input dealer | 1 | 1 | 3 | 3 | 2 |
| Transporter | 1 | 1 | 3 | 3 | 2 |

Farmers are the most vulnerable of all the value chain participants. The vulnerability score gives the relative vulnerability of each value chain participant.

# RECOMMENDATIONS

# 04

## 4.1 Adaptation and Coping Strategy and Action Plan

Table 8: Adaptation and Coping Strategy and Action Plan

| Critical hazard and its impacts | Suggested Coping and Adaptation Strategies (CAS) | Duration of strategy (immediate, medium or long term) | Availability of resources | Adoption by sections of community (few, medium, large) |
|---|---|---|---|---|
| **Drought** | | | | |
| Low rainfall, insufficient harvesting of water<br><br>Scarcity of water for irrigation | • Promote rainwater harvesting and catchment area treatment (CAT) in tomato and potato growing areas. Invest in check dams, farm ponds, and other harvesting structures. This will improve soil moisture and reduce erosion.<br>• Promote micro irrigation, particularly drip irrigation, to optimise the use of water.<br>• Undertake construction and repair of reservoirs and ponds for providing lifesaving irrigation.<br>• Promote alternative crops. | Immediate/ short term | NMSA, MGNREGS, IWMP, RKVY, National Food Security Mission (NFSM), Mission for Integrated Development of Horticulture (MIDH), National Mission for Agricultural Extension & Technology (NMAE&T), GoM schemes for crop protection and agriculture inputs Bank loans with state subsidies on micro-irrigation | All |
| Soil temperature increase | • Undertake land use planning and soil management to reduce ambient temperature (landscape management).<br>• Promote mulching, nutrient application, crop diversification, and crop integration with introduction of drought-tolerant varieties.<br>• Diversify using crops other than those with significant adverse impact. | Medium | State government scheme for agriculture inputs, irrigation and plant protection<br><br>Capacity-building of farmers in climate adaptive agricultural practices | Medium |

| Critical hazard and its impacts | Suggested Coping and Adaptation Strategies (CAS) | Duration of strategy (immediate, medium or long term) | Availability of resources | Adoption by sections of community (few, medium, large) |
|---|---|---|---|---|
| **Drought** | | | | |
| Decline of yield due to poor plant growth | • Application of manure, fertilisers and growth stimulants<br>• Crop diversification to other resilient crops or varieties | Medium term<br><br>Short term – medium term | State government scheme for agriculture inputs, irrigation and plant protection<br><br>Capacity-building of farmers in climate adaptive agricultural practices | All |
| | • Promote crop insurance.<br>• Expand coverage and availability of agro-met advisory/early warning system by information sharing through mobile apps and messages. | Medium | Restructured Weather Based Crop Insurance Scheme, Pradhan Mantri Phasal Bima Yojana, | Few |
| **Hailstorm** | | | | |
| Entire crop loss, damage to plants, inferior quality of surviving produce | • Use of hail net, hail cap, poly houses | Short term | NMSA, DoA and DoH schemes | Large |
| Soil erosion | • Soil conservation measures | Short/long term | NMSA, RKVY | Medium |
| Damage equipment and other infrastructure | • Insurance | Medium term | Equipment insurance, Restructured Weather Based Crop Insurance Scheme, Pradhan Mantri Phasal Bima Yojana, Disaster Management support from DoA | Few |

| Critical hazard and its impacts | Suggested Coping and Adaptation Strategies (CAS) | Duration of strategy (immediate, medium or long term) | Availability of resources | Adoption by sections of community (few, medium, large) |
|---|---|---|---|---|
| Small farm sizes with poor aggregation of produce and lack of collective planning by farmers | • Aggregation by FPOs and marketing on behalf of farmers<br>• Market linkages with processors, traders | Short term - medium term | AGMARKNET<br>eNAM<br>Commodity trading entities, Processing units<br>Banks and financial institution schemes | Medium |
| Poor post-harvest infrastructure<br><br>Poor last-mile connectivity<br><br>Poor processing facilities | • Development of cold storage networks<br>• Incentivise private sector processing facilities | Medium | Agriculture Infrastructure Fund Scheme 2021, Agriculture Marketing Infrastructure Scheme, the Agriculture Infrastructure Fund (AIF), Pradhan Mantri Kisan SAMPADA Yojana<br><br>Bank finance schemes | Large |
| Poor access to finance especially by small farmers | • Develop product-specific District Credit Plans, and Block Credit Plans<br>• Conduct training and capacity building programme on entrepreneurship development<br>• Use FPOs as intermediaries | Short term | KCC.<br>NRLM (SC/ST, women, and so on)<br>MFI, NBFC, SHG promotion, Credit Guarantee Scheme of NABARD, UPNRM | Large |

