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# Assessment of the Technological Feasibility of Climate change Adaptation Strategies and Contingency Plans in Dryland Areas

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**ABSTRACT: Drylands are particularly affected by climate change through changing rainfall patterns and land degradation, which reduces the ability of crops, livestock and people to cope with dryland conditions. The present study was conducted in Datia and Parbhani districts of Madhya Pradesh and Maharashtra state, respectively to assess the technological feasibility of climate change adaptation strategies and contingency plans. Sixty farmers from each district were personally interviewed using a pre-tested interview schedule. The feasibility indices were calculated using normalization, weightage and aggregation for all the recommended climate change adaptation technologies of the contingency plans for both the district. The results revealed that "Using different varieties (e.g. early maturing, drought-resistant) for early season drought" ranked first, while "Installation of insect traps and grow trap crops along the border to control pest population" ranked second and "Seed priming in water for 12- 15 hours in wheat, mustard and chickpea, if there is low rainfall" ranked third in Datia district. In case of Parbhani district."If rain is delayed by 10-15 days Raise cotton seedlings in polythene bags and transplant when sufficient soil moisture is available. "Modifying planting, harvesting, and fertilizing practices for crops" and "Re-sowing of the crop if the plant population is less than 50per cent in Soybean. Pigeon pea and Black gram" was ranked first, second and third respectively.**

**Keywords:** Dryland, Contingency plan, Climate change adaptation, Normalization and Technological feasibility.

## INTRODUCTION

Climate change has been responsible for some historical losses to human civilisations regarding certain natural events like droughts, hurricanes, floods, and heat waves (Bandh *et al.,* 2021). The Earth's climate is changing. Some of this change is due to natural variations that have been taking place for millions of years, even more, human activities that release heat-trapping gases into the atmosphere are warming the planet by contributing to the "greenhouse effect.". The Intergovernmental Panel on Climate Change (IPCC, 2007) anticipated that the global mean temperature might rise somewhere in the range of 1.4 and 5.8 °C by 2100. It has likewise been concurred that the climate change vulnerabilities are identified with the formative condition of a nation, as shown by the differential effects of climate change on nations at various formative levels (Paglia and Parker 2021). Likewise, a nation's vulnerability to climate change can be reduced with the help of suitable mitigation and adaptation options. Climate change is a global threat to the food and nutritional security of the world. As greenhouse-gas emissions in the atmosphere are increasing, the temperature is also rising due to the greenhouse effect (Malhi *et al.,* 2021). Climate change additionally presents that vulnerabilities should be looked from an alternate point of view. Inside the climate change adjustment network, there is a typical declaration that we could adapt better to the present climate risks, potentially we could altogether diminish the effects of future climate change (Eriksen *et al*. 2020). Crop production is highly sensitive to climate. It gets affected by long-term trends in average rainfall and temperature, annual climate variations, shocks during different stages of growth, and extreme weather events (Srivastav *et al.,* 2021). The best and most timely responses against climate change are suitable adaptation measures. Accurately perceiving the risks associated with climate change is an essential factor for planning and then implementing adaptations (Mahmood *et al.,* 2021).

Contingency planning is an administration apparatus used to examine the effect of potential emergency and guarantee that satisfactory and suitable courses of action are made ahead of time to react in an auspicious, compelling and proper route to the necessities of the influenced population. Drought is a repetitive regular element that results from the absence of precipitation over an expanded time frame (*e.g.* a season or quite a while). It is an impermanent deviation of precipitation and dampness conditions from the mean, therefore contrasting from aridity and seasonal aridity. Planning for drought is a dynamic procedure that considers financial, agricultural, mechanical and political patterns (Wilhite, 1996). Farmers' knowledge contributes to understand trends in crop diversity and support the design of strategies for adaptation to climate change (Labeyrie *et al.*, 2021).

There are many adaptation practices in the production systems that have been proposed and tested for minimizing the effects of climate change. Some socioeconomic and political setup contributes to adaptation, while others may inhibit it (Aryal *et al.*, 2020). Adaptation measures requires inclusive and adaptive local institutions, sufficient financial assistance, and climate information services (Singh and Chudasama, 2021). Decisions regarding strategic adaptation measures have to be taken by the farmers. Such decisions made by farmers lead to successful climate change adaptation in the agriculture sector because they are the key investors in this sector. While predisposed by their political and social settings, the ultimate authority in decision making by concerning distinct processes are retained by the farmers. Adoption of technologies and measures is a process of decision-making and enabling farmers to make better choices regarding strategic adaptations requires provision for essential knowledge and information regarding appropriate technologies and better farm management practices. The technologies recommended by the institutions should be socially, economically, technically feasible for the farmers to adopt. With this brief background the study has been undertaken.