## 4.2 Adaptation partnerships

Table 9: Adaptation partnerships

| Institution | Role of institution and its effectiveness | Potential adaptation support and sector of support |
|---|---|---|
| Department of Agriculture and line departments | Government agency responsible for the promotion of agricultural development | Provide farm advisory services and extension support for adoption of new technologies.<br><br>Provide logistic support in form of supply of inputs like seed, fertilisers, and plant protection materials and implements the policy framework, public investments, and support services needed for the economic advancement of farming communities.<br><br>Provide support for agriculture, soil and water conservation measures, water harvesting, erosion control and the like.<br><br>Provide marketing services. |
| Krishi Vigyan Kendra (KVK) | Technology assessment and demonstration for its application; capacity development | Provide capacity-building and technology support to farming communities for climate smart solutions in agriculture. |
| District disaster management authority | Educate various stakeholders about their specific roles and responsibilities during various stages of the Disaster Management Cycle. | Develop, review and assess effective disaster management practices. |
| NABARD | Provides investment and production credit for various developmental activities and projects taking place in rural areas taking place in rural areas | Support the preparation of project concept note and DPR.<br><br>Focus on tomato in Potential Linked Credit Plan, State Level Bankers Committee. |
| Lead Bank<br>And other banks / financial institutions | Coordinating the efforts of all credit institutions in the allotted districts to increase the flow of credit to agriculture, small-scale industries, and other economic activities included in the priority sector in rural and semi-urban areas | Mobilise KCC and other adaptation measures through finance and banking.<br><br>Develop financial products for climate adaptive agriculture requirements.<br><br>Restructure loans to mitigate climate change impact and contemporary repayment ability. |

| Institution | Role of institution and its effectiveness | Potential adaptation support and sector of support |
|---|---|---|
| District administration | Coordinating all government offices within the district | Monitor and evaluate schemes and programmes engaging with climate-related hazards and adaptation measures |
| Agricultural Produce Market Committee (APMC) | Established by the state government to regulate markets and to safeguard farmers' interests and protect them from exploitation. | Ensure complete transparency in pricing system and transactions, provide market-led extension services to farmers, and furnish them with complete market-related information. |
| Department of Environment, Science and Technology (DEST) | Plan, coordinate, promote and oversee environment conservation and enhancement programmes through environmentally compatible management practices and technologies. | Strengthen environmental awareness, assessment, advocacy and action by facilitating organised collection, collation and dissemination of environmental information. |

# References


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# List of Abbreviations

| | |
|---|---|
| AGMARKNET | Agricultural Marketing Information System |
| AIF | Agriculture Infrastructure Fund |
| APMC | Agriculture Produce Marketing Committee |
| BMZ | German Federal Ministry for Economic Cooperation and Development |
| 0C | Degree Celsius |
| CAS | Coping and adaptation strategies |
| CAT | Catchment Area Treatment |
| CCA | Climate Change Adaptation |
| CRM | Climate Risk Management |
| DAP | District Agriculture Plan |
| DoA | Department of Agriculture |
| DoH | Department of Horticulture |
| DEST | Department of Environment, Science & Technology |
| eNAM | National Agriculture Market |
| FIG | Farmer Interest Group |
| FPC | Farmer Producer Company |
| FPO | Farmer Producer Organisation |
| FSG | Farmer Study Group |
| GIC | Green Innovation Centre for the Agriculture and Food Sector |

| | |
|---|---|
| GoI | Government of India |
| GoM | Government of Maharashtra |
| IWMP | Integrated Watershed Management Programme |
| KCC | Kisan Credit Card |
| KVK | Krishi Vigyan Kendra |
| MGNREGS | Mahatma Gandhi National Rural Employment Guarantee Scheme |
| MoAFW | Ministry of Agriculture and Farmers' Welfare |
| MoEFCC | Ministry of Environment, Forest and Climate Change |
| MFI | Micro Finance Institution |
| MGNREGS | Mahatma Gandhi National Rural Employment Guarantee Scheme |
| MIDH | Mission for Integrated Development of Horticulture |
| MT | Metric Ton |
| NABARD | National Bank for Agriculture and Rural Development |
| NBFC | Non-Banking Financial Companies |
| NMAE&T | National Mission for Agricultural Extension & Technology |
| NMSA | National Mission for Sustainable Agriculture |
| NRLM | National Rural Livelihoods Mission |
| NFSM | National Food Security Mission |
| PMPBY | Pradhan Mantri Phasal Bhima Yojana |
| PRODUCE | Producers Organization Development and Upliftment Corpus |
| RKVY-RAFTAAR | Rashtriya Krishi Vikas Yojana - Remunerative Approaches for Agriculture and Allied Sector Rejuvenation scheme |
| SAP | State Agricultural Plan |
| SAPCC | State Action Plan for Climate Change |
| SC/ST | Scheduled Caste or Scheduled Tribe |
| SFAC | Small Farmers' Agri-Business Consortium |
| SHG | Self-Help Group |
| SMCPL | Suvigya Management Consultants Private Limited |
| UPNRM | Umbrella Programme on Natural Resources Management |

# List of Tables



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