## MATERIALS AND METHODS

The study was conducted to assess the technological feasibility of climate change adaptation strategies and contingency plans in Datia and Parbhani districts of Madhya Pradesh and Maharashtra state, respectively. From each of the selected districts, sixty farmers were personally interviewed with the help of pre-tested interview schedule, thus constitute a total sample size of 120. For this purpose, feasibility indices were calculated.

**Feasibility index.** Following steps are basic in the estimation of feasibility index: normalization, weightage and aggregation.

Feasibility indices were calculated using data for each technology. By aggregating the relative indices of compatibility, relative advantage, trialability, ease of application, ease of availability, ease of accessibility and eco-friendliness, the cumulative composite feasibility index was calculated.

**Relative advantage:** It was operationalized as a degree to which the technology was relatively advantageous over others.

**Compatibility**: It was operationalized as a degree to which the adaptation technologies were perceived as consistent with the existing values, past experiences, and needs of potential adopters.

**Trialability:** It was operationalized as a degree to which adaptation technologies were perceived to be trailable.

**Usefulness:** It was operationalized as a degree to which adaptation technologies were perceived to be useful.

**Ease of application:** It was operationalized as a degree to which adaptation technologies were perceived to be easy to apply.

**Ease of availability:** It was operationalized as a degree to which adaptation technologies were perceived to be easily available.

**Eco-friendliness:** It was operationalized as a degree to which adaptation technologies were perceived to be Eco-friendly.

The data obtained for each criterion were normalized to make the data comparable across the indicators using the following formula.

$$\text{Normalized Value} = \frac{X_a - X_{\min}}{X_{\max} - X_{\min}}$$

Where,

Index = normalized value of an indicator

$X_a$ = actual value of the same indicator

$X_{\min}$ = minimum value of the same indicator

$X_{\max}$ = Maximum value of the same indicator

**Aggregation**: The normalized indicators were aggregated for each technology. The arithmetic mean was used to aggregate indicator scores within each technology. The weightage of each seven criteria were obtained through experts' opinion. Finally, Technology Feasibility Index (TFI) was calculated with following formula:

$$\text{Technology Feasibility Index} = \sum_{i=1}^{n} I_i W_i$$

Where,

I = sub-indices

W = Weightage of the criterion

## RESULTS AND DISCUSSION

The feasibility assessment of the technologies for the contingency plans and climate change adaptation were carried out with respect to the following criterion *viz.* compatibility, trialability, relative advantage, ease of accessibility, ease of application, ease of availability and eco-friendliness. Feasibility index was developed with integration of these sub-indices and adding weightage to these sub-indices based on expert opinion. Based on their respective feasibility index, the technologies were ranked.

From the Table 1 it is evident that "Using different varieties (e.g. early maturing, drought-resistant) for early season drought" ranked first, while "Installation of insect traps and grow trap crops along the border to control pest population" ranked second and "Seed priming in water for 12- 15 hours in wheat, mustard and chickpea, if there is low rainfall" ranked third. Whereas, "Crop diversification (cereals + pulses + oil seeds+ tress species etc.) "ranked last (XVII rank) for the Datia district. Similar findings were reported by Williams *et al.* (2021) in his study on feasibility assessment of climate change adaptation options across Africa: an evidence-based review. Reddy *et al.* (2019)

mentioned that there are a number of options in soil, water and nutrient management technologies that contribute to both adaptation and mitigation including in situ moisture conservation, rainwater harvesting and efficient utilization, integrated nutrient management modules, resilient crops and cropping systems.

**Table 1: Feasibility index for the technologies provided for Datia district.**

| Sr. No. | Technologies | Feasibility index | Rank |
|---|---|---|---|
| 1. | Crop diversification (cereals + pulses + oil seeds + tress species etc.) | 0.624 | XVII |
| 2. | Modifying planting, harvesting, and fertilizing practices for crops | 0.658 | VI |
| 3. | Conservation agriculture (e.g. soil protection, agroforestry) | 0.653 | VII |
| 4. | Using different varieties (e.g. early maturing, drought-resistant) for early season drought | 0.697 | I |
| 5. | Crop insurance | 0.649 | IX |
| 6. | Installation of insect traps and grow trap crops along the border to control pest population | 0.684 | II |
| 7. | Construction of rain water harvesting structures | 0.647 | X |
| 8. | White grub Management in ground nut- Chlorpyriphos 20EC @ 2.5 l/ha | 0.629 | XVI |
| 9. | Thinning and re-sowing to maintain optimum plant population | 0.638 | XIV |
| 10. | Seed priming in water for 12-15 hours in wheat, mustard and chickpea, if there is low rainfall | 0.682 | III |
| 11. | Application of Chlorpyriphos 1 kg a.i./ha in Groundnut to control pests | 0.644 | XIII |
| 12. | Thinning of every 4$^{th}$ row in sorghum and bajra, if there is acute shortage of water | 0.68 | IV |
| 13. | Spray 0.2per cent mancozeb 76per cent WP against wheat rust. | 0.634 | XV |
| 14. | Re-sowing of the crop if the plant population is less than 50% | 0.645 | XII |
| 15. | Seed Treatment with Bavistin thiram in 2:1 ratio for the control of Phytophthora Blight in case of Sesamum | 0.653 | VIII |
| 16. | Draining out excess water from the field to overcome waterlogging | 0.677 | V |
| 17. | Summer deep ploughing | 0.646 | XI |

**Table 2: Feasibility index for the technologies provided for Parbhani district.**

| Sr. No. | Technologies | Feasibility index | Rank |
|---|---|---|---|
| 1. | Crop diversification (cereals + pulses + oil seeds + tress species etc.) | 0.625 | IX |
| 2. | Modifying planting, harvesting, and fertilizing practices for crops | 0.661 | II |
| 3. | Conservation agriculture (e.g. soil protection, agroforestry) | 0.638 | VI |
| 4. | Using different varieties (e.g. early maturing, drought-resistant) | 0.603 | XIII |
| 5. | Crop insurance | 0.631 | VII |
| 6. | Installation of insect traps and grow trap crops along the border to control pest population | 0.648 | IV |
| 7. | Construction of rain water harvesting structures | 0.567 | XV |
| 8. | Summer deep ploughing | 0.559 | XVI |
| 9. | Thinning and re-sowing to maintain optimum plant population | 0.588 | XIV |
| 10. | If rain is delayed by 45 days, Keep fallow and plan for early Rabi Crops like Sorghum, Chickpea, Sunflower and Safflower | 0.621 | XI |
| 11. | In Sorghum avoid top dressing of fertilizers at vegetative stage till sufficient soil moisture is available | 0.629 | VIII |
| 12. | Thinning of every 4th row in Sorghum and Pigeon pea, if there is acute shortage of water | 0.613 | XII |
| 13. | If rain is delayed by 10-15 days Raise cotton seedlings in polythene bags and transplant when sufficient soil moisture is available | 0.706 | I |
| 14. | Re-sowing of the crop if the plant population is less than 50per cent in Soybean, Pigeon pea and Black gram | 0.649 | III |
| 15. | Providing of wider space between rows and plants to protect plants from early season drought | 0.623 | X |
| 16. | Draining out excess water from the field to overcome waterlogging | 0.64 | V |

It is evident from Table 2 that technologies were ranked based on feasibility index where "If rain is delayed by 10-15 days Raise cotton seedlings in polythene bags and transplant when sufficient soil moisture is available, "Modifying planting, harvesting, and fertilizing practices for crops" and "Re-sowing of the crop if the plant population is less than 50per cent in Soybean, Pigeon pea and Black gram" was ranked first, second and third respectively. Whereas," Summer deep ploughing" ranked last in case of Parbhani district. Similar findings were reported by Williams *et al.* (2021) in his study on feasibility assessment of climate change adaptation options across Africa: an evidence-based review. Chary *et al.* (2022) reported that the climate resilience in rainfed agriculture can be better addressed through risk and vulnerability assessment at sub-district level; scaling out resilient technologies through government programmes, better preparedness for weather aberration and capacity building of stakeholders.

## CONCLUSION

The present study was conducted in Datia and Parbhani districts of Madhya Pradesh and Maharashtra state, respectively to assess the technological feasibility of climate change adaptation strategies and contingency plans. It was found that it is evident that "Using different varieties (e.g. early maturing, drought-resistant) for early season drought" ranked first, while "Installation of insect traps and grow trap crops along the border to control pest population" ranked second in case of Datia district. Whereas, "If rain is delayed by 10-15 days Raise cotton seedlings in polythene bags and transplant when sufficient soil moisture is available ranked first and" Summer deep ploughing" ranked last in case of Parbhani district. The recommended climate change adaptation technologies /strategies should be socially, economically and technically feasible for greater adoption by the farmers to combat drought. Similar kind of research studies can be conducted in different locations to provide effective and efficient adaptation strategies to changing climate scenario in agriculture. Through feasibility assessment studies and understanding the needs and problems of the farmers facing due to adverse climatic conditions, it will help the research and extension system to provide feasible technological options to the farmers for climate change adaptation.

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**Conflicts of Interest.** None.

## REFERENCES

Aryal, J. P., Sapkota, T. B., Khurana, R., Khatri-Chhetri, A., Rahut, D. B. and Jat, M. L. (2020). Climate change and agriculture in South Asia: Adaptation options in smallholder production systems. *Environment, Development and Sustainability*, *22*(6), 5045-5075.

Chary, G. R., Bhaskar, S., Gopinath, K. A., Prabhakar, M., Prasad, J. V. N. S., Rao, C. A. and Rao, K. V. (2022). Climate resilient rainfed agriculture: Experiences from India. In Climate Change Adaptations in Dryland Agriculture in Semi-Arid Areas (pp. 3-18). Springer, Singapore.

Eriksen, C., Simon, G. L., Roth, F., Lakhina, S. J., Wisner, B., Adler, C. and Prior, T. (2020). Rethinking the interplay between affluence and vulnerability to aid climate change adaptive capacity. *Climatic Change*, *162*(1), 25-39.

Labeyrie, V., Renard, D., Aumeeruddy-Thomas, Y., Benyei, P., Caillon, S., Calvet-Mir, L. and Reyes-García, V. (2021). The role of crop diversity in climate change adaptation: Insights from local observations to inform decision making in agriculture. *Current Opinion in Environmental Sustainability*, *51*, 15-23.

Mahmood, N., Arshad, M., Mehmood, Y., Shahzad, M. F. and Kächele, H. (2021). Farmers' perceptions and role of institutional arrangements in climate change adaptation: Insights from rainfed Pakistan. *Climate Risk Management*, *32*, 100288.

Malhi, G. S., Kaur, M. and Kaushik, P. (2021). Impact of climate change on agriculture and its mitigation strategies: A review. *Sustainability*, *13*(3), 1318.

Paglia, E. and Parker, C. (2021). The intergovernmental panel on climate change: guardian of climate science. In *Guardians of Public Value* (pp. 295-321). Palgrave Macmillan, Cham.

Reddy, K. S., Chaudhari, S. K., Prabhakar, M., Rao, K. V. and Prasad, J. V. N. S. (2019). Natural Resource Management Strategies for Climate Resilient Agriculture in Rainfed Areas. Challenges and Opportunities in Rainfed Agriculture under Changing Climate Scenario, 1.

Richards, M. (2003). *Poverty reduction, equity and climate change: challenges for global governance*. Overseas Development Institute.

Singh, P. K. and Chudasama, H. (2021). Pathways for climate change adaptations in arid and semi-arid regions. *Journal of Cleaner Production*, *284*, 124744.

Srivastav, A. L., Dhyani, R., Ranjan, M., Madhav, S. and Sillanpää, M. (2021). Climate-resilient strategies for sustainable management of water resources and agriculture. *Environmental Science and Pollution Research*, *28*(31), 41576-41595.

Wilhite, D. A. (1996). A methodology for drought preparedness. *Natural Hazards*, *13*(3), 229-252.

Williams, P. A., Simpson, N. P., Totin, E., North, M. A. and Trisos, C. H. (2021). Feasibility assessment of climate change adaptation options across Africa: an evidence-based review. *Environmental Research Letters*, *16*(7), 073004.

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